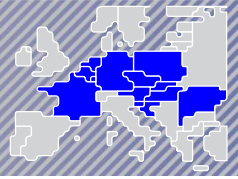


MESC – presentation of the Core CCR

Introduction to the Core region

- The Core region consists of 12 bidding zones, merging the former CWE and CEE regions, and proposes the application of the Flow Based approach for both the DA and ID capacity calculation

- The Core region combines bidding zones of different sizes in a highly meshed system. Margins on CNECs are typically shared between all cross-border exchanges in the region, with at least the neighboring bidding zone borders having a significant impact.

- CNEC selection plays a pivotal role in the Core CCM:
  - Application of Minimum RAM, providing a minimum margin to all CNECs (20% of Fmax)
  - Consideration of cross border sensitivities (a max zone to zone PTDF of at least 5%)
- Optimization of Remedial Actions is key. Costly actions are considered implicitly.

Agenda

1. **Current status**
2. Principles of CNEC selection and the application of Minimum RAM
3. Principles of Remedial Action optimization

1. Current status

On 15/03, Core TSOs received a request for amendment (RfA) from the Core Energy Regulators Regional Forum (CERRF) for both the DA and ID FB CCM. The RfAs reflect the position of all Core NRAs.

The amended proposals and Explanatory Note have been submitted on 04/06/2018 by all Core TSOs within two months following the request from the NRAs:

CCMs for DA and ID have been amended

- in line with the Request for Amendment received from Core NRAs, and;
- in line with discussions during meetings with Core NRAs, Core SPoC NRAs, and Core lead NRAs

Explanatory Note has changed as well:

- Improved by keeping only detailed explanations on elements not tackled in the Proposals with the objective to facilitate the readability, and to limit any risk of inconsistency between the Proposal and its Explanatory Note
- A high level process flow with regard to DA FB capacity calculation has been added

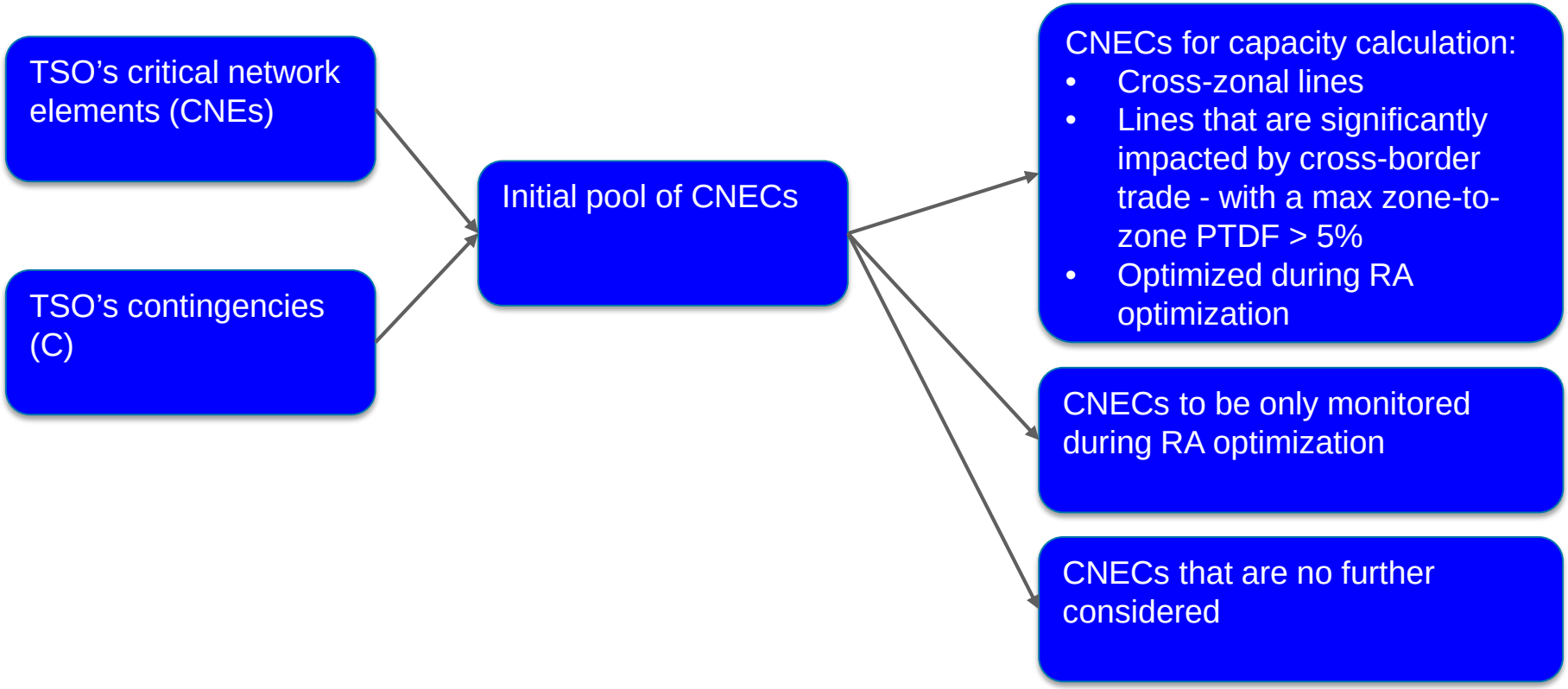
➔ In the next slides, the content of the amended CCMs will be further explained

Agenda

1. Current status
2. **Principles of CNEC selection and the application of Minimum RAM**
3. Principles of Remedial Action optimization

2. Principles of CNEC selection and the application of Minimum RAM

Critical network elements and contingencies: 5% sensitivity threshold



CNEC selection threshold: maximum zone-to-zone PTDF > 5%

- There is a combination of two bidding zones where a 1000 MW bilateral exchange - between these two bidding zones - induces at least a flow of 50 MW

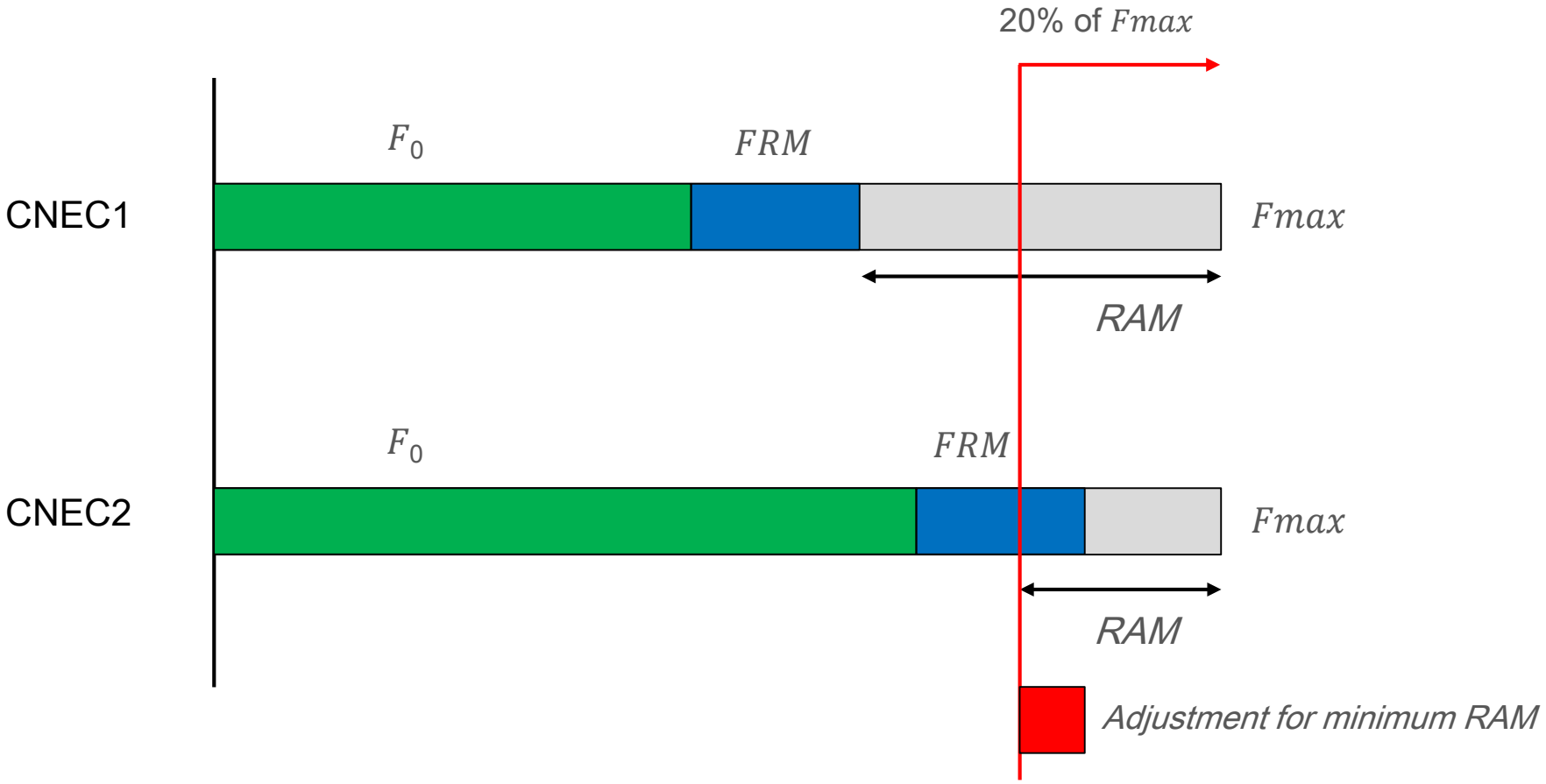
2. Principles of CNEC selection and the application of Minimum RAM

Critical network elements and contingencies: 20% minRAM

Core TSOs apply an adjustment to have a minimum RAM available for commercial exchanges

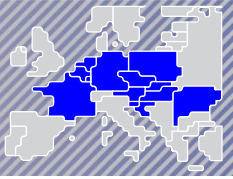
- The application of the minimum RAM adjustment kicks in when the RAM – in a situation without any commercial exchanges in the Core region ($F0$) – is lower than 20% of the CNEC's $Fmax$.
- The adjustment for minimum RAM (AMR) per CNEC is determined with the following equation:

$$AMR = max(0.2F\_max - (F\_max - FRM - F\_0);0)$$



2. Principles of CNEC selection and the application of Minimum RAM

Critical network elements and contingencies: 5% sensitivity threshold ***and*** 20% minRAM

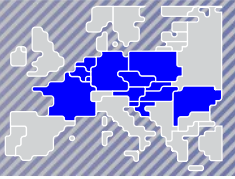


The impact of the 5% CNEC selection threshold can only be assessed in conjunction with the notion of minimum RAM.

- CNEC1
  - Max zone-to-zone PTDF = 5%
  - minRAM = 20% of Fmax = 200 MW
  - This CNEC is able to allow for a commercial exchange of at least 200/0.05 = 4000 MW
- CNEC2
  - Max zone-to-zone PTDF = 10%
  - minRAM = 20% of Fmax = 200 MW
  - This CNEC is able to allow for a commercial exchange of at least 200/0.1 = 2000 MW
- When we are referring to the same pair of bidding zones, CNEC1 cannot be limiting in the presence of CNEC2

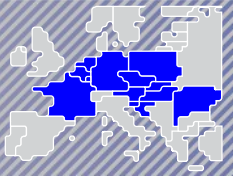
Generally speaking, the minimum RAM ensures that CNECs with lower maximum zone-to-zone $PTDF$s are less likely to become presolved than CNECs with higher maximum zone-to-zone $PTDF$s.

Agenda



1. Current status
2. Principles of CNEC selection and the application of Minimum RAM
3. **Principles of Remedial Action optimization**

3. Principles of Remedial Action optimization



The Core CCM considers remedial actions thrice:

- **During the RAO**: Non-costly Remedial Actions (RAs) are optimized in the foreseen operating point following from the CGMA process. The Remedial Action Optimization (RAO) ensures a proper coordination of the selected RA by considering both the positive and negative impact of any RA
- **MinRAM**: A minimum of 20% of the maximum admissible flow (Fmax) on any CNEC is provided to the market (the MinRAM principle). The capacity is guaranteed by the implicit use of costly RAs (which are only activated after the market clearing)
- **LTA inclusion**: The Core TSOs ensure that at least the volume of Long Term Allocated (LTA) capacity is provided to the market. If needed, these volumes are secured by the implicit activation of additional (costly) RAs.

As a result:

- **There is always a minimum capacity provided to the market (due to MinRAM and LTA inclusion)**
- **Core TSOs do not perform an explicit trade off between costs and benefits as it would imply TSOs forecasting market spreads on all Core borders, which goes along with a high forecasting error.**
- **Costly RAs are only activated as close to real time as possible, i.e. when the market outcome is known**

Objective of the RAO: Enlarge FB domain while respecting network security limits

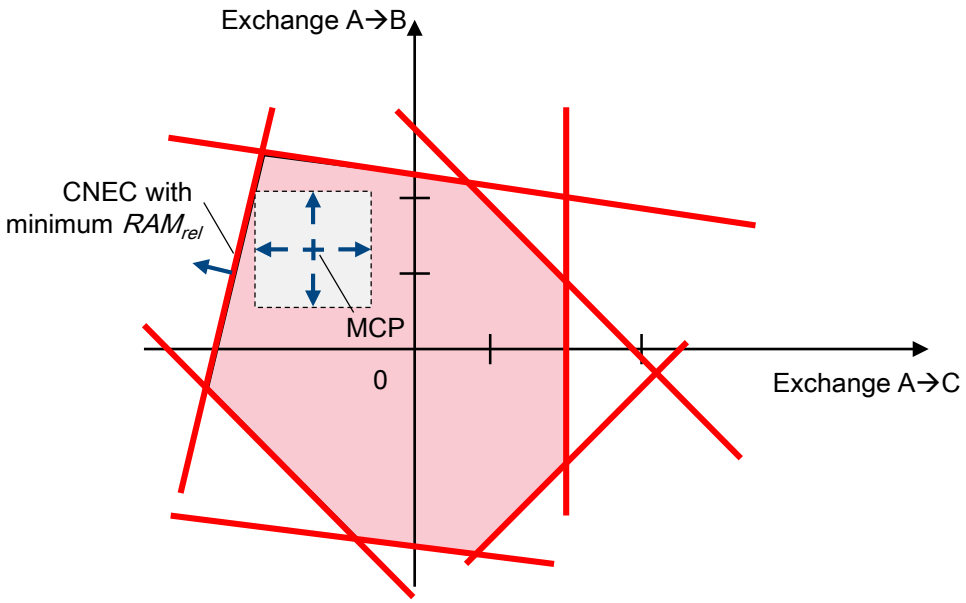
- Enlarge domain around a starting point, i.e. a vector of Net Positions (NPs) (MCP: market clearing point)
- The starting point is the NPs of the CGM (NP forecast, to be determined by CGMA)

Mathematical formulation: Maximization of minimum relative margin

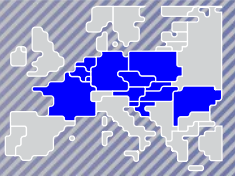
- Idea: A CNEC can bear more cross-zonal exchange, the larger its RAM and the smaller its PTDFs are. Expressed by RAM_{rel}:

$$RAM_{rel} = \frac{RAM}{\sum_{(A,B)\in Pairs\ of\ Core\ bidding\ zones\ with\ commercial\ border} |PTDF_{A\rightarrow B}|}$$

  - Note: In case of precongestion (negative RAM on at least one CNEC before RAO), the absolute RAM is maximized
- The minimum RAMrel determines the CNEC that most strongly limits the CZC, while treating all directions equally
- Effect: Maximization of an n-dimensional “cube” around the predefined MCP (square in 2 dimensions)



3. Principles of Remedial Action optimization



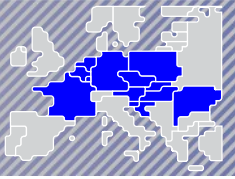
- The Core region combines bidding zones of different sizes in an highly meshed system. Margins on CNECs are typically shared between all cross border exchanges in the region, with at least the neighboring bidding zone borders having a significant impact.

- Due to the burdening and relieving effect of an RA, amongst others PSTs, it is near impossible to secure all the market directions at the same time.

- Moreover, estimating the additional value for the market (considering the 12 bidding zones in the Core region) by relieving multiple congestion is infeasible without knowing ex ante the market direction and prices. In the Core region, price spreads are also significant and can be very volatile. Hence both determining costs and benefits is seen as very challenging.

- Since the LTA values are already ensured by the implicit activation of additional (costly) RAs, deviating from the method to ensure a minimum margin would lead to an incoherent treatment of capacities

- Core TSOs deem the proposed solution, providing a minimum capacity to the market via LTA inclusion and minimum margin, most fitting for the region. An explicit trade off between cost and benefits is, currently, considered infeasible.



Appendix

Operational security limits and contingencies

I_{max}

The maximum admissible current (I_{max}) is the physical limit of a CNE according to the operational security policy in line with Article 25 of the SO GL. I_{max} is defined as a permanent or temporary physical (thermal) current limit of the CNE. A temporary current limit means that an overload is only allowed for a certain finite duration (e.g. 115% of permanent physical limit can be accepted during 15 minutes). I_{max} can be a fixed limit, or a limit that is weather dependent.

F_{max}

The value F_{max} describes the maximum admissible power flow on a CNEC in MW.

F_{max} is calculated from I_{max} by the given formula:

$$F_{max} = \sqrt{3} \cdot I_{max} \cdot U \cdot cos(\varphi)$$

The power factor cos(φ) is assumed to equal one.

FAV

The remaining available margin (RAM) on a CNE may be increased or decreased by the final adjustment value (FAV), where positive values of FAV (given in MW) reduce the available margin on a CNE while negative values increase it. The FAV can be set by the responsible TSO during the validation phase.

Flow Reliability Margin (FRM)

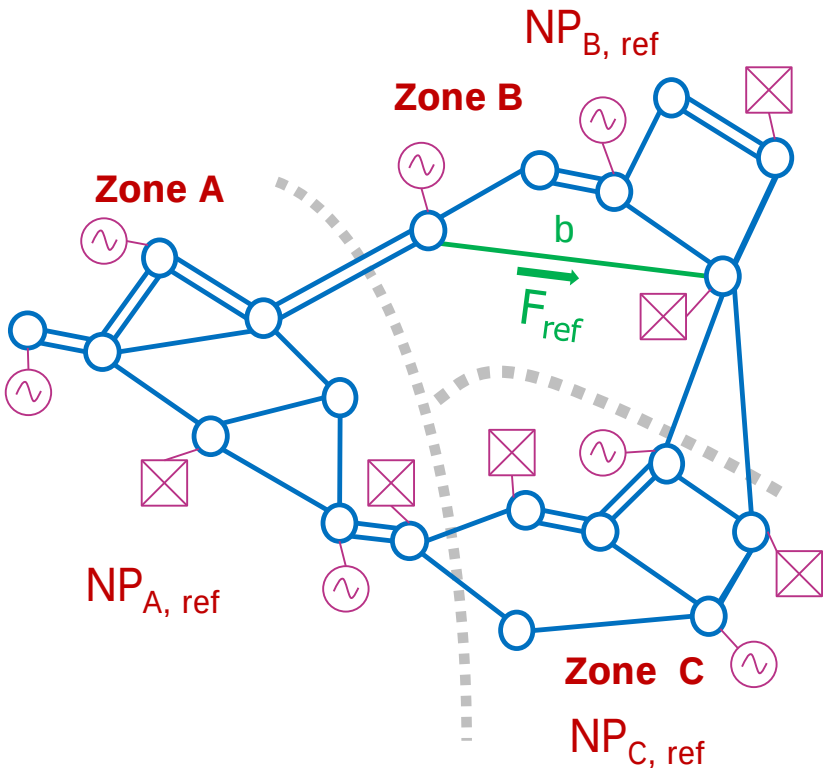
- **FRMs** are the Flow Reliability Margins.
  The common capacity calculation methodology is based on forecast models of the transmission system. For the day-ahead market e.g., the inputs are created two days before the delivery date of energy with available knowledge. Therefore, the outcomes are subject to inaccuracies and uncertainties. The aim of the reliability margin is to cover a level of risk induced by these forecast errors.

- Reliability margins are key for ensuring security of the grid, nonetheless they should not be oversized: they reduce the capacities available to the market and the welfare of the MC.

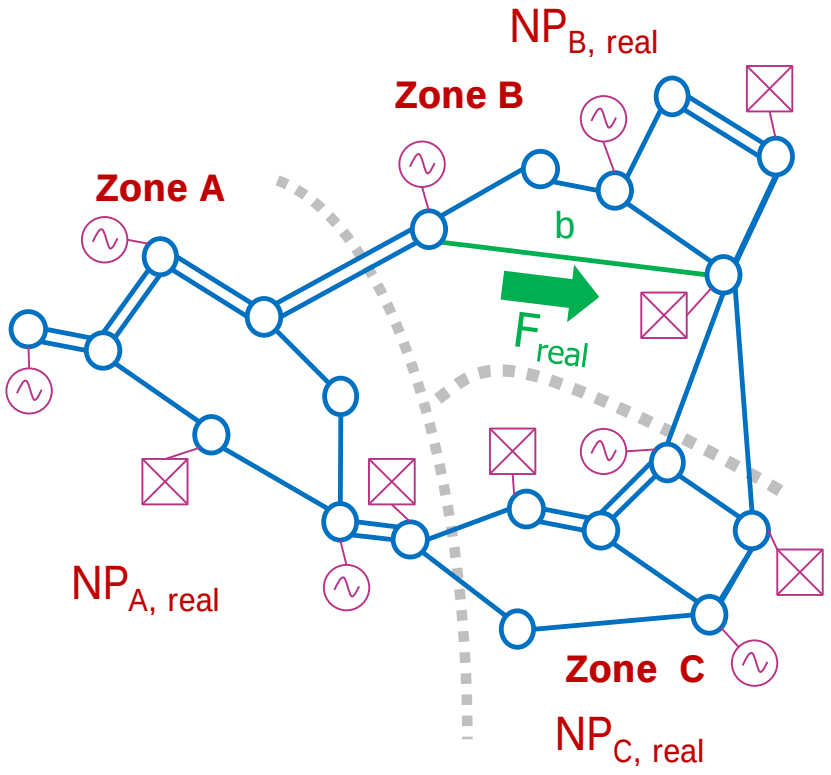
- FRMs are determined and justified by the Transmission System Operators (TSOs) on the basis of statistical analysis applied on probability distributions of deviations between the expected power flows at the time of the capacity calculation and realized power flows in real time.

Flow Reliability Margin (FRM)

CGM_{D-2} with reference net positions



$CGM_{real\ time}$

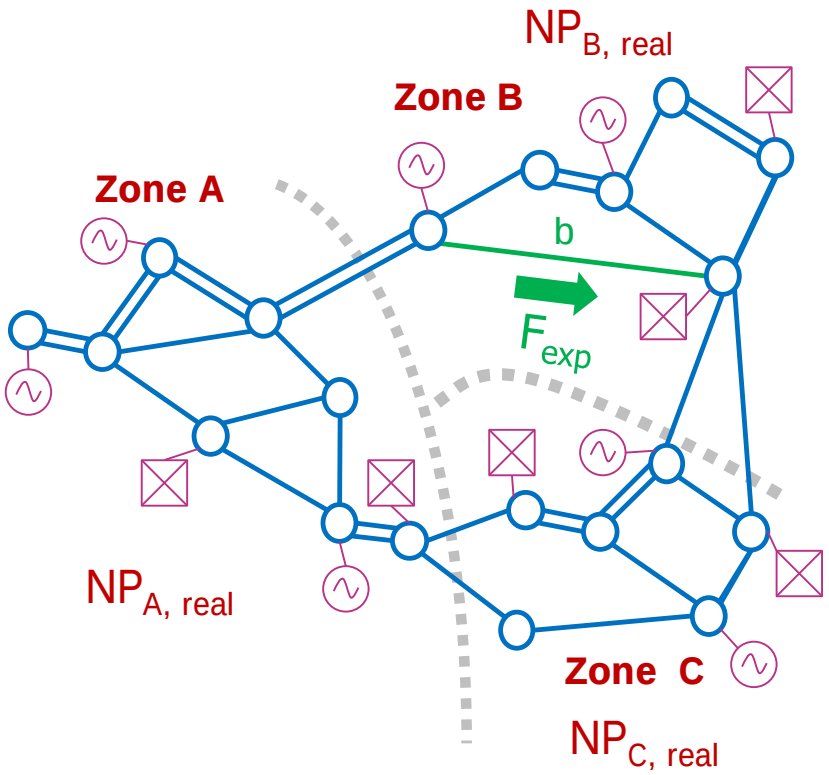


Legend

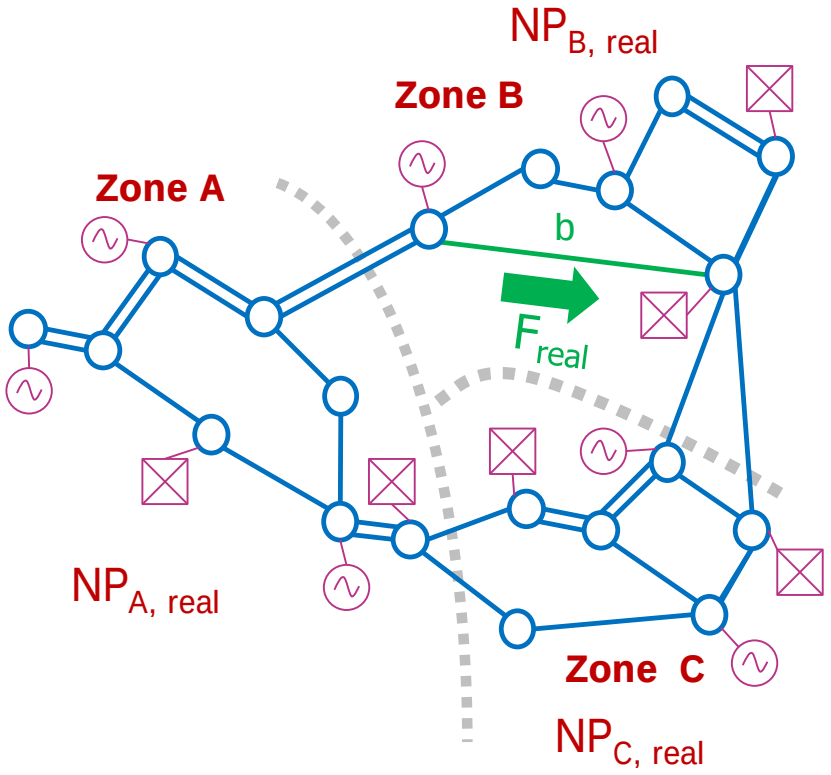
- **CGM –** Common Grid Model
- **NP** – Net Position = Export - Import = the volume of power to be exported or imported
- **F_{ref}** – Reference flow, reflects the loading of the CBs given the exchange programs of the chosen reference day

Flow Reliability Margin (FRM)

CGM_{D-2} with real time net positions



$CGM_{real\ time}$

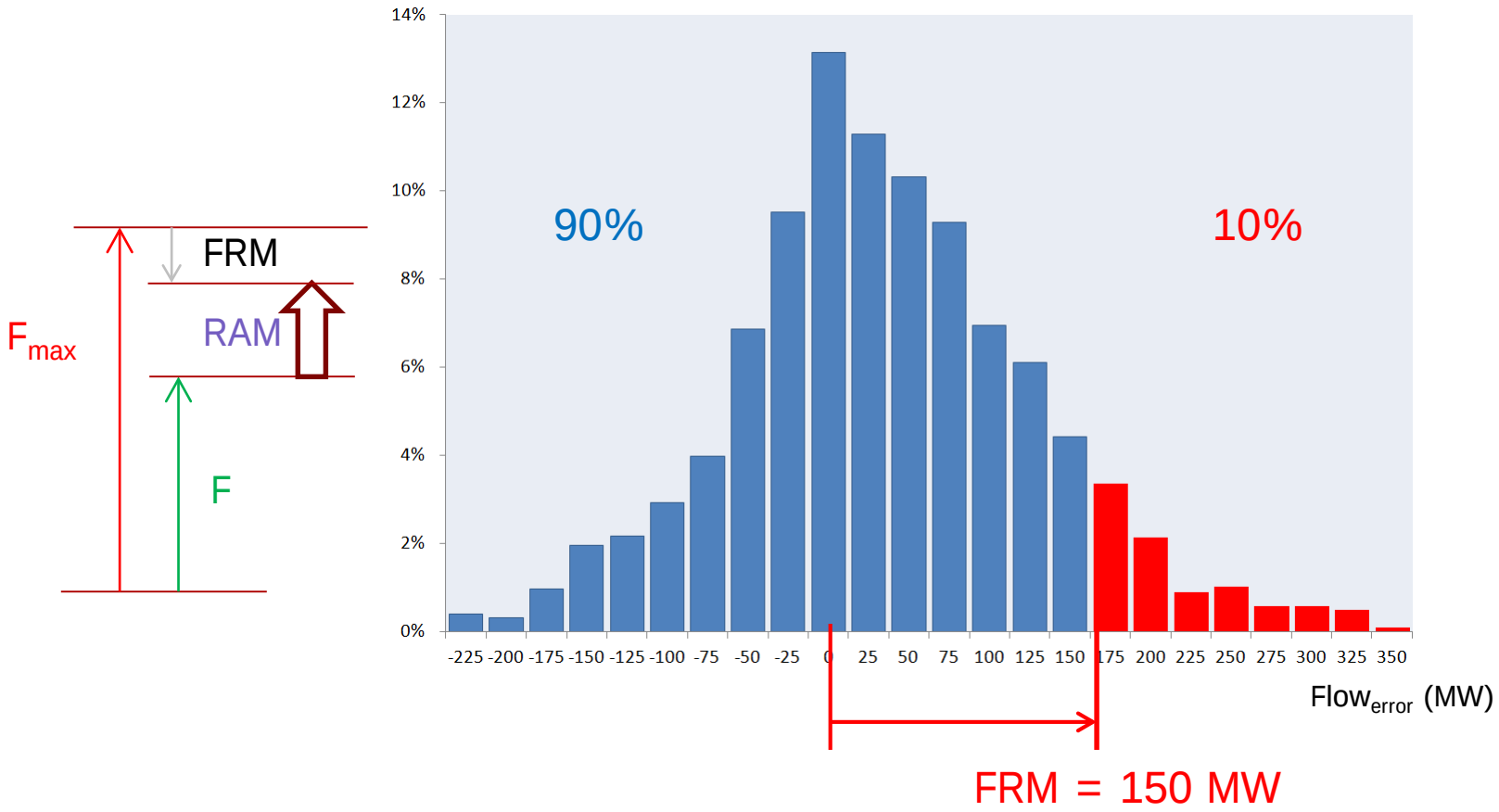


Legend

- **CGM** – Common Grid Model
- **NP** – Net Position = Export - Import = the volume of power to be exported or imported
- **F_{exp}** – Expected flow

Flow Reliability Margin (FRM)

$$Flow_{error} = F_{real} - F_{exp}$$



Generation Shift Key (GSK)

- **GSK** defines how (in %) a change in net position is mapped to generating units of a bidding zone; used to translate the change in balance of one MW into a change on the equivalent generation of specific nodes of that area. The GSK values can vary for every hour and are given in dimensionless units. (A value of 0.05 for one unit means that 5% of the change of the net position of the hub will be realized by this unit).

- GSK is a necessary approximation of the real dispatch behavior. The approximation impact is mitigated by using best available forecasted net positions for CGM creation, such that GSK only covers the difference of the net position between forecast and market coupling result.