COMPASS LEXECON

Procurement strategies for a dynamic allocation of FRR means

A report for Elia

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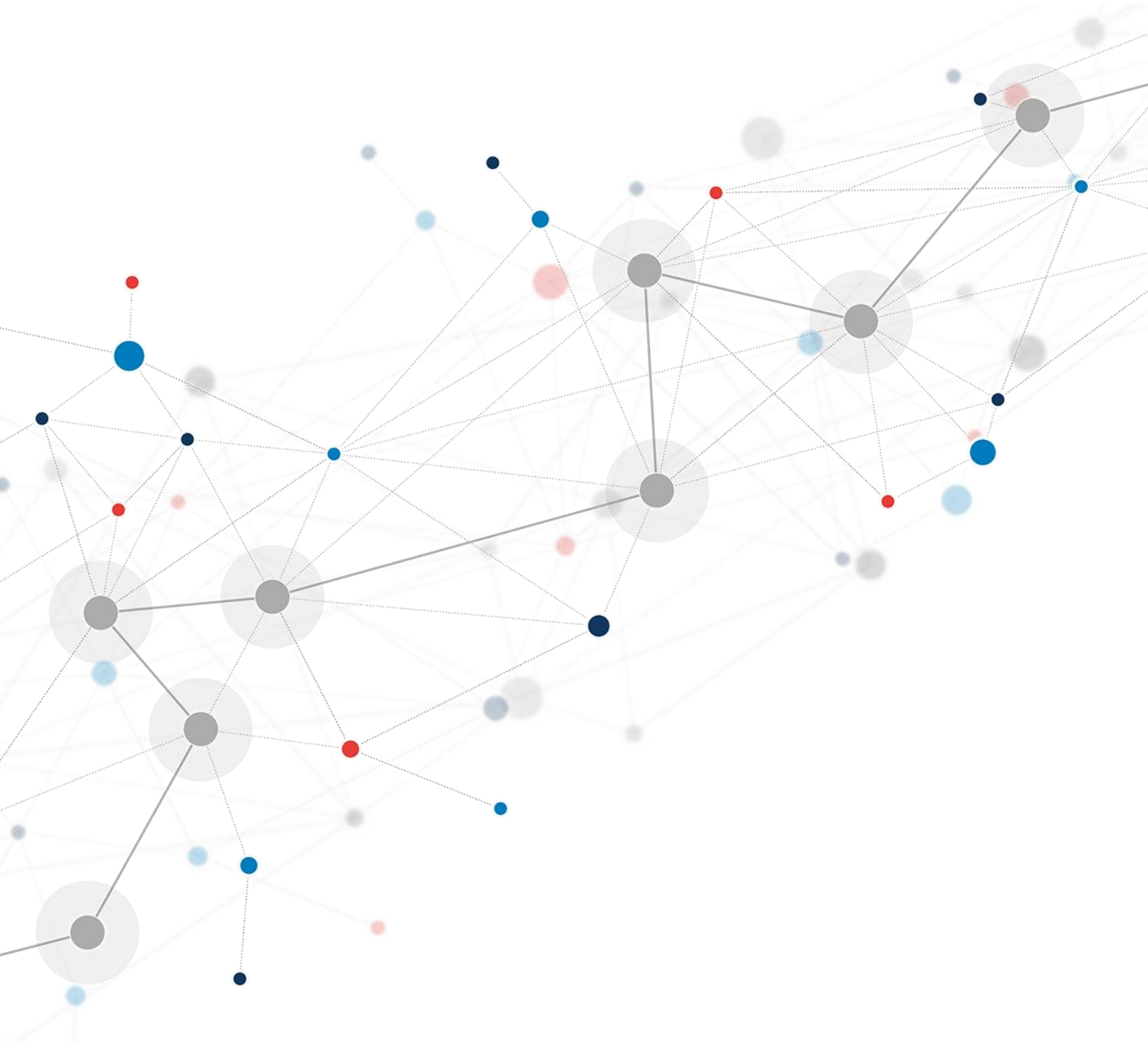
31 August 2022
Public
Final



Contents

Executive summary

Context and objective of the study

In application of electricity balancing guideline[1] (hereafter referred to as "EBGL"), TSOs shall analyse the optimal provision of balancing capacity aiming at minimising its costs while meeting the operational security standards. Amongst other, this analysis shall take into account the volume of non-contracted balancing energy bids which are expected to be available both within their control area and within the European.

In the framework, Elia is investigating the possibility to optimise the allocation of the required reserve capacity needs to contracted and non-contracted balancing means trough a dynamic calculation of the available balancing means.

One of the key elements to consider non-contracted balancing energy bids in the calculation of the FRR means, and the FRR balancing capacity to be procured, is the ability to make an accurate prediction of the availability in day-ahead. In 2021, Elia published a study on the daily prediction of non-contracted balancing energy bids.[2] In the current framework, it confirmed the possibility to deliver relatively accurate predictions for mFRR non-contracted balancing energy bids in the Load Frequency Control (LFC) block. Nevertheless, it is to be confirmed to what extent the implementation of explicit bidding, shorter full activation times and European balancing energy platforms currently planned in 2023 will affect these results. In contrast, available data and current state of the aFRR market did not allow to confirm the potential at this moment.

In addition, appropriate procurement mechanisms need to be found to deduct the predicted available non-contracted capacity from the balancing capacity to be procured.

In this context, Compass Lexecon has been mandated by Elia to carry out a study, which objectives are:

- **to conduct a qualitative assessment of possible procurement strategies** for the consideration of day-ahead predicted availabilities of non-contracted balancing energy bids in a daily calculation of FRR balancing capacity to be procured and
- **to identify, for each approach, the benefits and risks for the parties involved, as well as the possible impact on market functioning**.

Definition of the methodological approach and criteria and identification of the possible options

Methodology

To carry on this assignment, we followed a relatively straight-forward methodological approach, consisting of in:

[1] Commission Regulation (EU)2017/2195 of 23 November 2017 establishing a guideline on electricity balancing here.

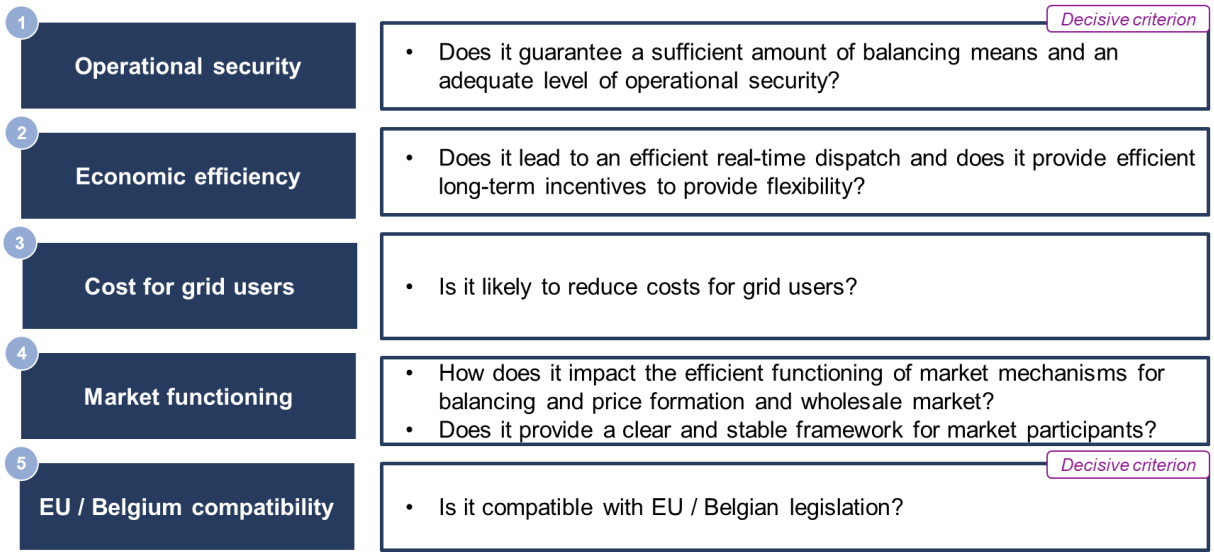
[2] https://www.elia.be/en/public-consultation/20211001_public-consultation-on-the-daily-prediction-of-non-contracted-balancing-energy-bids

- **the definition of the assessment criteria**;
- **the identification of the procurement options**;
- **the assessment of these procurement options** against the predefined criteria, relatively to the status quo situation;
- **the presentation to and discussion with involved stakeholders** of our analysis and preliminary recommendations; and
- **the elaboration of our final recommendations to Elia.**

Assessment criteria

We defined five main criteria to evaluate the procurement options, which were discussed with stakeholders:

Figure 1 – Definition of the assessment criteria



Source: Compass Lexecon

Amongst these criteria, the operational security and the EU / Belgian compatibility were considered as 'decisive criteria' as an option that leads to an unacceptable level of operational security or that is not legally[3] compatible with existing legislations would not be an acceptable solution, however it scores against other criteria.

Procurement strategy options

Prior to stakeholders' engagement, we had identified three main procurement strategy options:

- **No procurement based on post-market re-scheduling**. In this option, no procurement of balancing capacity (at least of a certain type) is organised in day-ahead. In case Elia anticipates a lack of balancing means in real time based on market participants' programs, it would have to

[3] The reader should note that Compass Lexecon is neither a law firm nor a legal advisor. Therefore, the EU / Belgian compatibility was analysed based on our knowledge and understanding of the requirements of the directly relevant regulations from a technical perspective and cannot be considered as a legal analysis.

re-schedule or start up plants in the day-ahead or intraday timeframe to free up sufficient balancing capacity.

- **Intermittent procurement**. This option allows Elia to avoid procuring balancing capacity in day-ahead when expected available non-contracted balancing energy bids are sufficient. Should they not be sufficient, Elia would procure the whole amount of required balancing capacity, (except potentially the deduction of volumes provided through sharing of reserves with neighbouring countries).
- **Partial procurement**. This option allows Elia to procure lower volumes of balancing capacity in day-ahead by taking into account expected available non-contracted balancing energy bids (and sharing of reserves).

Based on a stakeholder's suggestion, we considered increasing procurement of mFRR capacity beyond the balancing capacity requirement as an additional option. However, this option implies raising network reliability standards for operational security above minimum criteria set by the legal framework specified in the system operation guidelines or the regulatory framework specified in the LFC block operational agreement, which is a separate question. We consider that increasing the volume related to the dimensioning of the mFRR needs, or re-assessing the pursued reliability levels, falls outside of the scope of this study,

Evaluation of the procurement strategy options against the assessment criteria

Operational security

In the status quo today, the balancing capacity procured by Elia corresponds to the requirement based on its dimensioning after deducting contributions from the sharing of reserves with neighbouring countries for upward mFRR. As regards downward mFRR, non-contracted bids complemented with sharing of reserves are sufficient to cover the dimensioned requirement most of the time, so Elia does not contract downward mFRR capacity. As a result, this approach guarantees Elia to have at its disposal sufficient balancing resources to balance the system as according to its operational security standards..

Conversely, other considered approaches may lead to situations in which expected non-contracted bids do not materialise. In such cases, if Elia is able to anticipate these situations sufficiently in advance, it would have to resort to remedial actions, such as starting up plants. However, should this not be anticipated sufficiently in advance or if no such remedial actions are available for Elia (due to technical constraints of power plants such as e.g. start-up times), such balancing resources' shortage may lead to operational security issues, resulting in a degradation of the balance of the Belgian system up to the activation of exceptional measures such as, as a last resort, load curtailment.

In the systematic absence of procurement, situations of lack of non-contracted means will likely occur frequently based on current liquidity, as Elia's assessment shows, in the vast majority of time (around 80%), non-contracted bids do not cover its needs. Furthermore, the current generation mix does not guarantee that Elia will have access to adequate resources to re-schedule plants when needed, due to slow start-up times of conventional thermal units such as combined-cycle gas turbines (CCGTs) or due to risks that the available capacity is already fully used, for instance during near-scarcity events. In such situations, Elia will thus have no other options than balancing the system in degraded operational security levels.

In intermittent and partial procurement approaches, operational security issues may occur because:

- Even though, in general, non-contracted bids available in the balancing market in the status quo would likely be present as well in case of intermittent or partial procurement, we have identified situations in which **the change in procurement induces changes in dispatch behaviour and impact the availability of non-contracted bids**.
- Moreover, **forecasting the availability of non-contracted bids is not an easy task** and a 100% forecast accuracy is likely not a realistic target. It is therefore difficult to reach adequate volumes available at 'firm' availability level and anticipate radical changes. Unless forecasting can be substantially improved, this additional risk will add up to risks taken in the dimensioning methodology, which in turn may exceed an acceptable level.

Comparing more specifically intermittent and partial procurement strategies, partial procurement would likely lead to more frequent tight situations insofar as it reduces procurement volumes not only when non-contracted bids are expected to be sufficient to cover the whole requirement, but also when it covers only part of it.

Consequently, **these operational security concerns need to be addressed before considering the implementation of such options**. **Further quantitative studies on availability and predictability of non-contracted bids should confirm sufficient liquidity** of such resources before these strategies can be considered in practice.

Economic efficiency

Contracted capacities are not able to participate in the wholesale market. Reducing mFRR capacity procured in all three options considered frees up some capacity which can then participate in the wholesale market, improving the real-time dispatch of generators. This results in lower costs and potentially lower day-ahead and/or intraday market prices in Belgium. However, the impact on prices could be limited in practice given the relative share of freed-up capacities compared to European wholesale markets.

In case of no procurement, if Elia has to resort on post-market rescheduling to secure mFRR, frequent rescheduling actions may eventually harm dispatch efficiency, especially as Elia may only have access to a limited pool of resources (e.g. due to start-up time or to limited access to decentralised resources). Given current non-contracted bids' liquidity levels, high level of rescheduling would indeed be expected.

For partial and intermittent, the gains will depend on the frequency of remedial actions necessary in times when non-contracted bids do not cover Elia's requirement in real time.

In addition, and put forward by stakeholders, the downside of reducing mFRR capacity procurement costs is that it could harm long-term incentives to maintain or develop flexible capacities following a reduced demand for this balancing capacity service. In case of intermittent procurement however, we expect this effect may not be exaggerated insofar as mFRR capacity prices tend to be low when non-contracted bids are sufficient to cover Elia's balancing capacity requirement. It is also possible that this effect will be mitigated in part by higher mFRR energy prices, due to lower participation in the mFRR energy market.

Cost for grid users

From the perspective of grid users, reducing or completely removing mFRR capacity auctions mechanically decreases mFRR capacity procurement costs compared to the status quo. However, Elia may need to resort to remedial actions if it lacks mFRR means, which costs may reduce or exceed savings in procurement costs.

Entirely removing auctions naturally avoids the highest mFRR capacity procurement costs, but the costs of rescheduling actions will likely be significant for Elia and overbalance in cost advantages gained by not procuring mFRR capacity.

Should remedial actions be limited, partial procurement has a high potential for cost savings, as it reduces procurement volumes when any volume of non-contracted capacity is expected, and not limited to situations where it exceeds requirements as in intermittent procurement and where mFRR capacity prices are low. Conversely, due to the correlation between high availability of non-contracted mFRR energy bids and low mFRR capacity prices, cost savings would likely be limited in the intermittent procurement option, and lower than expected in the partial procurement.

Last, direct and indirect cost effects could eventually lead to counterbalancing effects on the capacity remuneration mechanism by influencing the 'missing money' of generators. Indeed, the reduction of mFRR capacity revenues may increase the missing money of the formerly participating capacities in the mFRR capacity auctions of a similar magnitude as a maximum. Conversely, the likely increase in mFRR energy prices would cover part of the reduced mFRR capacity revenues, therefore limiting the impact on CRM costs.

Market functioning

In case of no mFRR capacity procurement based on post-market rescheduling, market instability may appear in case of frequent Elia interventions to maintain sufficient level of mFRR means, which would be likely given current liquidity.

In intermittent and partial procurement, the absence of recurrent mFRR capacity auctions and the variability of volumes (in case of partial) may affect the visibility of market participants in the market. This could be alleviated if the absence of auctions or the reduction of volumes to be procured would follow clear patterns. For example, these patterns could be the absence of mFRR capacity auctions in summer or at night only, or stable volume reduction over predefined periods.

In the absence of clear patterns, the market environment would become less predictable and less stable. This could discourage market participation or result in operational errors at market side. It could be detrimental to its functioning in the short and long run and increase market power in the balancing energy market.

In addition, reducing mFRR capacity procured could decrease mFRR energy market liquidity, leading to increased risk market power issues. Some generators could indeed gain a pivotal position more easily if fewer participants submit bids. This concern might be mitigated by the introduction of the MARI platform, where locally sourced mFRR energy bids would compete against bids from other systems.

EU / Belgian compatibility

For partial and intermittent procurement of mFRR capacity, we have not found compatibility issues with the Belgium/ EU legal and regulatory framework.

For no procurement of mFRR capacity based on post-market rescheduling, even though we have not identified any firm incompatibilities for this option either, implementing the latter would nevertheless be a significant departure from current arrangements in Belgium. Similarly, this option would constitute a deviation from the EU target model if post-market rescheduling were frequent.

Conclusion

In conclusion, the no procurement scenario would be a significant reform with uncertain benefits and high operational risks, as, most of the time in the current context, upward mFRR capacity needs are not covered by the available non-contracted balancing means, and post-market rescheduling would be frequently necessary. We would therefore recommend discarding it for the moment.

Partial procurement, and intermittent procurement to a lesser extent, could unlock cost savings to grid users in the short term at least. However, these options could lead to deteriorated and potentially unacceptable level of operational security in case remedial actions are frequently needed.

Indeed, these options could entail higher operational risks due to the difficulty or impossibility to guarantee the availability of non-contracted mFRR energy bids. In addition, they raise concerns regarding market stability, which could in turn have impacts in the longer run.

Consequently, these operational security concerns need to be addressed before considering the implementation of such options. Further quantitative studies on availability and predictability of non-contracted bids, as well as on patterns, should confirm sufficient liquidity of such resources before these strategies can be considered in practice.

Table 1 - Summary assessment of the mFRR capacity procurement options considered compared to the status quo

	Status quo	No procurement based on post-market rescheduling	Intermittent procurement	Partial procurement
1 Operational security		 Risk of insufficient mFRR resources, as capacity may not always be available through rescheduling, and visibility on available generation could be limited for Elia.	 Risk of insufficient mFRR energy bids in real time, due to impacts on dispatch and non-contracted bids forecasting errors.	 Risk of insufficient mFRR energy bids in real time (greater than intermittent procurement), due to impacts on dispatch and non-contracted bids forecasting errors.
2 Economic efficiency		 Dispatch efficiency could improve, but frequent rescheduling can result in inefficiencies.	 Could increase liquidity in the wholesale market. Remedial actions in case of reserve shortage could create inefficiencies. Long term incentives to provide flexibility could be reduced.	 Could increase liquidity in wholesale market. Remedial actions in case of reserve shortage could create inefficiencies. Long term incentives to provide flexibility could be reduced.
3 Cost for TSO / grid users		 Lower procurement cost but costly re-dispatching/ start up, which could increase further.	 Some mFRR capacity procurement cost reduction, but potentially at times of lower mFRR prices, and risk of costly remedial actions.	 Reduced mFRR capacity procurement costs, but could be counterbalanced by higher remedial costs. Impact on long term incentives could have upward effect on costs.
4 Market functioning		 More instability and complexity in the wholesale market. Potentially discriminant to decentralised generation.	 No regular auctions guaranteed, creating uncertainty and could result in operational errors.	 Procurement volumes less predictable. Market power and mFRR energy prices could increase.
5 EU / Belgium compatibility		 Significant departure from current arrangements and EU target model. Requires substantial regulatory/ operational changes.	 No identified incompatibility with EBGL/ Belgium legal and regulatory framework.	 No identified incompatibility with EBGL/ Belgium legal and regulatory framework.

1 Introduction: context and objective of the study

In European power markets, market parties – through their balancing responsible parties (BRPs) – are responsible for balancing injections and offtakes in their portfolio. They may take actions until real time within their portfolio or in the intraday market, in order to resolve imbalances in their portfolio, e.g. to compensate for forecast errors on generation output or load, or for a power plant outage.

The role of the system operator, Elia, is complementary to the market and aims at neutralising the residual imbalance between injection and offtake that is not covered by market players. By means of the imbalance settlement price (ISP), it incentivises the market to cover their balancing responsibility as much as possible. This ISP is mainly driven by the cost of activating balancing energy to resolve the residual system imbalance, as well in both an upward (to deal with energy shortage) and downward (to deal with energy surplus) direction.

One specificity of the Belgian market design and ISP is that it provides incentives to BRPs not only to balance their own portfolio, but also to balance the whole Belgian power system in real time. Thanks to this 'reactive' balancing mechanism, part of the required flexibility is delivered by intra-day markets and real-time actions of market participants, and not by Elia.

As described in the Figure 2 below, Elia uses different types of balancing capacity to cover the residual system imbalances. Whereas the Frequency Containment Reserve (FCR) is dimensioning at the synchronous area level to stabilise the frequency, the Frequency Restoration Reserve (FRR) is dimensioned at the control zone – the Load Frequency Control (LFC) block – to ensure that the frequency in the synchronous zone is restored, and that the control zone is re-balanced. The automatic FRR (aFRR) is mainly used to compensate for short and random imbalances. The manual FRR (mFRR) serves as compensation for long, persistent and/or very extensive imbalances.

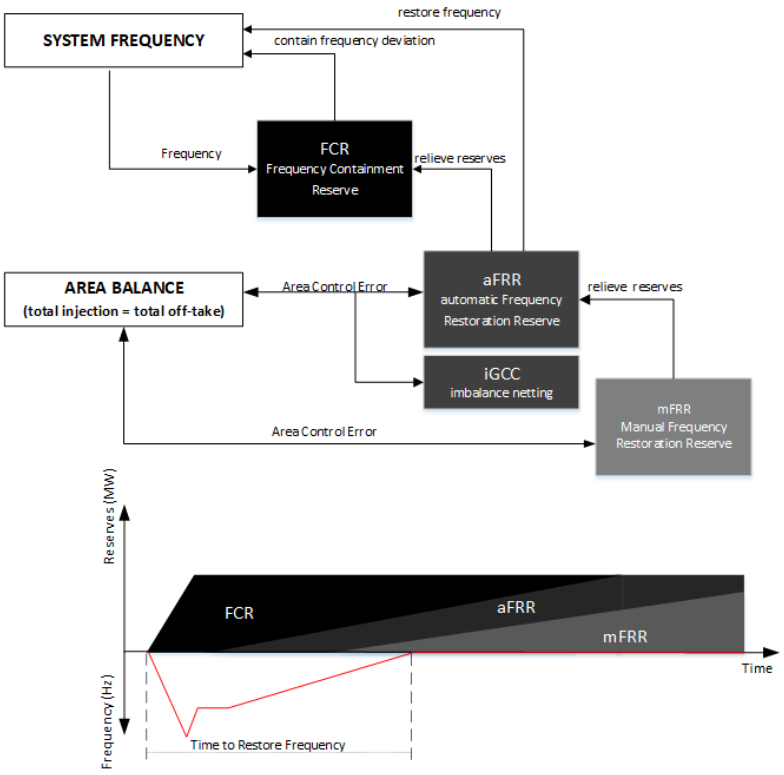
In accordance with Article 157 of the system operation guideline[4] (hereafter referred to as SOGL), the methodology to dimension the FRR / aFRR / mFRR needs is defined in the LFC Block Operational Agreement (LFC BOA)[5], a document which is subject to NRA approval, after public consultation.

As of 4 February 2020, Elia implemented a dynamic dimensioning for up- and downward FRR needs. This means that the balancing capacity is determined in day-ahead, for each 4-hour block of the next day, based on system conditions determining the risk of facing an imbalance and the FRR needs are allocated into aFRR and mFRR needs.

[4] Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation, here

[5] https://www.elia.be/en/electricity-market-and-system/system-services/keeping-the-balance

Figure 2 - Overview of Elia's balancing activation process



Source: Elia

Article 32(1) of electricity balancing guideline[6] (hereafter referred to as "EBGL") specifies that each TSO shall perform an analysis of the optimal provision of balancing capacity aiming at minimising its costs while meeting the operational security standards. This analysis shall take into account the following options for the provision of the balancing capacity:

- the procurement of balancing capacity within control area and exchange of balancing capacity with neighbouring TSOs, when applicable;
- the sharing of reserves, when applicable;
- the volume of non-contracted balancing energy bids which are expected to be available both within their control area and within the European market.

In the framework, Elia is investigating the possibility to further optimise the allocation of the required reserve capacity needs to contracted and non-contracted balancing means through a dynamic calculation of the available balancing means. In the status quo today, the balancing capacity procured by Elia corresponds to the requirement based on its dimensioning and deducting contributions from the sharing of reserves with neighbouring countries for upward mFRR. The current approach guarantees Elia to have at its disposal sufficient balancing resources to balance the system as according to its operational security standards, and even beyond as, most of time, it gets non-contracted bids in addition.

[6] Commission Regulation (EU)2017/2195 of 23 November 2017 establishing a guideline on electricity balancing here

One of the key elements to take into account non-contracted balancing energy bids in the calculation of the FRR means, and the FRR balancing capacity to be procured, is the ability to make an accurate prediction of the availability in day-ahead.

In 2021, Elia published a study on the daily prediction of non-contracted balancing energy bids.[7] The main conclusions were:

- **aFFR**: no substantial volumes of aFRR non-contracted balancing energy bids can be predicted, due to low liquidity and the limited time series available at the time of the study.
- **Downward mFRR**: confirmation of Elia's current approach not to procure downward mFRR balancing capacity as observed non-contracted balancing means almost cover the full downward mFRR capacity needs.
- **Upward mFRR**: available date has shown that a potential volume of 500 MW (including reserve sharing) can be predicted with a reliability of 99.0%, on average, while a volume of 1000 MW can be ensured for 14% of the time. It is confirmed that there is a potential value for this prediction tool, but many uncertainties are present following upcoming system evolutions (evolution to explicit bidding, reduction of the full activation time and implementation of the EU balancing energy platforms).

In addition, appropriate procurement mechanisms need to be found to deduct the predicted available non-contracted capacity from the balancing capacity to be procured.

In this context, Compass Lexecon has been mandated by Elia to carry out a study, which objectives are:

- **to conduct a qualitative assessment of possible procurement strategies** for the consideration of day-ahead predicted availabilities of non-contracted balancing energy bids in a daily calculation of FRR balancing capacity to be procured and
- **to identify, for each approach, the benefits and risks for the parties involved, as well as the possible impact on market functioning.**

Given the study on the daily prediction of non-contracted balancing energy bids, the study focuses mostly on upward mFRR balancing capacity.

[7] https://www.elia.be/en/public-consultation/20211001_public-consultation-on-the-daily-prediction-of-non-contracted-balancing-energy-bids

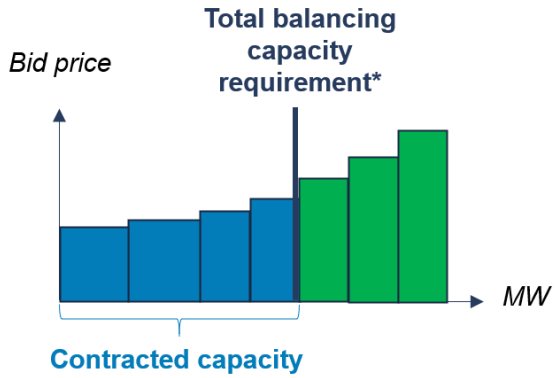
2 Methodological approach for the study

In this section, we start by describing the status quo arrangements which will be used as a baseline for the assessment of mFRR capacity procurement options. We then provide an outline of the methodology used in this study, alongside the options considered and assessment criteria retained for the analysis. We finish by providing a brief assessment of the status quo arrangements against the criteria.

2.1 Description of the current market functioning: the status quo

Elia calculates the required mFRR capacity need based on its dimensioning methodology in accordance with the LFC block operational agreement. Then, Elia determines based on its calculation methodology in the LFC Means the mFRR balancing capacity to be procured considering reserve sharing and non-contracted bids through a static calculation, as shown on **Error! Reference source not found.**. This static calculation is set at 0 MW for upward mFRR due t o the lack of a sufficiently firm availability of these bids.

Figure *3* - Currently, Elia procures upward mFRR capacity to cover its upward mFRR capacity requirement, after reserve sharing deductions.



**After reserve sharing deductions.*

Source: Compass Lexecon

Note: The x-axis shows the balancing capacity volume offered, while the y-axis shows the bid price submitted in the auction.

To procure mFRR capacity, Elia publishes the mFRR capacity demand for day D early in the morning of the day before (D-1) every day. Therefore, BSPs are informed of the demand ahead of the gate closure for the capacity auctions. Elia procures mFRR capacity per block of 4 hours of day D (also referred to as “CCTU”). At 10am on day D-1, Elia organises 6 auctions: one auction for each of the CCTUs. Elia selects the capacity bids for each CCTU based on the merit order. The bids are

ranked from lowest to highest price and Elia selects bids until the dimensioned demand for mFRR capacity is covered.

The mFRR capacity auctions result in awarded mFRR capacity for concerned BSPs. The awarded mFRR capacity is remunerated according to the paid-as-bid mechanism: Elia pays the BSP the price requested in each selected mFRR capacity bid.

In the current pre-MARI market design, BSPs with contracted mFRR capacity must offer the corresponding mFRR energy bids in the mFRR energy market on day D-1 by 3pm latest.[8] These bids can be updated until the mFRR balancing gate closure time on day D. In addition, BSPs can also offer their remaining available active power as non-contracted mFRR energy bids either on a (i) mandatory basis or on a (ii) voluntary basis depending on obligations from the Federal Grid Code.[9]

i. **Mandatory non-contracted mFRR energy bids**: After the procurement of mFRR Capacity for day D in the auction the day before, the BSP is required to submit at least the volume of contracted capacity in the form of mFRR energy bids. In accordance with article 226(1) of the Federal Grid Code, BSPs must put at the disposal of Elia the (upward or downward) active power that remains available, subject to technical conditions such as installed capacity of 25MW or more.

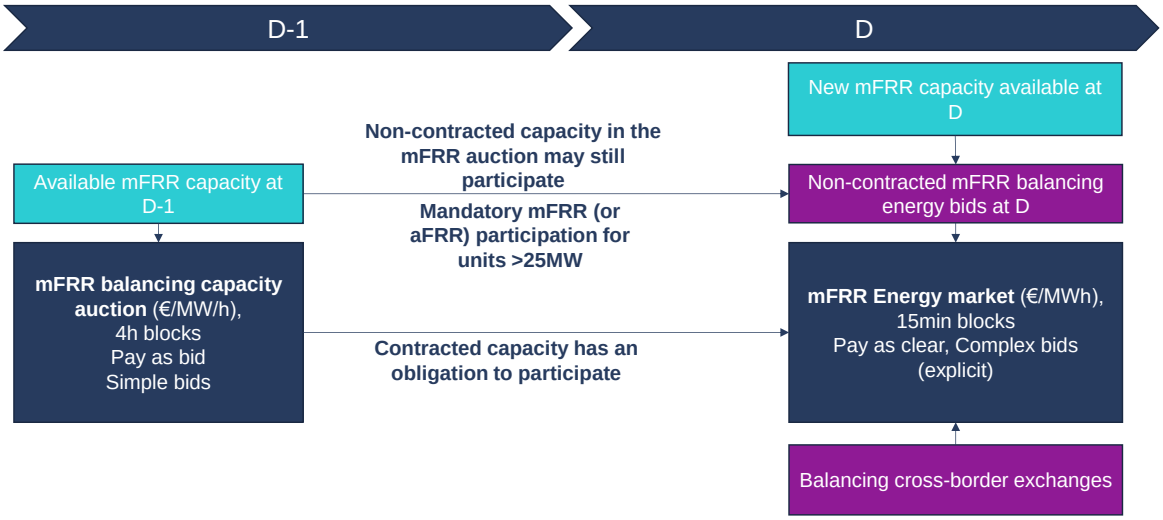
ii. **Voluntary non-contracted mFRR energy bids:** In addition, in accordance with article 226(2) of the Federal Grid Code, BSPs can voluntarily offer upward or downward active power that is not subject to the above-mentioned obligations, to Elia in the form of balancing energy bids.

BSPs can submit mFRR energy bids for each quarter-hour of day D. A quarter-hour corresponds to one “mFRR market time unit. mFRR energy remuneration is based on paid-as-cleared principles: all mFRR energy bids in the same selection are remunerated at the same clearing price. As long as Elia locally selects mFRR energy bids for activation (and when in fallback procedure), the mFRR energy clearing prices are determined locally. Once connected to the mFRR-Platform, the clearing prices for the mFRR energy activated in the Elia LFC Block will be determined on a European level.

[8] See ART. II.10 Submission of mFRR energy bids of the ‘Terms and Conditions for balancing service providers for manual Frequency Restoration Reserve (mFRR)’ (2020) available here. Under the MARI platform, TSOs can submit bids up to 12 minutes before the beginning of the mFRR MTU of the respective standard mFRR balancing energy product bid. See Article 9 of the MARI Implementation Framework here.

[9] See the Belgium Federal Grid Code here (in French).

Figure 4 - Overview of mFRR capacity and energy auctions (post-MARI)



Source: Compass Lexecon

Non-contracted bids to come from different types of market players and from diverse situations. Non-contracted mFRR energy bids could be submitted from resources (i) which participated in the mFRR capacity auction and were unsuccessful, or (ii) which did not participate in the corresponding mFRR capacity auction in D-1 (see Figure 5 below):

i. **Non-contracted mFRR energy bid unsuccessful in the D-1 mFRR capacity tender** ('green' bids on Figure 5 below). There may be different situations for which mFRR capacity bids would be unsuccessful in the auction, such as:

   a. **A market participant having a higher opportunity cost than the last accepted capacity** in the auction, and so the capacity would not be accepted.

   b. **A market participant having overestimated the opportunity cost of not participating in the day-ahead or intraday market**. In this case, the participant should have been accepted, but its incorrect estimation has led to a bidding price higher than the last accepted capacity.

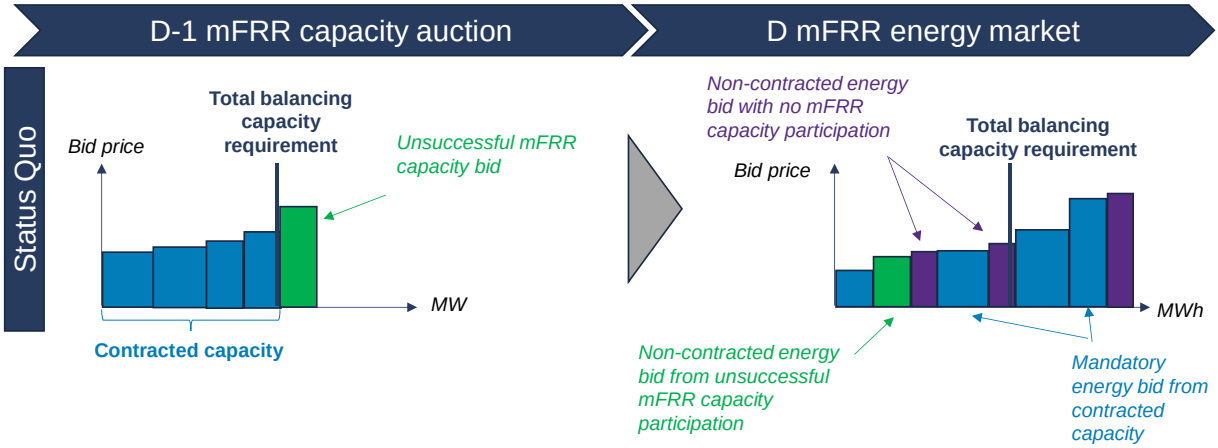
   c. **A market participant may have overestimated the price of the last accepted capacity**, given that the auction is pay-as-bid. Theoretically, in a pay-as-bid auction, the optimal strategy is to bid as close as possible to the last accepted capacity to maximise revenues. Inaccuracies in forecasting this price upfront may lead to suboptimal outcomes and certain capacities not being accepted in the auction.

   d. **Due to differences in market times units**. For mFRR capacity, products are defined in blocks of 4 hours, while it is 1 hour for the day-ahead market and up to 15 minutes for imbalances. This time mismatch may imply that the opportunity cost of committing for 4 hours is higher for certain hours, and so impact the entire bid price.

ii. **Non-contracted mFRR energy bid which did not participate in the D-1 mFRR capacity tender** ('purple' bids on Figure 5 below). This covers the remaining available capacity in real time which submits a non-contracted bid voluntarily of mandatorily. For instance, this could cover capacity which was expected to be dispatched in day-ahead but was not in the

end, or capacity kept for the intraday market by a market participant which was not used in the end.

Figure 5 - Non-contracted mFRR energy bids



Source: Compass Lexecon analysis

Currently Elia procures the mFRR service locally – complemented by bilateral agreements with neighbouring TSOs for reserve sharing. In accordance with the European Guideline on Electricity Balancing (EBGL) all TSOs are developing a European platform for mFRR energy exchanges (project "MARI").10 The connection to the mFRR-Platform requires a substantial design review to ensure that the local and the European levels match well.

2.2 Description of our methodological approach

To evaluate different procurement strategies for mFRR procurement, we started by identifying the relevant options for procurement and defining an evaluation criterion for assessing these options. We then evaluated each option against the criteria, in comparison with a status quo situation, to issue recommendations on their potential for implementation in Belgium. This methodological approach is represented in Figure 6.

Figure 6 – High-level conceptual evaluation methodology for the study

As part of our study, we conducted two public workshops with Elia which was attended by a range of stakeholders. Comments made by stakeholders in response to the analysis presented have been

[10] Starting from 2022, the exchange of mFRR energy will be organised at European level via the mFRR-Platform, which serves to facilitate the integration of the European balancing energy markets. The platform is concerned with exchanges of mFRR energy only and does not account for mFRR capacity reservation.

considered and included in the analysis of this report. In the Annex (section 7), we include the minutes from both workshops as well as additional comments submitted by stakeholders in writing.

2.3 Identification of the procurement options

2.3.1 Description of the options considered for the assessment

Prior to stakeholders' engagement, we had identified three main procurement strategy options:

- **No procurement based on post-market re-scheduling**. In this option, no procurement of upward mFRR is organised in day-ahead. In case Elia anticipates a lack of balancing means in real time based on market participants' programs, it would have to re-schedule or start up plants in the day-ahead or intraday timeframe to free up sufficient balancing capacity.
- **Intermittent procurement**. This option allows Elia to avoid procuring upward mFRR capacity in day-ahead when expected available non-contracted balancing energy bids are sufficient. Should they not be sufficient, Elia would procure the whole amount of required balancing capacity, (except potentially the deduction of volumes provided through sharing of reserves with neighbouring countries).
- **Partial procurement**. This option allows Elia to procure lower volumes of upward mFRR capacity in day-ahead by taking into account expected available non-contracted balancing energy bids (and sharing of reserves). As in the intermittent procurement, should they be sufficient to cover the whole need on a specific period, Elia would not procure any balancing capacity.

2.3.2 Other options considered

Increasing mFRR capacity procurement

We received feedback from a stakeholder that the options considered only focused on reductions of mFRR capacity contracting, while an additional option could focus on increasing such contracting. Accordingly, we considered increasing procurement of mFRR capacity as an additional option. However, it implies raising network reliability standards for operational security, which is a separate question.

While the options considered are assessed against the status quo procurement methodology, we consider that increasing the volume related to the dimensioning of the mFRR needs, or re-assessing the pursued reliability levels, falls outside of the scope of this study.

Topic focus 1 - Increasing mFRR capacity procurement option

Increasing procurement of mFRR capacity as an option for Elia

Today, Elia contracts its need for mFRR upward capacity (after taking into account sharing) following a dimensioning taking into account (i) a probabilistic method pursuing a 99% reliability level and (ii) a deterministic method covering the dimensioning incident. This methodology has shown to provide operational security and is in line with minimum European legal requirements (system operation guidelines).

Thus, increasing contracted capacity for mFRR implies raising the network reliability level beyond minimum legal requirements. While the options considered are assessed against the status quo procurement methodology, we consider that increasing the volume related to the dimensioning of the mFRR needs, or re-assessing the pursued reliability levels, and falls outside of the scope of this study. In any case, for a given level or reliability chosen, the options for procurement considered in the study can still be considered.

High level considerations with respect to the proposed option

Should higher levels of mFRR procurement than the dimensioning need be carried out, operational security would increase with higher reliability standards associated with this strategy.

However, as detailed in the mechanisms described in section 3.2.2, procuring more mFRR capacity volumes risk decreasing dispatch efficiency, leading to higher wholesale market prices. In any case, increased reliability standards would lead to direct increases in costs for the system, all else equal.

2.4 Assessment criteria

The assessment criteria retained for assessing the suitability of each of the options outlined in section 2.3 is as follows:

- **Operational security**: does the procurement option guarantee a sufficient amount of balancing means and an adequate level of operational security?
  - This criterion assesses the impact of each option on operational system security in Belgium.
- **Economic efficiency**: does the procurement option lead to an efficient real-time dispatch and does it provide efficient long-term incentives to provide flexibility?
  - This criterion assesses the efficiency of each option in terms of dispatch, i.e. of total costs to meet demand. To do so, we also consider indirect impacts on the wholesale market. We also assess the impact of each option on the investment signals sent in the longer run to flexible capacity able to provide balancing services.
- **Cost for grid users**: is the procurement option likely to reduce costs for grid users?
  - This criterion assesses the impacts of each option on costs for grid users through grid tariffs.
- **Market functioning**: how does the procurement option impact the efficient functioning of market mechanisms for balancing and price formation and wholesale market? Does it provide a clear and stable framework for market participants?

  - This criterion assesses the market framework for each option, to evaluate potential impact on market processes and price formation.

- **EU / Belgian compatibility**: is it compatible with EU and Belgian legislation?

  - This criterion assesses whether key compatibility issues are present which may hinder the implementation of the options outlined in section 2.3.

Amongst these criteria, the operational security and the EU / Belgian compatibility were considered as 'decisive criteria' as an option that leads to an unacceptable level of operational security or that is not legally[11] compatible with existing legislations would not be an acceptable solution, however it scores against other criteria.

2.5 Brief assessment of the status quo arrangements

As outlined, in section 2.1, Elia procures the full amount of its required mFRR capacity volumes in the status quo arrangements, after taking into account reserve sharing. As a result, we can evaluate this mFRR capacity procurement strategy against the criteria outlined in section 2.4 above:

- **Operational security**: Today, Elia contracts its need for mFRR upward capacity following a dimensioning considering (i) a probabilistic method pursuing a 99% reliability level and (ii) a deterministic method covering the dimensioning incident. Procuring the full mFRR capacity volume required to cover the dimensioned reserve volumes has shown to provide operational security in Belgium.

- **Economic efficiency**: By procuring its full mFRR capacity requirement, Elia secures its balancing means. However, it means that this capacity is unavailable to participate in the wholesale market. This could in turns decrease the efficiency of real time dispatch and *in fine* constitute a cost for energy consumers.[12]

- **Cost for grid users**: Procuring mFRR capacity induces costs for grid users, as the remuneration paid to mFRR providers are fed through network tariffs. The availability of non-contracted bids implies that some of these costs could be avoided by reducing procurement should the appropriate mechanism be found to access these non-contracted bids on the day, prompting the development of the present study.

- **Market functioning**: The current procurement arrangements for procuring mFRR capacity provide a stable framework for market participants, as auctions are conducted on a daily basis for the full reserve need.

- **EU / Belgian compatibility**: Elia's status quo methodology for mFRR capacity procurement is in line with minimum European legal requirements such as the system operation guidelines. As mentioned in section 2.1, the Belgian balancing are ongoing reforms to align with the implementation of European balancing platforms such as MARI. This is considered in our assessment qualification of the status quo.

[11] Starting from 2023, the exchange of mFRR energy will be organized on a European level via the mFRR-Platform, which serves to facilitate the integration of the European balancing energy markets. The platform is concerned with exchanges of mFRR Energy only and does not account for mFRR capacity reservation.

[12] For a detailed analysis of this mechanism, see section 3.2.2.

Table 2 - Summary of status quo assessment

	Status quo – Full mFRR capacity volume procurement
1 Operational security	Procuring the full amount of required mFRR capacity allows Elia to safeguard the operational security of the system.
2 Economic efficiency	The status quo arrangements may cause inefficiencies on the real time dispatch, since it prevents contracted capacities to participate in the wholesale market.
3 Cost for grid users	Contracting mFRR capacity is a cost for grid users, and contracting the full amount could be inefficient given the presence of non-contracted bids which could reduce this cost.
4 Market functioning	Regular auctions with predictable volumes offer a stable framework for market participants.
5 EU / Belgium compatibility	The framework is already in place, and the status quo analysis situation takes into account the planned evolution of the Belgium market design to align with EBGL/ Belgium legal and regulatory framework, and the MARI platform.

3 Option 1: No procurement complemented with post-market rescheduling

This section (i) provides a brief description of the option of the option not to procure mFRR capacity by relying on post-market rescheduling to ensure available margins in case of insufficient availability of mFRR means, (ii) presents our assessment of the option against the predefined criteria and (iii) draws preliminary conclusions on the relevance of this option.

3.1 Overview of the 'no procurement complemented with post-market rescheduling' option

The first option considered is not to procure mFRR capacity in day-ahead at all, relying on the use of rescheduling after the day-ahead wholesale market stage in order to ensure available upward mFRR balancing means. In this option, upfront mFRR capacity procurement would not be organised at the day-ahead stage as Elia would rely on non-contracted bids only. Thanks to mandatory participation in the mFRR energy market, Elia could reschedule or start up plants to free up sufficient balancing capacity which would submit bids in the mFRR energy market.

Indeed, in accordance with article 226(1) of the Federal Grid Code[13], technical facilities with installed capacity of 25MW or more, as well storage capacity, have to provide to Elia their upward and downward available capacity for balancing. As a result, rescheduling generators in situations of foreseen lack of non-contracted mFRR energy could give Elia access to adequate balancing means without contracting capacity in day-ahead, at least if sufficient flexibility or rescheduling possibilities are available after day-ahead.

In order to ensure sufficient upward mFRR capacity on the day, Elia would have to monitor its available balancing means after the day-ahead market schedule is drawn. For instance, based on the schedules provided by market participants, should there be risks that mFRR capacity be below requirements, Elia would proceed to rescheduling actions. Post-market rescheduling would allow Elia to redispatch generation or start up new plants to provide additional mFRR capacity.

Post-market rescheduling has similarities with the exceptional measures foreseen in the LFC operational block agreement, defining operational procedures in case of escalation[14], exhausted FRR[15] or elevated FRCE.[16] The LFC operational block agreement currently in place grants Elia the right to require changes in the active power production or consumption of power generating modules and demand units. This procedure can be activated when Elia detects high FRCE, or situations where the balancing capacity needs are not adequately covered (escalation procedure),

[13] See the Belgium Federal Grid Code here (in French).

[14] i.e. when the FRR means required to cover the FRR needs following the dimensioning of FRR are not available.

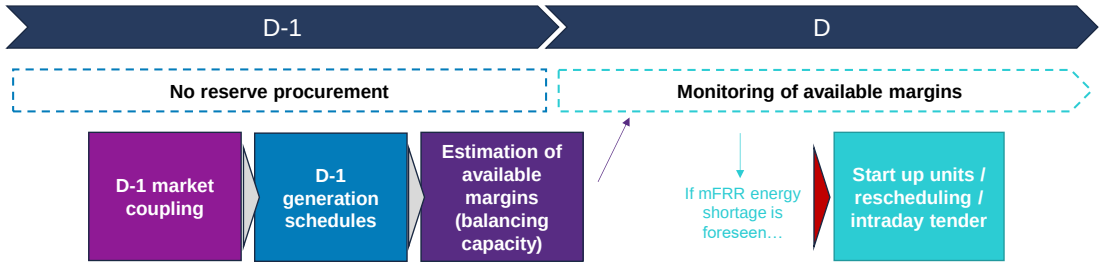
[15] i.e. when Elia detects an exceptional event which has not been fully taken into account in the FRR needs, for instance due to storms.

[16] In line with the System Operation Guidelines, 'frequency restoration control error' or 'FRCE' means the control error for the frequency restoration process which is equal to the Area Control Error of a LFC area or equal to the frequency deviation where the LFC area geographically corresponds to the synchronous area.

or an exceptional event which has not been fully taken into account in the FRR needs (exhausted reserve procedure).

With the LFC operational block agreement and under certain exceptional circumstances, Elia activates units which are available that cannot be activated via the FRR processes. Once these units are activated, they facilitate the availability of balancing energy bids on these units via the FRR processes. It is to be stressed that these mechanisms are currently designed as exceptional measures, and that there is no guarantee that these will facilitate the required flexibility when needed.

Figure 7 - Illustration of the post-market rescheduling option with no procurement of mFRR capacity



3.2 Assessment of the 'no procurement complemented with post-market rescheduling' option

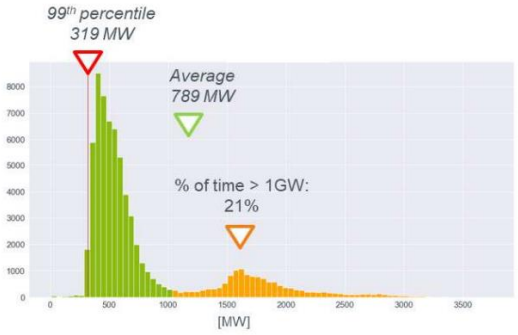
3.2.1 Operational security

The option to rely on post-market rescheduling to ensure adequate levels of available mFRR energy for balancing means instead of upfront mFRR capacity procurement comprises operational risks.

As shown on Figure 8 below, situations where the volume of non-contracted upward mFRR means will be below Elia's 1000MW requirement are frequent based on current liquidity. According to Elia, actual non-contracted volume would only be larger than 1000 MW for 21 % of the time between 2019 and 2021. Given these volumes, we would expect Elia to be required to frequently use post-market rescheduling if it were to be implemented with current liquidity levels. It is worth noting that the results of this analysis could be impacted with upcoming market design changes, such as the move to explicit bidding, the connection with the MARI platform, or the planned reduction of mFRR activation times.[17]

[17] For more information on planned changes, see Elia's 2022 design note for mFRR here, section 3.2 on activation times and section 9.1 on explicit bidding

Figure 8 - Available non-contracted upward mFRR balancing means, 2019-2021



Source: Elia, 2021. Study on the daily prediction of non-contracted balancing energy bids.

Notes: The figure shows a distribution of the realised total non-contracted upward mFRR balancing means between 2019 and 2021. These have been implicitly calculated by Elia based on the last known schedules and may also contain capacity which would have been eligible for providing non-contracted aFRR balancing means. The distribution of available volumes demonstrates an average volume of 789 MW. Nevertheless, this would only result in a volume of 319 MW for 99% of the time or a volume larger than 1000 MW for 21 % of the time (the current upward FRR needs remain around 1000 MW). Although this may seem substantial, it should be noted that this already takes into account the mFRR sharing contribution.

In this context, there are two main operational risks if Elia were to rely on frequent post-market rescheduling to ensure adequate non-contracted upward mFRR means:

1. **Constraints on the availability of balancing means**. There could be situations where Elia cannot access the adequate resources to reschedule plants when needed. For example, slow start-up times of conventional thermal units such as CCGTs may limit Elia's ability to ensure that sufficient mFRR capacity is available close to real time. In addition, there could also be instances where all available capacity is already fully used, for example during near-scarcity events or because, through this mechanism, Elia does not have access to all capacities, including decentralised capacities for instance (see below). As a result, Elia may not be able to free up additional balancing means through post-market rescheduling in these situations;

2. **Lack of visibility of balancing means**. Even if Elia would always have access to sufficient liquidity, post-market rescheduling requires Elia to have a clear view on available resources and be able to predict correctly available resources in real time. There could be situations where Elia lacks visibility on certain resources to be able to have a clear vision of available resources. In the current implicit bidding framework, Elia may not have a clear view of the decentralised balancing means or power plant or pumped hydro technical constraints may not be fully visible either for instance. As a result, Elia may trigger post-market rescheduling even though sufficient resources would have been available in real time (and conversely). The move to explicit bidding for mFRR balancing energy bids will ensure visibility of balancing means, however.

So, as long as available balancing energy bids are not found to cover the balancing capacity needs for most of the time, we expect that removing mFRR capacity procurement and replacing it with a post-market rescheduling mechanism would induce meaningful operational security risks in Belgium. Rescheduling actions would need to be carried out frequently given current non-contracted mFRR means liquidity levels and are prone to availability and visibility constraints which could lead to lack of balancing means.

3.2.2 Economic efficiency

The absence of mFRR capacity auctions in the post-market rescheduling with no procurement of mFRR option can improve the efficiency of the dispatch, leading to economic gains for energy consumers. Operational issues may however lead to costly remedial actions taken by Elia which threaten these benefits. This option also has impacts on the long-term incentives to provide flexibility.

Effects on the real-time dispatch (static generation costs)

In the absence of mFRR capacity auctions, the no-longer contracted mFRR capacity will be able to participate in the wholesale energy market.

We can distinguish several cases:

1. *The no-longer contracted capacity has a short-run marginal cost (SRMC) below the market price*. In the mFRR capacity auction, it would bid at least its opportunity cost.[18] Its participation in the wholesale energy market pushes out higher bids from the merit order, resulting in a reduction of the market price, as well as a reduction of the generation cost to meet demand. The generation cost savings are represented in the Figure 9 as the difference between the short-run marginal costs (the bid prices in a competitive market) of the bids pushed out of the merit order in red in the figure and the short-run marginal costs of the no-longer contracted capacity represented in orange in the figure.

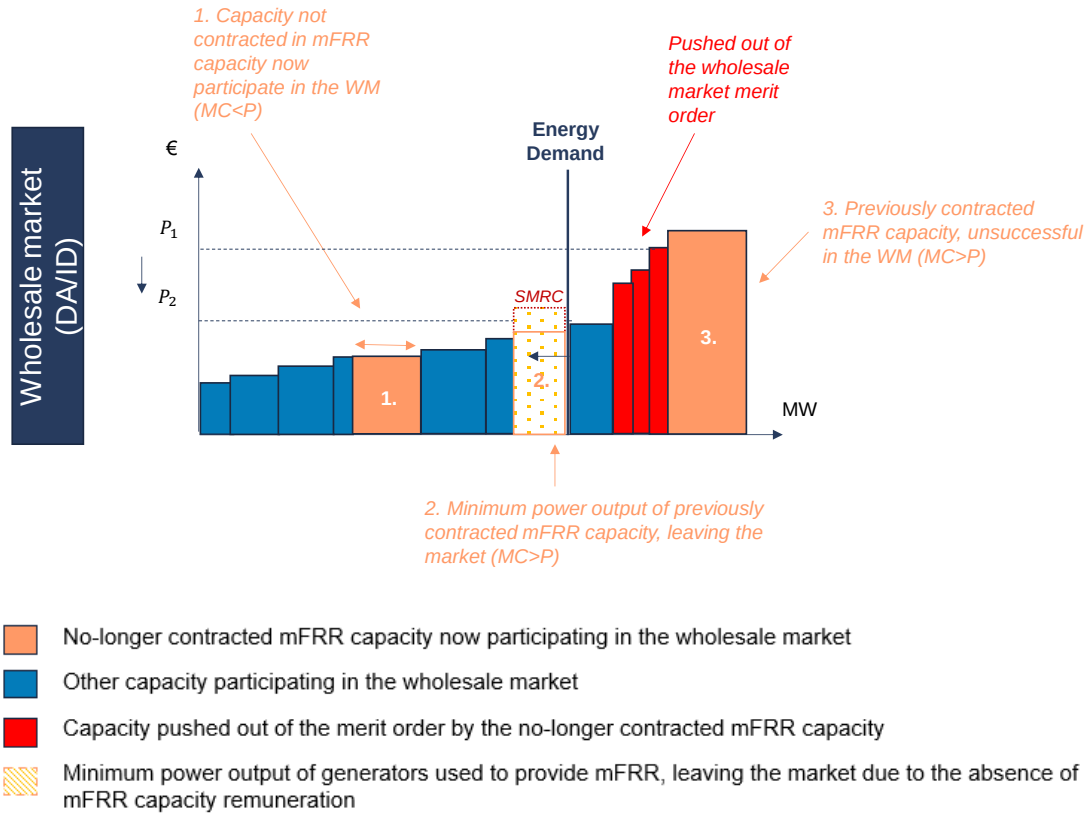
2. *The no-longer contracted capacity has a short-run marginal cost above the market price but has technical constraints such as minimum running power*. As a result of these technical constraints, to provide mFRR capacity, the generator will have to produce and sell electricity in the wholesale market as a price taker at a price not covering its short-run marginal cost. In the mFRR capacity auction, it would bid at least the negative profit of this sale of energy in the wholesale market. In the absence of mFRR capacity auction, it will bid in the wholesale energy market at its SRMC, and it will be replaced by capacities with lower SRMC. This would result in a higher wholesale price but, at the same time, in a reduction of the generation cost to meet demand.

3. *The no-longer contracted capacity has a short-run marginal cost above the market price and no technical constraints such as minimum running power*. In the mFRR capacity auction, it could bid close to zero (although in a pay-as-bid auction, it would try to bid closer to the price of the marginal bidder). If it participates in the wholesale energy market, it would bid its SRMC and would not be activated. It would therefore neither affect the wholesale price nor the generation dispatch and costs.

These three configurations are illustrated on Figure 9 below.

[18] The cost of the missed opportunity of not participating in the wholesale market by participating the upward mFRR market. For 1MW of capacity, a generator would miss out on payments at wholesale market price by being contracted for mFRR provision.

Figure 9 - Electricity wholesale market dispatch in absence of mFRR balancing capacity procurement



Source: Compass Lexecon analysis

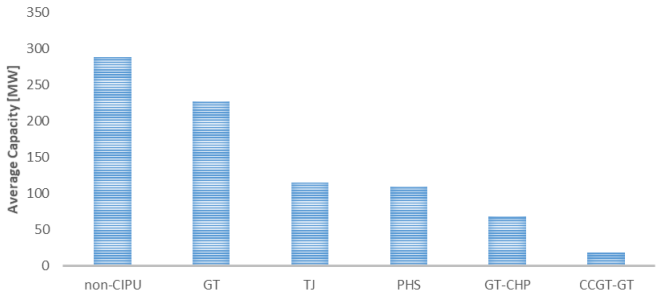
Notes: The figure shows a representation of the electricity wholesale market (day-ahead or intraday), illustrating the expected impact of the absence of upward mFRR capacity auctions on dispatch.

Therefore, the absence of mFRR capacity auctions would reduce generation costs based on day-ahead/ intraday[19] schedules (it reduces costs in situations 1 and 2 and is neutral in situation 3). As regards its impact on wholesale price, there might be upward and downward impacts. However, looking at the current participation in the upward mFRR capacity auctions, most of the technologies do not have the type of constraints leading to the situation 2 (see Figure 10 below).[20] The impact on wholesale prices is likely to be downward in most cases and in average.

[19] This reasoning stands for the final dispatch resulting from the wholesale market up to intraday, potentially also including reactive balancing. This is because BRPs can also use non-contracted bids to balance their portfolios. Even if the generation unit is not activated in day-ahead, the generator can still react to an imbalance in real time and optimise the dispatch.

[20] As shown on Figure 10, the majority of mFRR capacity is provided from stand-still with limited minimal production constraints.

Figure 10 – mFRR balancing energy bids associated to contracted capacity per technology in Belgium, February 2019 to January 2021



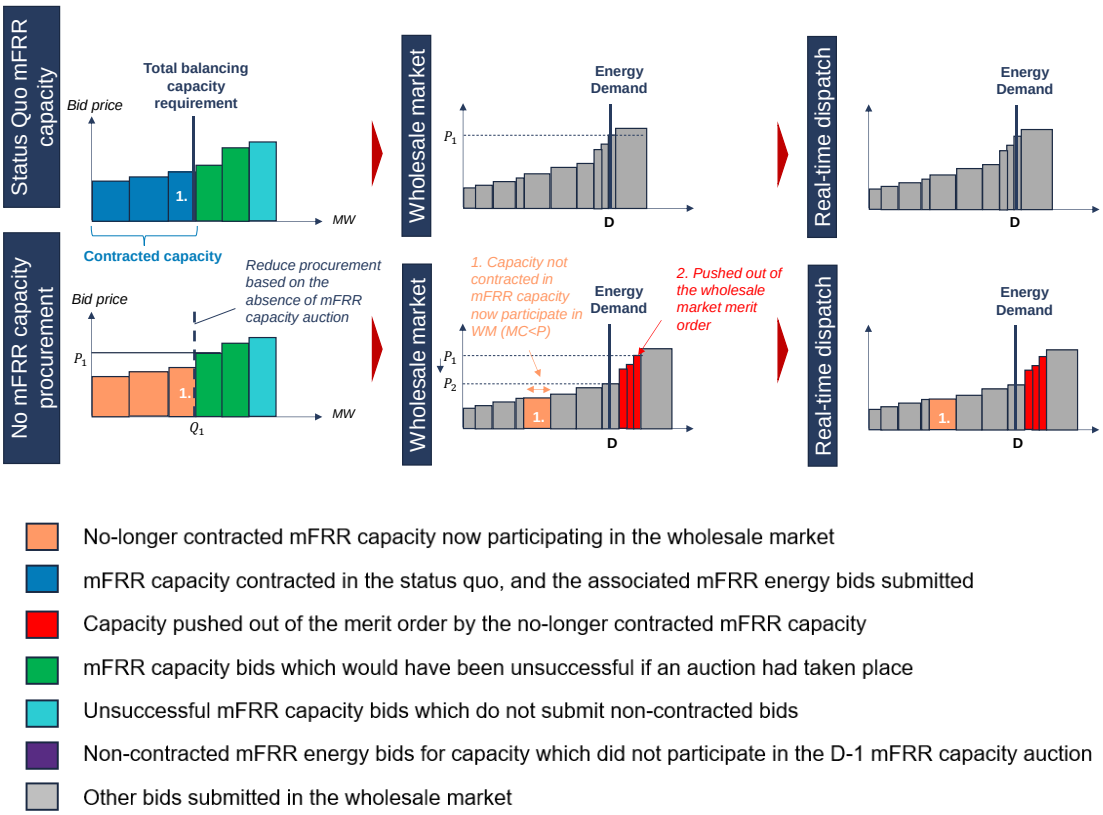
Source: Elia, 2021. Study on the daily prediction of non-contracted balancing energy bids.

Notes: The figure above shows how mFRR balancing capacity is mainly provided with smaller units (formerly known as non-CIPU), gas turbines (GT) and turbojets (TJ) and pumped-hydro storage (PHS). The non-CIPU was not observed to provide non-contracted reserves. Elia assumes PHS, GT and TJ to provide mFRR from stand still.

Looking at the real-time dispatch – as well as DSR activation – which takes into account both the wholesale market dispatch (including all market participants' actions) and balancing actions by the TSO, two situations can be distinguished:

1. **No upward balancing activation**. In the case where there is no (or limited) need for Elia use upward balancing means in real time, the actual dispatch will be the one resulting from market participants' decisions in the wholesale market. Thus, as explained before, it is more efficient in absence of mFRR capacity procurement, as no-longer contracted capacity can participate in the wholesale market and may push out more expensive generators from the merit order.

Figure 11 - Real-time dispatch in status quo and no procurement with post-market rescheduling scenarios when Elia does not face an upward balancing need



Source: Compass Lexecon analysis

Notes: The figure shows mFRR capacity auctions and the wholesale market merit orders, along with the resulting real-time dispatch when no upward mFRR activation is carried out in both the status quo and no procurement with post-market rescheduling scenario (where no auction is carried out). Not procuring mFRR capacity improves real-time dispatch.

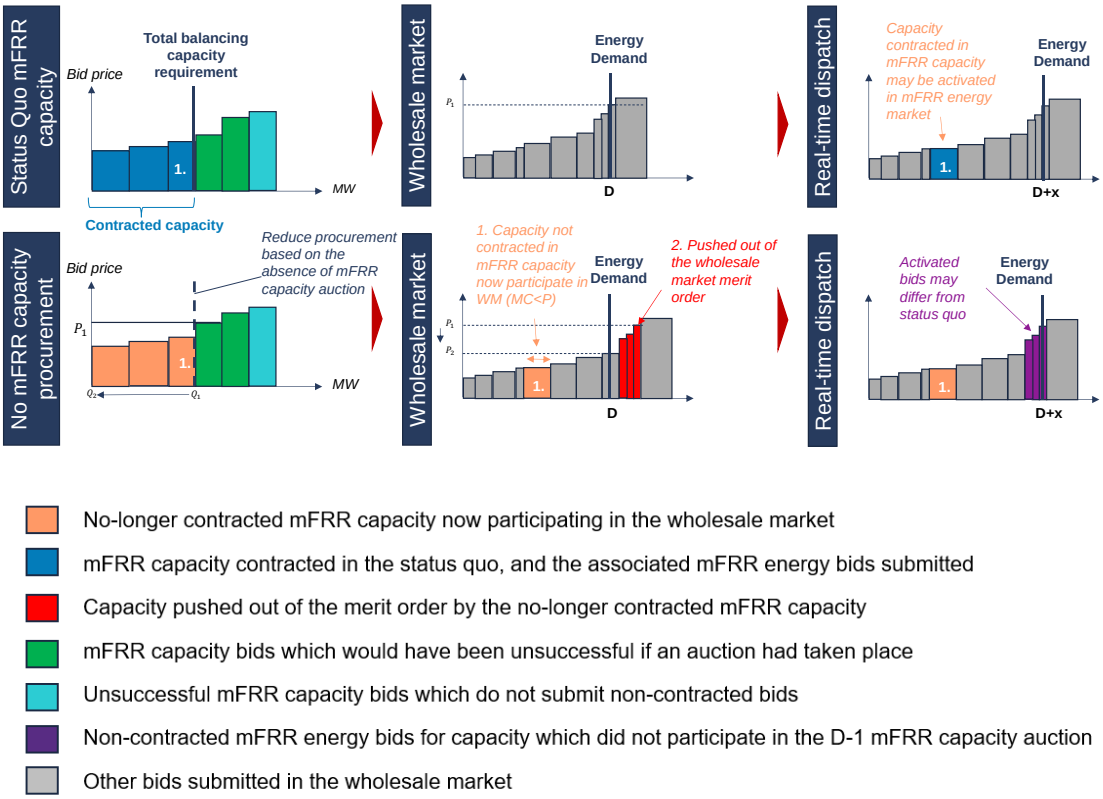
2. **Upward balancing activation**. In the case where Elia faces a (significant) requirement for upward balancing means in real time, the real-time generation dispatch should remain comparable whether mFRR capacities were contracted (in the status quo) or not (no procurement of mFRR capacity).

    a. Status quo: necessary contracted mFRR capacity is activated, hence figuring in the real-time dispatch.

    b. No mFRR capacity procurement with post-market rescheduling: the previously contracted mFRR capacity may be dispatched in the wholesale market, and the next lowest-costs non-contracted mFRR energy bids are activated, even though some previously contracted mFRR capacity may no longer participate as their SRMC is above the market price but may be replaced by non-contracted mFRR energy bids with higher SRMC. Overall, the real-time dispatch remains equivalent, although it could be less efficient.[21]

[21] It is worth noting that the merit order could change in the mFRR Energy market between the two options. As a result, there could still be differences in real-time dispatch.

Figure 12 - Real-time dispatch in status quo and no procurement with post market rescheduling scenarios when Elia faces an upward balancing need



Source: Compass Lexecon analysis

Notes: The figure shows mFRR capacity auctions and the wholesale market merit orders, along with the resulting real-time dispatch when upward mFRR activation is carried out in both the status quo and no procurement with post-market rescheduling scenario (where no auction is carried out). Not procuring mFRR capacity improves real-time dispatch.

In practice, subject to having indeed sufficient non-contracted resources and even though there might be loss of efficiency in specific cases, given the low probability of activating significant volumes of upward mFRR, the absence of mFRR capacity procurement would likely increase efficiency of the real-time dispatch compared to the status quo.

The analysis of efficiency gains of the real-time dispatch described in this section is valid under the assumption that no rescheduling actions are required by the TSO to ensure that the adequate levels of balancing means are available. If rescheduling actions are necessary after day-ahead market clearing, then the efficiency of the final dispatch may deteriorate due to more expensive capacities being started to increase balancing means.

Indirect effects on mFRR energy market

The absence of mFRR capacity auctions would likely impact mFRR energy market outcome as well. Indeed, some of the no-longer contracted capacity may no longer participate in the mFRR energy market. As a result, Elia may need to activate more expensive bids to balance the system, resulting in higher mFRR energy price and higher imbalance settlement price. As explained above, this would limit the overall efficiency gains that appeared in the wholesale market, while it still reduces total generation costs to satisfy demand.

On the other hand, higher imbalance tariffs would provide more incentives to reduce imbalances for generators, which could *in fine* be translated a reduced need for activation of balancing energy. This benefits further grid users because mFRR energy costs would decrease.

3.2.3 Cost for grid users

Due to the absence of mFRR capacity auctions in this option, the costs of procuring mFRR capacity fall to zero, to the benefit of grid users. Conversely, the costs of rescheduling or starting up new generating units could be high and overbalance the costs gains from no mFRR capacity procurement.

Elia would need to compensate generators for their start-up costs of generators turned on with rescheduling, as well as activation costs. These costs could be higher than the cost savings due to the absence of mFRR capacity remuneration. Compared to a situation with full procurement of the mFRR capacity requirement, Elia would not necessarily be able to call on the cheapest units. However, Elia would still avoid remunerating all capacity selected in the auction, and only the rescheduled generators, which might *in fine* constitute a lesser cost for grid users.

The frequency of post-market rescheduling actions would also influence the cost of this option. In section 3.2.1, we have shown that such actions would occur frequently given current liquidity levels. Between April 2019 and April 2021, non-contracted upward mFRR means were not enough to cover Elia's requirements 79% of the time.[22] From this perspective, we can expect the total cost of post-market rescheduling to be significant.

Note that besides the total cost, we should also consider the cost allocation implications as the balancing capacity procurement costs, re-dispatching costs and balancing activation costs have different cost allocation to grid users.

[22] See Figure 8 in section 243.2.1.

Topic focus 2 - Capacity Remuneration Mechanisms

Do impacts on Capacity Remuneration Mechanism cancel out grid cost benefits of not procuring mFRR capacity?

The absence of mFRR upward capacity could imply lower revenues for some flexible capacities. This may increase their missing money, potentially up to their loss of revenues (for a capacity without missing money, the impact could be lower). This could in turn impact capacity remuneration mechanism's costs. The additional revenues on the wholesale market and/or the mFRR energy prices' increase, due to lower procurement volumes of mFRR capacity, would, on the contrary, reduce the missing money and temper the impact on capacity remuneration mechanism's costs.

Overall, considering the pay-as-bid pricing principle of the capacity remuneration mechanism, the additional costs on the capacity remuneration mechanism would therefore be lower – or equal at worst – than the cost savings in the mFRR capacity procurement.

Is adequacy impacted for capacities who can't access the CRM?

On principle level, adequacy is ensured by the capacity remuneration mechanism and not mFRR capacity procurement. Including adequacy considerations in the mFRR procurement methodology risks overlapping incentives in an uncoordinated way with the capacity remuneration mechanisms.

In practice, the CRM guarantees that the capacity level necessary to adequacy is achieved. Taking into account the loss of revenue of the mFRR provider, the CRM will do so (i) either by covering the missing money of the mFRR provider, keeping it in the market, (ii) or by selecting a capacity provider that would not have been selected in the status quo, but which becomes now more competitive than the mFRR provider.

Some existing units providing mFRR may not be able to participate in the CRM.[1] The loss of mFRR revenues may push them out of the market, forcing them to shut down. However, their closures need to be announced in advance to the TSO, who will take that into account in the evaluation of the capacity to be procured in the CRM. Therefore, the CRM would cover for the impacts on adequacy of their closures. However, in that specific example, the additional procurement cost in the CRM may exceed cost reduction in the FRR capacity procurement.

3.2.4 Market functioning

Changing the generation schedules frequently to increase available balancing means would impact wholesale market functioning, (i) as the wholesale market prices would often not correctly reflect the value of energy taking into account balancing capacity requirements and (ii) as it may become harder for market participants to forecast revenues on wholesale energy markets.

i. In theory, the optimal dispatch is obtained through a co-optimisation of energy and balancing capacity procurement. As such, rescheduling frequently would cause the price of energy to not reflect only the marginal cost of generation, but also the provision of balancing capacity when balancing capacity is scarce in the system at the given time.

ii. As rescheduling actions carried out by Elia to unlock balancing needs if needed would be carried out on after the day-ahead market closure, we expect the intraday prices to be most impacted by these actions. Uncertainty on the difference between day-ahead prices and intraday prices would increase, as rescheduling actions would impact production schedules

in real time. For generators, this would imply an increased difficulty to optimise their bidding portfolio across the day-ahead and intraday timeframes. In other words, risk management is made more difficult by rescheduling actions.

Changing the schedule after the market clearing stage would therefore complexify intraday market price forecasts, and as such decrease their predictability. Electricity producers' bidding decisions may be impacted by this greater uncertainty and decrease the overall efficiency of wholesale market outcomes. As a result, we expect that post-market rescheduling actions would harm market functioning.

In addition, post-market rescheduling actions on the generation schedule could be seen as discriminatory against decentralised resources which are not able to reap rewards from making their balancing capacities available.

3.2.5 EU / Belgium compatibility

We have not identified any firm incompatibilities for this option with Electricity Balancing or System Operation Guidelines or the Belgian or the wider EU frameworks, subject to the ability of Elia to have sufficient reserve capacity as according to the article 157(4) of the System Operation Guideline. Nevertheless, implementing post-market rescheduling while removing mFRR capacity auctions would be a significant departure from current arrangements in Belgium. Similarly, this option would constitute a deviation from the EU target model if post-market rescheduling were frequent.

Belgium's current arrangements are characterised by a reactive balancing approach within a self-dispatch model.[23] Generating units self-dispatch, and strong incentives are given to contribute to system balancing through imbalance prices. This approach gives flexibility to BRPs until close to real time while limiting to the minimum interventions of Elia in advance. The measure included in the LFC block operational agreement[24] allowing Elia to require changes in the active power production or consumption of power generating modules and demand units was intended and designed to be limited to very exceptional circumstances, but not to a regular post-market rescheduling. As a result, post-market rescheduling with no mFRR capacity auctions would be a significant change in system operation regulatory and operational arrangements in Belgium.

In addition, there is a risk that post-market rescheduling solution is not technology neutral, as mentioned in the section 3.2.4. This option could favour large-scale generation flexibility as opposed to decentralised flexibility outside of the generation schedule. This could constitute a compatibility issue with the EU framework.

3.3 Conclusion on no procurement based on post-market rescheduling

Not procuring upward mFRR capacity and relying on post-market rescheduling instead raises operational security risks as Elia may no longer have access to all necessary resources to balance the system, especially given the frequency to which Elia would have to resort to these post-market actions based on current estimations of Elia. Moreover, Elia could be constrained in terms of available capacity to reschedule and has limited visibility on distributed resources able to offer mFRR.

[23] According to the Electricity Balancing Guidelines, a 'self-dispatching model' means 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.

[24] See Elia's LFC block operational agreement here.

Indeed, insofar as decentralised flexibility develops but does not have obligation to participate and provide schedules in advance and its available flexibility in the balancing timeframe, this could raise concerns in terms of visibility on these resources by Elia, and therefore in terms of operational security, efficiency and discriminatory treatment between large-scale generation resources and decentralised flexibility.

In the current system, this model option is considered infeasible. Currently low mFRR liquidity would imply frequent re-scheduling actions and induce operational security risks. Post-market rescheduling can only be used as back-up in exceptional circumstances to reduce operational risks, as it is foreseen today in the LFC operational block agreement. It could be a useful measure to complement other procurement strategies though.

In the long run however, if sufficient flexibility would be available, including through decentralised flexibility which is expected to develop strongly, and is able to cover almost systematically full reserve needs without contracting, this model could be investigated again. As a result, we recommend discarding this option as long as mFRR balancing capacity is not almost always fully covered by non-contracted resources.

Table 3 - Summary of Option 1 assessment

	Option 1 - No procurement based on post-market rescheduling
1 Operational security	Risk of insufficient mFRR resources, as capacity may not always be available through rescheduling, and visibility on available generation could be limited for Elia.
2 Economic efficiency	Dispatch efficiency could improve, but frequent rescheduling can result in inefficiencies.
3 Cost for grid users	Lower procurement cost but costly re-dispatching/ start up, which could increase further.
4 Market functioning	More instability and complexity in the wholesale market. Potentially discriminant to decentralised generation.
5 EU / Belgium compatibility	Significant departure from current arrangements and EU target model. Requires substantial regulatory/ operational changes.

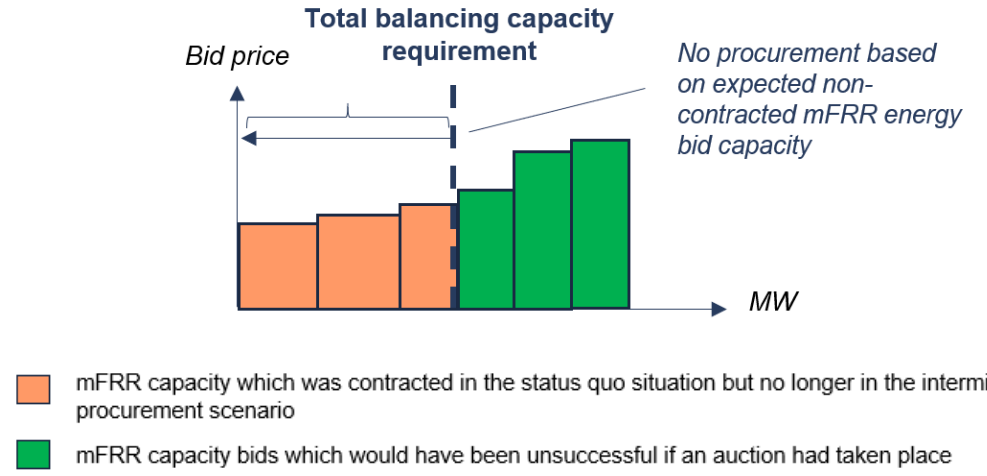
4 Option 2: Intermittent procurement

This section (i) provides a description of the option of intermittent procurement, (ii) presents our assessment of the option against the predefined criteria and (iii) draws conclusions on the relevance of this option.

4.1 Overview of the intermittent procurement option

Intermittent procurement would allow Elia to avoid procuring upward mFRR capacity in day-ahead when expected available non-contracted balancing energy bids are sufficient to cover its entire requirement (see Figure 13). Should they not be sufficient, Elia would procure the whole amount of required balancing capacity, apart from the potential deduction of volumes provided through sharing of reserves with neighbouring countries.

Figure 13 - The intermittent procurement option



Source: Compass Lexecon analysis

Notes: The figure shows an illustration of the merit order in mFRR capacity auctions. Under the status quo, Elia procures upward mFRR capacity of to its total requirement shown as the dotted line. Under intermittent procurement, Elia would not procure any capacity in situations when non-contracted bids are expected to fulfil the entire requirement on the next day. The total balancing capacity requirement accounts for reserve sharing deductions.

4.2 Assessment of the intermittent procurement option

4.2.1 Operational security

Compared to the status quo where Elia procures its full upward mFRR requirement on an ongoing basis, moving to intermittent procurement could potentially induce greater operational risks. These risks are caused by two effects: (i) impacting the dispatch through reduced mFRR capacity procurement, which in turns reduces non-contracted bids availability on the next day, and (ii) inaccurately forecasting non-contracted upward mFRR bids for the next day. We consider these two effects in turns below.

Operational risk from impacts on dispatching

Intermittent procurement could reduce non-contracted upward mFRR bids available for the next day. The possibility of intermittent procurement depends on the extent to which non-contracted bids in the status quo would still be available if no procurement is carried out.

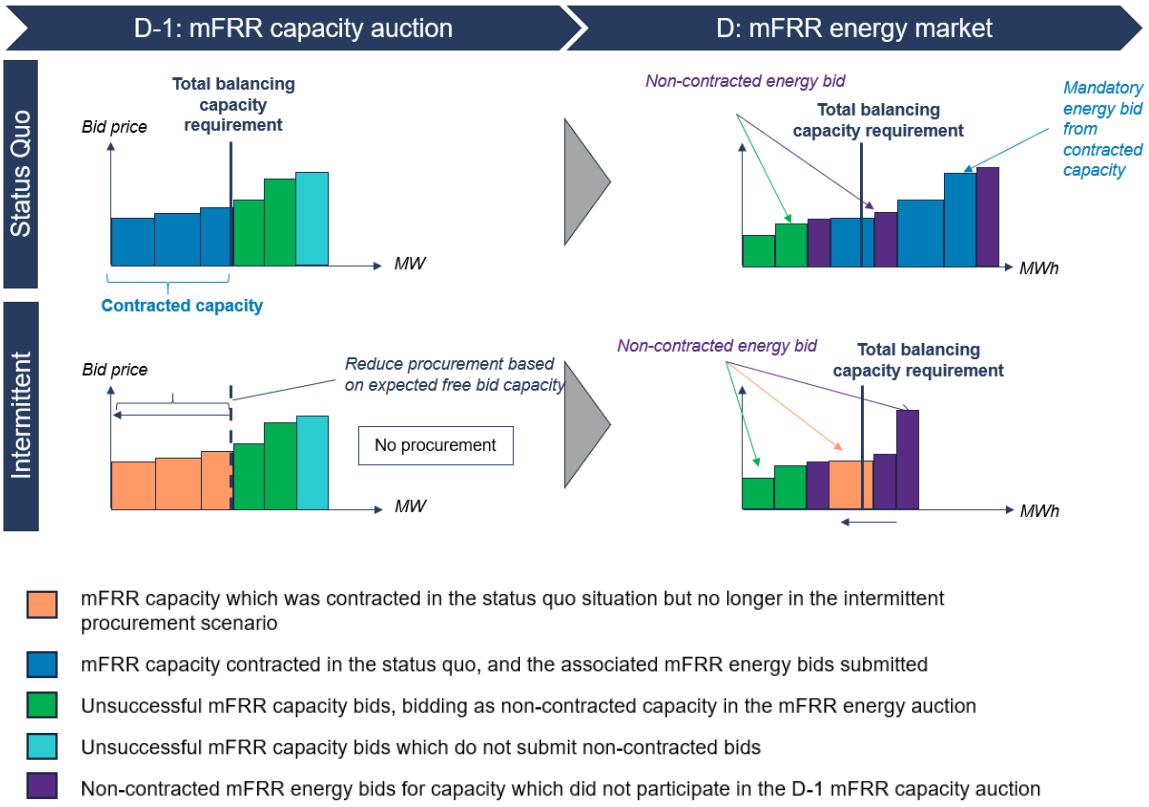
In a case where the expected volume of non-contracted upward mFRR bids under status quo conditions covers the required balancing capacity and Elia thus decides not to procure mFRR capacity for the next day, non-contracted mFRR bids could remain unaffected and successfully cover Elia's upward mFRR needs. This capacity was indeed available to provide mFRR in the status quo without having previously been contracted by Elia, and so would not be directly affected by the absence of mFRR capacity procurement (see Figure 14 below, and section 0 for more detail on non-contracted mFRR energy bids).

We illustrate this mechanism in Figure 14, comparing mFRR energy bids available in the case of full procurement or no procurement of upward mFRR capacity. The figure shows that even though some capacity which would have been contracted in the upward mFRR capacity auction no longer participates in the subsequent mFRR energy market, enough non-contracted bids are present to cover Elia's total balancing requirement – as forecasted on the previous day.

The non-contracted mFRR energy bids would remain constant between the status quo and intermittent procurement scenario if the dispatch remains unaffected by the absence of mFRR capacity auction, and if opportunity costs' expectations remain constant. Changes in opportunity costs expectation could indeed affect generators' decisions to bid into the mFRR energy market.[25]

[25] All else constant, and as detailed in section 3.2.2, the absence of upward mFRR capacity auction would tend to decrease wholesale market prices and increase mFRR energy prices. As a result, the opportunity cost of participating in the wholesale market increases, which could incentivise participants to keep capacity closer to real-time and offer non-contracted mFRR energy bids instead.

Figure 14 – Best-case scenario with intermittent procurement: non-contracted bids are not affected by the absence of mFRR capacity auction

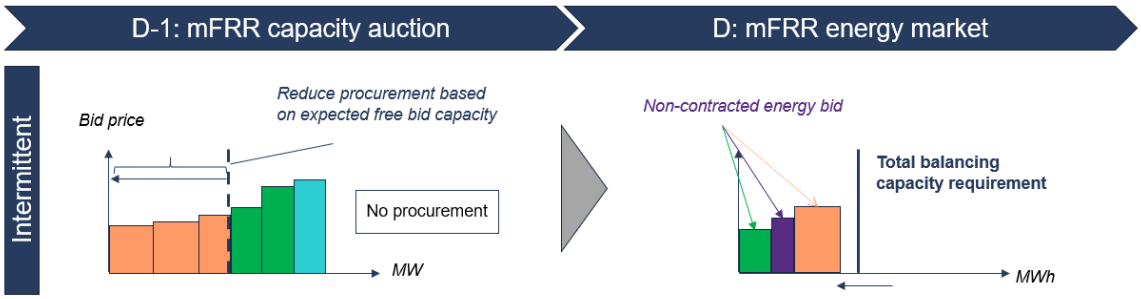


Source: Compass Lexecon analysis

Notes: The figure shows the mFRR auction process, starting from capacity auctions on the day-ahead, onto energy activation in the balancing timeframe, comparing the status quo arrangement with a situation where no procurement is made. In this case, intermittent procurement does not reduce the availability of non-contracted capacity participating in the upward mFRR energy auction. mFRR capacity is expressed in MW, while mFRR energy is expressed in MWh.

However, there could also be cases where the volume of non-contracted bids is reduced by the absence of mFRR capacity auction in the intermittent procurement option. This outcome may be caused by a change in the dispatch precipitated by the absence of mFRR capacity procurement. In certain situations, the absence of mFRR capacity auction may cause some generators not to run, lowering the amount of non-contracted upward mFRR available in real time. This is illustrated in Figure 15, which shows a situation where the reduction in non-contracted capacity leads to an insufficient amount of upward mFRR compared to Elia's requirement, thus hindering operational security.

Figure 15 - Worst-case scenario with intermittent procurement: non-contracted bids are reduced by the absence of mFRR capacity auction



- mFRR capacity which was contracted in the status quo situation but no longer in the intermittent procurement scenario
- Unsuccessful mFRR capacity bids, bidding as non-contracted capacity in the mFRR energy auction
- Unsuccessful mFRR capacity bids which do not submit non-contracted bids
- Non-contracted mFRR energy bids for capacity which did not participate in the D-1 mFRR capacity auction

Source: Compass Lexecon analysis

Notes: The figure shows the mFRR auction process, starting from capacity auctions on the day-ahead, onto energy activation in the balancing timeframe in a situation where no procurement is made. In this case, intermittent procurement reduces the availability of non-contracted capacity participating in the upward mFRR energy auction. mFRR capacity is expressed in MW, while mFRR energy is expressed in MWh.

Dispatch may be affected by the absence of procurement, such as in the following situation:

- In certain cases, it may be profitable for a generator to provide its minimum technical production of energy in the day-ahead market at a loss, to be able to provide upward mFRR services and receive associated revenues. If a generator expects mFRR capacity payments to at least cover its loss to start up its production units, then the generator would at least breakeven, if not profit, from the provision of mFRR considering the additional mFRR energy payments.
- Part of the remaining capacity of this generator could be contracted to provide upward mFRR capacity by Elia. The remaining capacity of this generator would be counted as available non-contracted capacity which would participate in the mFRR energy market. If Elia accounts for these non-contracted bids in its decision to withhold mFRR capacity procurement intermittently on a given day, then an issue could arise.
- Indeed, removing the mFRR capacity auction on this occasion could alter the generator's behaviour, as it may decide not to run altogether since its losses in the day-ahead market would not be covered by mFRR capacity payments. As a result, this generator would not bid any energy in the upward mFRR energy market, for both its previously contracted capacity, and non-contracted bids forecasted to be participating by Elia.
- Thus, the dispatch schedule of the generator would have changed, resulting in a decrease in non-contracted bids. This could cause operational issues if upward mFRR is insufficient to ensure operational security of the network. For added clarity, we illustrate this mechanism with the worked example below.

Topic focus 3 - Illustrative example of intermittent procurement effects on mFRR energy bids

Intermittent procurement could reduce capacity available to provide mFRR in real time, by influencing dispatch decisions

Power system

Demand of **400MW**

Balancing capacity requirement of **200MW**

Generator 1

Plant of **500MW** (Pmin* is **200MW**)

Marginal cost of **€40/MWh**

Generator 2

Plant of **500MW** (Pmin* is **100MW**)

Marginal cost of **€50/MWh**

- **Scenario 1 – Status-quo mFRR procurement of the full capacity need**

To meet the demand and balancing capacity requirement, both plants need to be dispatched to provide 400MW of energy in the wholesale market (up to 300MW for **Generator 1** and at least 100MW for **Generator 2**) and 200MW of balancing capacity.

As a result, available non-contracted bids in the balancing market would amount to 400MW.

- **Scenario 2 – No mFRR capacity auction (intermittent procurement)**

In an intermittent procurement scenario, the TSO would forecast non-contracted bids. Based on the status quo, as there are 400MW of non-contracted bids, they would exceed its 200MW requirement so the TSO would decide not to procure any mFRR capacity.

In such a case,

- **Generator 1** would produce 400MW for the wholesale market, since it has the cheaper marginal cost, and provide 100MW of reserve in the mFRR energy market.
- **Generator 2** would therefore neither produce nor provide balancing capacity. This is because there are no capacity payments to cover the losses of the generator to run at Pmin.

In such a case, available balancing capacity would only be 100MW and would not meet the balancing capacity requirement.

This worked exercise shows that intermittent procurement could also impact generation schedules and reduce the reserve available in real time.

**Pmin = minimum power output*

Operational risk from forecast error

For intermittent procurement to be implemented, Elia would need to know with a high level of certainty whether enough non-contracted upward mFRR bids would be submitted on the next day. While Elia's study on the daily prediction of non-contracted energy bids shows that such prediction has a reliability level of 99% for upward mFRR (see Figure 16), forecasting non-contracted upward mFRR bids for the next day still comprises a risk of error.

Forecast error on the quantity of free bids for the next day may lead Elia inaccurately assessing that no procurement is needed on a particular day. In turns, this could lead to mFRR shortages in real time, increasing the operational risk for the Belgian power system.

Figure 16 - Performance of the several algorithms for forecasting the non-contracted mFRR means compared to a static approach

		Static	Linear regression	Random Forests	Neural Networks
UPWARD	Volume [MW]	319	388	500	463
	Reliability	99.0%	99.0%	98.9%	99.0%
	MAE	5.4	4.53	3.24	3.95

Source: Elia, 2021

Notes: the table represents the final results for the three algorithm categories which are quantitatively analysed towards their ability to forecast the non-contracted balancing means, compared to the 'static' methodology. The latter is based on a fixed value based on the 99th percentile of the probability distribution.

Elia's study shows that meaningful volumes of non-contracted upward mFRR energy bids at a 99% confidence level, which is also the level of reliability aimed of network. Today, Elia dimensions its mFRR upward capacity needs using a probabilistic methodology, complemented with a deterministic methodology covering the dimensioning incident. The probabilistic dimensioning methodology aims for attaining 99% network reliability level. In other words, the methodology used determines the procurement capacity levels to be able to cope with 99% of possible frequency events, considered that the procured capacity will be available with a (close to) 100% reliability.[26]

Because the prediction tool also has a reliability level of 99%, the forecast error on non-contracted upward mFRR bids cumulates with the risk taken into account in the probabilistic dimensioning methodology and would lead to cases where network reliability is lower than 99%.

Another factor may negatively affect the accuracy of the predictions of the forecasting algorithms: non-contracted capacity prediction is conducted using machine learning based on historic data. Sudden market evolutions will result in inaccuracies in forecasting, which could also lead to situations where balancing capacity needs are not fully covered. In particular, it does not consider the consequences of the modification of the full activation time requirement.[27] With the move to explicit bidding, the machine learning algorithm will be operational once sufficient data is available to conduct non-contracted mFRR predictions with adequate certainty.

Nevertheless, two factors may alleviate operational security risk from forecast inaccuracies and are also worth considering:

- The forecast error could overestimate as well as underestimate non-contracted bids' availability on the next day. There could be events where more non-contracted bids are submitted than expected, thus causing no threat to – or even leading to higher – operational security.
- Elia could increase the reliability of its forecasts by lowering its expectation of non-contracted upward mFRR bids – much like a safety buffer. As an illustration, if Elia expects

[26] See Article 157(4) of the System Operation Guideline.

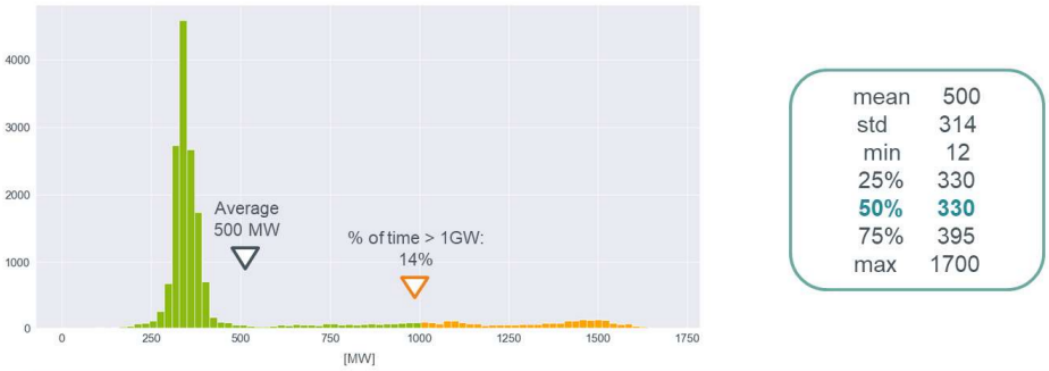
[27] Machine learning happens in an environment where resources are activated in a particular timeframe. Changing the technical requirements will change who can provide mFRR energy, as required by the implementation of the MARI platform.

at least 500MW of non-contracted bids for the next day with a likelihood of 99%, then Elia could be even more certain that at least 450MW of non-contracted bids would materialise.

However, in practice, Elia's study shows that occurrences where mFRR capacity procurement is set to zero would be rare under intermittent procurement[28] (around 14% of the time) and increasing the algorithm's reliability level would make these instances even more scarce (see Figure 17 below). This option is therefore limited, at least for short- or medium-term implementation.

In addition, the study stresses that results are likely to be (negatively) impacted by the implementation of explicit bidding and shorter full activation times.

Figure 17 - Histogram of predicted available upward non-contracted mFRR balancing energy bids



Source: Elia; 2021. Study on the daily prediction of non-contracted balancing energy bids.

Topic focus 4 - Stress-testing procurement strategies against extreme balancing activation events

Stress-testing intermittent procurement with extreme balancing activations

As part of interactions with stakeholders during the course of the study (see the Annex in section 7 for workshop minutes and stakeholder Q&A), we received a question asking whether the procurement options had been stress tested against past situations of extreme balancing activations. In times of very high balancing activations, the idea is that reducing mFRR capacity procurement could decrease resilience to extreme events.

Specific stress tests are in general not conducted as the objective of Elia's reserve dimensioning and balancing capacity determination is to cover the LFC block imbalances under 'normal' conditions, including covering the dimensioning incident. Events in which available means fall short of the LFC block imbalance are not unlikely following using a 99.0% reliability criterion and an N-1 dimensioning incident.

4.2.2 Economic efficiency

The intermittent procurement option can improve the efficiency of the dispatch, leading to economic gains for energy consumers. Operational issues may however lead to costly remedial actions taken

[28] See Elia's final report p.42 here.

by Elia which threaten these benefits. This option also has impacts on the long-term incentives to provide flexibility, as well as on the capacity remuneration mechanism.

Effects on the real-time dispatch (static generation costs)

Intermittent procurement has a similar mechanism described in section 3.2.2 for option 1, whenever forecasted non-contracted capacity volumes are sufficient for Elia to decide not to procure mFRR capacity. In the absence of mFRR capacity auctions, the no-longer contracted mFRR capacity will be able to participate in the wholesale energy market.

In absence of mFRR capacity procurement, we can distinguish several cases:

1. The no-longer contracted capacity has a short-run marginal cost (SRMC) below the market price.
2. The no-longer contracted capacity has a short-run marginal cost above the market price but has technical constraints such as minimum running power.
3. The no-longer contracted capacity has a short-run marginal cost above the market price and no technical constraints such as minimum running power.

Following the same mechanisms as the ones outlined in the analysis in section 3.2.2, and following these three configurations illustrated on the corresponding Figure 9 of this same section, the intermittent procurement would reduce generation costs based on day-ahead/ intraday[29] schedules (it reduces costs in situations 1 and 2 and is neutral in situation 3).

As regards its impact on wholesale price, there might be upward and downward impacts. However, looking at the current participation in the upward mFRR capacity auctions, most of the technologies do not have the type of constraints leading to the situation 2. The impact on wholesale prices is likely to be downward in most cases and in average. It is worth noting that the impact could be limited in practice given the relative share of freed-up capacities compared to European wholesale markets.

Similar to the analysis outlined in section 3.2.2, looking at the real-time dispatch[30] – as well as DSR activation –, two situations can be distinguished: (i) no upward balancing activation and (ii) an upward balancing activation by Elia.

With no upward balancing activation, intermittent procurement improves real-time dispatch as no-longer contracted capacity can participate in the wholesale market and may push out more expensive generators from the merit order (see Figure 11 in section 3.2.2). In the case where Elia faces a requirement for upward balancing means in real time, the real-time generation dispatch should remain comparable whether mFRR capacities were contracted, as in the status quo, or not, as under intermittent procurement if no mFRR capacity auction is held (see Figure 12 in section 3.2.2).

In practice, subject to having indeed sufficient non-contracted resources as anticipated and even though there might be loss of efficiency in specific cases, given the low probability of activating significant volumes of upward mFRR, the absence of mFRR capacity procurement does increase

[29] This reasoning stands for the final dispatch resulting from the wholesale market up to intraday, potentially also including reactive balancing. This is because BRPs can also use non-contracted bids to balance their portfolios. Even if the generation unit is not activated in day-ahead, the generator can still react to an imbalance in real time and optimise the dispatch.

[30] By real time dispatch, we consider both the wholesale market dispatch (including all market participants' actions) and balancing actions by the TSO.

efficiency of the real-time dispatch compared to the status quo (and would at least not reduce its efficiency).

Nevertheless, as seen in Section 4.2.1, cases may occur where not enough mFRR non-contracted bids are available in the balancing timeframe. Should this situation arise, we can distinguish two different cases:

1. **The upward mFRR shortage could not be foreseen in advance by Elia**. In this case, there is a threat to the operational security of the system, with a high cost of exceptional measures or interruptions at the value of lost load.

2. **The upward mFRR shortage could be anticipated by Elia.** In this case, Elia would have to take actions to increase available mFRR resources, e.g. by starting up plants a few hours before real time as it is foreseen in the LFC block operational agreement (see section 3.1 for more detail on this point). These actions could lead to a generation dispatch similar to the status quo, for instance, if, in the status quo, these plants would have participated in the mFRR capacity auction and been selected. However, these actions could lead to a much less efficient dispatch. Indeed, when carrying out these measures, Elia may not have access to the full pool of resources, for instance decentralised flexibility etc. and may therefore use more expensive means.

   Moreover, such an approach requires Elia to take actions several hours before real time if needed but given Elia's limited visibility on actual availability of mFRR energy bids, there is also a risk that Elia takes unnecessary actions to trigger more resources, realising in real time that it was not necessary and resulting in additional efficiency losses.

As a result, the efficiency gains that could be triggered by avoiding mFRR capacity procurement when non-contracted mFRR energy bids are expected to cover system needs are conditional to the ability to correctly anticipate these situations. Alternatively, should these forecast errors be frequent, there is a significant risk that intermittent procurement leads to efficiency losses, in addition to operational security risks.

Indirect effects on mFRR energy market

The absence of mFRR capacity auctions would likely impact mFRR energy market outcomes as well. Indeed, some of the no-longer contracted capacity may no longer participate in the mFRR energy market. As a result, Elia may need to activate more expensive bids to balance the system, resulting in higher mFRR energy price and higher imbalance settlement price. As explained above, this would limit the overall efficiency gains that appeared in the wholesale market, while it still reduces total generation costs to satisfy demand.

On the other hand, higher imbalance tariffs would provide more incentives to reduce imbalances for generators, which could *in fine* be translated a reduced need for activation of balancing energy. This benefits further grid users because mFRR energy costs would decrease.

Long-term incentives to provide flexibility to the system

As further detailed in the next section assessing the costs of intermittent procurement to grid users (see section 4.2.3), the recurrent absence of mFRR capacity auctions mechanically reduces the revenues earned by mFRR providers. On the other hand, the absence of mFRR capacity auctions may raise mFRR energy market prices, and so increase the revenues of activated generators.

Indeed, the absence of capacity contracting might induce some providers not to participate in the mFRR energy market. If so, Elia may need to activate more expensive bids to balance the system,

resulting in higher mFRR energy price and higher imbalance settlement price, benefitting to remaining mFRR energy providers.

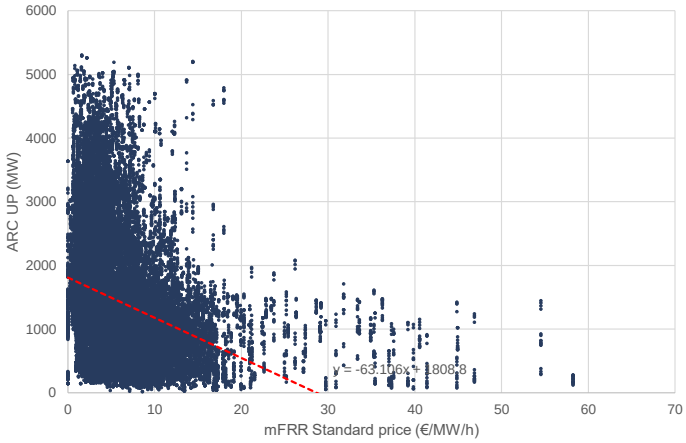
However, this second effect would unlikely compensate for the first. Consequently, in the intermittent procurement scenario, mFRR providers would expect lower revenues, which would dampen the incentives to provide flexibility in the long term.

The materiality of this impact depends on the frequency of intermittence of mFRR capacity auctions, and the corresponding missing value captured by market participants.

- The analysis of the predictability of non-contracted bids performed by Elia shows that the absence of mFRR capacity auction under an intermittent procurement scenario would be rare, in the short term at least.
- In situations where mFRR capacity procurement could be avoided, the available non-contracted bids would exceed the capacity to be procured. In these situations, competition in the mFRR capacity auction should therefore be high and mFRR capacity prices would likely be low.

The latter is confirmed by the empirical analysis of available non-contracted capacity volumes and mFRR capacity prices, shown on Figure 18. Situations with high mFRR capacity prices tend to be correlated to situations of lesser available upward non-contracted capacity. As a result, intermittent procurement would be less likely to avoid mFRR procurement at times of high prices.

Figure 18 - Correlation between available non-contracted balancing capacity (corrected for CCGTs and Hydro) and mFRR Standard capacity price



Source: Compass Lexecon analysis of Elia data.

Notes: The plot shows the upwards non-contracted available capacity and corresponding average mFRR capacity price for each market time unit. To compute this correlation, we reconstructed the average price of the mFRR Standard awarded capacity using bids data; and the implicit non-contracted capacity by 15min time units between February 2020 and January 2022.

Therefore, even though intermittent procurement would negatively affect long-term incentives to provide flexibility to the system, this effect would likely be limited.

4.2.3 Cost for grid users

Direct effects on mFRR capacity procurement costs

Intermittent upward mFRR procurement has a direct reduction effect on mFRR capacity procurement costs, by lowering the volumes procured by Elia. With intermittent procurement, in

periods where expected non-contracted bids cover the mFRR required capacity, hence no mFRR capacity auction is organised, mFRR capacity that would have been contracted in the status quo no longer receives mFRR capacity payments.

This effect could be tempered by the lower mFRR capacity prices which are often observed on days with high volumes of non-contracted bids are available, as just seen in section 0. Therefore, the gains obtained in occurrences when intermittent procurement is possible may be limited by the lower price.

As explained in section 0, intermittent procurement could negatively affect long-term incentives to provide flexibility to the system, even though, similarly as for the previous point, this effect could be tempered by the lower mFRR capacity prices in occasions of absence of procurement. As a result, these dampened incentives may affect available mFRR resources and procurement costs may increase in the long run, limiting savings in the future.

4.2.4 Market functioning

Market stability and predictability

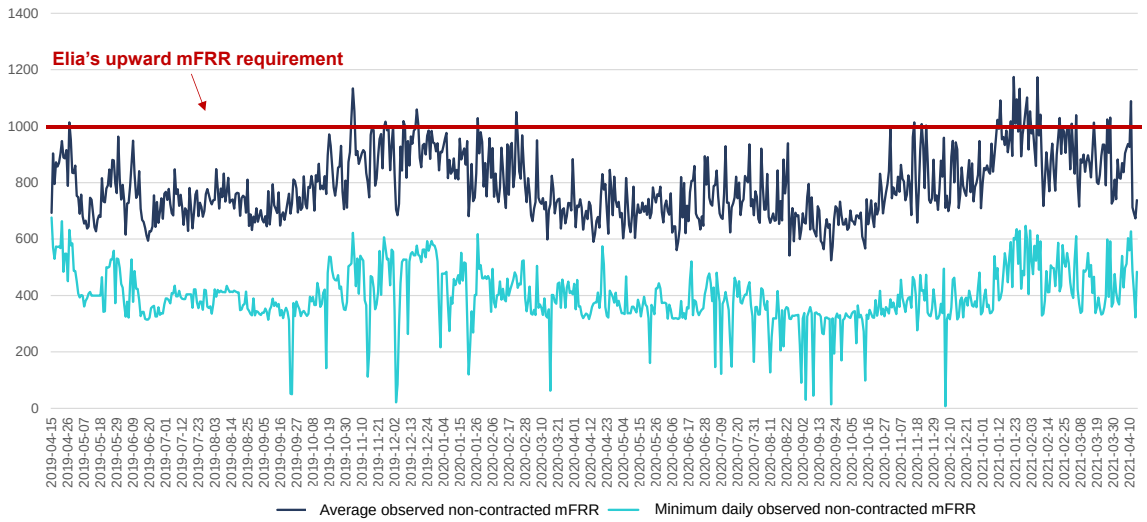
In the intermittent procurement scenario, mFRR capacity procurement would not be systematic. Based on its prediction of non-contracted bids' availability on given periods, Elia would organise or not mFRR capacity auction. The lack of visibility and systematism regarding the organisation of such auction may create an unpredictable or unstable market environment, making market forecasts more difficult.

It could also result in operational errors on the market side. For example, irregular intermittent procurement could lead to situations where market participants mistakenly do not submit bids, or even voluntary non-participation. This could be detrimental to the mFRR capacity auctions in the short and long run and increase market power in the balancing energy market if participation is reduced. In particular, due to the absence of auctions on certain periods, (smaller) market participants may need to downsize their operating teams, fostering this kind of situations.

This issue could be limited if intermittent procurement arrangements follow regular patterns which are predictable and constant across time. Seasonal, monthly or weekly patterns of intermittent procurement would provide more visibility for market participants.

Such patterns could not be found in historical data, however, as shown on Figure 19. In practice, implementing intermittent procurement may therefore imply irregular cancellation of mFRR capacity auctions and induce uncertainty for market participants as to when auctions would take place.

Figure 19 – Daily average observed non-contracted upward mFRR balancing means between April 2019 and April 2021 (MW).



Source: Compass Lexecon analysis of Elia data

Notes: The graph shows the daily average and minimum of upward non-contracted mFRR balancing means by 15-min time units between 15 April 2019 and 15 April 2021, in MW. We do not observe any seasonal, monthly or weekly patterns for which available capacity is over Elia's mFRR requirement.

Between April 2019 and April 2021, there has been no occurrence where observed upward mFRR non-contracted balancing means have been above 1000MW for a full day. The daily average non-contracted upward mFRR balancing capacity has been above the threshold in some occurrences, however.

It is worth noting that we can observe a pattern in observed mFRR non-contracted capacity exceeding Elia's mFRR needs between 3am and 5am. This however should be taken carefully, as this could be direct result of optimistic assumptions of pumped hydro mFRR available capacity during the night. Technical constraints on pumped hydro reservoirs could lead to overestimation of these available capacities.

Thus, the fact that mFRR capacity auctions are not systematically organised may result in a less stable market functioning, reducing long-term visibility for market participants and increasing risks of operational errors on the market side (e.g. unvoluntary non-participation in the auctions). Therefore, intermittent procurement raises the risk that, if implemented, the procurement framework would not be sufficiently rewarding for market players to participate in the upward mFRR auctions.

Competition impacts on mFRR capacity and mFRR energy prices

Intermittent procurement of mFRR capacity may impact competition and market power in mFRR energy and capacity[31] markets. Lower participation in the mFRR energy market would likely reduce competition and increase risks of market power, as available mFRR capacity in real time would more often be close to total balancing capacity requirement, making bids likely to be activated pivotal. The use of market power may result in even higher mFRR energy prices.

These higher prices could though attract new flexibility in the mFRR energy market or through reactive balancing – lowering activated mFRR volume – thus mitigating market power. However, in the intermittent procurement scenario and given Elia's analysis on non-contracted bids' availability, such situations might be rare and too uncertain to actually drive additional flexibility development.

[31] See Section 4.2.4 on mFRR capacity markets impacts on competition in the case of irregular intermittent auctions.

Lastly, the participation in EU balancing platforms (MARI) will also contribute to mitigating market power concerns. Through the MARI platform, Elia will be able to access mFRR bids submitted in neighbouring countries. This will stimulate competition and would help mitigate competition issues which may arise in intermittent procurement since Belgian mFRR energy bids would be in competition with mFRR bids submitted in neighbouring countries.

4.2.5 EU / Belgium compatibility

We have not identified any firm incompatibilities for this option with Electricity Balancing or System Operation Guidelines or the Belgian or the wider EU frameworks, subject to the ability of Elia to have sufficient reserve capacity as according to the article 157(4) of the System Operation Guideline. . In particular, intermittent procurement seems to be in line with Article 32 Commission Regulation (EU) 2017/2195 of 23 November 2017 (EBGL)[32], insofar as it specifies that '*each TSO shall perform an analysis on optimal provision of reserve capacity aiming at minimisation of costs associated with the provision of reserve capacity. This analysis shall take into account […] the volume of non-contracted balancing energy bids which are expected to be available both within their control area and within the European platforms taking into account the available cross-zonal capacity'.*

4.3 Conclusion on intermittent procurement

Intermittent procurement could in theory provide cost savings to grid users but entail higher operational risks due to the difficulty/ impossibility to guarantee the non-contracted bids' availability, leading to a lower level of operational security. Much will depend on the accuracy of the prediction of the non-contracted balancing energy bids. In addition, intermittent procurement raises concerns regarding market stability, which could in turn have impacts in the longer run. This option could only be considered if periods of full coverage would follow predictable patterns, but this is not demonstrated in the analyses so far.

Table 4 - Summary of Option 2 assessment

	Option 2 - Intermittent procurement
1 Operational security	Risk of insufficient mFRR energy bids to fulfil Elia's requirements in real time, due to impacts on dispatch and non-contracted bids forecasting errors.
2 Economic efficiency	Could increase liquidity in the wholesale market. Remedial actions in case of reserve shortage could create inefficiencies. Long term incentives to provide flexibility could be reduced.
3 Cost for grid users	Some mFRR capacity procurement cost reduction, but potentially at times of lower mFRR prices, and risk of costly remedial actions.
4 Market functioning	No regular auctions guaranteed, creating uncertainty and could result in operational errors.
5 EU / Belgium compatibility	No identified incompatibility with EBGL/ Belgium legal and regulatory framework.

[32] Commission Regulation (EU)2017/2195 of 23 November 2017 establishing a guideline on electricity balancing here.

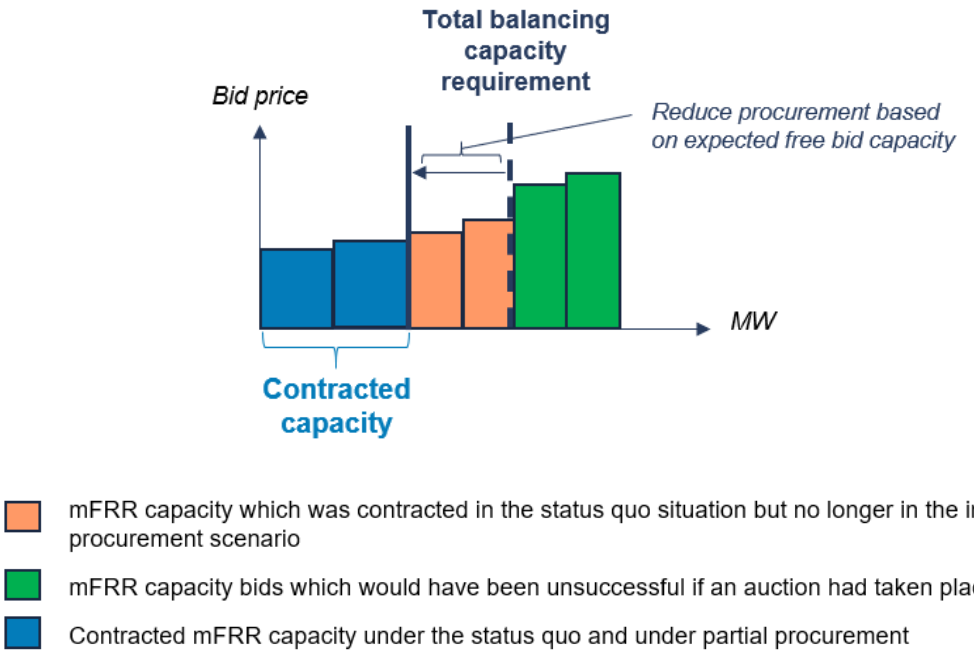
5 Option 3: Partial procurement

This section (i) provides a description of the option of partial procurement, (ii) presents our assessment of the option against the predefined criteria and (iii) draws conclusions on the relevance of this option.

5.1 Overview of the partial procurement option

Partial procurement would allow Elia to procure lower volumes of upward mFRR capacity in day-ahead by considering expected available non-contracted upward mFRR energy bids and sharing of reserves (see Figure 20). As in the intermittent procurement option, should they be sufficient to cover the whole need on a specific period, Elia would not procure any upward mFRR capacity.

Figure 20 - The partial procurement option



Source: Compass Lexecon analysis

Notes: The figure shows an illustration of the merit order in mFRR capacity auctions. Under the status quo, Elia procures upward mFRR capacity of to its total requirement shown as the dotted line. Under partial procurement, Elia deduces the expected volume of non-contracted mFRR energy bids to its procurement of mFRR capacity for the next day. The total balancing capacity requirement accounts for reserve sharing deductions.

5.2 Assessment of the partial procurement option

5.2.1 Operational security

Compared to the status quo where Elia procures its full upward mFRR requirement on an ongoing basis, moving to partial procurement could potentially induce greater operational risks. Similarly to intermittent procurement, the operational risks are caused by two effects: (i) impacting the dispatch

through reduced mFRR capacity procurement, which in turns reduces non-contracted bids availability on the next day, and (ii) inaccurately forecasting non-contracted upward mFRR bids for the next day.

We consider these two effects in turns below and show that the operational risks in partial procurement of upward mFRR would likely be greater than in intermittent procurement.

Operational risk from impacts on dispatching

Partial procurement could reduce non-contracted upward mFRR bids available for the next day. Similar to intermittent procurement, the possibility of partial procurement depends on the extent to which non-contracted bids in the status quo would still be available if no procurement is carried out.

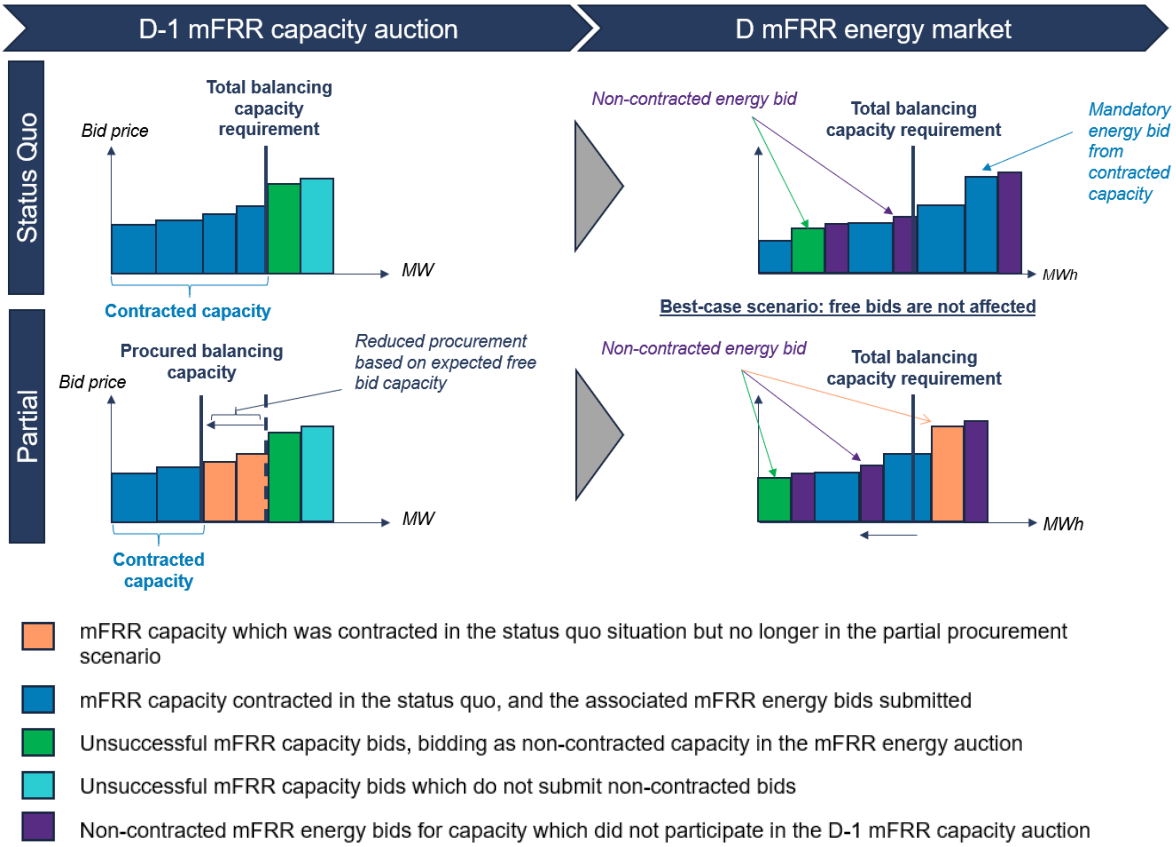
In a case where the expected volume of non-contracted upward mFRR bids under status quo conditions covers the required balancing capacity and Elia thus decides to reduce its mFRR capacity procured for the next day, non-contracted mFRR bids could remain unaffected and successfully cover Elia's upward mFRR needs. The non-contracted capacity was indeed available to provide mFRR in the status quo without having previously been contracted by Elia, and so would not be directly affected by the absence of mFRR capacity procurement.

We illustrate this mechanism in Figure 21, comparing mFRR energy bids available in the case of full procurement or partial procurement of upward mFRR capacity. The figure shows that even though some capacity which would have been contracted in the upward mFRR capacity auction no longer participates in the subsequent mFRR energy auction, enough non-contracted bids are present to cover Elia's total balancing requirement – as forecasted on the previous day.

The non-contracted mFRR energy bids would remain constant between the status quo and partial procurement scenario if the dispatch remains unaffected by the lack of mFRR capacity auction, and if opportunity costs expectations remains constant. Changes in opportunity costs expectation could indeed affect generators' decisions to bid into the mFRR energy market.[33]

[33] All else constant, and as detailed in section 3.2.2, the absence of upward mFRR capacity auction would tend to decrease wholesale market prices and increase mFRR energy prices. As a result, the opportunity cost of participating in the wholesale market increases, which could incentivise participants to keep capacity closer to real-time and offer non-contracted mFRR energy bids instead.

Figure 21 – Best-case scenario with partial procurement: non-contracted bids are not affected by the reduction of procured mFRR capacity volumes



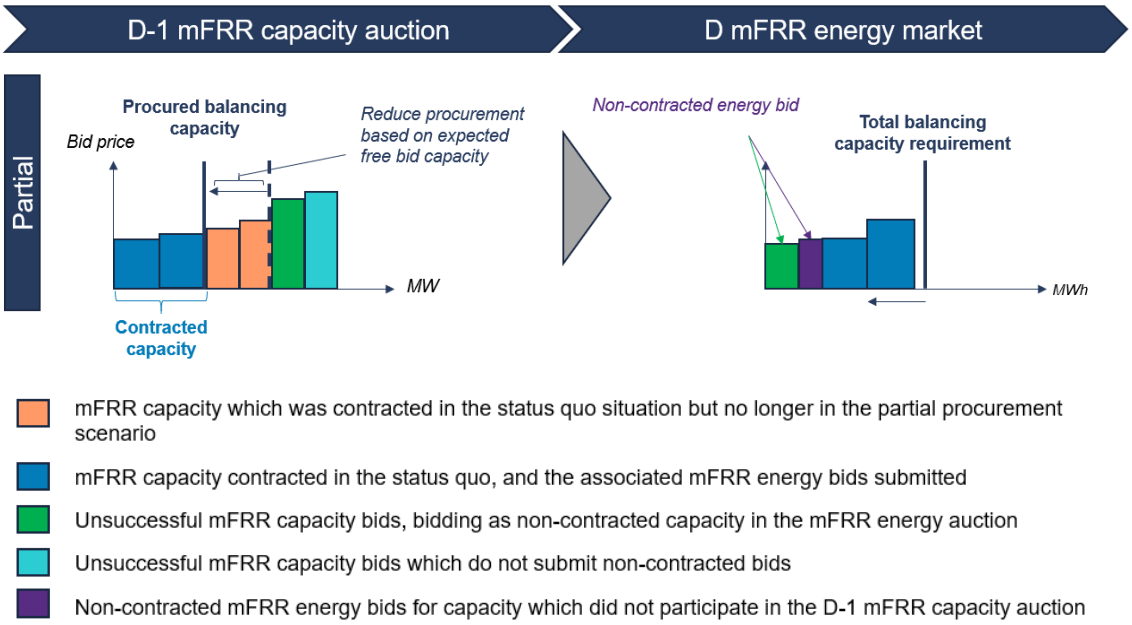
Source: Compass Lexecon analysis

Notes: The figure shows the mFRR auction process, starting from capacity auctions on the day-ahead, onto energy activation in the balancing timeframe, comparing the status quo arrangement with where the total upward mFRR capacity requirement is only partially procured in advance. In this case, partial procurement does not reduce the availability of non-contracted capacity participating in the upward mFRR energy auction. mFRR capacity is expressed in MW, while mFRR energy is expressed in MWh.

However, there could also be cases where the volume of non-contracted bids is reduced by the decrease in upward mFRR capacity procured in the partial procurement option. Similar to intermittent procurement, this outcome may be caused by a change in the dispatch precipitated by the reduction in mFRR capacity procurement.

In certain situations, the reduction of mFRR capacity may cause some generators not to run, lowering the amount of non-contracted upward mFRR available in real time. This is illustrated in Figure 22**Error! Reference source not found.**, which shows a situation where the reduction in non-contracted capacity leads to an insufficient amount of upward mFRR compared to Elia's requirement, thus hindering operational security.

Figure 22 - Worst-case scenario with partial procurement: non-contracted bids are reduced by the absence of mFRR capacity auction



Source: Compass Lexecon analysis

Notes: The figure shows the mFRR auction process, starting from capacity auctions on the day-ahead, onto energy activation in the balancing timeframe, comparing the status quo arrangement with where the total upward mFRR capacity requirement is only partially procured in advance. In this case, partial procurement reduces the availability of non-contracted capacity participating in the upward mFRR energy auction. mFRR capacity is expressed in MW, while mFRR energy is expressed in MWh.

Similar to the intermittent procurement option, dispatch may be affected by the decrease in upward mFRR procurement, such as in the following situation:

- In certain cases, it may be profitable for a generator to provide its minimum technical production of energy in the day-ahead market at a loss, to be able to provide upward mFRR services and receive associated revenues. If a generator expects mFRR capacity payments to at least cover its loss to start up its production units, then the generator would at least breakeven, if not profit, from the provision of mFRR considering the additional mFRR energy payments.
- Part of the remaining capacity of this generator could be contracted to provide upward mFRR capacity by Elia. The remaining capacity of this generator would be counted as available non-contracted capacity which would participate in the mFRR energy market. If Elia accounts for these non-contracted bids to reduce mFRR capacity procurement, then an issue could arise.
- Indeed, if the generator is not contracted in the mFRR capacity auction, then the generator's behaviour could be altered. The generator may decide not to run altogether since its losses in the day-ahead market would not be covered by mFRR capacity payments. As a result, this generator would not bid any energy in the upward mFRR energy market, for both its previously contracted capacity, and non-contracted bids forecasted to be participating by Elia.
- Thus, the dispatch schedule of the generator would have changed, resulting in a decrease in non-contracted bids. This could cause operational issues if upward mFRR is insufficient

to ensure operational security of the network. For added clarity, we illustrate this mechanism with the worked example below.

Topic focus 5 - Illustrative example of partial procurement effects on mFRR energy bids

Partial procurement could reduce capacity available to provide mFRR in real time, by influencing dispatch decisions

Power system

Demand of **400MW**

Balancing capacity requirement of **200MW**

Generator 1

Plant of **500MW** (Pmin is **200MW**)

Marginal cost of **€40/MWh**

Generator 2

Plant of **200MW** (Pmin is **100MW**)

Marginal cost of **€50/MWh**

- **Scenario 1 – Status-quo mFRR procurement of the full capacity need**

To meet the demand and balancing capacity requirement, both plants need to be dispatched to provide 400MW of energy in the wholesale market (300MW for **Generator 1** and 100MW for **Generator 2**) and 200MW of balancing capacity.

As a result, available non-contracted bids in the balancing market would amount to 100MW.

- **Scenario 2 – mFRR partial capacity auction**

In a partial procurement scenario, the TSO would forecast non-contracted bids. Based on the status quo, as there are 100MW of non-contracted bids, the TSO would reduce its mFRR capacity procurement by 100MW, procuring only the remaining 100MW.

In such a case,

- **Generator 1** would produce 400MW for the wholesale market, since it has the cheaper marginal cost, and would bid 100MW at 0 opportunity cost in the mFRR capacity market.
- **Generator 2** would therefore neither produce nor provide balancing capacity. This is because there are no capacity payments to cover the losses of the generator to run at Pmin.

In such a case, available balancing capacity would only be 100MW in total and would not meet the balancing capacity requirement.

This worked exercise shows that partial procurement could also impact generation schedules and reduce the reserve available in real time.

**Pmin = minimum power output*

Compared to intermittent procurement, partial procurement of upward mFRR capacity has an added risk of mFRR shortage occurrences. This is because intermittent procurement would affect mFRR procurement volumes only in the events where the forecasted volumes of non-contracted bids cover the entire requirement for upward mFRR. In the case of partial procurement, procured volumes would be reduced whenever non-contracted bids are forecasted, so with a much greater frequency. Therefore, situations where non-contracted bids are affected by changes in dispatch could occur more frequently, inducing a greater operational risk for the system.

Operational risk from forecast error

Similar to the intermittent procurement option, Elia would need to know with a high level of certainty the volume non-contracted upward mFRR bids which would be submitted on the next day in order to define its procurement volumes for the previous day. While Elia's study on the daily prediction of non-contracted energy bids shows that such prediction has a reliability level of 99% for upward mFRR, forecasting non-contracted upward mFRR bids for the next day still comprises a risk of error.

Forecast error on the quantity of free bids for the next day may lead Elia inaccurately assessing the volume of upward mFRR capacity to be procured on a particular day. In turns, this could lead to mFRR shortages in real time, increasing the operational risk for the Belgian power system. See Section 4.2.1 on operational risk from forecast error for a discussion on the reliability of predictions of non-contracted bids.

Unlike intermittent procurement, where increasing the reliability of the forecasting algorithms would reduce the rare occurrences where mFRR capacity volumes are set to zero, increasing the reliability of algorithms for partial procurement could be a more relevant mitigation measure. If Elia increased the reliability of algorithms by reducing its expected volumes of non-contracted bids, then partial procurement could still be carried out by deducting the remaining, more probable, volume of expected non-contracted bids. However, the expected volume reduction might be much more limited, hence there is still the trade-off between expected reduction of volumes with reliability in partial procurement, although without a threshold effect like for the intermittent procurement option.

Topic focus 6 - MARI and mFRR availability

Expected mFRR supply in neighbouring systems could be used to reduce mFRR capacity contracted in Belgium through reserve sharing or energy balancing exchanges

In accordance with EBGL article 32 and the System Operation Guidelines (SOGL) article 157, TSOs can reduce balancing capacity requirements by accounting sharing. Elia is currently accounting a sharing contribution with four neighbouring countries in its dimensioning.

All EU TSOs are developing a European platform for mFRR energy exchanges (project "MARI"). Through the MARI platform, Elia will be able to access mFRR bids submitted in neighbouring countries.

The expected additional mFRR accessible through MARI, considering cross-border transmission capacity, could also be used to reduce contracted mFRR capacity in Belgium in line with Article 32 of the EBGL referring to the volume of non-contracted balancing energy bids which are expected to be available both within their control area and within the European platforms taking into account the available cross-zonal capacity. It raises however similar issues as domestic non-contracted bids (predictability…) and it is important to avoid double-counting the energy bids through sharing and balancing energy exchange. Reserve sharing should indeed be coordinated across neighbouring countries in order to avoid double-counting of reserves across different TSOs.

As specified by the MARI implementation framework (Art. 3.10), 'each participating TSO may request the activation of a higher volume of standard mFRR balancing energy product bids from the common merit order lists, than the total volume of balancing energy submitted by this TSO to the mFRR-Platform.' 'In that case the mFRR-Platform will inform all participating TSOs, without undue delay, sending to them the information regarding the additional volume requested.' A TSO could activate more mFRR than submitted to the MARI platform, but if it is too recurrent, it would likely trigger reactions and suspicions of freeriding.

The sharing of reserve – coupled with available cross-border capacities – should be considered in reserves' dimensioning, as is already the case. mFRR bids available on the MARI platform – coupled with available cross-border capacities – could thus be taken into account through partial procurement. This could though be only to a limited extent as, if Elia requests volumes higher than submitted too frequently, this may trigger reactions and suspicions of freeriding.

It is worth noting that there is a risk that future market design evolutions for cross-border exchanges, such as the introduction of new balancing platforms, may impact the predictability of forecast algorithms. This risk is well recognised and presented in the study conducted by Elia in 2021 and was subsequently raised by a stakeholder in writing during the course of the study. It stresses the need to update the quantitative analyses on non-contracted FRR balancing means prediction after the introduction of the EU balancing platforms.

5.2.2 Economic efficiency

Partial procurement may improve dispatch efficiency in the wholesale market by freeing up capacity previously participating in the mFRR energy market. However, should there not be sufficient mFRR capacity in real time, the TSO may have to resort to costly and less efficient measures to guarantee operational security. The long-term incentive for flexibility may also be reduced, leading to less efficient evolution of the mix.

Effects on the real-time dispatch (static generation costs)

With a similar mechanism than options 1 and 2 of this study, partial procurement will likely improve dispatch efficiency compared to the status quo of full mFRR capacity procurement. This is because the reduction in mFRR capacity volumes procured would allow the no-longer contracted mFRR capacity to participate in the wholesale energy market. The effects will have a different materiality however, as partial procurement will free up capacity for wholesale participation on a continuous basis. Whether this effect is greater than intermittent procurement would depend on the frequency of the absence of mFRR capacity auction in intermittent procurement.

As for options 1 and 2, we can distinguish several cases:

1. The no-longer contracted capacity has a short-run marginal cost (SRMC) below the market price.
2. The no-longer contracted capacity has a short-run marginal cost above the market price but has technical constraints such as minimum running power.
3. The no-longer contracted capacity has a short-run marginal cost above the market price and no technical constraints such as minimum running power.

Following the same mechanisms as the ones outlined in the analysis in section 3.2.2 and following these three configurations illustrated on the corresponding Figure 9 of this same section, the partial procurement option would reduce generation costs based on day-ahead/ intraday[34] schedules (it reduces costs in situations 1 and 2 and is neutral in situation 3).

As regards its impact on wholesale price, there might be upward and downward impacts. However, looking at the current participation in the upward mFRR capacity auctions, most of the technologies do not have the type of constraints leading to the situation 2. The impact on wholesale prices is likely to be downward in most cases and in average.

Similar to the analysis outlined in section 3.2.2, looking at the real-time dispatch[35] – as well as DSR activation –, two situations can be distinguished: (i) no upward balancing activation and (ii) an upward balancing activation by Elia.

With no upward balancing activation, partial procurement improves real-time dispatch as no-longer contracted capacity can participate in the wholesale market and may push out more expensive generators from the merit order.[36] In the case where Elia faces a requirement for upward balancing means in real time, the real-time generation dispatch should remain comparable whether mFRR capacities were contracted in full, as in the status quo, or at reduced levels, as under partial procurement.[37]

In practice, subject to having indeed sufficient non-contracted resources as anticipated and even though there might be loss of efficiency in specific cases, given the low probability of activating significant volumes of upward mFRR, the reduction of mFRR capacity procurement does increase efficiency of the real-time dispatch compared to the status quo (and would at least not reduce its efficiency).

[34] This reasoning stands for the final dispatch resulting from the wholesale market up to intraday, potentially also including reactive balancing. This is because BRPs can also use non-contracted bids to balance their portfolios. Even if the generation unit is not activated in day-ahead, the generator can still react to an imbalance in real time and optimise the dispatch.

[35] By real-time dispatch, we consider both the wholesale market dispatch (including all market participants' actions) and balancing actions by the TSO.

[36] See Figure 8 in section 3.2.2 for an illustration of the mechanism.

[37] see Figure 9 in section 3.2.2 for an illustration of the mechanism.

Nevertheless, as seen in section 5.2.1, cases may occur where not enough mFRR non-contracted bids are available in the balancing timeframe. Should this situation arise, we can distinguish two different cases:

1. **The upward mFRR shortage could not be foreseen in advance by Elia**. In this case, there is a threat to the operational security of the system, with a high cost of exceptional measures or interruptions at the value of lost load.

2. **The upward mFRR shortage could be anticipated by Elia.** In this case, Elia would have to take actions to increase available mFRR resources, e.g. by starting up plants a few hours before real time as it is foreseen in the LFC block operational agreement (see section 3.1 for more detail on this point). These actions could lead to a generation dispatch similar to the status quo, for instance, if, in the status quo, these plants would have participated in the mFRR capacity auction and been selected. However, these actions could lead to a much less efficient dispatch. Indeed, when carrying out these measures, Elia may not have access to the full pool of resources, for instance decentralised flexibility etc. and may therefore use more expensive means.

   Moreover, such an approach requires Elia to take actions several hours before real time if needed but given Elia's limited visibility on actual availability of mFRR energy bids, there is also a risk that Elia takes unnecessary actions to trigger more resources, realising in real time that it was not necessary and resulting in additional efficiency losses.

As a result, the efficiency gains that could be triggered by reducing mFRR capacity procurement when non-contracted mFRR energy bids are expected to be submitted are conditional to the ability to correctly anticipate these situations. Alternatively, should these forecast errors be frequent, there is a significant risk that partial procurement leads to efficiency losses, in addition to operational security risks.

Indirect effects on mFRR energy costs

The reduction in procured mFRR capacity would likely impact mFRR energy market outcomes as well. Indeed, some of the no-longer contracted capacity may no longer participate in the mFRR energy market. As a result, Elia may need to activate more expensive bids to balance the system, resulting in higher mFRR energy price and higher imbalance settlement price. This effect is considered in the real-time dispatch efficiency presented above.

On the other hand, higher imbalance tariffs would provide more incentives to reduce imbalances for generators, which could *in fine* be translated a reduced need for activation of balancing energy. This benefits further grid users because mFRR energy costs would decrease.

Long term incentives to provide flexibility to the system

As further detailed in the next section assessing the costs of procurement to grid users (see section 5.2.3), the reduction of procured mFRR capacity mechanically reduces the revenues earned by mFRR providers. This impact would be more material than for intermittent procurement auction, as there would be more instances where procurement volumes would be reduced for mFRR capacity.[38]

This revenue reduction effect is tempered to some extent because in situations where mFRR capacity procurement is reduced significantly, the available non-contracted bids would be high. In

[38] It Is worth remembering that, under partial procurement, instances where forecasted non-contracted bids cover the entire mFRR capacity requirement would also lead to the procurement of 0MW of mFRR, just like intermittent procurement.

these situations, competition in the mFRR capacity auction should therefore be high and mFRR capacity prices would likely be low.

The latter is confirmed by the empirical analysis of available non-contracted capacity volumes and mFRR capacity prices, as previously shown in section 0, particularly Figure 18**Figure *18***. Situations with high mFRR capacity prices tend to be correlated to situations of lesser available upward non-contracted capacity. As a result, the higher the volume of avoided contracted mFRR capacity, the lesser the price per MW saved by doing partial procurement.

Further, it should be noted that indirect effects increasing mFRR energy prices (see section 5.2.3) could counterbalance the lack of mFRR capacity revenue and provide incentives for long-term flexibility. The reduction in mFRR capacity volumes procured may raise mFRR energy market prices, and so increase the revenues of activated generators.

Indeed, the absence of capacity contracting might induce some providers not to participate in the mFRR energy market. If so, Elia may need to activate more expensive bids to balance the system, resulting in higher mFRR energy price and higher imbalance settlement price, benefitting to remaining mFRR energy providers.

Therefore, even though partial procurement would negatively affect long-term incentives to provide flexibility to the system, this effect would likely be limited.

5.2.3 Cost for grid users

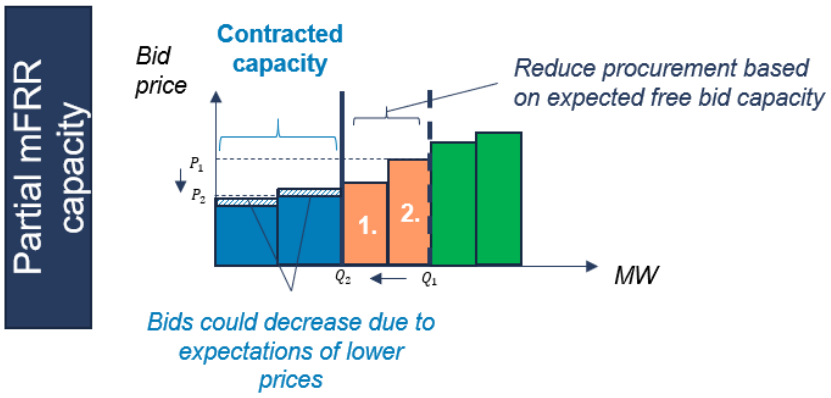
Direct effects on mFRR capacity procurement costs

Partial upward mFRR procurement has a direct reduction effect on mFRR capacity procurement costs, through two effects:

1. **Volume effect**: by lowering procured volumes, costs are decreased by the volume of the no-longer contracted mFRR capacity multiplied by the most expensive previously accepted bid prices.
2. **Price effect**:
    a. The reduction in procured volumes will reduce the marginal bid price, i.e. the bid price of the most expensive selected bidder. In a pay-as-bid auction, infra-marginal bidders may try to bid above their marginal or opportunity cost to get closer to the marginal price and capture (part of) the infra-marginal rent. Consequently, the decrease in marginal mFRR prices will likely result in lower bid price.
    b. In addition, higher mFRR energy prices – as explained in the previous subsection – could increase the expected revenue for contracted mFRR capacity. This would in turn reduce the opportunity cost for providing mFRR capacity and potentially reduce mFRR capacity price. However, as mentioned above higher imbalance prices would increase incentives to balance the system, reducing balancing activations: this might limit the feedback on mFRR capacity prices.

We expect the volume effect to be the main channel of cost reduction for partial procurement.

Figure 23 - Partial procurement effect on mFRR capacity costs



mFRR capacity which was contracted in the status quo situation but no longer in the partial procurement scenario

mFRR capacity contracted in the status quo, and the associated mFRR energy bids submitted

Unsuccessful mFRR capacity bids, bidding as non-contracted capacity in the mFRR energy auction

Source: Compass Lexecon analysis

Notes: The figure shows an illustration of the merit order in mFRR capacity auctions under partial procurement. mFRR capacity procurement costs are reduced by the reduction in procured volumes and the decrease in bid prices for the remaining contracted capacity.

As a result, partial procurement would reduce procurement costs paid by grid users. However, should there be not sufficient mFRR capacity in real time, the TSO may have to resort to costly and less efficient measures to guarantee operational security. The long-term incentive for flexibility may also be reduced, leading to higher costs in the long run.

5.2.4 Market functioning

Market stability and predictability

Under partial procurement, capacity to be contracted could vary significantly across auctions depending on non-contracted bids' forecasts and so be less predictable to market parties. It would also make wholesale market prices less predictable. Predictable auctions contribute to creating a stable market framework, as well as limit transaction costs for market participants. By contrast, an unpredictable or unstable market environment could discourage market participation and result in operational errors on the market side.

Similar to intermittent procurement, irregular procurement in the partial option could lead to situations where market participants mistakenly do not submit bids, or even voluntary non-participation. This could be detrimental to the mFRR capacity auctions in the short and long run and increase market power in the balancing energy market if participation is reduced.

Competition impacts on mFRR capacity and mFRR energy prices

Lower participation in the mFRR energy market would likely reduce competition and increase risks of market power, as available mFRR means in real time would be closer to total balancing capacity requirement, making bids likely to be activated pivotal. The use of market power may result in even higher mFRR energy prices.

These higher prices could though attract new flexibility in the mFRR energy market or through reactive balancing – lowering activated mFRR volume – thus mitigating market power. However, in the partial procurement scenario and given Elia's analysis on non-contracted bids' availability, such situations are likely rare and would therefore probably not have a significant effect.

An added risk is that by procuring volumes accounting for expected free bids, market participants gain insights on the expected non-contracted capacity for the next day. This information could potentially be used to manipulate mFRR energy prices, as some generators could infer their potential market power in the balancing market.

However, as mentioned in section 4.2.4, the participation in EU balancing platforms (MARI) will also contribute to mitigating these market power concerns. Through the MARI platform, Elia will be able to access mFRR bids submitted in neighbouring countries. This will stimulate competition and would help mitigate competition issues which may arise in partial procurement since Belgium mFRR energy bids would be in competition with mFRR bids submitted in neighbouring countries. Nevertheless, it is worth noting that the increased competition from neighbouring countries through the MARI platform could deter market participation locally in Belgium.

5.2.5 EU / Belgium compatibility

We have not identified any firm incompatibilities for this option with Electricity Balancing or System Operation Guidelines or the Belgian or the wider EU frameworks, subject to the ability of Elia to have sufficient reserve capacity as according to the article 157(4) of the System Operation Guideline. In particular, we expect intermittent procurement to be in line with Article 32 Commission Regulation (EU) 2017/2195 of 23 November 2017 (EBGL)[39], specifying that '*each TSO shall perform an analysis on optimal provision of reserve capacity aiming at minimisation of costs associated with the provision of reserve capacity. This analysis shall take into account […] the volume of non-contracted balancing energy bids which are expected to be available both within their control area and within the European platforms taking into account the available cross-zonal capacity'.*

5.3 Conclusion on partial procurement

For the same reasons as intermittent procurement, partial procurement may raise operational risk concerns if the expected available non-contracted bids are no longer there in practice. Cost decreases associated to partial procurement could be higher than intermittent procurement due to reduced procurement volumes, at relatively higher prices.

However, the costs induced by lower operational security and reduced market stability could outweigh the gains. The impact of this option on mFRR capacity prices could also reduce long-term incentives for flexibility development. Partial procurement would likely lead to a less predictable and stable market environment than the status quo. In addition, lower mFRR availability in real time could increase market power in the balancing market.

Overall, while this model can result in procurement cost savings, it presents drawbacks as it could induce operational risks and additional uncertainty for market players. Managing these risks would limit cost savings, by means of reducing volumes which can be taken into account or expensive measures to manage the operational risks.

[39] Commission Regulation (EU)2017/2195 of 23 November 2017 establishing a guideline on electricity balancing here.

Table 5 -Summary of Option 3 assessment

	Option 3 - Partial procurement
1 Operational security	Risk of insufficient mFRR energy bids to fulfil Elia's requirements in real time (greater than intermittent procurement), due to impacts on dispatch and non-contracted bids forecasting errors.
2 Economic efficiency	Could increase liquidity in wholesale market. Remedial actions in case of reserve shortage could create inefficiencies. Long term incentives to provide flexibility could be reduced.
3 Cost for grid users	Partial procurement would reduce mFRR capacity procurement costs, but could be counterbalanced by higher remedial costs. Impact on long term incentives could have upward effect on costs in the future.
4 Market functioning	Procurement volumes less predictable. Market power and mFRR energy prices could increase.
5 EU / Belgium compatibility	No identified incompatibility with EBGL/ Belgium legal and regulatory framework.

6 Conclusion

In 2021, Elia published a study on the daily prediction of non-contracted balancing energy bids. It confirmed the possibility to deliver relatively accurate predictions for mFRR non-contracted balancing energy bids. Following this study, Elia is investigating the possibility to optimise the allocation of the required balancing capacity needs to contracted and non-contracted balancing means through a dynamic calculation of the available balancing means.

In this context, Compass Lexecon has been mandated by Elia to carry out a study, which objectives are: (i) to conduct a qualitative assessment of possible procurement strategies for the consideration of day-ahead predicted availabilities of non-contracted balancing energy bids in a daily calculation of FRR balancing capacity to be procured and (ii) to identify, for each approach, the benefits and risks for the parties involved, as well as the possible impact on market functioning.

We identified three main procurement strategy options for Elia, which are:

(i) **not to procure mFRR capacity and rely on post-market rescheduling** to ensure adequate balancing means,
(ii) **intermittent procurement of mFRR capacity** by procuring no volumes when expected non-contracted mFRR energy bids cover Elia's entire requirement, and
(iii) **partial procurement of mFRR capacity** by deducting expected volumes of non-contracted bids from procurement volume on the previous day.

We then identified an assessment criterion, to evaluate these options compared to the status quo arrangements in terms of (i) operational security, (ii) economic efficiency for energy consumers (iii) costs for grid users, (iv) market functioning and (v) the compatibility with Belgian and EU legislation. Amongst these criteria, the operational security and the EU / Belgian compatibility were considered as 'decisive criteria' as an option that leads to an unacceptable level of operational security or that is not legally compatible with existing legislations would not be an acceptable solution, however it scores against other criteria.

6.1 Overview of assessments

6.1.1 Operational security

In the status quo today, the balancing capacity procured by Elia corresponds to the requirement based on its dimensioning. It considers the sharing of reserves with neighbouring countries, but it does not take into account non-contracted bids dynamically. As a result, this approach provides sufficient guarantee to Elia to have at its disposal sufficient balancing resources to balance the system as according to its operational security standards, and even beyond as, most of time, it gets non-contracted bids in addition.

Conversely, other considered approaches may lead to situations in which expected non-contracted bids do not materialise. In such cases, if Elia is able to anticipate these situations sufficiently in advance, it would have to resort to remedial actions, such as starting up plants. However, should this be anticipated, such balancing resources' shortage may lead to operational security issues, resulting in a degradation of the balance of the Belgian system up to the activation of exceptional measures such as, as a last resort, load curtailment.

In the systematic absence of procurement, situations of lack of non-contracted means will likely occur frequently based on current liquidity, as Elia's assessment shows, in the vast majority of time (around 80%), non-contracted bids do not cover its needs. Furthermore, the current generation mix does not guarantee that Elia will have access to adequate resources to re-schedule plants when needed, due to slow start-up times of conventional thermal units such as combined-cycle gas turbines (CCGTs) or due to risks that the available capacity is already fully used, for instance during near-scarcity events. In such situations, Elia will thus have no other options than balancing the system in degraded operational security levels.

In intermittent and partial procurement approaches, operational security issues may occur because:

- Even though, in general, non-contracted bids available in the balancing market in the status quo would likely be present as well in case of intermittent or partial procurement, we have identified situations in which **the change in procurement induces changes in dispatch behaviours and impact the availability of non-contracted bids**.
- Moreover, **forecasting the availability of non-contracted bids is not an easy task** and it is difficult to reach adequate volumes available at 'firm' availability level and anticipate radical changes. Unless forecasting can be substantially improved, this additional risk will add up to risks taken in the dimensioning methodology, which in turn may exceed an acceptable level.

Comparing more specifically intermittent and partial procurement strategies, partial procurement would likely lead to more frequent tight situations insofar as it reduces procurement volumes not only when non-contracted bids are expected to be sufficient to cover the whole requirement, but also when it covers only part of it.

Consequently, **these operational security concerns need to be addressed before considering the implementation of such options**. **Further quantitative studies on availability and predictability of non-contracted bids should confirm sufficient liquidity** of such resources before these strategies can be considered in practice.

6.1.2 Economic efficiency

Contracted capacities are not able to participate in the wholesale market. Reducing mFRR capacity procured in all three options considered frees up some capacity which can then participate in the wholesale market, improving the real-time dispatch of generators. This results in lower costs and potentially lower day-ahead and/or intraday market prices in Belgium. The impact on prices should however not be overestimated following the limited share of Elia's balancing capacity in a European energy market.

In case of no procurement, if Elia has to resort on post-market rescheduling to secure mFRR, frequent rescheduling actions may eventually harm dispatch efficiency, especially as Elia may only have access to a limited pool of resources (e.g. due to start-up times or limited access to decentralised resources). Given current non-contracted bids' liquidity levels, high level of rescheduling would indeed be expected.

For partial and intermittent, the gains will depend on the frequency of remedial actions necessary in times when non-contracted bids do not cover Elia's requirement in real time.

In addition, the downside of reducing mFRR balancing capacity procurement costs is that it could harm long-term incentives to maintain or develop flexible capacities. Some of the flexible capacities, which might have been profitable in the mFRR balancing capacity tender, may leave the market or not develop due to lower market depth. In case of intermittent procurement however, we expect this effect to be limited insofar as mFRR capacity prices tend to be low when non-contracted bids are

sufficient to cover Elia's balancing capacity requirement. This effect can also be mitigated in part by higher mFRR energy prices, due to lower participation in the mFRR energy market.

6.1.3 Cost for grid users

From the perspective of grid users, reducing or completely removing mFRR capacity auctions mechanically decreases mFRR capacity procurement costs compared to the status quo. However, Elia may need to resort to remedial actions if it lacks mFRR means, which costs may reduce or exceed savings in procurement costs.

Entirely removing auctions naturally avoids the highest mFRR capacity procurement costs, but the costs of rescheduling actions will likely be significant for Elia and overbalance in cost advantages gained by not procuring mFRR capacity.

Should remedial actions be limited, partial procurement has a high potential for cost savings, as it reduces procurement volumes when any volume of non-contracted capacity is expected, and not limited to situations where it exceeds requirements as in intermittent procurement and where mFRR capacity prices are low. Conversely, due to the correlation between high availability of non-contracted mFRR energy bids and low mFRR capacity prices, cost savings would likely be limited in the intermittent procurement option, and lower than expected in the partial procurement. Note that lower balancing capacity procurement can result in higher mFRR energy prices, due to lower participation in the mFRR energy market.

Last, direct and indirect cost effects could eventually lead to counterbalancing effects on the capacity remuneration mechanism by influencing the 'missing money' of generators. Nonetheless, the increase in CRM costs would not be sufficient to cancel out savings.

Besides the final effect on the total cost, one should also take into account cost allocation as the different costs and revenues mentioned above may have different implications for grid. Balancing energy prices affect grid users (via balancing responsible parties) in function of their portfolio positions, while balancing capacity procurements affects grid users in function of their grid use.

6.1.4 Market functioning

In case of no mFRR capacity procurement based on post-market rescheduling, market instability may appear in case of frequent Elia interventions to maintain sufficient level of mFRR means, which would be likely given current liquidity.

In intermittent and partial procurement, the absence of recurrent mFRR capacity auctions and the variability of volumes (in case of partial) may affect the visibility of market participants in the market. This could be alleviated if the absence of auctions or the reduction of volumes to be procured would follow clear patterns. For example, these patterns could be the absence of mFRR capacity auctions in summer or at night only, or stable volume reduction over predefined periods.

In the absence of clear patterns, the market environment would become less predictable and less stable. This could discourage market participation or result in operational errors at market side. It could be detrimental to its functioning in the short and long run and increase market power in the balancing energy market (and balancing capacity market to a probably lesser extent).

In addition, reducing mFRR capacity procured could decrease mFRR energy market liquidity, leading to increased risk market power issues. Some generators could indeed gain a pivotal position more easily if fewer participants submit bids. This concern should be mitigated by the introduction of the MARI platform, where locally sourced mFRR energy bids would compete against bids from other systems.

6.1.5 EU / Belgium compatibility

For partial and intermittent procurement of mFRR capacity, we have not found compatibility issues with the Belgium/ EU legal and regulatory framework as long Elia complies with Article 157(4) of the SOGL "*All TSOs of a LFC block shall have sufficient reserve capacity on FRR at any time in accordance with the FRR dimensioning rules. The TSOs of a LFC block shall specify in the LFC block operational agreement an escalation procedure for cases of severe risk of insufficient reserve capacity on FRR in the LFC block.*"

For no procurement of mFRR capacity based on post-market rescheduling, frequent re-scheduling in an inherently inflexible system may imply compliancy issues with Article 157(4). However, no other firm incompatibilities have been identified but it is clear that implementing the latter would nevertheless be a significant departure from current arrangements in Belgium. Similarly, this option would constitute a deviation from the EU target model if post-market rescheduling were frequent.

6.2 Conclusion and recommendations

In conclusion, the no procurement scenario would be a significant reform with uncertain benefits and high operational risks, as, most of the time in the current context, upward mFRR capacity needs are not covered by the available non-contracted balancing means, and post-market rescheduling would be frequently necessary. We would therefore recommend discarding it for the moment.

Partial procurement, and intermittent procurement to a lesser extent, could unlock cost savings to grid users in the short term at least. However, these options could lead to deteriorated and potentially unacceptable level of operational security in case remedial actions are frequently needed.

Indeed, these options could entail higher operational risks due to the difficulty or impossibility to guarantee the availability of non-contracted mFRR energy bids. In addition, they raise concerns regarding market stability, which could in turn have impacts in the longer run.

Consequently, these operational security concerns need to be addressed before considering the implementation of such options. Further quantitative studies on availability and predictability of non-contracted bids, as well as on patterns, should confirm sufficient liquidity of such resources before these strategies can be considered in practice.

7 Annex

7.1 Minutes of the first stakeholder workshop of 21 April 2022

1. Participants

- Kristof De Vos, ELIA
- Nicolas Pierreux, ELIA
- Arno Motté, ELIA
- Amandine Leroux, ELIA
- Charles Verhaeghe, Compass Lexecon
- Fabien Roques, Compass Lexecon
- Michael Van Bossuyt, Febeliec
- Arthur Fieuws, RentaPort
- Pierre Bayart, RentaPort
- Aron Vanneste, Flexcity
- Emiel Maes, Flexcity
- Stephan Spiecker, RWE
- Loïc Donnay De Casteau, Engie
- Marijn Maenhoudt, CREG

2. Introduction by ELIA

Kristof De Vos (ELIA) provided an introduction to explain the context of the study, the previous work carried out by ELIA and the objectives of the workshop.

Some parties (RentaPort) asked if optimising the dimensioning of aFRR and mFRR is in scope of the study as well. ELIA answered that the dimensioning of the needs is out of scope: for FRR, this topic was covered by the dynamic dimensioning study (link) and for aFRR in the dynamic dimensioning study (link).

3. Presentation by Compass Lexecon

Fabien Roques and Charles Verhaeghe (Compass Lexecon) presented their preliminary work on the procurement strategies for a dynamic allocation of FRR means.

As regards the first option that was put forward (no procurement with post-market rescheduling), FEBELIEC raised questions on the implications in terms of operational security and also mentioned to be attentive towards the cost for the grid user as the allocation of re-dispatching (i.e. referred here as post-market rescheduling) costs may be different. FEBELIEC warned also about the risk of

gaming in case re-dispatching actions are predictable. FEBELIEC suggested however not to discard this option too quickly if it could, at a later stage and provided such re-dispatching actions would then be exceptional, reduce significantly costs for consumers.

FEBEG asked if available liquidity is taken into account in the analysis. ELIA confirms that this was the scope of the 2021 study and that this will be re-analysed in 2023 and 2024 after having experience on the new market evolutions.

As regards the intermittent procurement option,

i) Some parties (FEBELIEC) considered that the market power risks should be limited by the introduction of the MARI platform and the induced competition from neighbouring countries. ELIA explained that this is not a given as large uncertainty exists on the additional liquidity accessible through the balancing platforms considering potential limitations on the available cross-border transmission capacity after intra-day.

ii) They raised questions on the impact on costs and on the fact that mFRR capacity prices are likely low when free bids' availability is high and mentioned they needed more time to consider this. They suggested not to discard this option too quickly if it could reduce significantly costs for consumers.

iii) Market participants such as demand response providers (Flexcity) confirmed that the lack of predictability and the fact that mFRR auctions would not be organised on a systematic basis could alter the functioning of the market and discourage participants. They also mentioned that demand response providers need to cover for their availability costs, and therefore need mFRR capacity remuneration to provide it.

As regards the partial procurement option,

iv) Some parties (FEBELIEC) also considered that the market power risks should be limited by the introduction of the MARI platform and the induced competition from neighbouring countries (cf. remarks and answers while discussing intermittent procurement).

v) The possibility of cross-border balancing and its impact on partial procurement was discussed. ELIA explained that distinction has to be made between sharing of reserves – which could be taken into account, considering available interconnection capacity, to reduce procured capacity and availability of energy bids in the MARI platform, for which the operational experience of the MARI platform is necessary before drawing conclusions. In addition, it is important avoid double counting of volumes.

vi) Stakeholders suggested not to discard this option too quickly if it could reduce significantly costs for consumers.

The overall conclusions of Compass Lexecon were as follows:

vii) No procurement based on post market scheduling in the current market context where upward mFRR capacity needs are frequently not covered by the available non contracted balancing means would be a significant reform with uncertain benefits and high operational risks.

viii) Partial and intermittent procurement could in theory provide cost savings to grid users but entail higher operational risks due to the difficulty / impossibility to guarantee the free bids' availability and leads to a lower level of operational security. In addition, they

raise concerns regarding market stability (particularly in case of intermittent procurement), which could in turn have impacts in the longer run.

ix) When considering partial procurement (and intermittent to a lesser extent), long run impact on investment in or maintaining flexible capacity, and impact on market power need to be duly taken into account.

4. Wrap-up and next steps

ELIA and Compass Lexecon invited stakeholders to provide written additional by 4th May or contact ELIA.

A second workshop will be organised on 10 May. ELIA invited stakeholders to attend physically as much as possible in order to have more interactive discussions.

7.2 Minutes of the second stakeholder workshop of 10 May 2022

1. Participants

- Kristof De Vos, ELIA
- Nicolas Pierreux, ELIA
- Arno Motté, ELIA
- Charles Verhaeghe, Compass Lexecon
- Fabien Roques, Compass Lexecon
- Augustin Lorne, Compass Lexecon
- Emiel Maes, Flexcity
- Loïc Donnay De Casteau, Engie
- Jean-François Waignier, FEBEG
- Steven Harlem, Luminus
- Gilles Bertrand, CREG

2. Introduction by ELIA

Kristof De Vos (ELIA) welcomed participants and introduced the workshop. ELIA explained the context of the study, the previous work carried out by ELIA and the objectives of the workshop.

3. Presentation by Compass Lexecon

Charles Verhaeghe (Compass Lexecon) presented the different options considered for the study on mFRR dynamic means procurement. The options presented included an additional option to increase of mFRR capacity procurement, suggested by FEBEG in writing in response to the first workshop. Compass Lexecon carried out a poll using an online tool, asking participants whether, in their view, all relevant options had been identified. Two participants anonymously answered the poll, and both replied ‘yes’.

Compass Lexecon presented the assessment criteria and gave a summary of the main comments made by stakeholders on the options considered in the previous workshop as well as the written

submission raised by FEBEG. Compass Lexecon presented analysis addressing FEBEG's suggested additional option, noting that increasing operational security standards fell outside of the scope of the study on procurement mechanisms.

As regards to the evaluation of options, Engie stressed the need for a quantitative assessment of effects, particularly to check what the impacts of these options would be on balancing prices compared to day-ahead prices. The assessment would test whether direct procurement costs are offset by indirect price effects.

ELIA replied to Engie's comments, reminding the scope of the current study to evaluate the impacts of each option qualitatively. If there is a need to further investigate elements of the qualitative analysis quantitatively, and provided that the data is available, then this could be carried out in a second stage.

Compass Lexecon presented an overview of the assessment of the different options with respect to operational security, covered in the first workshop. Compared to the status quo, all the considered options tend to increase operational security risks. Compass Lexecon presented analysis in response to questions/ comments raised by FEBEG in writing regarding the impacts of reducing contracted capacity on free bid availability, the inference from past data for free bid forecasting, the future evolutions in cross-border exchanges and stress testing the assessment in light of past extreme events.

With regards to the stress tests of the analysis in light of extreme events, ELIA noted that its internal analysis had found that sufficient non-contracted balancing means were available during the two events suggested by FEBEG. ELIA highlighted that while investigating extreme events was interesting, reserve dimensioning was carried out to cover reasonable system events with a 99% reliability level – thus not covering all possible extreme events.

Compass Lexecon carried out an online poll, asking participants whether they agreed that operational security is a risk or concern for implementing the different options considered, and prompted for comments on potential mitigation measures. Two participants anonymously answered the poll, and both replied that operational security was indeed a risk or concern.

Compass Lexecon presented a summary of the analysis of the different options with regards to economic efficiency and costs to grid users, previously detailed in the first workshop. Engie asked whether indirect effects on BRPs have been considered, pointing out the importance to consider the minimisation of direct and indirect costs for consumers – preferably quantitatively. Engie also enquired on the timeframe used to evaluate the costs and benefits of the options.

In response to Engie's comments, Compass Lexecon explained that a social welfare approach had been followed to evaluate economic efficiency. This implies looking at the efficiency of the final dispatch. The study also considers costs to grid users in complement to welfare. Short-term benefits are assessed with a static approach, and long-term incentives on market players are also assessed. Compass Lexecon presented analysis with respect to indirect costs on BRPs, addressing the question submitted by FEBEG and mentioned by Engie.

Engie enquired about the focus of the study on upward mFRR, while aFRR was used to a greater extent for balancing. ELIA and Compass Lexecon noted that, following the 2021 Dynamic Means study, it was found that aFRR market design changes limited the data available to build free bid forecasting machine learning algorithms, and that very few free bids had been submitted for aFRR so far. As a result, the study focused on mFRR for which free bids are submitted and can be forecasted. Compass Lexecon pointed out that the theoretical conclusions of the study would also be valid for aFRR, however.

Compass Lexecon presented a summary of the analysis of market impacts of each option, first outlined in the previous workshop, and provided analysis in response to FEBEG's question submitted in writing on the effects of reduced mFRR procurement on adequacy. Compass Lexecon carried out an online poll, asking participants whether they agreed that market functioning is a risk or concern for implementing the different options considered, and prompted for comments on potential mitigation measures. Two participants anonymously answered the poll, and both replied that market functioning was indeed a risk or concern.

Compass Lexecon presented the conclusions to the study:

'No procurement based on post-market re-scheduling' can be an option only in systems with very high liquidity, but current observations of liquidity are far from sufficient to consider this option;

'Intermittent procurement' can only be an option in systems with seasonal / predictable patterns of available non-contracted balancing energy bids (e.g., to maintain a stable market), however current observation does not confirm the existence of such patterns; and

'Partial procurement' is technically feasible and can bring economic gains but have important associated operational and market stability risks.

Compass Lexecon carried out an online poll, asking participants for their view on which option had the largest potential for implementation. Three participants anonymously answered the poll: two voted that the 'status quo' arrangements had largest potential, while another participant voted for 'partial procurement'. Compass Lexecon concluded by providing the result of the different online polls made during the workshop to participants.

4. Wrap-up and next steps

ELIA informed market participants of the next steps for study, stating that a written report would now be compiled. Written comments can be submitted by stakeholders until the end of June to be analysed and included in the report.

5. Summary of the workshop's anonymous poll answers

Question 1 – In your view, have all the relevant options been identified in order to optimize procurement of upward mFRR capacity? (2 voters)

1. Yes (2 votes)

2. No (0 votes)

Question 2 – Do you agree that operational security is a concern or risk for implementation? (2 voters)

1. Yes (2 votes)

2. No (0 votes)

Question 3 – Do you agree that market functioning is a concern or risk for implementation? (2 voters)

1. Yes (2 votes)

2. No (0 votes)

Question 4 – Which option has the largest potential for implementation? (3 voters)

1. Status quo (2 votes)

2. No procurement based on post-market rescheduling (0 votes)

3. Intermittent procurement (0 votes)

4. Partial procurement (1 vote)

5. None of the above (0 votes)

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