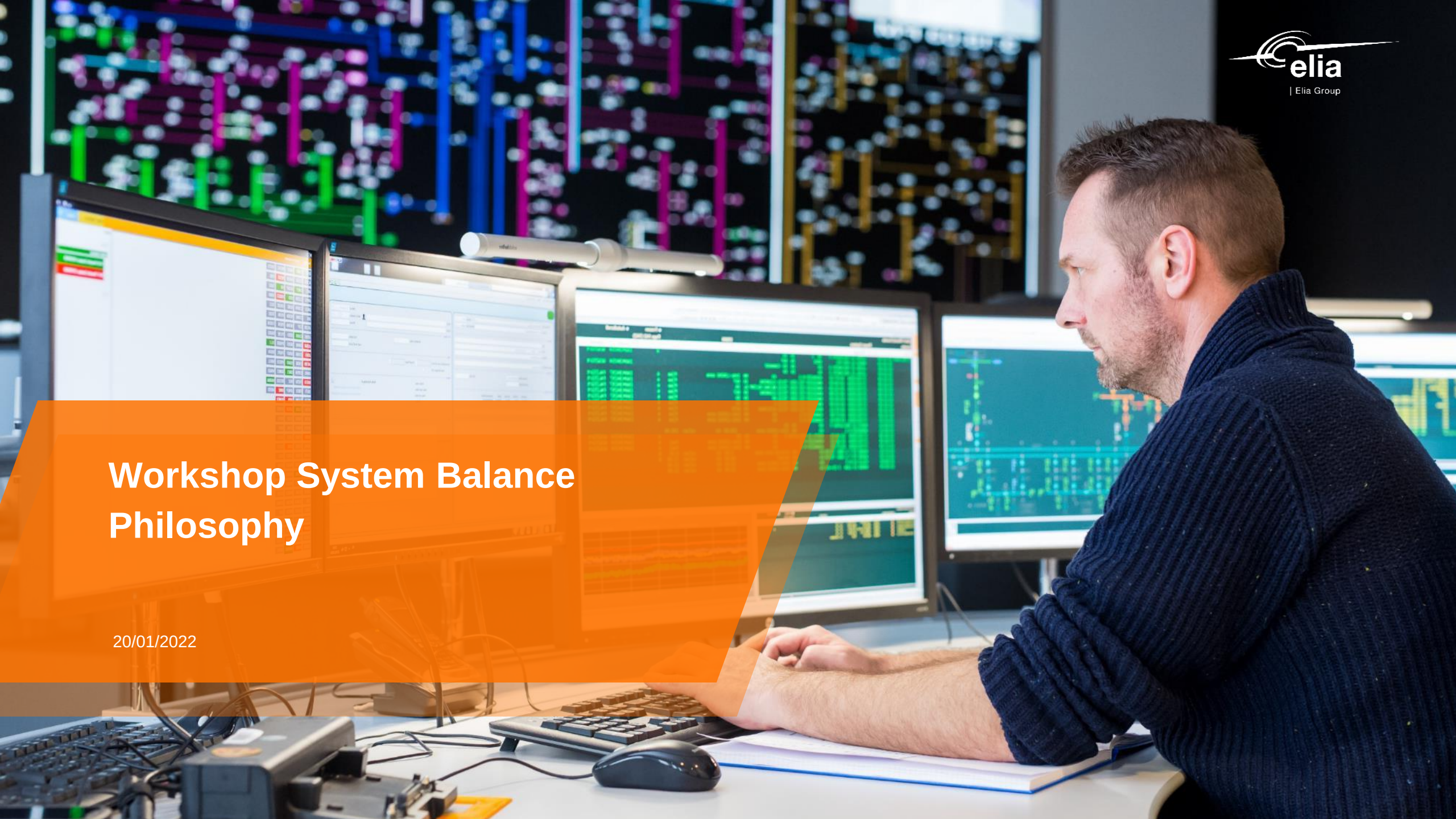


Workshop System Balance Philosophy

20/01/2022

Agenda

13:00 – 16:00 – System Balance Philosophy

System Balance Philosophy

Presented by Caroline Bosschaerts, Nicolas Pierreux & Anna Tsiokanos

1. Introduction

What are the current achievements of the market?

Reactive balancing model: a mix of implicit and explicit balancing

Belgium adopted a **reactive balancing model**, maximizing the opportunities for BRPs to balance their positions on the wholesale market over the imbalance settlement period (ISP), and help balancing the system by reacting to an imbalance price ➔ ***implicit balancing***

BRPs - Implicit balancing

incentivized by adequate imbalance prices to prepare their balance and/or help* the Balancing Area

- ➢ early adoption of single, marginal pricing
- ➢ short ISP
- ➢ application of an alpha adder when needed

enabled by adequate publications (mainly real-time SI and imbalance prices) and a facilitation of close-to-real-time (15') intraday trading

Elia should then only address **residual imbalances**, i.e. unpredictable events or forecast errors remaining near real-time

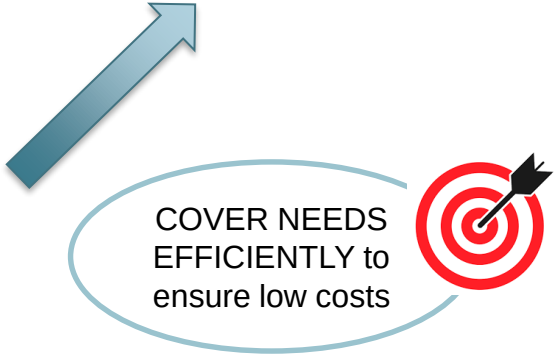
Elia does this by activating balancing reserves (contracted or not) ➔ ***reactive balancing***

BSPs** - Efficient explicit balancing

by **not procuring more reserves than necessary** (cf. dynamic dimensioning of balancing needs, consideration of reserve sharing and free bids)

by **opening the service to all** technologies and voltage levels (cf. balancing roadmap 2016-2020)

by **developing XB synergies** for activating balancing energy (cf. IGCC, MARI & PICASSO)

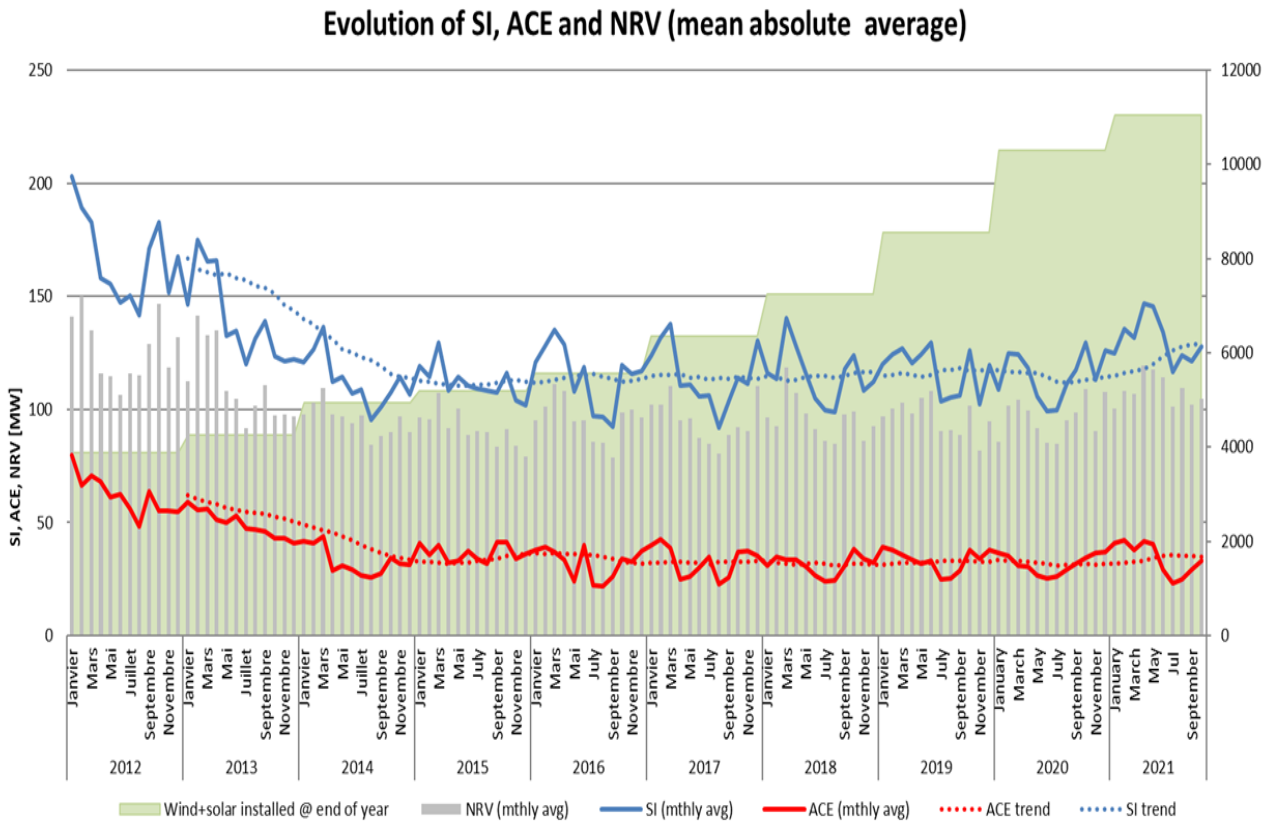


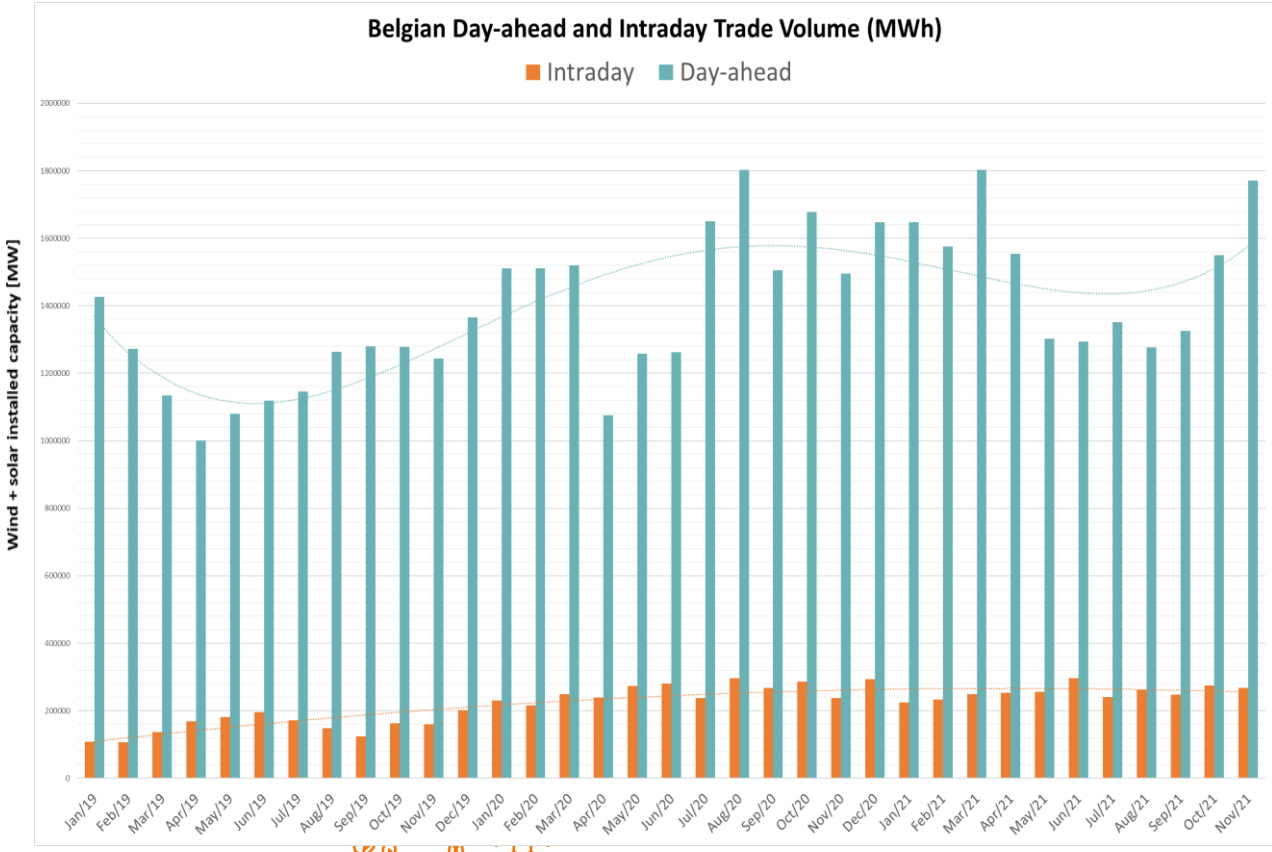
*under strict conditions
**BSPs but also inter-TSO means

Reactive balancing model: a successful model, fit for the future

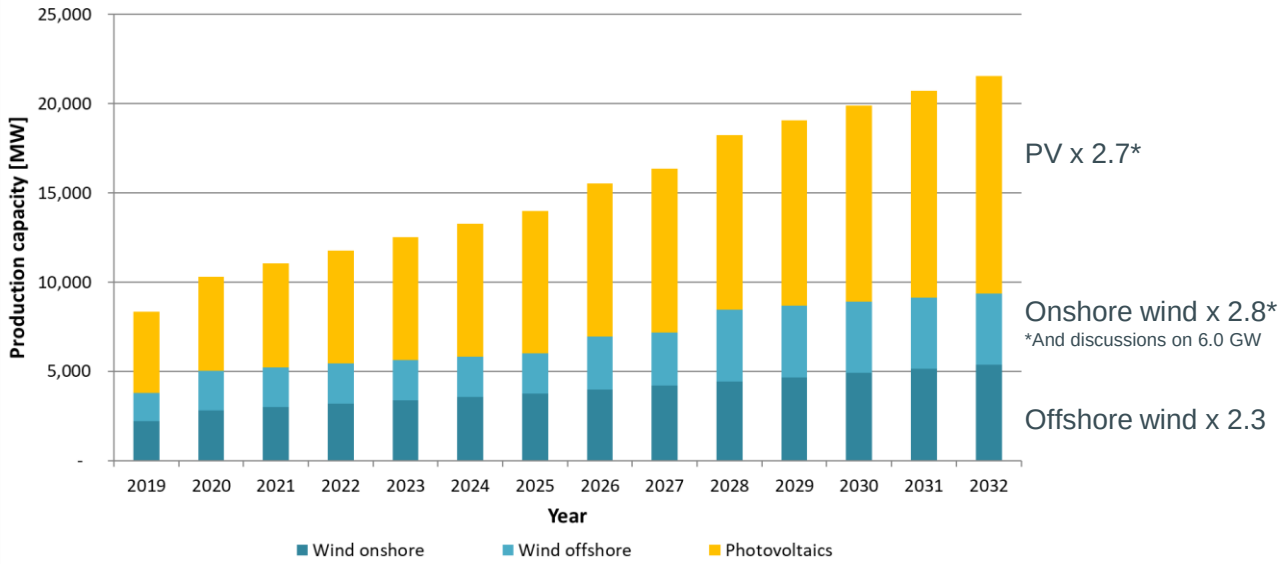
Reactive balancing has proven successful in practice, allowing an overall decrease and stabilisation of the system imbalance (and ACE) despite a significant increase in RES production

The importance of self/reactive-balancing and (15') local ID trading keeps increasing for managing fluctuations in RES production and meet climate ambitions



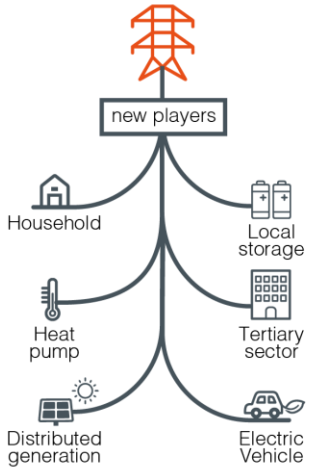


- Renewables in Belgium will more than double between 2019 - 2032 [MW]
- Need for more flexibility in the system is a consequence of the integration of (more) renewables.



'CENTRAL' scenario - Adequacy and flexibility study 2021

- New flexibility means are available at end-user level
- Regional markets provide access to cross-border flexibility
- Digitalization provides new tools to balance the system (close-to-real-time)



2. the challenge

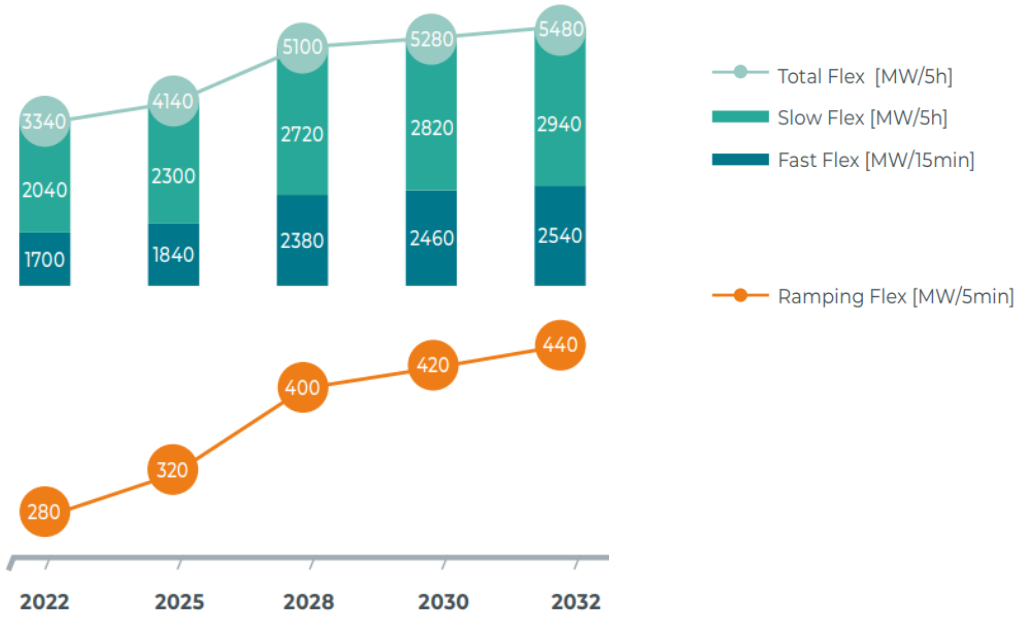
How to match the system's increasing flexibility needs with the availability of new flexibility means ?

Challenge:
Increasing renewable generation will increase the flexibility needs of the system…

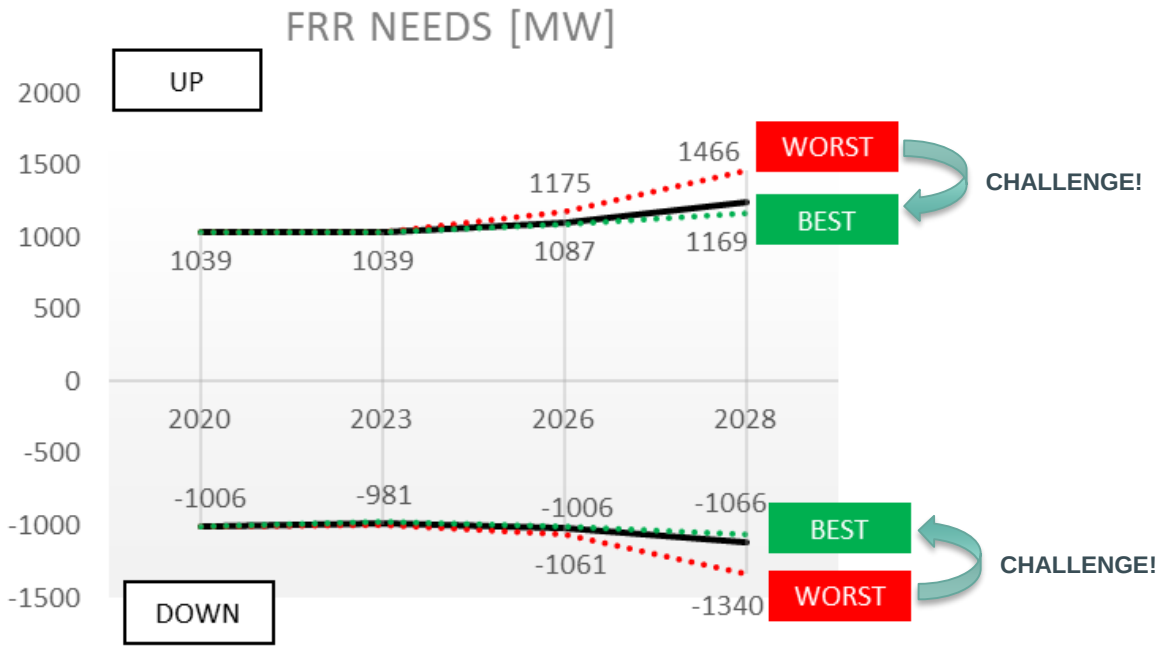
Increasing flexibility needs

Business as usual

Will increase reserve capacity needs



Upward flexibility needs (source: Adeqflex 2021)

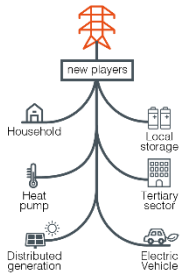


Reserve capacity projections (source: MOG 2 system integration study)

Only few degrees of freedom to manage flexibility needs

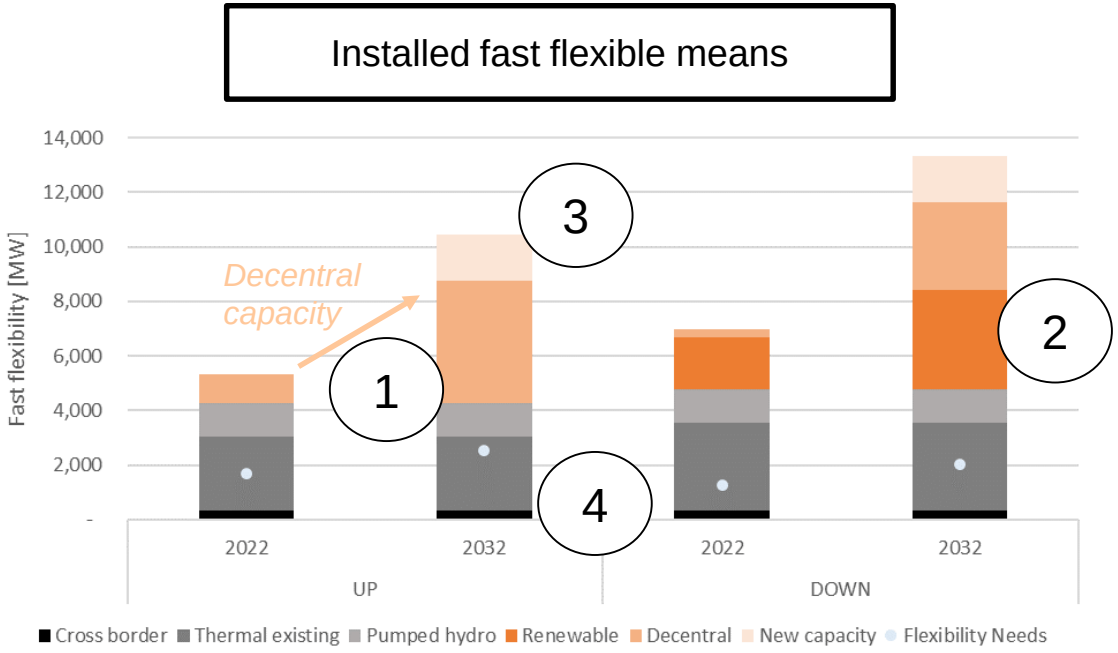
The extent to which FRR needs will increase can be managed by the LFC block imbalances (market balancing performance) and managing the dimensioning incident (not exceeding 1 GW)

Opportunities
…while increasing the flexibility in the system may help facilitating operational security (and economic efficiency)



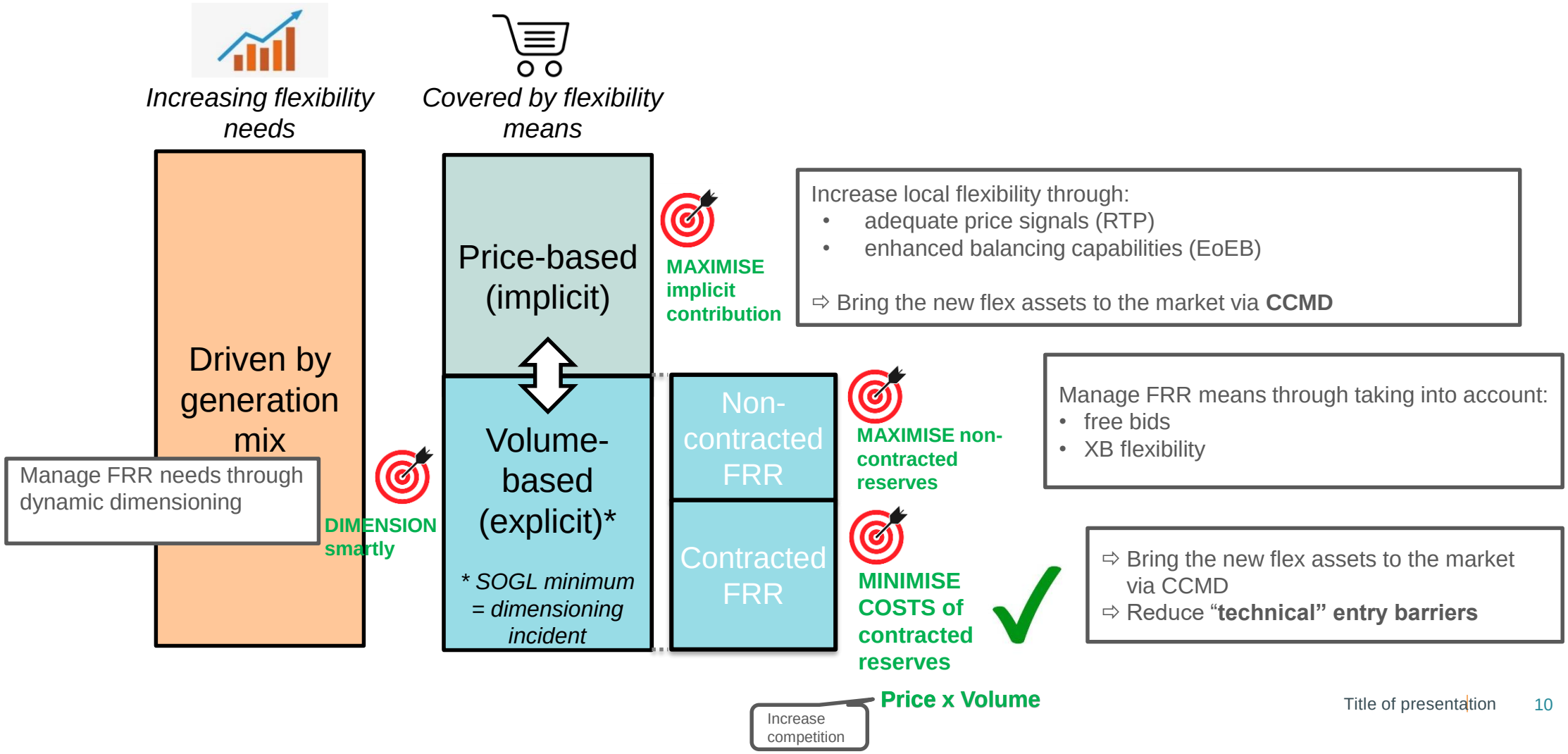
- Increased and diversified flexibility means will result in :
  - Ensure availability of reserves / flexibility when needed ➔ **operational security**
  - Better managing reserve needs and procurement / activation costs ➔ **economic efficiency**
- Projections made in adequacy and flexibility study 2021 assume a well-diversified portfolio of flexibility

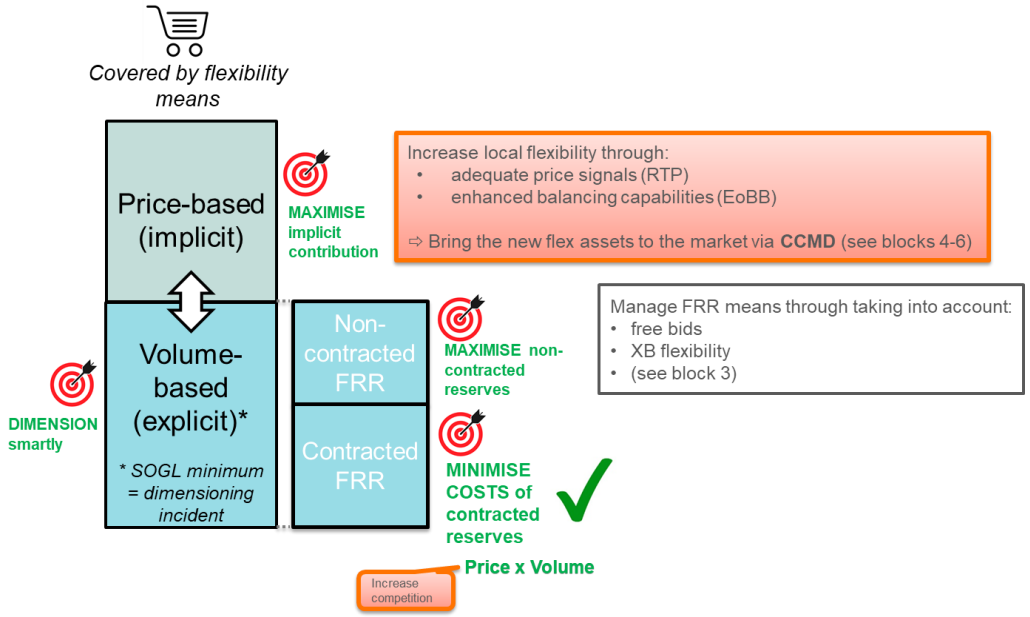
1. **The flexibility means will increase substantially towards 2032, in particular due to the expected increase in decentral battery storage and demand-side management if properly enabled (digitalization, CCMD…)**
2. Renewable generation management will also contribute to the downward flexibility
3. Additional thermal flexibility is expected to be delivered by new build capacity following the nuclear phase out
4. A certain potential of cross-border flexibility will become available as from 2022 with the EU balancing platforms



source: Adeqflex 2021

Efficient reserve management will become a key aspect in the energy transition





3. Which type of local flexibility could emerge?

New flexibility could help the system by optimizing it's consumption profile in different timeframes (DA/ID/RT)

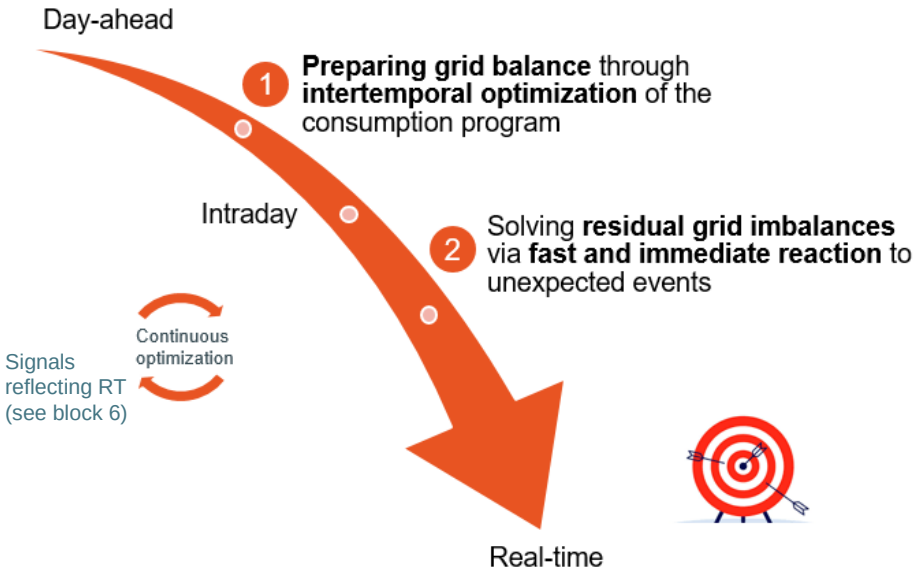
New electrical and controllable assets (electric vehicles, heat pumps) will be connected to the grid.

Their consumption profile will be driven by consumer's needs.

➔ Could lead to stretching the system (higher evening consumption peaks) or …

Proper incentives
Easy access

… demand side controllable assets could optimize their consumption profile to **help the power system while still reaching their main objectives, or even, in extreme situations, while slightly deviating from their main objectives**.



1 In order to be able to reach their main objective, demand side controllable (e.g. storable or shiftable) assets should be able to establish a consumption program upfront. If they receive, **well before real-time**, (price) **signals that properly reflect the real-time conditions***, these assets could **optimize their consumption pattern** to reach their main objective **while helping balance the grid.**

2 In case of unexpected events (forecast error, forced outage…), the real-time price of the electricity deviates from the previous price signals based on which the consumption program of an asset was made. Some assets able to quickly react to such events might either **re-optimize their consumption pattern** considering the last information available, or even **accept a small deviation from their main objective** in case of extreme real-time prices. This could help the system resorb residual imbalances in real-time.
Those adjustments could be implicit, explicit or a mix of both.

* We here mean the real-time *balance* conditions of the system, congestion management is not the focus of this presentation

The choice to opt for price-based and/or volume-based (explicit) reaction to offer the remaining flexibility in real-time will be specific to each asset

Both ways to offer remaining flexibility can indeed present different advantages for the end consumer or the service provider who manages some of his controllable assets :

	Advantages for consumers/ service providers
Explicit activation	• Access to a wider market (EU balancing market) • Transfer of the activation decision and risk to the TSO • (Min) activation price known ex-ante (actual price based on PAC) • Possible capacity fee
Implicit reaction	• No specific metering or communication requirement • No pre-qualification or delivery requirement and no exposure to penalty in case of under delivery • No administrative burden linked to explicit • Optimization possible over multiple ISPs (e.g. avoiding continuous switch on/switch off leading to wear and tear)

The **asset characteristics** (inertia,…), the **risk profile** of the asset manager, the metering and communication installations available, etc. might influence the decision to help the system implicitly and/or explicitly.

As implicit and explicit are complementary, **both implicit and explicit participations should be possible and even facilitated** in order to allow the whole residual flexibility to find its way to the system.

4. How to unleash the flex and bring it to the markets?

What are the key barriers, ingredients and instruments for succesfull participation of LV-flex?

	Competition	Price	Technical
Barriers	End consumer cannot engage with a third parties behind the meter	Variable price signals (and the contracts linked to it) are underdeveloped.	Tedious requirements (administrative, prequalification, metering, …) for participation in flexibility markets
Target	End consumers can easily contract with independent service providers behind the meter	All players have access to adequate price signals at any moment in time	Simplified consumer journey build on software based solutions.
Instruments needed	**Exchange of Energy Blocks (EoEB)** a decentralised exchange of energy between consumers and many other parties, significantly lowering entry barriers for new market players who can offer innovative energy services.	**Enhanced price signals** *(incl. adequate* ***information ex ante and back-propagation to DA/ID****)* so market actors can make optimal production, consumption & purchasing decisions, increasing market efficiency and fostering anticipation of potential RT issues.	• Reduced prequalification and metering requirements for participation in flexibility markets • EoEB-HUB – A platform to register & treat EoEB transctions, trusted by the end consumer • Digital tools (consent mgmt ,…) to support the development of new CC services • Real-time communication platform facilitating data exchange between market actors

CCMD provides the tools to split the flexible from the inflexible load, striking a balance between price opportunities and risks.

Inflexible load
Lower price risk
Lower opportunity

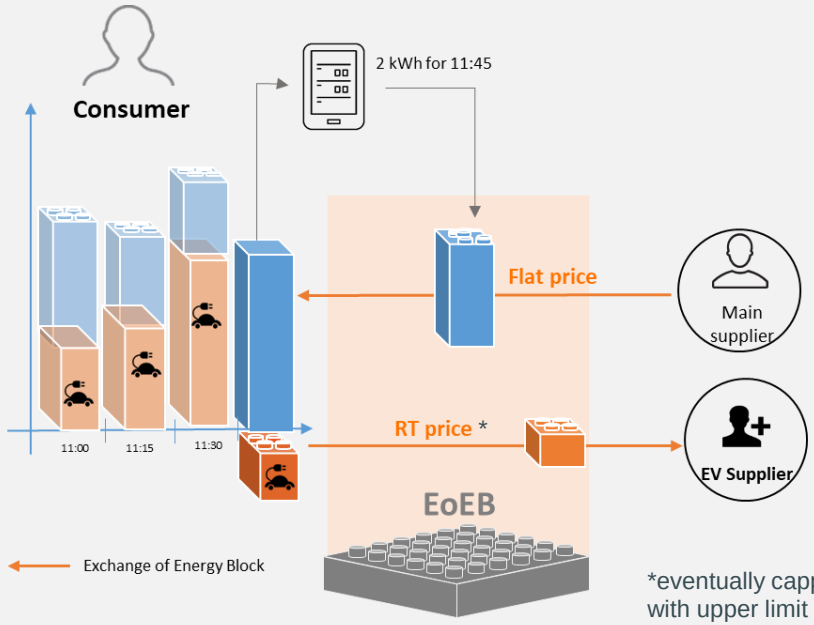
The residual inflexible part of the load is covered via a flat price (/static) contract by the default Supplier at AP-level.

Flexible load
Higher price risk
Higher opportunity

Via EoEB end-consumers can outsource the full management (electricity, flexibility) of their EV to a 3rd party. The charging process is optimized in function of market prices & benefits are directly captured by the end-consumer via a dynamic price contract (DA, ID, RT)

Example

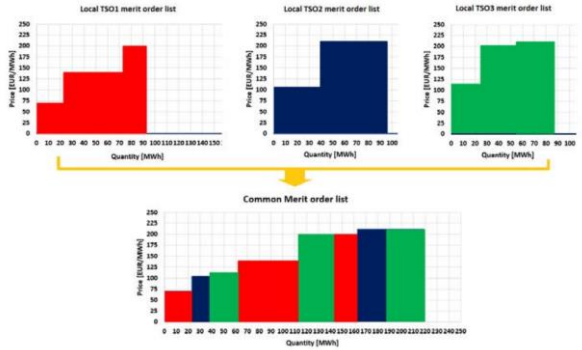
When the RTP is high (ex. 11:45-12:00), the end-consumer is able to sell electricity to market (V2G) and generate a revenue. He can safely consume his residual load at a fixed cost.



5. What should the real-time price look like to optimally stimulate implicit reaction of the market? First high-level considerations

With MARI and Picasso, the TSO will pool their explicit FRR means, but each TSO will remain responsible to balance its LFC area

With the EU integration of balancing markets, the EU control areas will **pool their explicit FRR means** in a common merit order list.



However, the **TSO is responsible to balance its LFC area**, which means that the **flexibility needs** should remain **defined locally**. Therefore, in case of price-based reaction to a real-time price reflecting imbalances of neighboring countries (of the uncongested area), the TSO could, in accordance with SOGL, have to:

- **Counteract** the price-based reaction **with automatic (or manual) activation** of explicit balancing bids, in order to **reduce the ACE of its LFC area** to zero;
- **Increase** the **balancing capacity to be procured** to cover the higher system imbalances of its LFC area.

Incentivizing the market to react to imbalances of neighboring countries is thus counterproductive and undesirable.

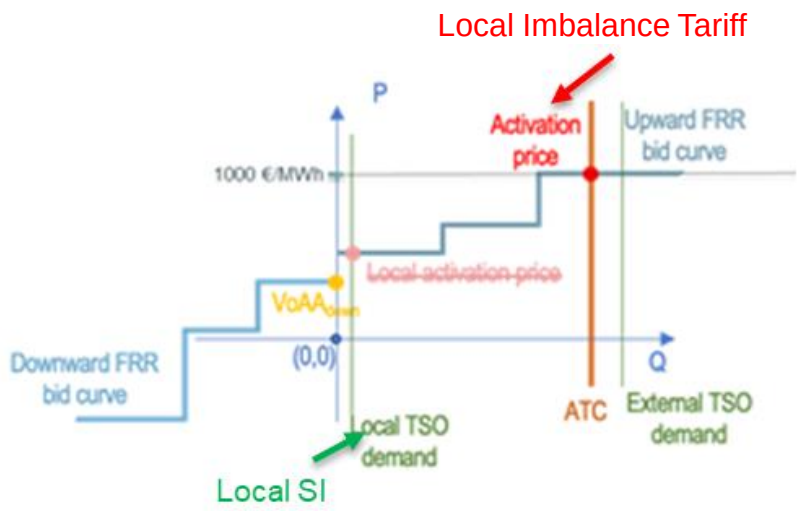
The real-time price should therefore incentivize the market to balance the local system

Does the current imbalance tariff properly reflect the RT condition of the system?

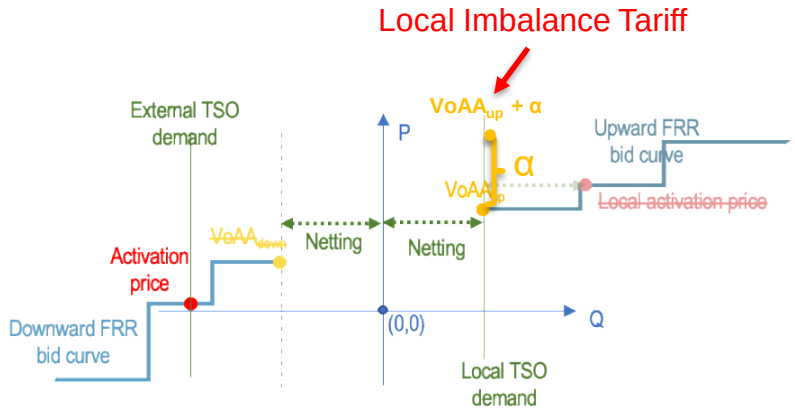
Most of the time… but not always :

When the system is close to be balanced, the imbalance tariff can be very high due to a lack of liquidity in the BE aFRR market, even when there is cheaper flexibility available in the mFRR market

The liquidity issue should be improved after the EU integration of balancing markets, however this integration will create a decorrelation between the local imbalance tariff and the local system imbalance :



The imbalance tariff could be very high even when the local system is closed to be balanced (e.g. in case of large SI in neighboring countries)



The main component of the imbalance tariff might be low even when the local system imbalance is high. In this situation, an additional component (i.e. α component) could ensure the local imbalance tariff remains a strong and appropriate incentive for the BRPs to balance their portfolio.

The current imbalance tariff should therefore evolve towards a self-sufficient and representative *real-time price* at all times

The current imbalance tariff is a ***penalty*** for the ***imbalances*** (in the wrong direction) of BRPs who have ***the legal and physical obligation to be balanced*** or help the system

From imbalance tariff

AS IS: imbalance tariff based on marginal price of activated balancing bids in Belgium

MARI/PICASSO: imbalance tariff based on cross-border marginal price

The EU integration of balancing markets will cause the decorrelation between local system imbalance, local balancing activations and local imbalance tariff and will hence raise some attention points

To real-time price

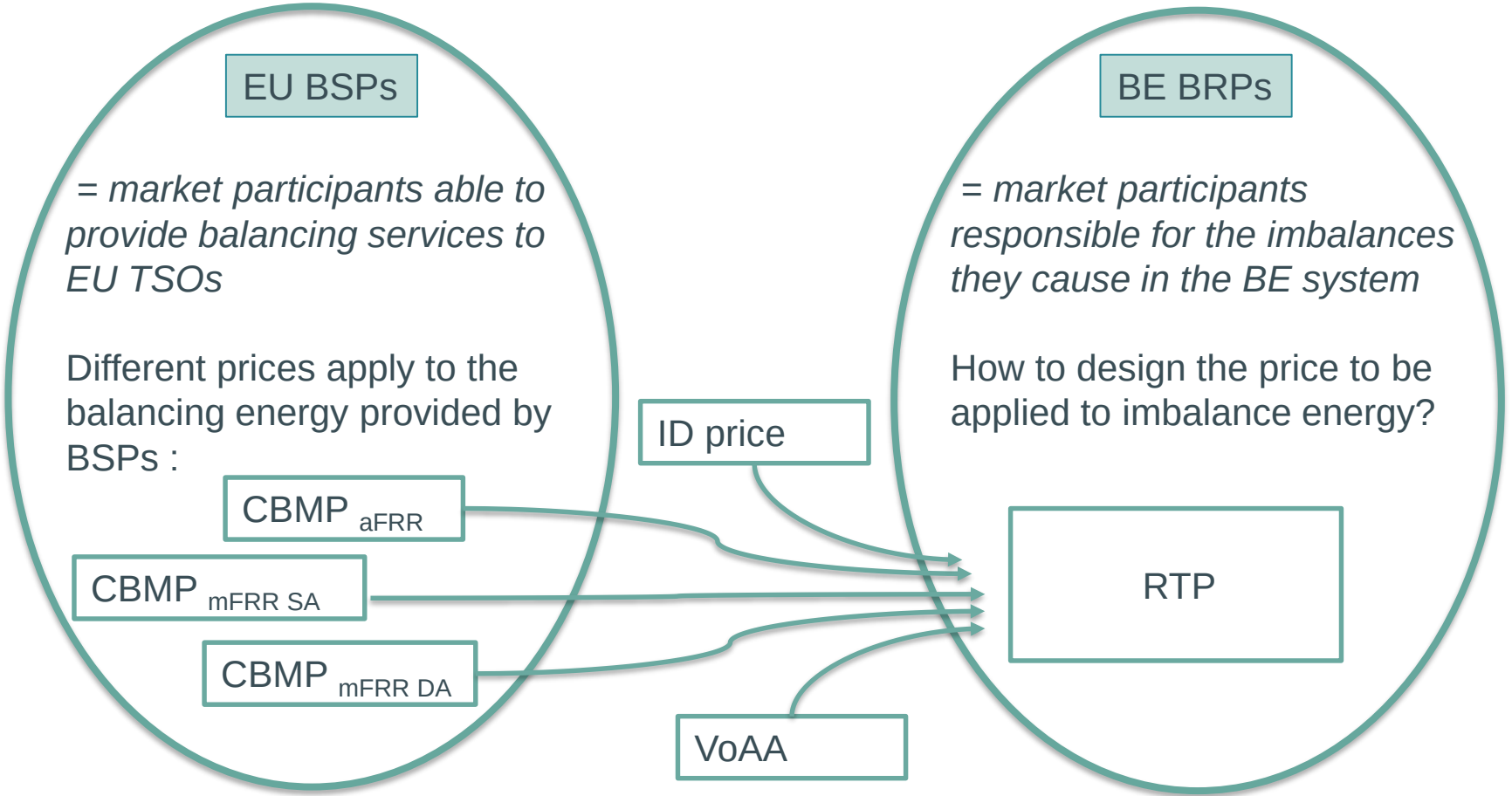
CCMD aiming at fostering:

- Larger price-based reactions
- The participation of new market players with less means to accurately forecast the RT conditions

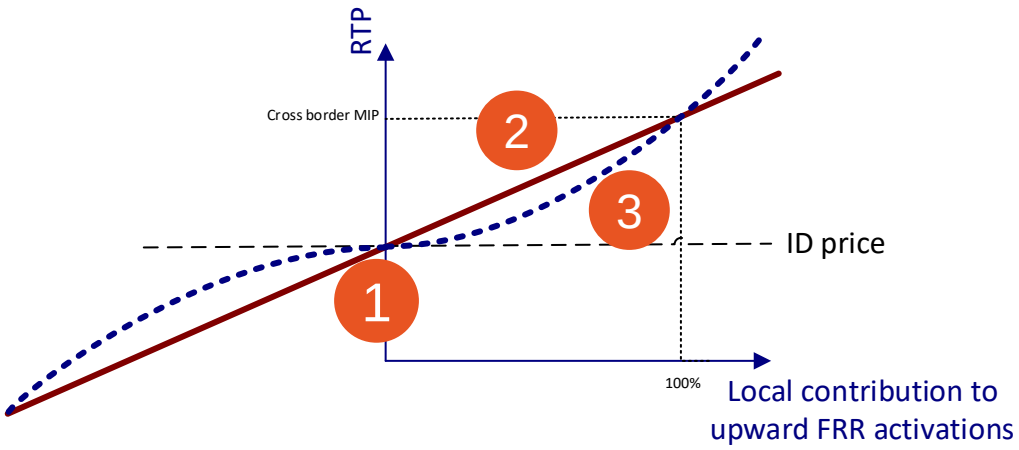
The real-time price will be used to ***settle the open positions*** of all the parties that bear a financial balance responsibility. It should be ***self-sufficien***t and ***representative of the RT condition of the system at all times.***

A RTP is to be designed to settle the imbalances of the Belgian BRPs

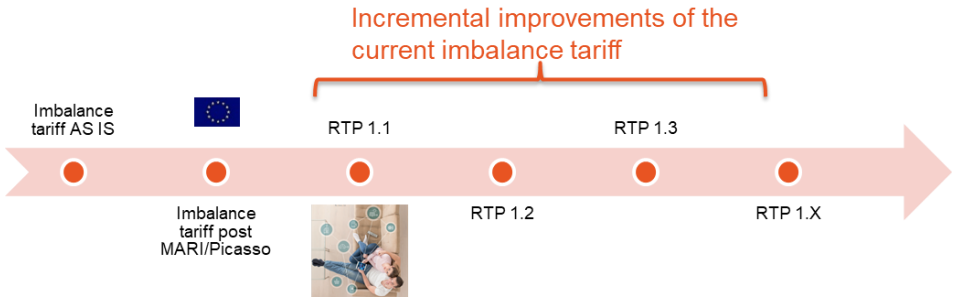
The cross-border marginal prices used to settle the balancing energy provided by the European BSPs can be used to build this RTP. However, other parameters (VoAA, ID index,…) could be taken into account since the RTP serves a very different purpose than balancing energy prices and applies to different market participants:



Some evolutions of the imbalance tariff should be prepared, and be implemented when required (depending on the system evolution and needs)



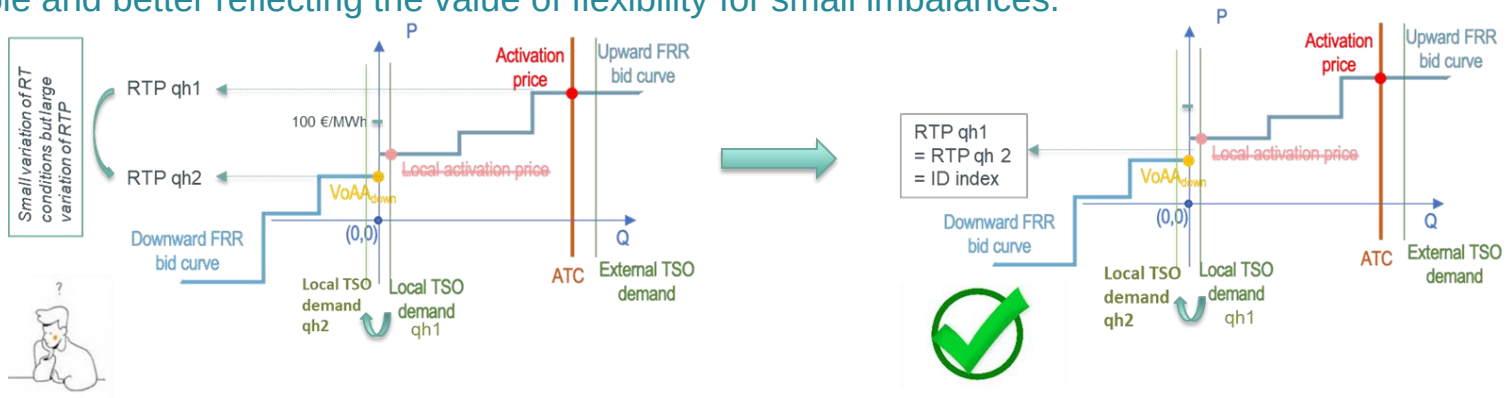
1. The ID price could be used as starting point for the calculation of the RTP
2. A formula allowing to capture the local contribution to the total (EU) FRR activations could be designed
3. This formula could be refined/made more and more dynamic to better reflect the ever-changing market sensitivity to real-time price
4. …



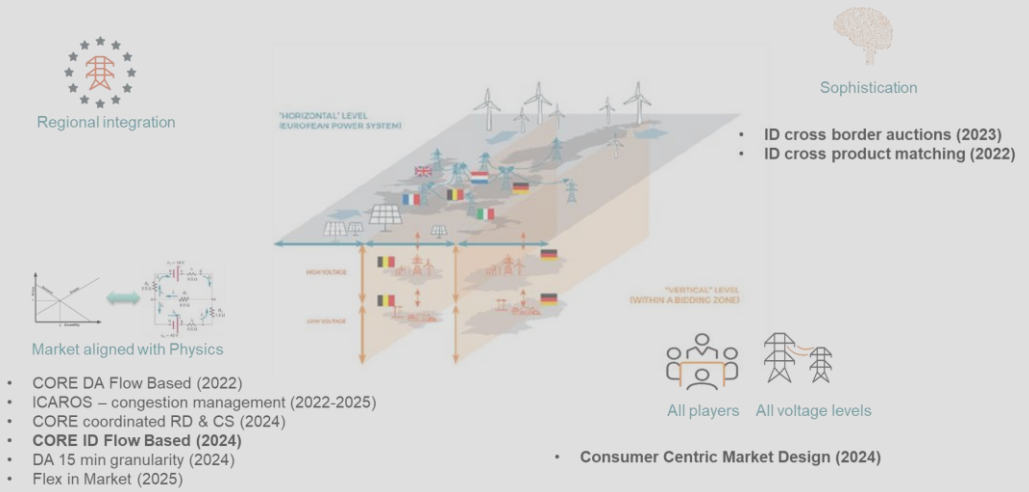
1

The ID price could be used as starting point for the calculation of the RTP

The RTP could be equal to the ID price for small imbalances, giving the signal to the market parties to ‘keep the plan’ (the market equilibrium reached in ID does not need to be modified if imbalances are small).This evolution would allow making the RTP more stable and better reflecting the value of flexibility for small imbalances.



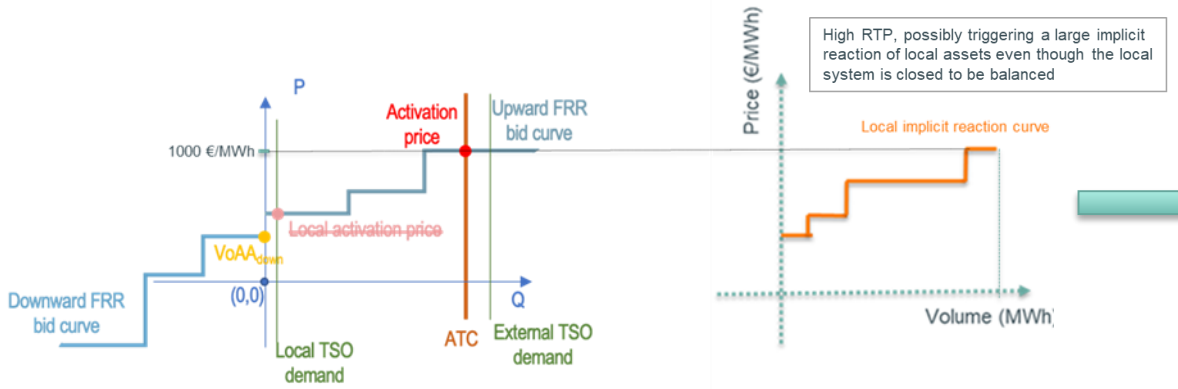
This evolution requires, as pre-requisite, the development of a robust and representative ID index, which is only possible if the ID market is sufficiently liquid. Several initiatives are ongoing to foster intraday liquidity:

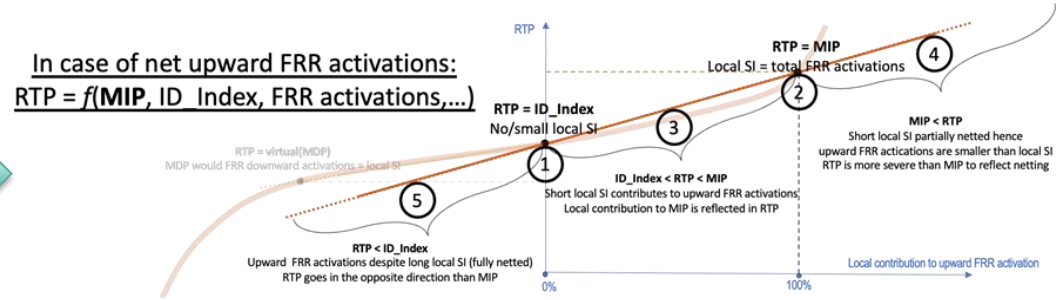


2

A formula allowing to capture the local contribution to the total (EU) FRR activations could be designed

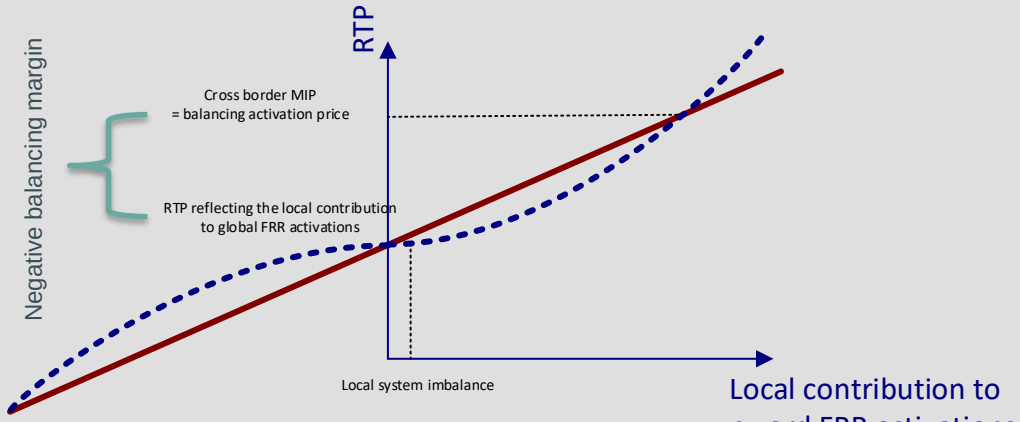
The RTP could be scaled according to the contribution of local FRR requests to the cross-border marginal FRR prices :





This development needs, as pre-requisite, the development of a robust price formula but also some regulatory alignments :

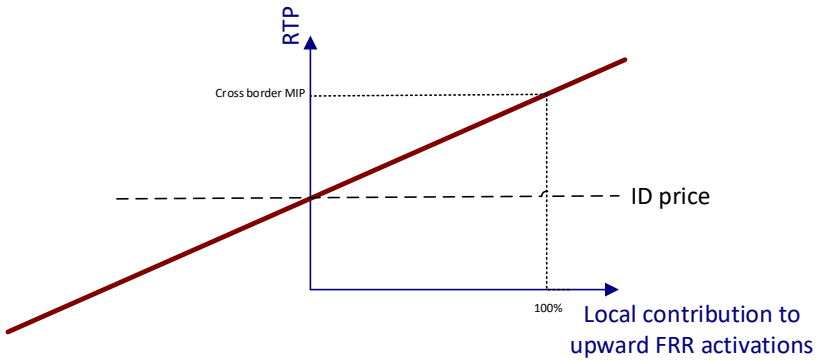
- EBGL does not allow RTP<WAP of positive activated balancing energy (resp. >WAP of negative activated balancing energy)
- Would more frequent negative balancing margins be acceptable?
- …



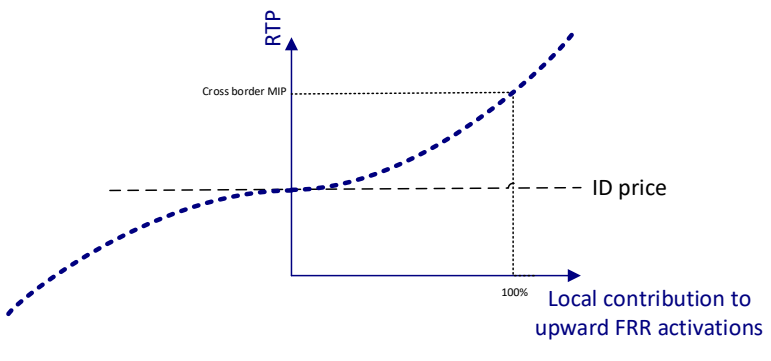
3

This formula could be refined/made more and more dynamic to better reflect the ever-changing market sensitivity to real-time price

From a simple parametric formula

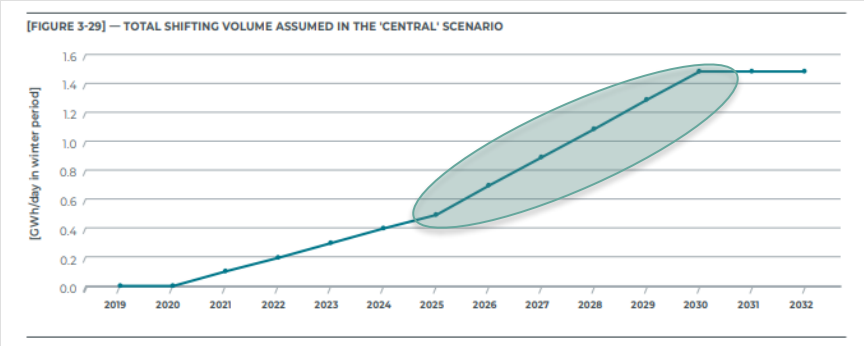


To a more complex parametric formula with parameters that can be adjusted in a more dynamic way to better reflect the market sensitivity curves

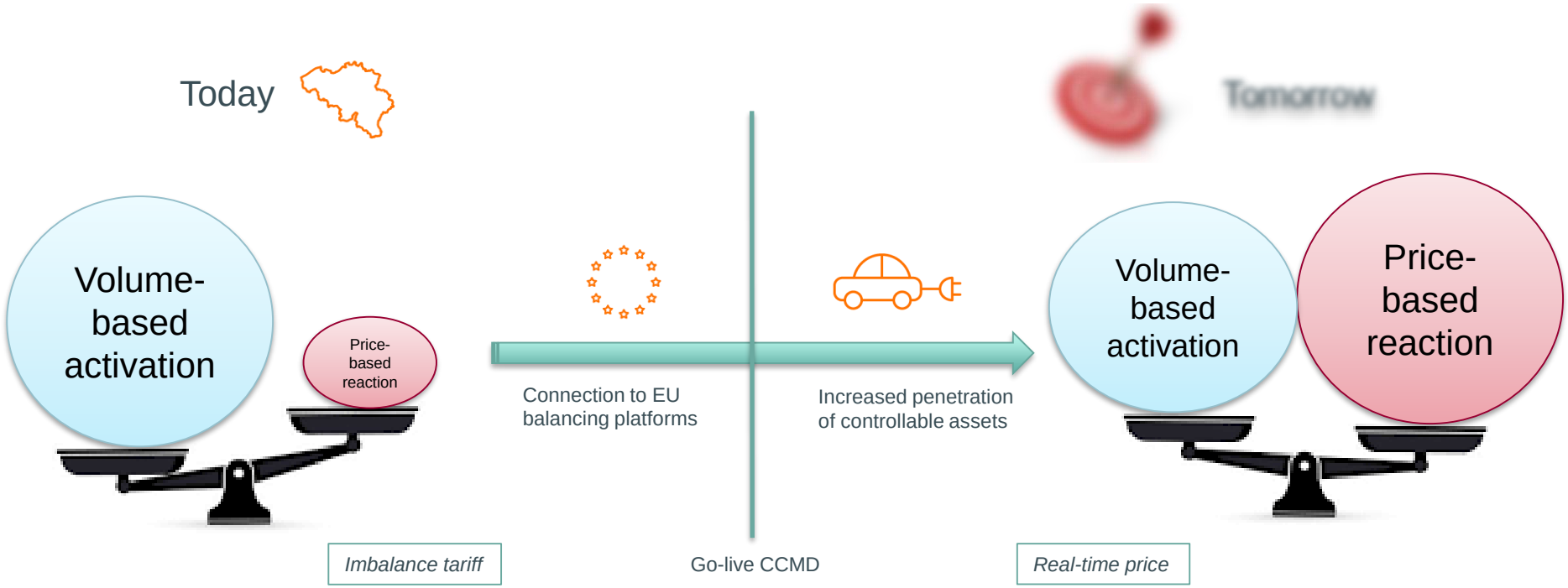


To a self-learning algorithm refining the RTP calculation based on a constant re-assessment of the market sensitivity to real-time price

This development requires, as pre-requisite, a good knowledge of the aggregated price-based reaction curve of the market at all times.
Once the total demand side participation becomes significant, this sensitivity curve will constantly evolve (throughout the day, months, years) and robust machine learning algorithms will be needed to support the computation of RTP



Ensuring a smooth evolution towards a more sophisticated/dynamic construction of the RTP

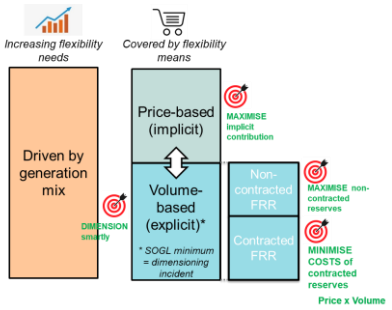


Imbalance tariff based on the **marginal price of the explicit activations** made by the TSO and quite **"static" adders**

AI based

Smart balancing controller setting the **RTP in a more dynamic way,** in order to trigger a given reaction from the market which **complements the explicit balancing bids** activated by the TSO (locally or abroad)

Bringing all the pieces together….
From good to great in 2024/5 – energy market



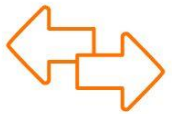
	Enablers			
	Improve playing field (better flex value)	Enlarge Playing filed	Lower entry Barriers	Optimize
	Price	Competition	Technical Barriers	Smartness
Real Time Market	• RTP • Back propagation • Transparency Relax BRP Balance Obligation (new)	• Technology neutral products • XB participation • EoEB (new)	• All players/all technologies • Reduce admin barriers (c/t ToE, metering requirements…) (new)	• AI: dynamic dimensioning • Forecast Free bids & Xborder for a smart allocation of means (new)
Intraday Market	• XB Auctions (new) • X-Product Matching (new)	• Flow Based (new)	• 15 min MTP	Regional Coordinated Redispatch and Cost Sharing (new)
Day Ahead Market	• Flex-in-Market (new)	• Flow Based (extension)	• 15 min MTP (new)	

Back-up slides

CZC constraints are very difficult to take into account in the steering of the local implicit reactions…

… leading to uncontrolled XB implicit reaction and RT overloads

ATC DE → BE = 200MW



4 This implicit reaction would increase BE aFRR demand, for instance to 350MW, resulting in a decoupling of BE and DE aFRR markets considering the limited ATC of 200MW

aFRR demand

+ 100 MW

- 400 MW

1 After netting, the residual EU imbalance is +300 MW

aFRR up offers

+100MW @ 60€/MWh

5 Leading to the activation of the full local aFRR stack in the upward direction and to a residual 50MW violation of ATC

+100MW @ 90€/MWh,
+200 MW @ 120€/MWh

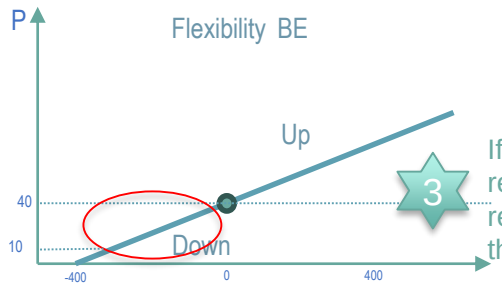
aFRR down offers

-100MW @ 7€/MWh

-100MW @ 20€/MWh,
-100MW@ 17€/MWh,
-300 MW @ 10€/MWh

2 Resulting in the activation of 300MW of aFRR down bids in DE @ 10€/MWh

Available flexibility



3 If the BE market players were incentivized to become even shorter to reduce the EU SI, f.i. by using the CBMP (10€/MWh) as RTP, it would result in a large implicit reaction in BE in the downward direction. Part of this reaction can be pretty much instantaneous (f.i. if provided by batteries)

➔ The difficulty to take CZC constraints into account when implicitly reacting to the CBMP might create inefficient SI oscillations and aFRR counteractivations