Workshop MOG 2

17.03.2023

Agenda

- Introduction
- OBZ balancing implications
- OBZ market design

Introduction

Overview of Task Force MOG 2 and ad-hoc workshop

TF and ad-hoc work. MOG 2

2022

- ***01/04*** — **TF MOG 2**
- ***24/06*** — **TF MOG 2** + *WS market*
- *16/09* — *Ad-hoc tech. WS*
- ***14/10*** — **TF MOG 2** + *WS market*
- *12/12* — *Ad-hoc tech. WS*

2023

- ***10/01*** — **TF MOG 2** + *WS market*
- *06/02* — *Ad-hoc market WS*
- *17/03* — *Ad-hoc balancing WS* — **Today**
- ***24/03*** — **TF MOG 2**

06/02: Ad-hoc workshop market MOG 2

- Presentation and exchanges on market design implications arising from EU legislation
- General principles of market functioning on capacity calculation/allocation and OBZ

Today : Ad-hoc workshop balancing and market

- Balancing implications for an offshore bidding zone
- Follow-up market design for offshore bidding zone

24/03: Task Force MOG 2

- **Balancing:** discussion feedback on mitigation measures
- **Dynamic & Harmonic:** introduction of needs for improvement of conformity process

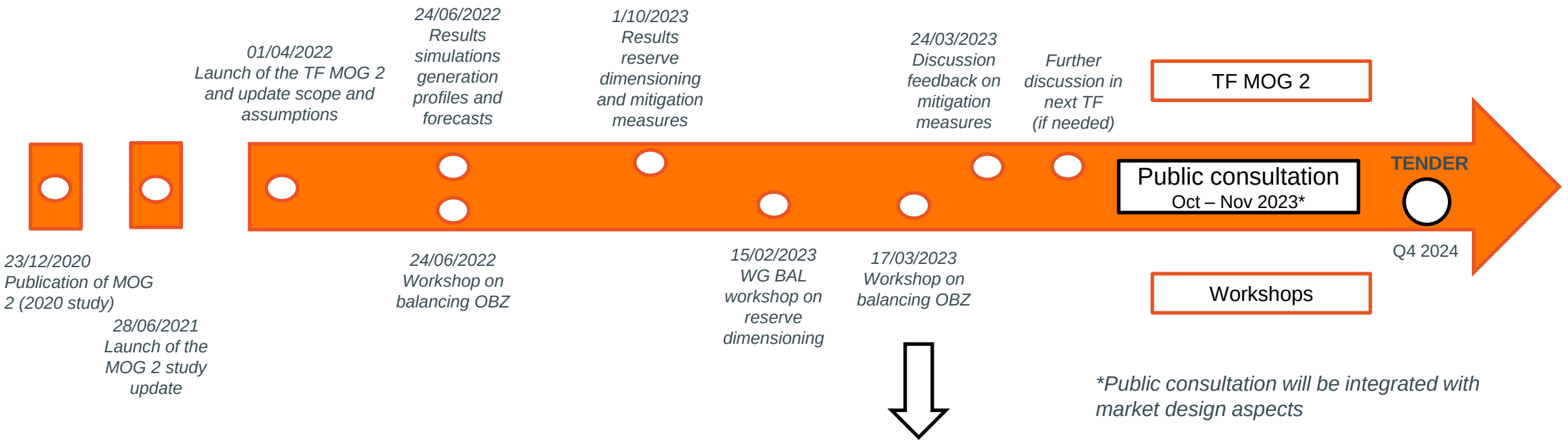
Balancing

MOG 2 - System Integration

Workshop on implications of an offshore bidding zone for balancing

Kristof De Vos, Aymen Chaouachi - 17.03.2023

Timeline balancing aspects

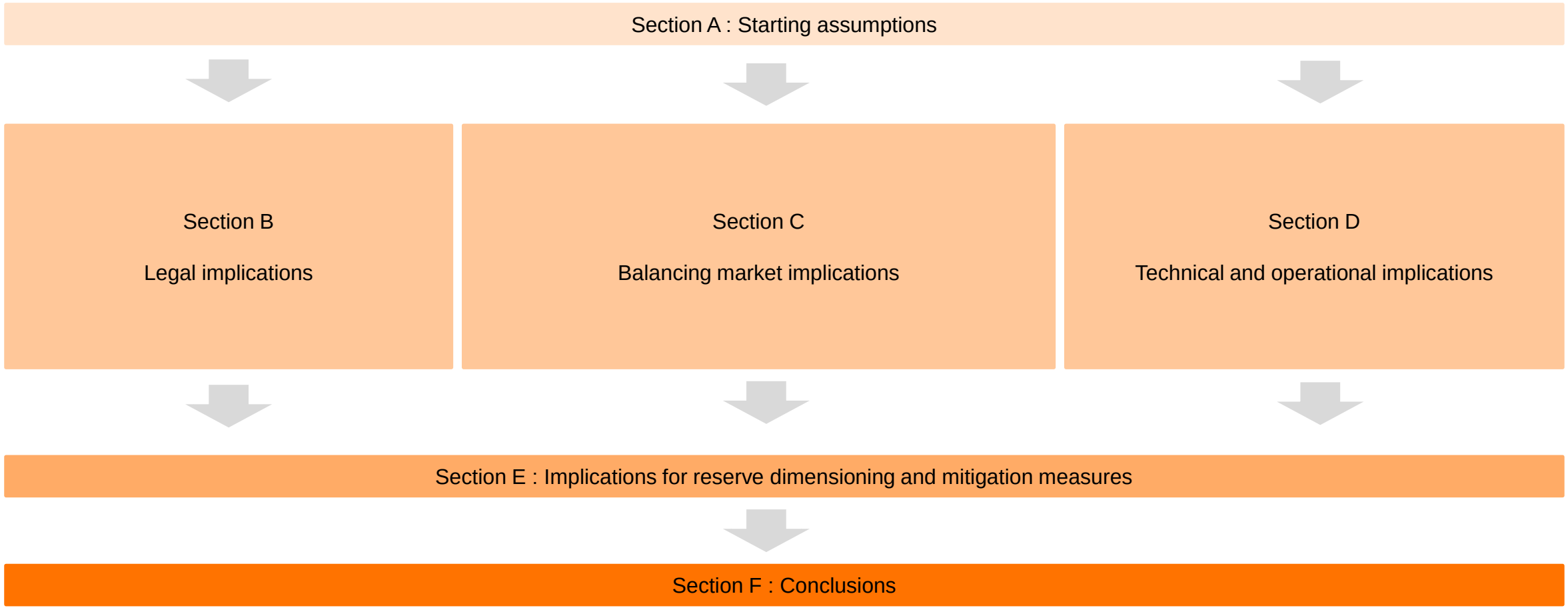


**Public consultation will be integrated with market design aspects*

Balancing implications for an offshore bidding zone

- provide further understanding on the implications of an offshore bidding zone for balancing (and tackle questions of stakeholders raised in TF MOG 2 workshop on 24.06.2022)
- clarify the potential impact on reserve dimensioning and recommended mitigation measures for exceptional balancing events (i.e. storms and ramps) as presented in TF MOG 2 on 10.01.2022

Structure of the presentation



High level summary of stakeholder questions

QUESTIONS RECEIVED FROM STAKEHOLDERS ON

- The need for an in depth analysis of interaction with EU Balancing platform and calculation of the imbalance settlement price.
- An analysis of risk of high balancing costs if there is only a UK-BE connection (outside of EU) as there is no visibility on the possible participation of the UK in de EU balancing platforms.
- How to equalize treatment of wind parks if you can do netting in case of the home market set-up, while this is not possible for OBZ, where you have to compete with the cross-border capacity.
- Clarification on the impact of an OBZ on the proposed mitigating measures (preventive curtailments, ramping rate limitations, …)?
- Clarification on what level (LFC Area, LFC Block, other?) the BRP balance obligation is applicable
- Clarification of the impact of an offshore bidding zone on the possibilities of a BRP to balance its portfolio
- Comparison of the balancing prices in UK vs BE and expected volatility of the balancing prices in an OBZ compared to the volatility of the BE market balancing prices

⇨ **Clarifications will be provided throughout the presentation**

A. Starting assumptions

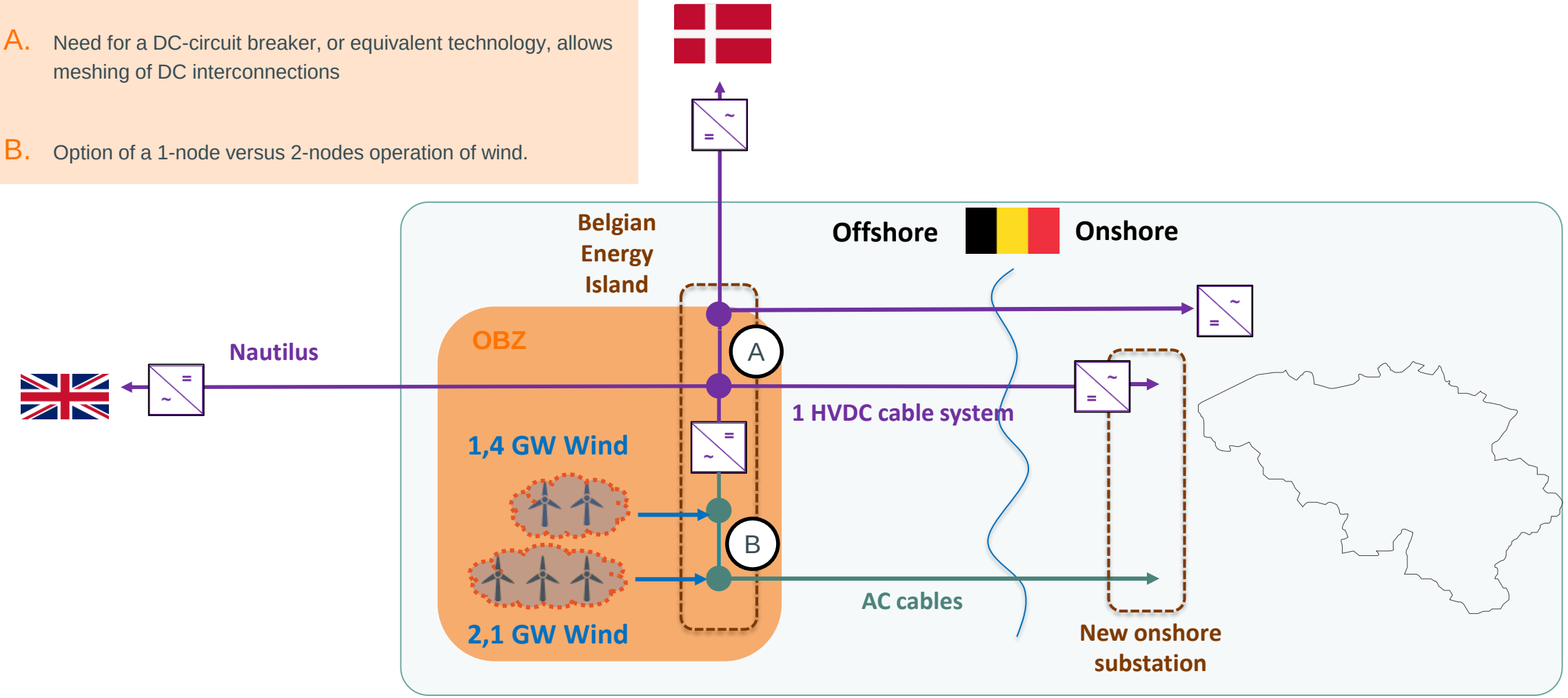
MOG 2 grid design

Reference case according to Federal Development Plan

Technical uncertainties

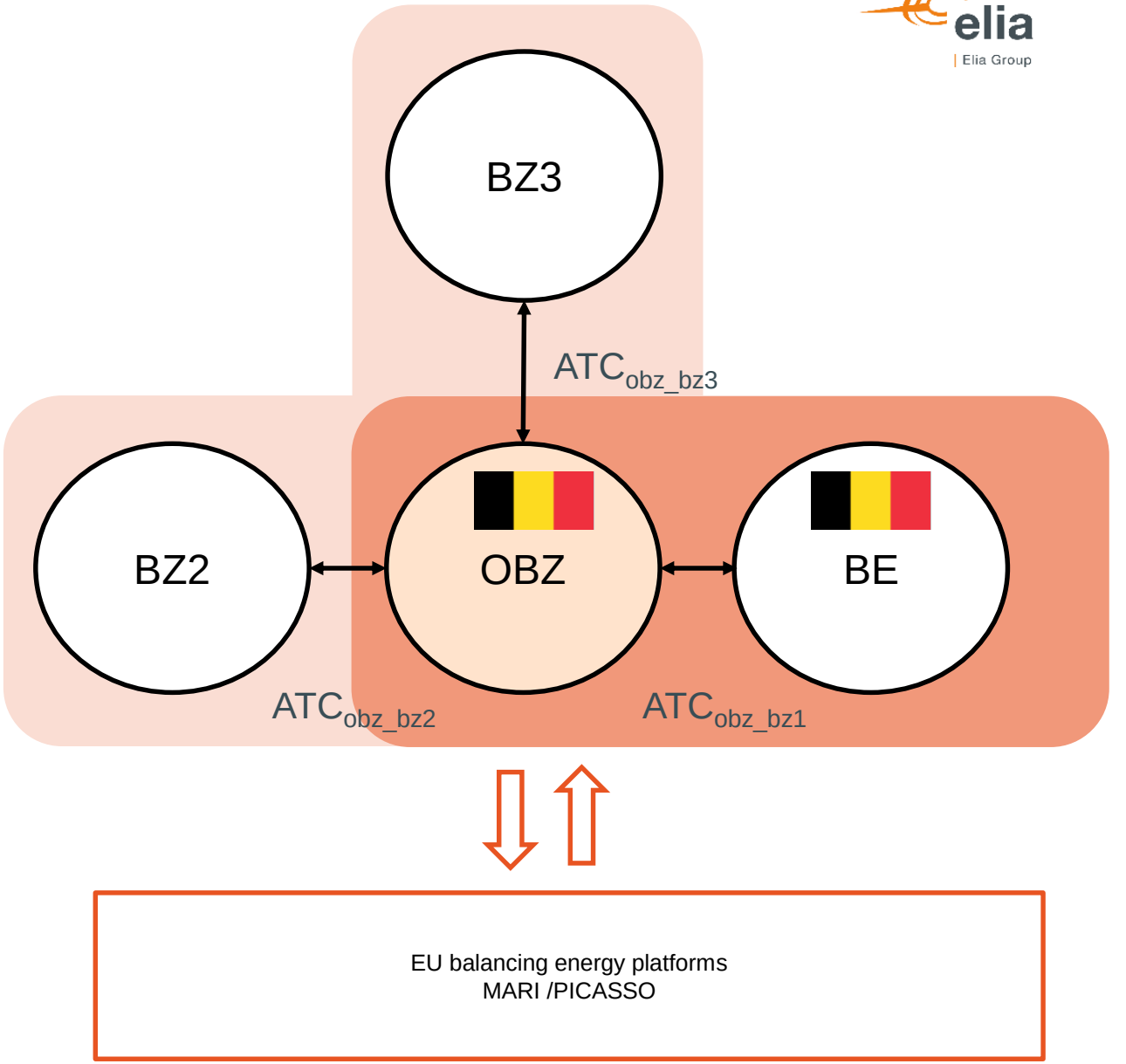
A. Need for a DC-circuit breaker, or equivalent technology, allows meshing of DC interconnections

B. Option of a 1-node versus 2-nodes operation of wind.



MOG 2 generalized market design

- Analyses in this presentation start from a generalized design based on a meshed HVDC grid with connections to several countries which are part of an integrated EU balancing market.
- Specific analysis will be presented on intermediate steps towards the realization of such conceptual design (e.g. before connection to Denmark and United Kingdom currently outside EU balancing market)
- **The objective is to demonstrate how an Offshore Balancing Zone could be operated in the balancing time frame.**



MOG 2 balancing responsibility

- **Per article 5 of Electricity Regulation 2019/943 (internal market for electricity – recast), all market participants shall be responsible for the imbalances they cause in the system. It clarifies that this entails full financial responsibility**
  - Via the imbalance tariff, the wind farm is incentivized to follow through on their sold volumes in the market. It can control this by improving forecasting accuracy or adjusting their position closer to real-time (intra-day, self-correction…).
  - Without balancing responsibility, higher forecast errors will result in increased risks for real-time flexibility shortages and network congestions, in worst case leading to demand shedding or renewable energy curtailment.
  - The lack of balancing responsibility renders the market ineffective to ensure its function of distributing the responsibility to dispatch the entire system and the TSO will need to take over this function via additional reserve capacity and exceptional balancing measures (of which costs will be attributed to the grid user)

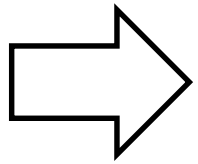
- **This presentation and design principles need to be seen in the light to create adequate (representing value of balancing energy) and consistent (in line with intra-day and day-ahead) price incentives in the balancing time frame allowing to** :
  - Mitigate the impact of renewable generation on reserve dimensioning (= balancing procurement costs) and exceptional balancing measures (= activations costs) accounted to the grid user

B. Legal implications

The legal framework requires establishing a separate imbalance price area for the offshore bidding zone

- According to Article 2(13) of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing 'imbalance price area' is the area for the calculation of an imbalance price.

- Article 6(6) of the said Regulation (EU) 2019/943 stipulates that each imbalance price area shall be equal to a bidding zone, except in the case of a central dispatching model where an imbalance price area may constitute a part of a bidding zone.



As Belgium is based on a self-dispatching model, an offshore bidding zone legally requires an imbalance price area

- *According to Article 2(18) of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (Network Code on Electricity Balancing - NC EB) 'central dispatching model' is a scheduling and dispatching model where the generation schedules and consumption schedules as well as dispatching of power generating facilities and demand facilities, in reference to dispatchable facilities, are determined by a Transmission System Operator (TSO) within the integrated scheduling process.*

- *According to Article 2(17) of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing, 'self-dispatching model' is a scheduling and dispatching model where the generation schedules and consumption schedules as well as dispatching of power generating facilities and demand facilities are determined by the scheduling agents of those facilities.*

A separate imbalance price area can only be achieved through a separated LFC area

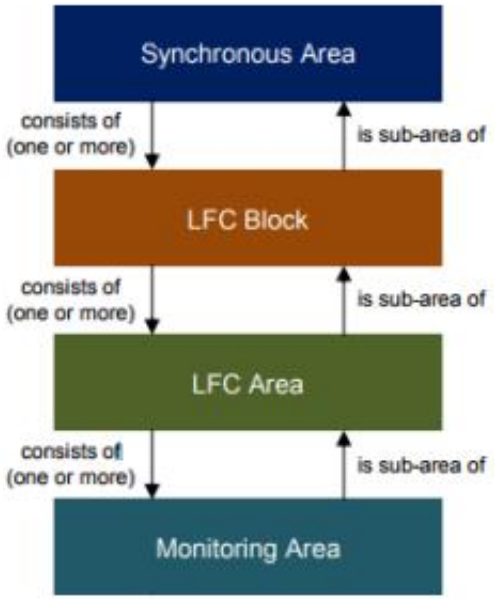


Figure 1. Types and hierarchy of areas operated by TSOs

Separating reserve activation processes allow to facilitate separate imbalance prices (through CBMP)

- The Synchronous Area has the obligation to fulfil the frequency quality target parameters by using the frequency containment process.

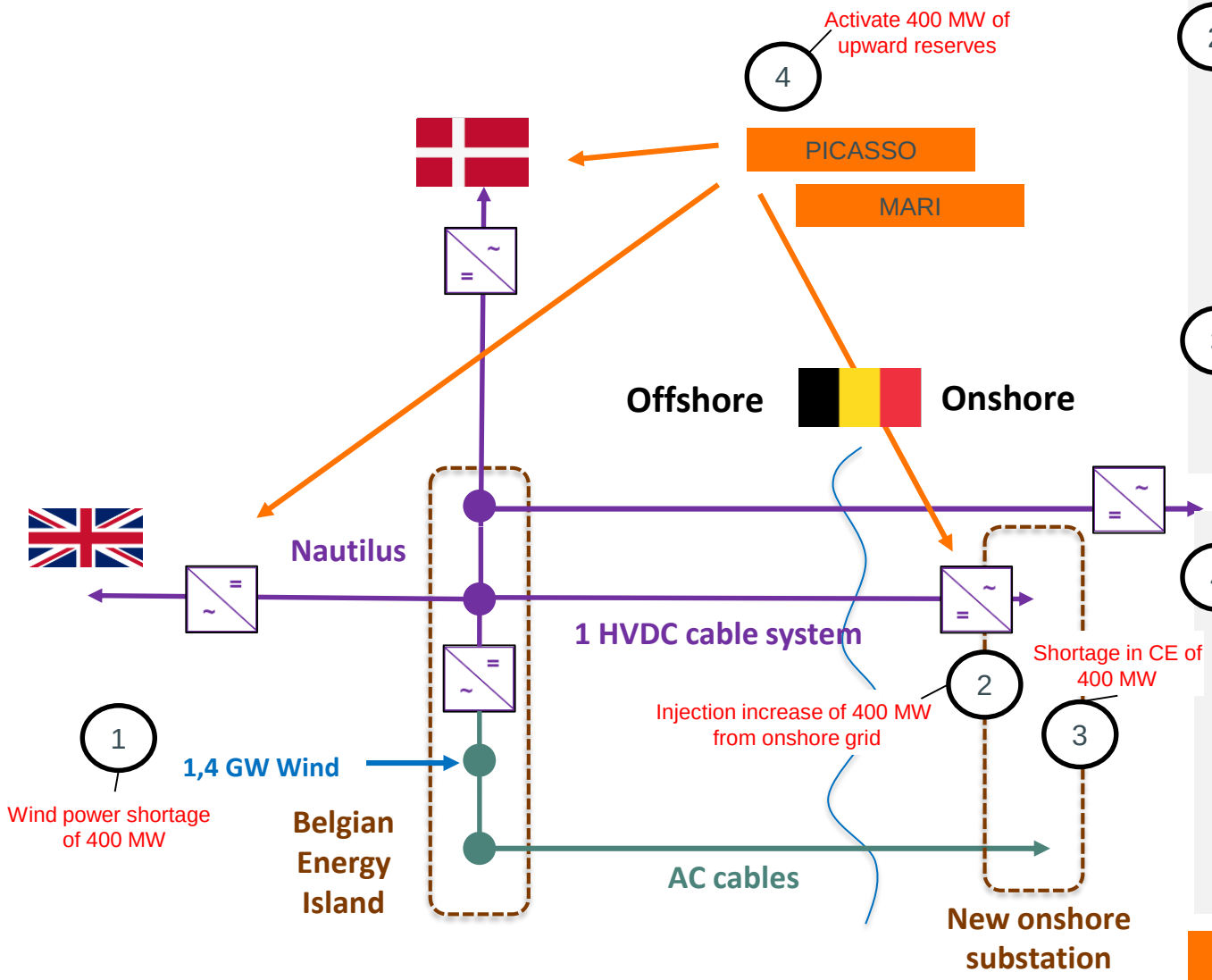
A LFC Block is in addition responsible for the dimensioning of frequency restoration reserve (FRR) and replacement reserves (RR).

A LFC Area has the additional obligation to fulfil the frequency restoration quality target parameters by using the frequency restoration process.

- A Monitoring Area has the obligation to calculate and measure the active power interchange in real-time in that area.

https://documents.acer.europa.eu/Official_documents/Acts_of_the_Agency/Annexes%20to%20the%20DECISION%20OF%20THE%20AGENCY%20FOR%20THE%20C4/ACER%20Decision%20on%20the%20Implementation%20framework%20for%20mFRR%20Platform%20-%20Annex%20I.pdf

Implications of a separate LFC area for the balancing market time frame



1 Assume an unexpected reduction of wind power generation

2 The HVDC system will react instantaneously to maintain DC voltage stability (balance within few milliseconds and HVDC controller will adapt set-points to :

- reduce injection to BE when importing to BE from island
- increase off-take from BE when exporting from BE to island

3 This reaction will create an instantaneous physical shortage in the mainland, impacting the frequency and to be compensated via FCR.

Technical / Operational timeframe

4 The SI / ACE of the offshore LFC Area will trigger a demand for upward activation of reserves in the EU balancing platforms. Note that a separate activation may occur from the SI / ACE in the onshore LFC Area

- EU balancing platforms will net the ACE / FRCE and optimize reserve activations over all the connected regions in function of the remaining ATC ID between OBZ and the connected regions
- Activations frees up activated FCR and bring cross-zonal exchanges in line with market outcome (including balancing).

Balancing market timeframe

Intra-day market timeframe

Real-time

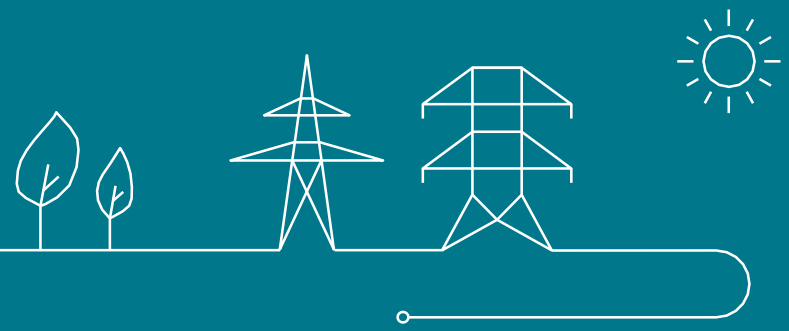
After milli-sec

After Seconds/ minutes

After 15 minutes

After 60 minutes

C. Balancing market implications



Implications of several LFC areas with separate imbalance prices

- Assuming that the bidding zones connected to the OBZ are part of the same EU balancing energy market, creating two LFC areas will allow to :
  - Align topology with day-ahead and intra-day time frame
  - **Facilitate adequate imbalance price signals**
  - Reduce TSO congestion management (by internalizing grid constraints in the balancing market)
  - Provide schedules as input for HVDC controllers

Instead of having one common Belgian area control error and system imbalance triggering activations on EU balancing energy platform, a separate area control error and imbalance is determined for both areas :

- the offshore bidding zone ($ACE_{ELIAoff}$)
- the onshore bidding zone (ACE_{ELIAon})

Both triggering separately the activations in EU balancing platforms

The OBZ balancing price converges with the cheapest balancing energy price in BZ and/or BE as long as there is remaining transmission capacity between two connected LFC area's

Illustration

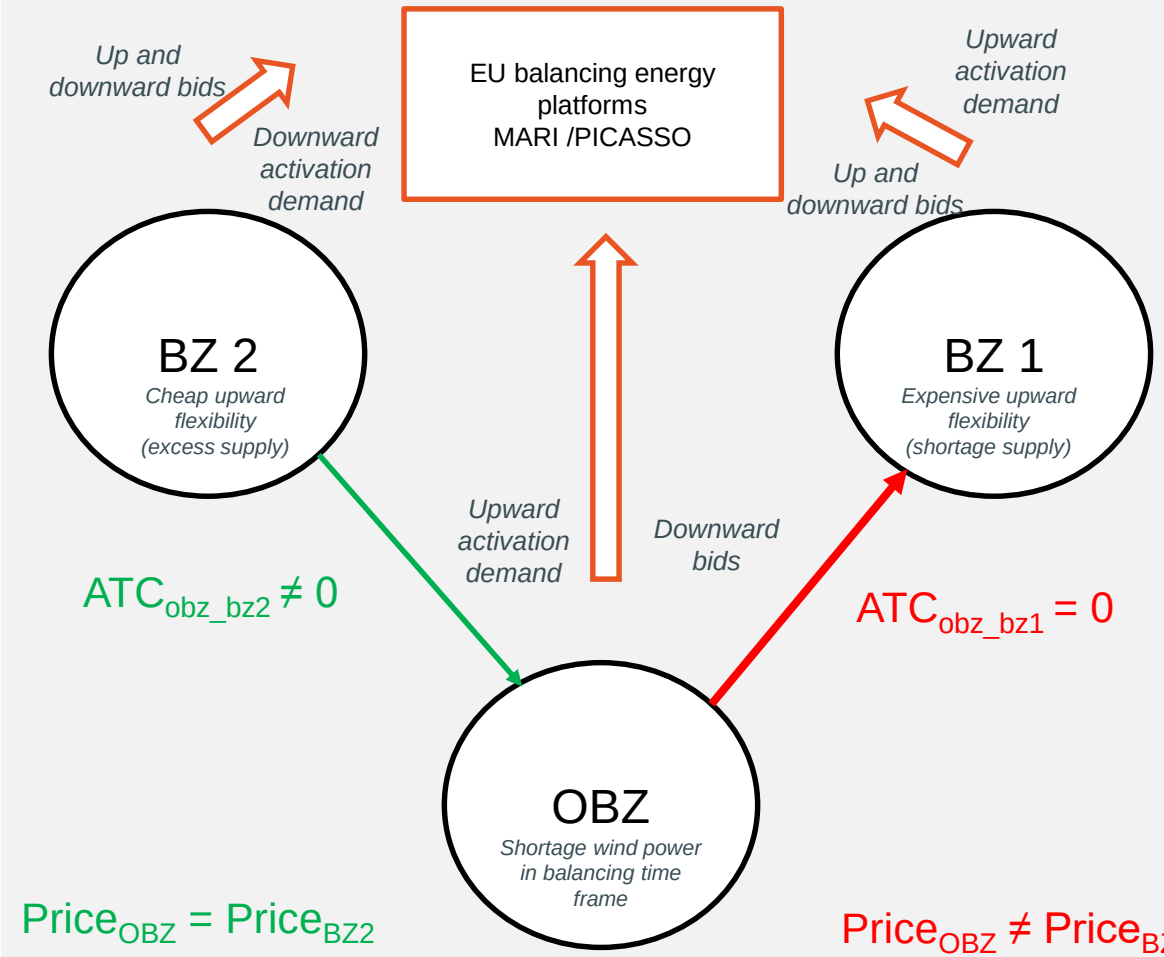
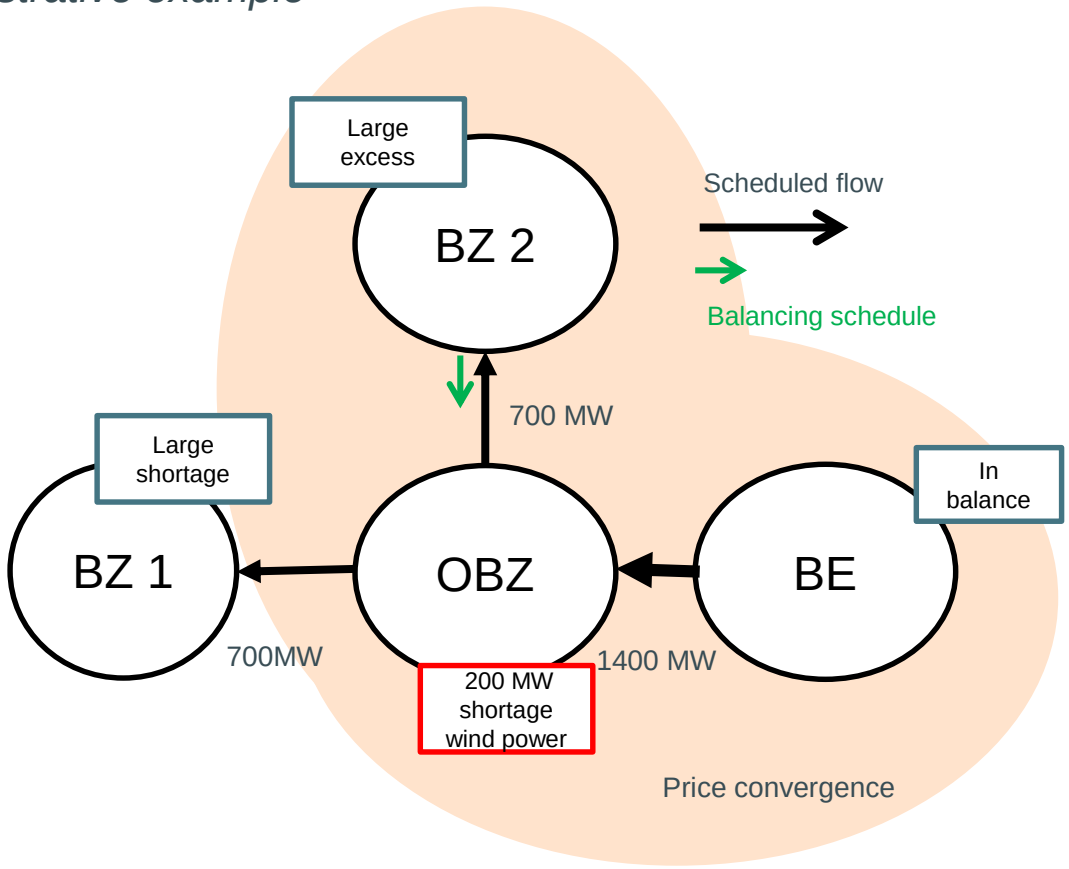


Illustration of price convergence

Illustrative example



Offshore wind power shortage are covered at the lowest accessible balancing prices

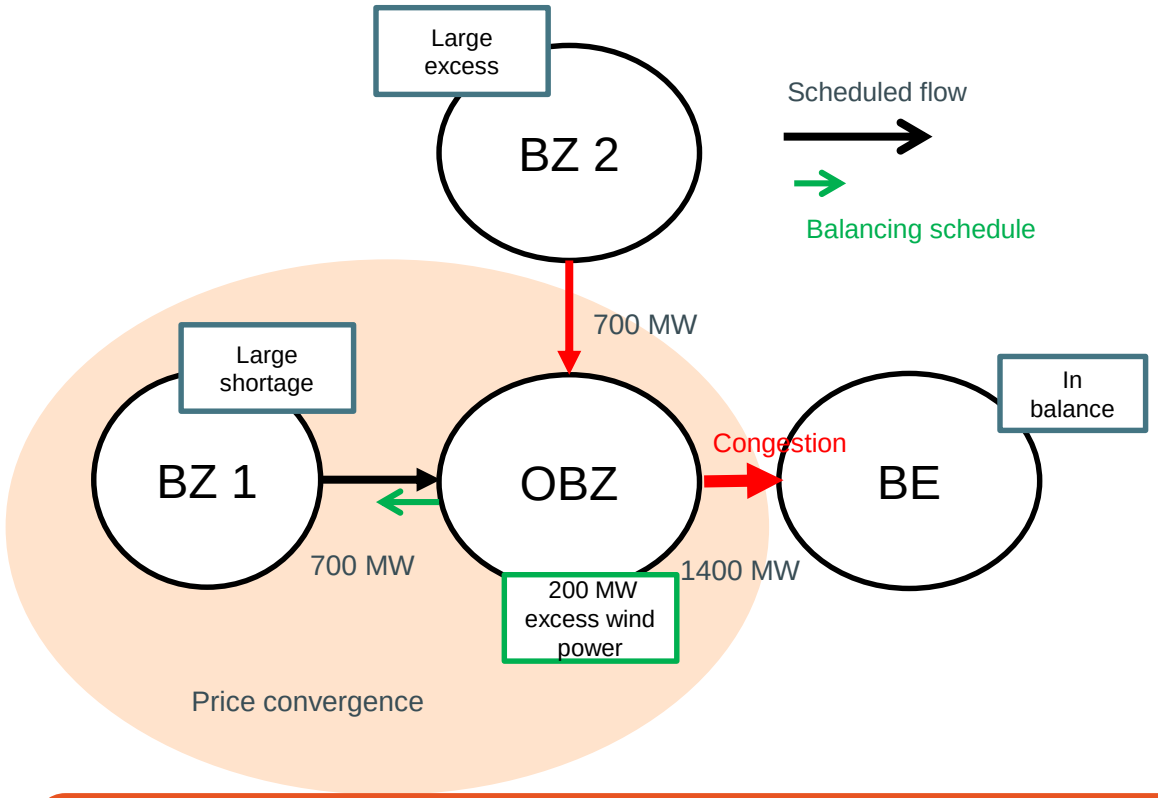
- Assume a shortage of 200 MW of wind power in the offshore LFC Area
- Injections from Belgium are instantaneously increased in order to maintain DC voltage stability resulting in a physical shortage in the Belgian LFC Area (represented by an ACE / SI of the offshore LFC Area)
- Remaining ATCs after ID with BZ1, BZ2 and Belgium allow to cover the shortage power in one or more of the connected LFC Areas:
  - Shortage is covered, in general in LFC Area with cheapest balancing prices (or in this case facing excess energy), willing to cover the shortage at a low price, in this case BZ2.
  - Balancing energy prices converges with BZ2 and in this case also with BE as long there is ATC between the LFC Areas
- BZ2 import schedule is adapted (reduced) in function of 200 MW shortage wind power.

Technical / Operational timeframe

Balancing market timeframe

Illustration of price divergence

Illustrative example



Wind power excess can be sold as upward balancing energy on the balancing platforms

With one LFC Area, this case would result in maintaining downward wind power regulation or cross-border re-dispatch measures

- Assume an excess wind power of 200 MW in the offshore LFC Area
- As there is in real-time no means to increase injections to Belgium, the excess wind power will need to be capped in function of operational limits of the HVDC system, in order to maintain DC voltage stability (or send to BZ 1 or BZ 2 if agreement with those TSOs)
- Wind power can offer available upward flexibility in PICASSO and MARI (typically at a very low price)
- Remaining ATCs with BZ1 and BZ2 allow to sell wind power in the connected bidding zones :
  - Energy is allocated to market with shortage, and highest willingness to pay for the excess energy, in this case BZ1.
  - Balancing energy prices converges with BZ1
- Preventive cap is released, BZ1 Import schedule is adapted (reduced) in function of 200 MW additional wind power.

Technical / Operational timeframe

Balancing market timeframe

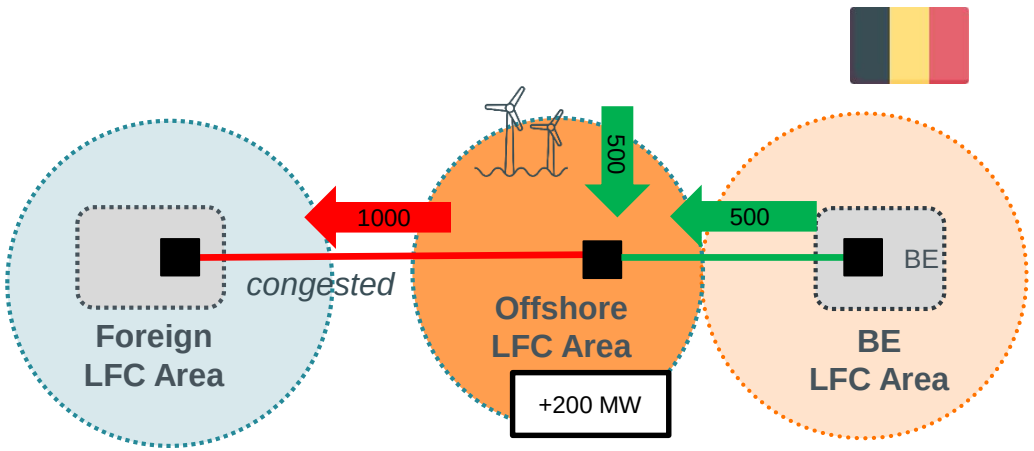
Presentation of several use cases

1) Use case 1: excess wind power during high BE export conditions
2) Use case 2: excess wind power during high BE import conditions
3) Use case 3: shortage wind power during high BE import conditions
4) Use case 4: shortage wind power during high BE export conditions

5) Particular use case 5 : connection to UK only (outside EU balancing cooperation)
6) Particular use case 6 : ATC lower than physical capacity on the HVDC system

Use case 1: excess wind power during high export conditions

1. excess export | 2. excess import | 3. shortage export | 4. shortage import



Cheaper balancing energy in BE LFC Area	$P_{BZ} \neq P_{offshore} = P_{BE}$
Cheaper balancing energy in foreign LFC Area	$P_{BZ} = P_{offshore} \neq P_{BE}$

- **Imbalance netting and balancing energy activations will be optimized through the balancing platform in function of available liquidity and available ATC**
  - Cross-border marginal price (balancing energy price) in offshore LFC Area converges to BE LFC area as long as there is available transmission capacity
  - Cross-border marginal price in offshore LFC Area may diverge from BE LFC Area when facing transmission capacity limitations (when activating cheap balancing energy in UK for the foreign LFC Area)
- **Separate LFC areas allow to manage the injection of excess renewable energy to BE LFC area while giving price incentives for downward wind power reductions if large excess power in BE LFC area**

Excess wind power in the offshore LFC area can be managed through

- Activation of balancing resources in Belgian LFC Area through EU balancing platforms

  Reduction of injection from BE to the OBZ to the connected LFC Areas (until ATC limitation) by means of downward activation of flexibility in Continental Europe

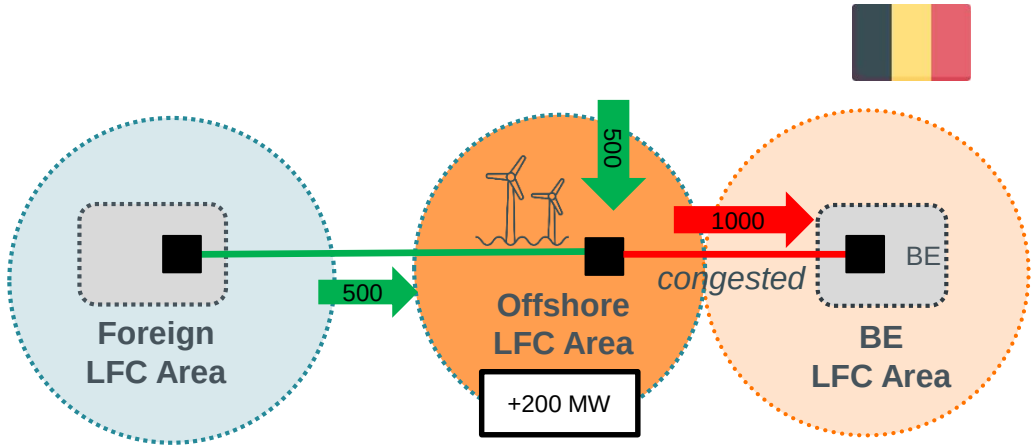
- Activation of balancing resources in Offshore LFC Area through EU balancing platforms

  Reduction of the offshore wind power injections through downward activation of wind power flexibility

- No activation of balancing resources in foreign LFC Areas (i.e. UK or DK) is possible due to transmission capacity limitations

Use case 2: excess wind power during high import conditions

1. excess export | **2. excess import** | 3. shortage export | 4. shortage import



Cheaper balancing energy in BE LFC Area	$P_{BZ} \neq P_{offshore} = P_{BE}$
Cheaper balancing energy in foreign LFC Area	$P_{BZ} = P_{offshore} \neq P_{BE}$

- **Imbalance netting and balancing energy activations will be optimized through the balancing platform in function of available liquidity and available ATC**
  - Cross-border marginal price (balancing energy price) in offshore LFC Area diverges from BE LFC Area as long as there are transmission capacity limitations
  - Cross-border marginal price in offshore LFC Area may converge to BE LFC area when facing available transmission capacity (when activating cheap balancing energy in BE for the foreign LFC Area)
- **Separate LFC areas facilitate the injection of excess renewable energy to connected bidding zone while giving price incentives for downward wind power reductions if large excess in foreign LFC Area**

Excess wind power in the offshore LFC area can be managed through

- No activation of balancing resources in Belgian LFC Area is possible due to transmission capacity limitations
- Activation of balancing resources in Offshore LFC Area through EU balancing platforms

  Reduction of the offshore wind power injections through downward activation of wind power flexibility

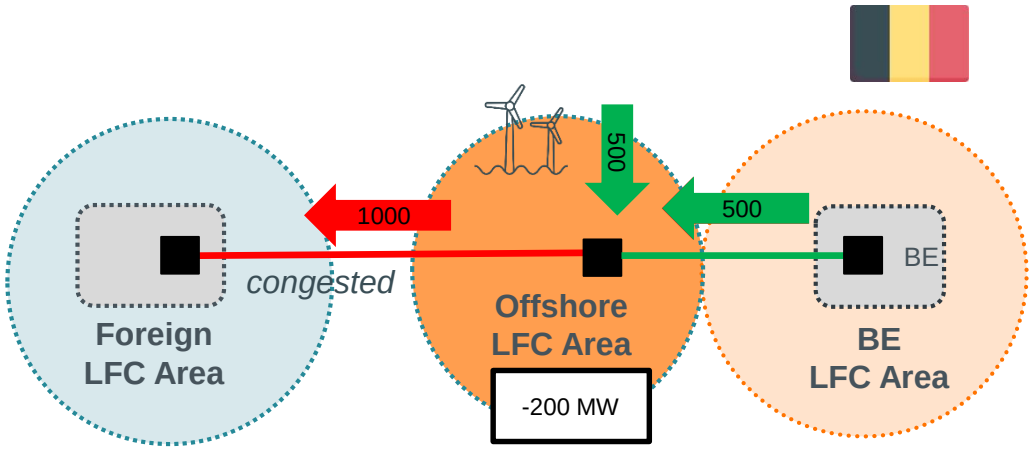
Note that (part of) wind power may be capped preventively by TSO following HVDC operational management (cf. Section D). Separated LFC Areas allow to facilitate the injection of wind power in the balancing time frame in function of available ATC

- Activation of balancing resources in foreign LFC Area through EU balancing platforms

  Reduction of the injection from the foreign LFC Areas to the OBZ (until ATC limitation) through downward activation of flexibility via the foreign LFC Area

Use case 3 : shortage wind power during high export conditions

1. excess export | 2. excess import | **3. shortage export** | 4. shortage import



Cheaper balancing energy in BE LFC Area	P_{BZ}	≠	$P_{offshore}$	=	P_{BE}
Cheaper balancing energy in foreign LFC Area	P_{BZ}	=	$P_{offshore}$	≠	P_{BE}

- **Imbalance netting and balancing energy activations will be optimized through the balancing platforms in function of available liquidity and available ATC**
  - Cross-border marginal price (balancing energy price) in offshore LFC Area remains equal to BE LFC area as long as there is available transmission capacity
  - Cross-border marginal price in offshore LFC Area may diverge from BE LFC Area when facing transmission capacity limitations (when activating cheap balancing energy in the foreign LFC Area for BE)
- **Separate LFC areas allow to cover the shortage of renewable energy at the lowest balancing price of the BE LFC Area and foreign LFC Area.**

Shortage wind power in the offshore LFC area can be managed through:

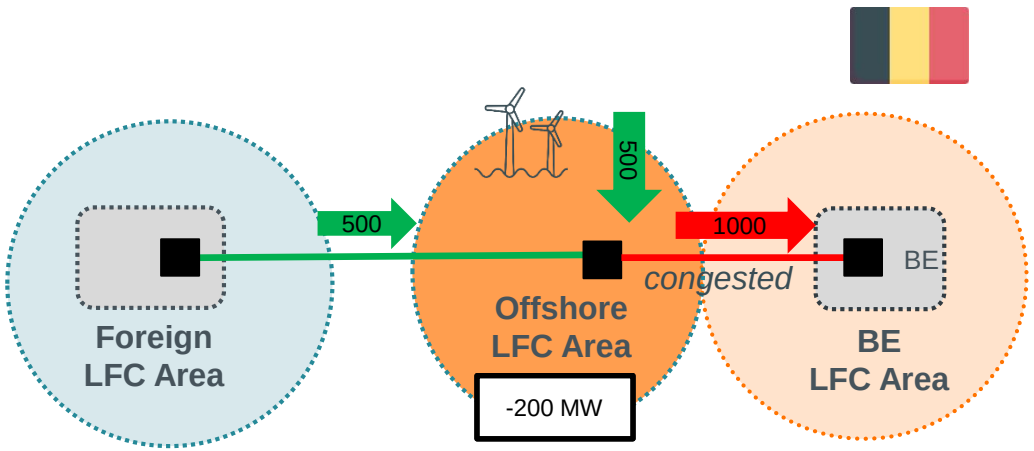
- Activation of balancing resources in Belgian LFC Area
  - ➢ Increase of the injection from BE to the OBZ (until ATC limitation) through upward activation of flexibility in continental Europe

Note that despite physical capacity on the HVDC interconnector, available transmission capacity can be limited as the capacity available for balancing results from a coordinated calculation in the Core CCR (cf. Use case 6).

- No activation of balancing resources in Offshore LFC Area following no or limited possibilities for upward regulation in the offshore LFC Area
- Activation of balancing resources in foreign LFC Area through EU balancing platforms
  - ➢ Reduction of the injection from OBZ to the foreign LFC Areas (until ATC limitation) through upward activation of flexibility via the foreign LFC Area

Use case 4: shortage wind power during high import conditions

1. excess export | 2. excess import | 3. shortage export | **4. shortage import**



Cheaper balancing energy in BE LFC Area	P_{BZ}	≠	$P_{offshore}$	=	P_{BE}
Cheaper balancing energy in foreign LFC Area	P_{BZ}	=	$P_{offshore}$	≠	P_{BE}

- **Imbalance netting and balancing energy activations will be optimized through the balancing platforms in function of available liquidity and available ATC**
  - Cross-border marginal price (balancing energy price) in offshore LFC Area remains equal to BE LFC area as long as there is available transmission capacity
  - Cross-border marginal price in offshore LFC Area may diverge from BE LFC Area when facing transmission capacity limitations (when activating cheap balancing energy in the foreign LFC Area for BE)

Separated LFC areas allow to cover the shortage of renewable energy at the lowest balancing price of the BE LFC area and foreign LFC Area

Shortage wind power in the offshore LFC area can be managed through:

- Activation of balancing resources in Belgian LFC Area through EU balancing platforms

  Reduction of the injection from BE to the OBZ (until ATC limitation) through upward activation of flexibility in continental Europe

- No activation of balancing resources in Offshore LFC Area following no or limited possibilities for upward regulation in the offshore LFC Area

- Activation of balancing resources in foreign LFC Area (if part of a balancing cooperation) through EU balancing platforms

  Increase of the injection from foreign LFC Areas to the OBZ (until ATC limitation) through upward activation of flexibility via the foreign LFC Area

Summary : balancing implications for an offshore bidding zone

Belgian bidding zone position (pre-balancing time frame)

OBZ Balancing position

Excess

Separated LFC areas allow to maximize injections of renewable generation while maintaining adequate price signals for downward wind power reductions if needed (i.e. during large excess in connected LFC Areas)

High export

- In general, activation of downward balancing energy bids possible via BE LFC Area
- Offshore LFC area balancing energy price are expected to converge with cheapest LFC Area
- Activation of downward bids on offshore wind is incentivized during large over-generation in Belgian LFC Area

High import

- In general, activation of downward balancing energy bids via connected LFC Area
- Offshore LFC area balancing energy price is expected to converge with cheapest LFC Area
- Activation of downward balancing energy bids is incentivized during large over-generation in connected LFC Area **

****A preventive wind power cap is required to maintain instant HVDC system stability (cf. section D)**

Shortage

Separate LFC areas allow to manage renewable energy shortages at the lowest balancing price over the connected LFC Areas

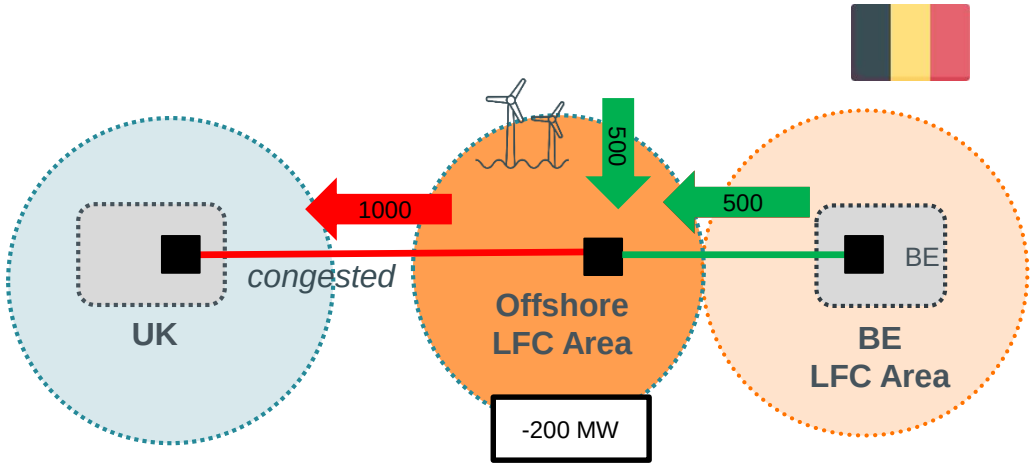
- In general, activation of upward balancing energy bids via Belgium or connected LFC Area
- Offshore LFC area balancing energy price is expected to converge with LFC area with cheapest balancing energy

- Activation of upward balancing energy bids via Belgium or connected LFC Area
- Offshore LFC area balancing energy price is expected to converge with LFC area with cheapest balancing energy

***Activation of upward balancing energy via Belgium can be subject to onshore transmission limits (cf. Use case 6)**

Special use case 5a: connection to UK only (outside EU balancing market)

Shortage wind



- **By means of a balancing cooperation with UK, imbalance netting and balancing energy activations will be optimized through the balancing platform / cooperation in function of available liquidity and available ATC**
  - Cross-border marginal price (balancing energy price) in offshore LFC Area converges to BE LFC area as long as there is available transmission capacity
  - Cross-border marginal price in offshore LFC Area may diverge from BE LFC Area when facing transmission capacity limitations (when activating cheap balancing energy in UK for BE)
- **A balancing cooperation with UK allows to cover the shortage of renewable energy at the lowest balancing price of the BE LFC Area and foreign LFC Area.**

Technical / Operational timeframe

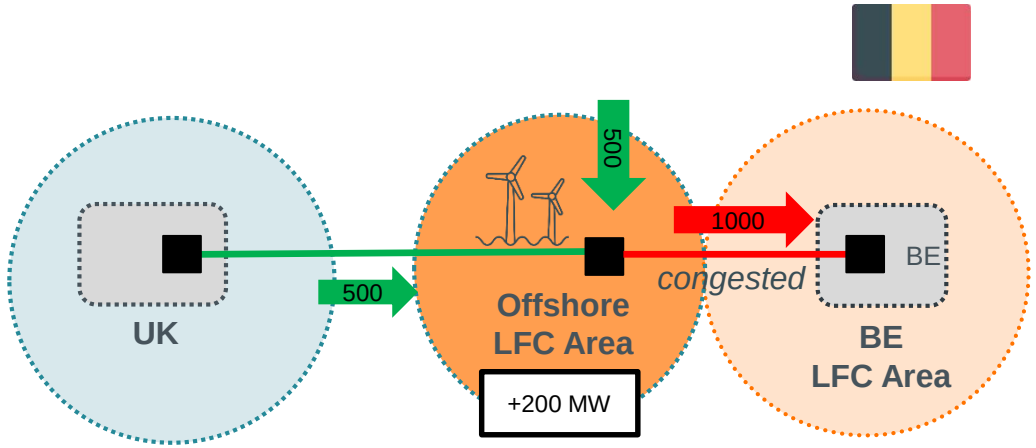
- Assume a shortage of 200 MW of wind power in the offshore LFC Area
- Injections from Belgium would need to be instantaneously increased in order to maintain DC voltage stability resulting in a shortage in the Belgian LFC Area (represented by an ACE / SI of the offshore LFC Area)
- In general, remaining ATC with Belgian LFC Area allows to cover the shortage power in Belgium via activation of balancing resources in Belgian LFC Area
  - Reduction of the injection from OBZ to BE through upward activation of flexibility in continental Europe. Balancing energy prices in OBZ converges with BE

Balancing market timeframe

- A balancing cooperation with UK (such as UK would join the EU balancing platforms) would also allow to cover the shortage power via activation of balancing resources in UK :
  - Reduction of the injection from OBZ to the UK LFC Area (up to ATC limitations) through upward activation of flexibility in the UK LFC Area

Special use case 5a: connection to UK only (outside EU balancing market)

Shortage during full export to UK



- **By means of a balancing cooperation with UK, imbalance netting and balancing energy activations will be optimized through the balancing platform / cooperation in function of available liquidity and available ATC**
  - Cross-border marginal price (balancing energy price) in offshore LFC Area diverges from BE LFC Area as long as there are transmission capacity limitations
  - Cross-border marginal price in offshore LFC Area may converge to BE LFC area when facing available transmission capacity (when activating cheap balancing energy in BE for the foreign LFC Area)
- **A balancing cooperation with UK facilitates the injection of excess renewable energy to connected bidding zone while giving price incentives for downward wind power reductions if large excess in UK**

Technical / Operational timeframe

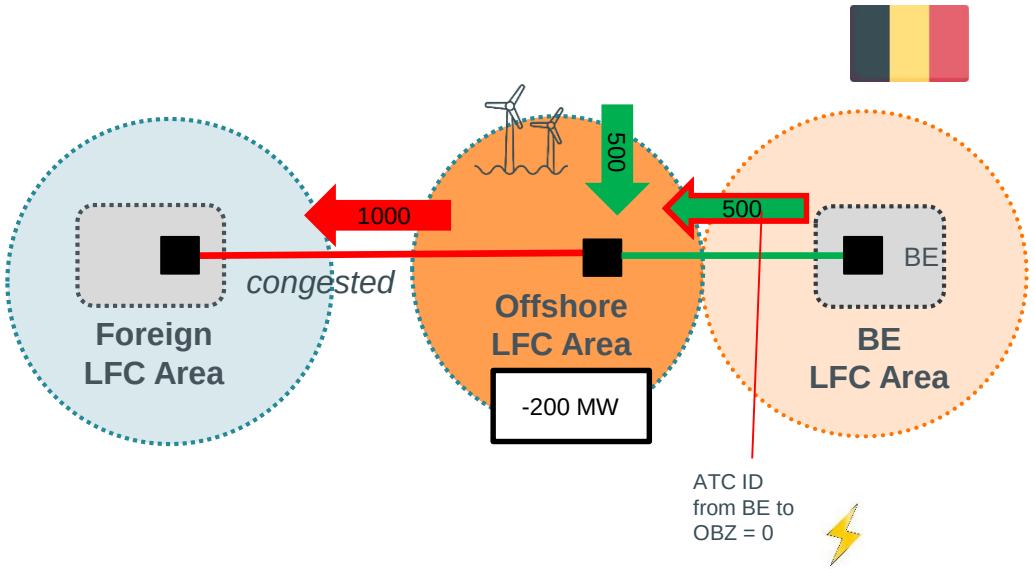
- Assume an excess of 200 MW of wind power in the offshore LFC Area
- Injections from Belgium would need to be instantaneously capped in order to maintain DC voltage stability resulting in a shortage in the Belgian LFC Area (represented by an ACE / SI of the offshore LFC Area)

Balancing market timeframe

- Due to the lack of ATC with Belgium, the only means for balancing are the available balancing resources in Offshore LFC Area
  - Reduction of the offshore wind power injections through downward activation of wind power flexibility
- A balancing cooperation with UK (such as UK would join the EU balancing platforms) would also allow to cover the excess power via activation of balancing resources in UK
  - Reduction of the injection from the UK LFC Area to the OBZ (until ATC limitation) through downward activation of flexibility in the UK LFC Area

Particular use case 6 : ATC lower than physical capacity on the HVDC system

Shortage* wind power



Note that despite physical capacity on the HVDC interconnector, available transmission capacity can be limited as the capacity available for balancing results from a coordinated calculation in the Core CCR. This may be due to :

- **Capacity calculation methods**
- **Operational limits in the onshore network**

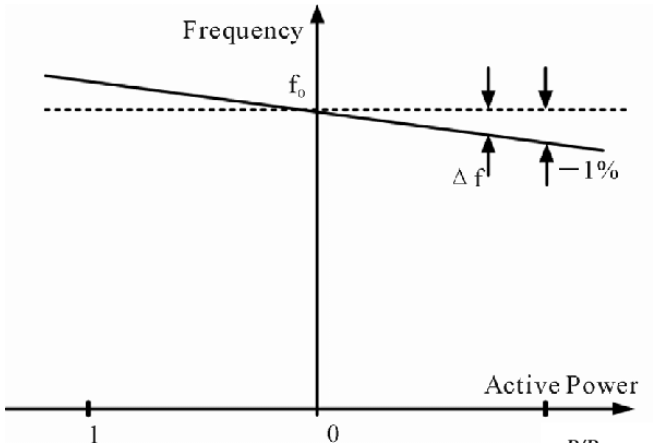
- When now assuming a shortage of 200 MW of wind power in the offshore LFC Area, the HVDC system cannot be balanced via the approaches presented previously.
  - The operational limits / ATC limitation from Belgium to the OBZ inhibit the activation of upward flexibility in Belgium to balance the HVDC system and sustain the export to the foreign LFC Area
- Note that the connection to multiple areas mitigations the risk of not being able to cover wind power shortage via one of the connected LFC Areas
- As there remains physical capacity on the system, solutions can be found to manage this specific use case and are currently under investigation

**Excess case can always be managed via downward reduction of the wind*

D. Technical / operational aspects related to balancing a meshed HVDC system

MTDC Vs AC Active Power Balancing

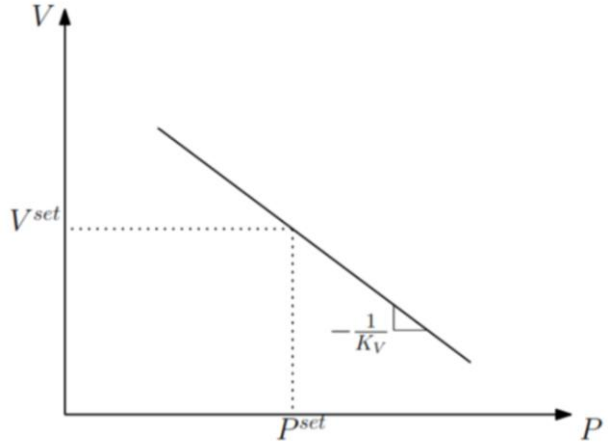
AC System



Frequency Droop based Control in AC System (eg FCR reserves)

- *Generation and Demand Balance reflect a stable 50Hz frequency*
- *Short system lead to lower frequency and vice versa*
- *LFC and local droop modulate active power to balance the system*
- *Deviation can be sustained for seconds*

DC System

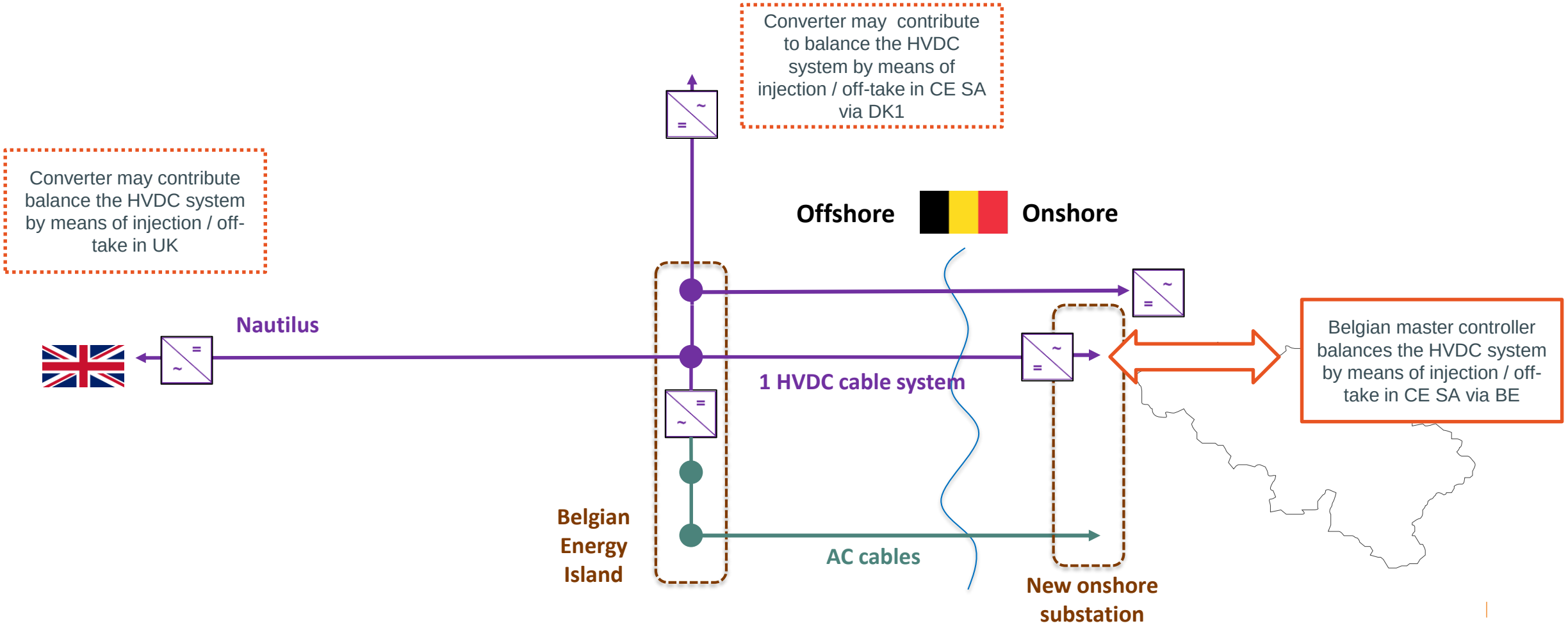


Voltage Droop based Control in MTDC

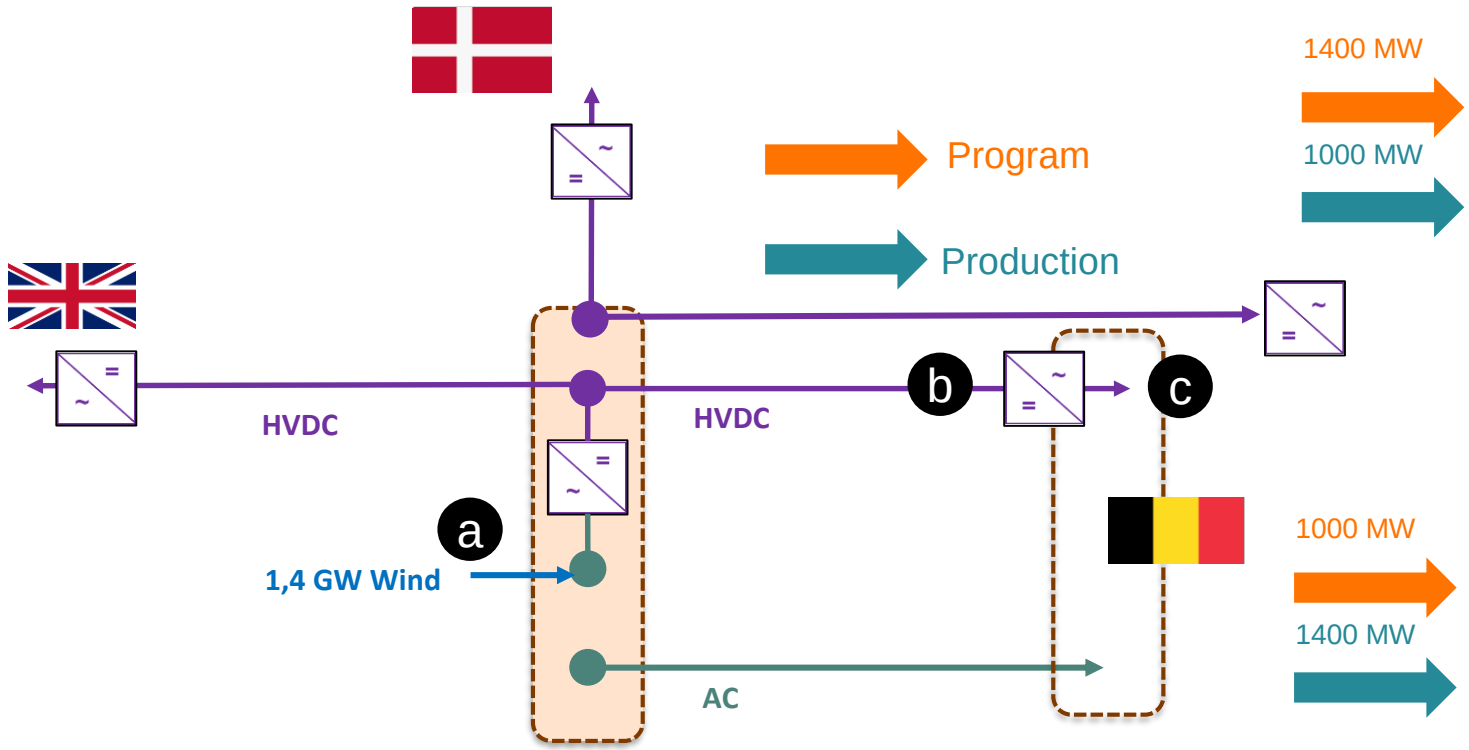
- *A balance is reflected by the DC Voltage*
- *Higher Voltage means excess of power and vice versa*
- *Central or local droop based control can balance the DC system*
- *Sustained (milliseconds) excess of power will damage assets*

Multi-terminal DC control

- Maintaining an instantaneous balance between injections and off-takes is key for DC voltage stability and safe operation of assets
- HVDC controller, being the interface between DC and AC grid, will be adjusting automatically to maintain the voltage stability



Example of balancing operations in a two nodes system without network constraints



- Considering that the offshore grid would be connected to the Elia LFC block, main automatic control is achieved through the HVDC convertor in Belgium. This will be shifting the physical shortage in Belgium onshore side, impacting the frequency in continental Europe.

Under generation

a Assume an unexpected reduction of wind power infeed

b HVDC system will need to react instantaneously to maintain DC voltage stability (balance within few milliseconds) by :
- reducing injection to BE when importing to BE from island
- increasing off-take from BE when exporting from BE to island

c This reaction will create a shortage in the mainland (to be compensated in the synchronous area via FCR and eventually FRR)

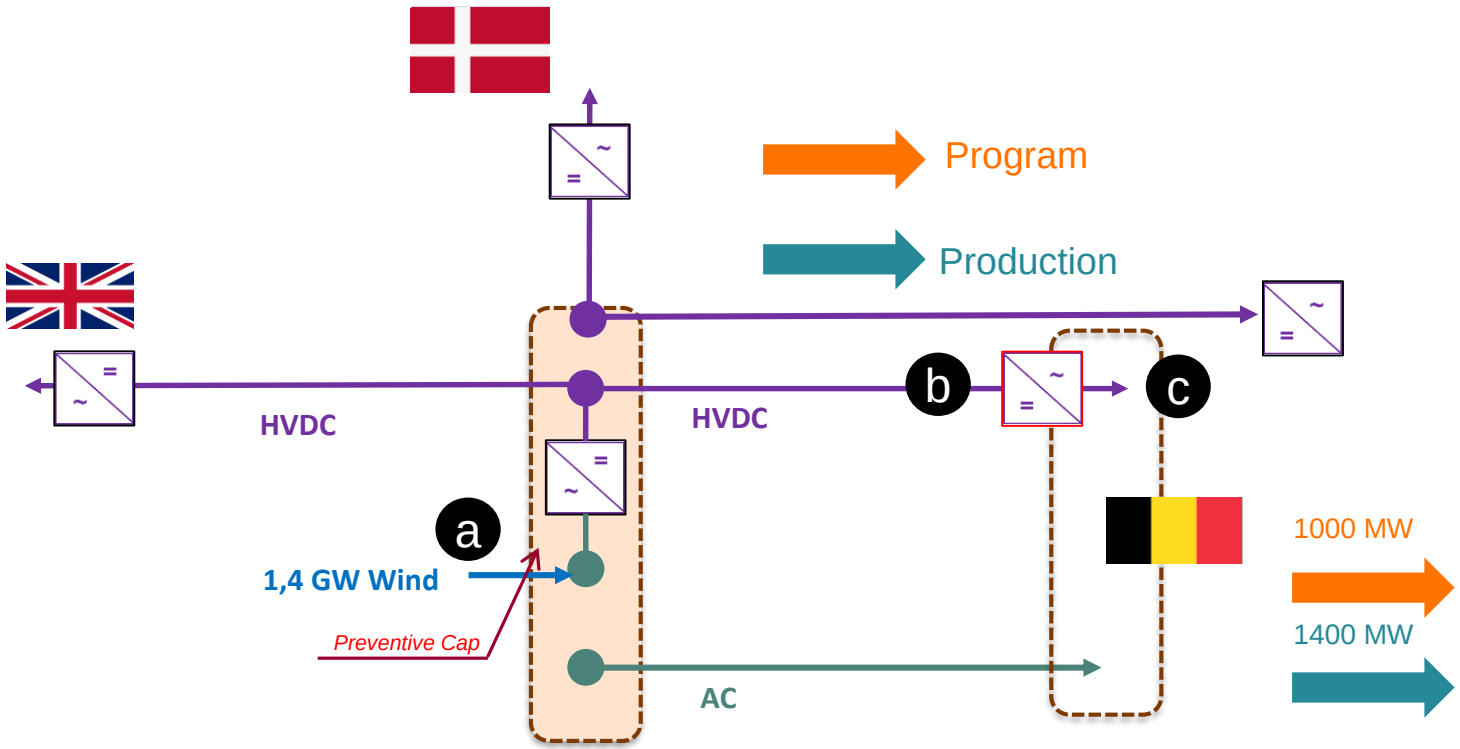
Over generation

a Assume an increase of wind power infeed

b HVDC system will react instantaneously to maintain DC voltage stability (balance within few milliseconds) by
- increasing injections to BE when importing to BE from island
- reducing off-take from BE when exporting from BE to island

c Reaction will create an excess in the mainland (to be compensated in the synchronous area via FCR and eventually FRR)

Example of balancing operation in a two nodes system with transmission constraints



- Considering that the offshore grid would be connected to the Elia LFC block, main control can be assumed to be through the HVDC convertor in Belgium. This will be shifting the physical excess in Belgium onshore side, impacting the frequency in continental Europe.
- In function of operational limits of the HVDC system, a preventive cap on wind power injections is required to manage unscheduled excess of wind power generation. This cap can be temporary in the sense that it can be relieved subject to a balancing cooperation with DK / UK

Over generation

a Assume an increase of wind power infeed

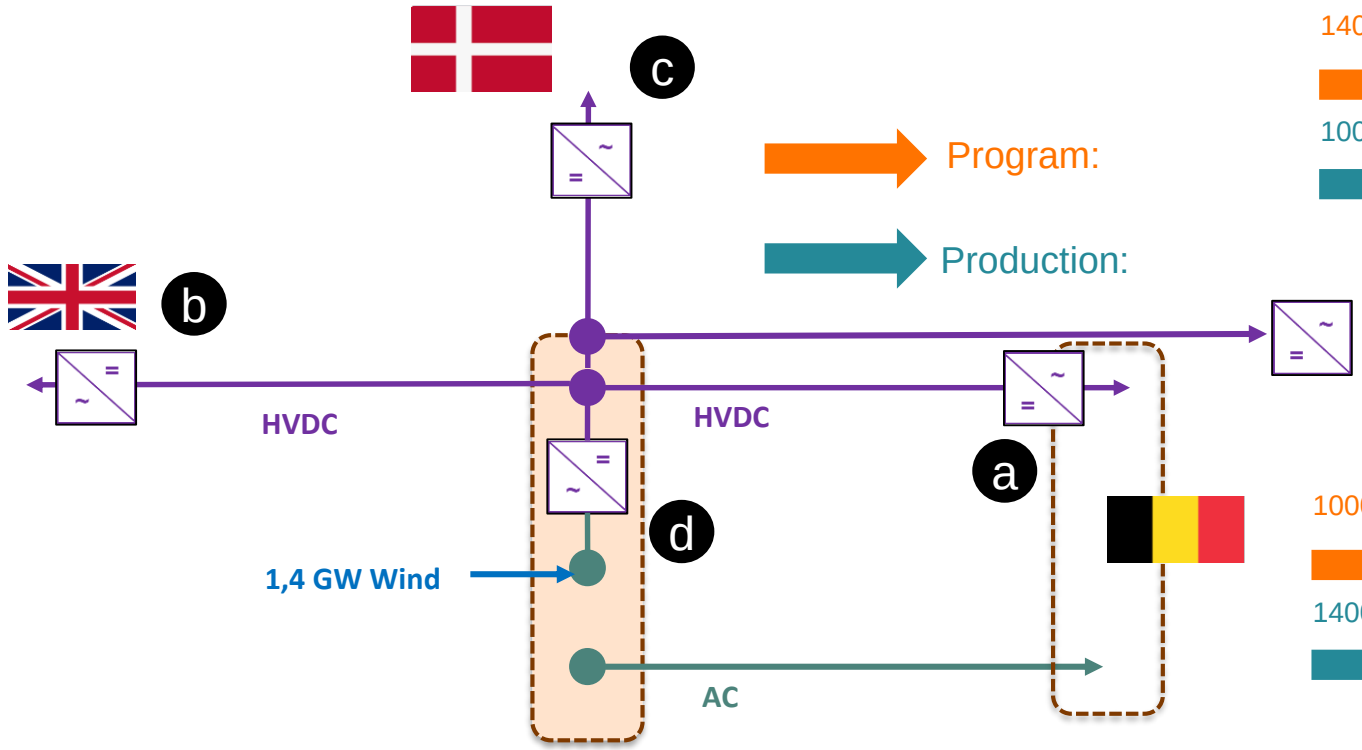
b HVDC system will react instantaneously to maintain DC voltage stability (balance within few milliseconds) by

- increasing injections to BE when importing to BE from island
- reducing off-take from BE when exporting from BE to island

➢ During high import conditions, DC capacity can be constrained requiring a temporary preventive cap of wind power infeed

c Reaction will create an excess in the mainland (to be compensated in the synchronous area via FCR and eventually FRR)

3. Example of effect of implementing balancing platforms or cooperations (conveying the right price signals)



- Economic optimization is possible via management of HVDC convertors with other connected regions (e.g. DK, UK), as well as active downward wind power regulation
- Note that a one node system will not behave fundamentally different, but most of the short-term wind power imbalances can be managed through the AC system, will reduce the need for activation of the preventive cap on wind power

Under generation

a DC converter will compensate shortage (in milli-seconds) by reducing injections (or increase off-take) to the mainland (to be compensated in CE SA)

- Economic cost can be optimized by :
  - b Increasing injections (or decrease off-take) in UK, if cheaper balancing energy and available ATC (to be compensated in UK SA)
  - c Increasing injections (or decrease off-take) in DK, if cheaper balancing energy and available ATC (to be compensated in the synchronous area)

Over generation

a HVDC converter will cap wind power exceeding available ATC and compensate accommodated excess (in milli-seconds) by increasing injections (or reduce off-take) to the mainland (to be compensated in CE SA)

- Economic cost can be optimized by :
  - b reducing injections (or reducing off-take) in UK, if cheaper balancing energy (to be compensated in UK SA)
  - c reducing injections (or reducing off-take) in DK, if cheaper balancing energy (to be compensated in the synchronous area)
  - d downward regulation of the wind power infeed (if expensive balancing energy)

E. Implications for portfolio balancing reserve dimensioning and mitigation measures

1. Implications for BRP portfolio balancing

- **Wind power plants in an offshore bidding zone are foreseen to remain responsible for their imbalance (via BRPs), and be subject to the imbalance price representing the value of balancing energy**

- **Wind power plants in an offshore bidding zone can use intra-day markets (60' before real-time) and downward control of wind power (up to real-time) to balance their positions**
  - In comparison to wind parks outside the OBZ, no portfolio advantages currently exist (no possibility to aggregate imbalances)
  - This is due to the lack of portfolio diversification options offshore (no or limited room for controllable generation sources, demand and storage)

- **Note that :**
  - Intra-day cross-zonal gate closure time is at 60' and further reductions are not a given in view of the gate closure time of the EU balancing energy platforms (25' before real-time, and 50' for TSOs connected to TERRE)
  - Other solutions (pooling portfolio imbalances over bidding zones, facilitate cross-zonal reactive balancing) are not straightforward in view of congestion management

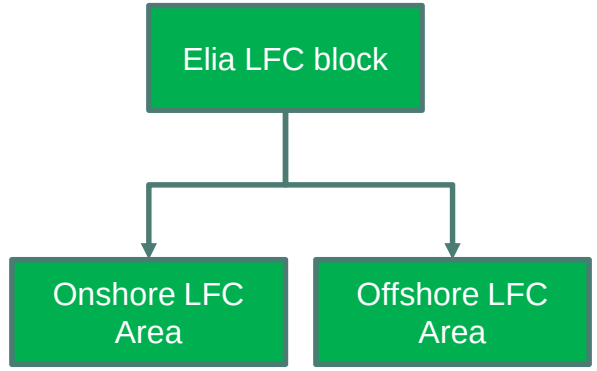
- Reduced reactive balancing possibilities are taken into account in market performance assumptions for reserve dimensioning and extreme balancing conditions (storms and ramps)
- It is expected that increased needs for reserve capacity will likely be managed via available non-contracted balancing energy bids of available flexibility in the onshore LFC Area (partial procurement)
- Note that in general, flexibility to manage extreme balancing conditions remains accessible via the EU balancing platforms

No impact on mitigation measures or balancing capacity needs

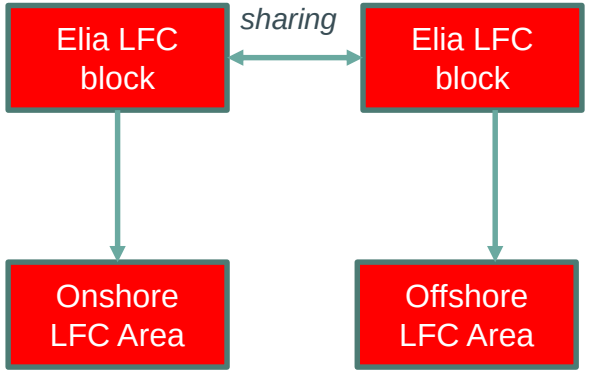
2. Implications for dimensioning

Justification of choice for dimensioning in one LFC block

- Dimensioning of reserve capacity together for the two LFC areas within one LFC block is the most pragmatic solution
  - Allows to internally net offshore imbalances with other imbalance drivers onshore
  - Geographical limitations (e.g. on the interconnector) can still be taken into account in the method
  - In line with approaches followed in the Nordics and Germany



- Alternative is to dimension reserve capacity separately for the two LFC areas by means of two LFC blocks which would mean that:
  - Netting of offshore imbalances with imbalance drivers onshore has to be done via framework of reserve sharing (facing stringent legal limitations) and exchange (only focusing on procurement cost)
  - This increases complexity and likely increases the balancing capacity procurement under assumption that above-mentioned limitations will not be perfectly resolved.



2. Implications for dimensioning

Impact of geographical limits : shortages

- **It is shown that wind power shortages offshore in general do not result in congestions and reserves remain freely accessible via continental Europe**
    - Wind power shortages are fully aggregated with other shortage / excess imbalances in LFC block reducing reserve needs following geographical smoothing (imbalance netting within the LFC block)

- **In the case that available transmission capacity after intra-day would be constrained (cf. use case 6) the access to balancing energy activations in BE LFC block might be limited**
    - This situation might not be resolved with additional reserve capacity in Belgium onshore LFC area*
    - This situation cannot be resolved in the offshore LFC area due to lack on upward flexibility
    - This situation might need to be managed in connected region (by activating upward flexibility) [to be investigated]

2. Implications for dimensioning

Impact of geographical limits : excess

- It is shown that wind power excess can result in congestions during periods with limited remaining ATC import (i.e. during full import to Belgium)
    - During these periods, wind power excess can be managed via downward regulation of wind power and no impact on balancing capacity procurement is expected
- In contrast to shortage situations, possible ATC limitations can always be managed via downward regulation of the wind power

- **It is demonstrated that the offshore bidding zone helps managing such situations by accessing balancing options in connected regions when available in terms of transmission capacity and energy**

Cross-border contributions to dimensioning in Elia LFC block

- The offshore grid provides additional opportunities for optimization by accessing balancing energy bids in other regions (UK and DK) via :
    - Reserve sharing with UK and DK (cf. current agreements with UK, DE, NL, FR)
    - Non-contracted balancing energy bids accessible via UK and DK

Subject to framework on regional sizing and procurement developed in the framework of the Clean Energy Package

3. Implications for proposed mitigation measures for storms and ramps

Shortage

- Sudden downward ramps (including storm cut-outs) can create sudden shortage imbalances which requires availability of balancing energy
- Elia proposed to manage this via high wind speed technologies (in case of storms) and last resort preventive curtailment measures (in case of storm cut-outs and other ramping events)
- In general, no congestions are expected during shortages and therefore no impact on the contribution foreseen by available reserves and preventive curtailment.
    - Note that the BRP measures via storm procedure remain relevant via the intra-day market and downward regulation
- In the case that available transmission capacity after intra-day would be constrained (e.g. due to internal congestions onshore) the access to onshore balancing energy is limited .
    - As such, this situation might need to be managed in connected region (by activating upward flexibility) [to be investigated]

Excess

- Sudden upward ramps (including cut-in after storm) can create sudden excess imbalances which requires availability of balancing energy
- Elia proposes to manage this via last resort ramping limitations (in case of storm cut-outs and other ramping events)
    - Note that the limitations are proposed to be triggered via the system imbalance. In order to correctly take into account system security risks, it is proposed to take into account the aggregated imbalance of the two LFC areas.
- Potential congestions during high import conditions can be managed via these ramping limitations if not already managed via the preventive generation cap (in case of real-time congestions). The ramp rate limitation and preventive cap are complementary measures

F. Wrap-up

Conclusions

This presentation starts from a generalized market design based on an OBZ connected to several bidding zones which are part of an integrated balancing market.

- This ensures robustness towards further evolutions towards an integrated European balancing market
- This allows to manage comprehensiveness of the presentation before introducing intermediate states and particular cases

legal

An OBZ legally requires to have a separate imbalance price area for the OBZ which needs to be facilitated by separated reserve activation via an offshore LFC area

markets

Separate imbalance price areas allow extending advantages of the OBZ by creating adequate and consistent price signals across time frames

The operation of two LFC areas within EU platforms allows to maximize renewable injections while accessing cheapest balancing resources to cover wind power shortages

The balancing energy price of the OBZ will diverge / converge based on activation requests / bids in connected region and remaining ATC after intra-day between the connected regions

Before connection to other balancing markets, the balancing energy price in OBZ is only expected to diverge during moments with excess wind power during high BE import conditions (cf. downward regulation of wind power)

technics

Offshore imbalances are physically balanced via real-time injections / off-take to / from the connected regions (in first instance Belgium)

Specific situations may occur where limited operational limits require TSO intervention :

- in order to manage excess wind exceeding operational limits of flows between connected regions : requires a preventive cap on wind power in function of remaining transmission capacity
- in order to manage shortage wind during periods of of transmission capacity limits within connected regions (under investigation).

- BRPs of wind parks in an OBZ can balance their offshore portfolio by trading in intra-day markets up to 60' before real-time. In the balancing timeframe, portfolio balancing across the two bidding zones (imbalance price areas) is not possible. However, downward regulation remains possible up to real time and imbalances can be resolved via the EU balancing markets
- Operating two LFC areas in one LFC block allows to minimize the impact on reserve dimensioning and proposed mitigation measures while mitigating the possible impact on balancing capacity procurement

Market design

Legal framework to define OBZ

Legal framework to review a bidding zone configuration

Commission Regulation (EU) 2015/1222 (CACM) of 24 July 2015 sets out detailed guidelines on cross-zonal capacity allocation and congestion management in the day-ahead and intraday markets. Articles 32 and 34 of the CACM set out rules on review of bidding zone configuration.

➔ full bidding zone review process = heavy process taking 2-3 years to come to a decision to review the bidding zone configuration

Commission Regulation (EU) 2019/943 (CEP Regulation) of 5 June 2019 on the internal market for electricity offers the possibility to follow CEP Article 14 instead of CACM

➔ offers an alternative way to decide on a review of the bidding zone configuration without having to apply the full bidding zone review process

A national approach with relative short lead times is possible

- **Step 1:** Elia writes a structural congestion report. Content of the report is not pre-determined. Elia's preliminary view:
  - Explain the anticipated structural congestion by referring to the hybrid grid design approved in most recent national development plan. Explaining the triggers, the status of implementation of those triggers, etc.
  - Introduce OBZ and the conditions to be met for the OBZ to be an efficient solution to manage the structural congestion.
  - Justify introduction of OBZ has a negligible impact on the neighboring TSOs ➔ decision can be made by Belgium alone
- **Step 2**: CREG approves the structural congestion report. This comes along with a **public consultation** as per national rules. Anticipate this takes **3 months**.
- **Step 3:** Elia and CREG notify the neighboring transmission system operators that, on basis of the approved structural congestion report, Belgium initiates a review of its bidding zone configuration.
- **Step 4:** **Belgium as Member State has 6 months** to **consult the relevant stakeholders**, take a **reasoned decision** on the creation of an OBZ and notify this to ACER & EC. The decision should mention an **implementation date.**
  - Relevant stakeholders
    - CEP regulation Art 14(7) states other Member States may submit comments
    - CEP is not explicit on who are the relevant stakeholders and hence if a public consultation is required. When we more concretely prepare this process, it is to be assessed if the public consultation organized by CREG in step 2 is sufficient.
  - Reasoned decision: content is build up in previous steps. Best practice to wrap-up comments received (if any) from relevant stakeholders and how these have been taken account of.
  - Implementation date: hints that the decision can be made sufficiently firm
- **Step 5:** Publication of the decision

Approach to integrate OBZ in the MOG II planning

Step 0

Pre-consultation on OBZ

Q4 2023

Elia continues to create awareness and engage with stakeholders

The objective is to do a **consultation on the role of OBZ, the conditions that trigger it and balancing aspects**.

2-3 years

Step 1

Formal process to create OBZ

The conditions to have sufficient certainty on scope and timing are monitored.

Uncertainties on scope / timing of the OBZ are likely to exist at the moment of first tender and hence the launch of the formal process is anticipated to take place thereafter.

Step 2

Implement the OBZ

The new bidding zone borders need to be formally assigned to a capacity calculation region. This requires an amendment to the pan-EU methodology of CCR determination.

The new bidding zone borders need to be integrated into the capacity calculation and allocation processes.

With a lead time of 2-3 years, the formal process to create the OBZ can be initiated when there is a firm decision on the implementation of the drivers of the OBZ

OBZ in the Electricity Market Reform

Elia's position on possible use of congestion income to compensate for reduced access to interconnected markets

- Also referred to as "Transmission Access Guarantee" (TAG)
- Elia shares ENTSO-E's position that TAG is not an appropriate instrument:
  - Capacity calculation is already heavily regulated to ensure non-discriminatory access to the transmission capacity.
  - The intrinsic impact on the business case of the OWF developer is not addressed. When transmission capacity is available the TAG is not active yet the price risk will still be there.
  - When the TAG is activated, there is no guarantee whether the congestion income allocated to the windfarm is sufficient or excessive: when the price spread is low, revenues are insufficient and when revenues are high, no profits are returned to the tariff payer.
  - It would lead to a non-proportionate hidden subsidy for one specific technology funded by the tariff payer.

In case public support is needed, there are more cost-efficient, transparent and proportionate mechanisms such as 2-sided capability-based CfDs

Thank you

Appendix

Annex 1 - list of received questions and answers on topics "Market design" and "OBZ process"

Questions market design	Answers
Regarding AC or DC connection for offshore generation, does it have an impact on the OBZ of HM choice?	Tackled during Jan 10 & Feb 6 sessions
What would be the governance of such a OBZ - role of TSO, of regulator?	This is prescribed by European legislation • At one side there is the legal process to establish an OBZ • On the other side there are the requirements stemming from CEP, CACM, FCA, SOGL, EGBL that have both o A pan-EU dimension, for example integration into balancing platforms and allocations o A regional dimension as each bidding zone border has to be assigned to a capacity calculation region (CCR) that governs capacity calculation and operational security analysis processes. In addition, there are also SORs (system operation regions) to coordinate some of the activities for which RCCs (regional cooperation centers) are responsible on a level at least as large as the CCR.
What are the implications of changes in the allocation process for the Nautilus interconnector with the UK (explicit/implicit/advanced hybrid coupling), and is the planning for these changes compatible with the timeline of the offshore wind auction in Belgium?	Tackled during Jan 10 & Feb 6 sessions
What are the detailed implications and pro's and con's of alternative regulatory solutions, as f.i. deviation and/or derogations to the EU framework? A full mapping and detailed comparison is deemed appropriate.	Exemptions and derogations from 70% regulation do not offer a proper (market-based) solution to manage the structural congestion.
What is the long-term perspective of the evolution of the proposed offshore bidding zone and related interconnectors/export capacity? Will the Belgian nodal offshore bidding zone in the future merge with other offshore bidding zones to create a large zonal bidding zone? This long-term view is essential for the offshore wind developers to be able to develop their view on price and volume expectations in order to prepare their bids;	The purpose of the OBZ is to manage structural congestion efficiently, so we expect OBZs to emerge on a case-by-case basis where a hybrid set-up is being implemented.

Questions Market design	Answers
What is the market arrangement for the period starting with the first operational wind farm in the PE zone and ending with the realization of the Nautilus interconnection with UK? In this period without interconnector, will a Home Market arrangement be put in place?	Tackled during Jan 10 & Feb 6 sessions
Question clarified after last workshop – NEW INPUT: Liabilities: what in case the DC link between the PEZ and BE experience delays, will there be any liability arrangement be put in place? What in case export capabilities of the PEZ are limited due to delays/problems in grid build out, but also in case of grid unavailability?	It is expected that Royal Decree liabilities (made on proposal of the CREG) is defined in 2024 addressing the questions on delay in grid build out and unavailability during operation.
Can you provide an overview of the DA prices in the UK for the last [2-3] years and the occurrence of negative prices, in comparison to BE DA prices?	Link to public available information through ACER : Microsoft Power BI
Does a NEMO (Epex, Nordpool,…) need to open a new market for the OBZ (DA and ID)? If yes, has this been discussed with the Nemo's? Is the timing towards implementation compatible?	Tackled in today's presentation: the OBZ will indeed have to be integrated into the SDAC/SIDC systems, and such implementation track is to be started up when the formal process to decide on OBZ is started.
Elia TF MOG2 1 April 2022: "Our goal is to create visibility on the market integration and grid design scenarios, whilst acknowledging these are inherently subject to legal/political context. This visibility should help the assessment of volume risk by parties bidding into the tender."	Tackled during Jan 10 & Feb 6 sessions
According to Elia, when a hybrid interconnector is built, the use of an OBZ is better than the 'home market approach' to optimise the use of the limited grid capacity. Can Elia share the calculations which demonstrates that the OBZ market design in the specific case of the PEZ provides additional social welfare for the Belgian society compared to the home market design? The conclusions of large-scale theoretical and generalized assessments demonstrating the merits of OBZ on social welfare may not apply to a bidding zone located this close to its home market.	Under a home market design the transmission capacity between Energy Island and coast will have to be ex-ante split during the capacity calculation process in D-2 based on forecasts. Forecasts come along with forecast errors, leading to situations where: - Forecast of offshore wind is underestimated => redispatch needed - Forecast of offshore wind is overestimated => underutilisation of the capacity thus welfare loss

Questions market design	Answers
Can you explain the difference between re-dispatching costs and congestion rents, and how they are dealt with in Elia? Are they passed-through via the tariffs (i.e. redispatch costs leading to higher tariffs and congestion rents leading to lower tariffs)? Do both redispatching costs and congestion rents incentive the TSO to invest in grid-capacity?	**Redispatch** Redispatch is a corrective action taken after the market coupling to keep the grid secure. The process of redispatch and the sharing of its associated costs is for Elia's grid (being part of CCR Core) subject to the respective Core methodologies. Redispatch costs are pass through to the tariffs, whilst at the same time Elia is being incentivized to keep these costs low. Investing in the grid is driven by a TOTEX approach. So indeed, an increasing level of redispatch cost (OPEX) leads in a natural way to look at grid investments (CAPEX) to alleviate the congestion. **Congestion rent** Congestion rents are a direct result of allocations. Allocations exist already for yearly, monthly and daily timeframes and are being implement for the intraday timeframe. The use of congestion rents is regulated (2019/943 regulation Article 19) and is to be used for: A) guaranteeing the actual availability of the allocated capacity including firmness compensation. B) maintaining or increasing cross-zonal capacities through optimisation of the usage of existing interconnectors by means of coordinated remedial actions, where applicable, or covering costs resulting from network investments that are relevant to reduce interconnector congestion. The congestion rent is thus to be used to pay for redispatch, to pay out the long-term transmission rights and to invest in the grid.

Questions OBZ process	Actions/Answers
What are the legislative changes required to introduce an OBZ for the PE zone (at BE and EU level)?	Tackled in today's presentation
What is the process and timeline to define the regulatory framework for the introduction of an OBZ for the PE zone, both at a national and at and EU level?	Tackled in today's presentation
Who finally decides whether or not an OBZ will be installed? If this is the Minister of Energy, have discussions with the Cabinet been started? Are they been involved?	Tackled in today's presentation. Yes, they have been involved.
What is the planning of Elia to implement these changes and how does it match with the planning of the offshore wind auction, without introducing additional delays?	Tackled in today's presentation
Has the UK or National Grid formally approved the concept of the OBZ? Should they? By when? What if they don't?	No
When the OBZ has evolved and multiple interconnectors have been installed between other countries, will the OBZ still be governed by Elia or governed/transferred by/to a new entity at EU level (offshore TSO?)?	The purpose of the OBZ is to manage structural congestion efficiently, so we expect OBZs to emerge on a case-by-case basis where a hybrid set-up is being implemented.