

# Qualitative Analysis of Cross-Border Exchange of Balancing Energy and Operational Reserves between Netherlands and Belgium

## Final Report

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## **Final Report**

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On behalf of: Elia System Operator NV / TenneT TSO B.V.

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## EXECUTIVE SUMMARY

The Framework Guidelines on Electricity Balancing, which were approved by ACER on 18 September 2012, call for coordination of national balancing mechanisms and for an increased exchange of operational reserves and balancing energy between European TSOs. In anticipation of the upcoming European regulations, Elia and TenneT have ordered DNV KEMA to conduct a qualitative analysis of potential cooperation models between the two TSOs.

In February 2013, ENTSO-E launched a call for pilot projects on balancing in order to test the feasibility of the balancing target model as explained in the Framework Guidelines on Electricity Balancing (FGEb), to evaluate the implementation impact and to gather and report on the experience gained. In response to this call, Elia and TenneT applied on 29<sup>th</sup> March 2013 for a cross-border balancing pilot project called "Design and evaluation of a harmonised reactive balancing market with XB optimisation of Frequency Restoration while keeping control areas, bid zones, and Regulatory oversight intact ". On 25<sup>th</sup> June 2013, the ENTSO-E Market Committee accepted and approved the nomination. This report need to be considered as a first deliverable of the pilot project.

Elia and TenneT have already taken initial steps for the cross-border exchange of operational reserves and balancing energy. For example, TenneT and Elia joined the International Grid Control Cooperation (IGCC) Agreement as of 1<sup>st</sup> February and 1<sup>st</sup> October 2012, respectively. In addition, Elia procures parts of its frequency containment reserves from France. Since 2013 there exists also a contract between both TSOs which arranges the sharing of manual frequency restoration reserves.

A comparison of the present arrangements shows that both countries share a lot of similarities with regards to the procurement and use of operating reserves and real-time balancing. Elia and TenneT rely on a similar set of products and processes and strive to rely on market-based mechanisms where possible. Moreover, the balancing mechanisms in both countries are based on a more 'reactive' balancing philosophy, which aims at providing clear and effective incentives for self-balancing by balance responsible parties (BRPs). In line with this approach, the time horizon of balancing services used by Elia and TenneT is principally limited to the current and the next consecutive program time unit (PTU), whereas BRPs are responsible for balancing themselves thereafter. Moreover, both TSOs try to incentivise BRPs to react immediately and reduce their imbalances in advance, for instance by means of self-balancing or through the intra-day market, in order to reduce the deviations which finally have to be resolved by the TSO.

Despite these similarities, a closer analysis reveals important differences. To start with, the detailed technical specifications of the main products are fairly different and not directly compatible with each other. Furthermore, the two TSOs apply different principles for remuneration of balancing energy from automatic and manual frequency restoration reserves. These differences are also reflected in a different use of these services; with an almost exclusive use of automatic frequency restoration reserves in the Netherlands, whereas Elia uses both automatic and manual frequency restoration

reserves for real-time balancing. Finally, frequency containment reserves are procured on a commercial basis in Belgium but have to be provided free of charge in the Netherlands.

To a certain degree, these differences reflect concerns about more limited flexibility and a high concentration in the market for the corresponding products in Belgium. Consequently, many elements of the present market design in Belgium focus on optimising the use of limited resources. In contrast, TenneT tries to rely on a simple set of standardized products in combination with market incentives as the main means of ensuring physical delivery.

Against this background and practical experiences to date, we have analysed different approaches for the exchange of operating reserves and balancing energy for each of the different products and processes. Based on this analysis, we conclude that potential benefits of cross-border activation of balancing energy between Belgium and the Netherlands are mainly related to the frequency restoration process. It appears that the most obvious benefits have already been achieved through the participation of both TSOs in the IGCC imbalance initiative and the signature of a reserve sharing contract between TenneT and Elia. Nevertheless our analysis indicates that there may still be considerable savings to be gained.

Some additional benefits may be generated by facilitating the cross-border exchange of frequency containment reserves (FCR). Conversely, we do not foresee any substantial benefits in the area of replacement reserves, which do not currently play a role in the balancing concept of both countries.

We do not advocate the joint contracting of automatic and/or manual frequency restoration reserves (FRR) at this stage. Although this may potentially generate considerable savings, we conclude that the exchange of contracted FRR currently appears as difficult, not the least due to regulatory restrictions on the reservation of cross-border transmission capacity for this purpose. It therefore appears more logical to initially focus on the first step, i.e. on the activation of balancing energy before taking any further steps in this respect

Based on these findings and our discussions with Elia and TenneT, we recommend that the following options for cross-border coordination in the area of operational reserves and balancing services are worth being considered by Elia and TenneT:

1. Exchange of frequency containment reserves (FCR),
2. Exchange of automatic frequency restoration reserves (aFRR),
3. Exchange of non-contracted manual frequency restoration reserves (mFRR).

The cross-border exchange of FCR does not involve direct physical exchanges between the countries concerned. Instead, it effectively implies a (partial) shift of each TSO's obligation to contribute to the total provision of FCR in continental Europe. Despite some regulatory constraints established by the ENTSO-E Operation Handbook and the draft Network Code on Load-Frequency Control and Reserves, there stills remains considerable scope for exchanging FCR obligations between both

countries. Moreover, our analysis indicates that this measure may potentially generate substantial savings, possibly reaching up to € 12 to 24 million.

At the same time, FCR represent a relatively simple product, which does not require any communication and centralised control in real time. We therefore propose to consider the establishment of a joint tendering mechanism for a single, standardised product. We furthermore believe that the design and implementation of joint tenders would be relatively straightforward.

Still, some changes would be required, including in particular the following:

- Development of minimum product specifications,
- Implementation of (new) IT systems for the procurement and settlement of FCR,
- Adaption of the existing legal, regulatory and contractual framework.

Most of these changes can probably be implemented at limited costs and efforts, provided that there is sufficient commitment not only from the side of the TSOs but also by the regulators. Similarly, our analysis has not identified any serious risks caused by the joint contracting of FCR.

As already indicated before, automatic FRR represent the main product for real-time balancing in Belgium and the Netherlands. It therefore appears natural to focus on further cross-border cooperation for this product. Elia and TenneT already participate in IGCC such that they already benefit from netting of system imbalances. We therefore recommend that the two TSOs focus on the design and implementation of a more comprehensive approach that is based on the use of a common merit order for automatic FRR. Although the restrictions by the Framework Guideline on Electricity Balancing on the use of cross-border capacity for the exchange of balancing energy imply that a joint mechanism may not be able to exploit the full theoretical potential of this measure, a first simplified estimate indicates that this measure may also generate substantial savings for the two countries, i.e. more than € 10 million per annum.

In contrast to the case of FCR discussed before, the exchange of automatic FRR has to overcome several challenging issues. These are mostly related to product design and the current principles for activation and remuneration in the two countries. More specifically, the exchange of automatic FRR will require the following:

- Decide on treatment or harmonisation of current product specifications (ramp rates),
- Harmonisation of activation principles,
- Design and implementation of new and/or adaption of existing IT systems,
- Adaption of the existing legal, regulatory and contractual framework.

Arguably, the first two elements represent the most challenging issues to be overcome since they are related to some of the key differences between present arrangements in both countries.

This indicates that the corresponding changes and decisions would be far from being trivial. Moreover, inadequate design decisions may lead to deteriorating regulation quality and subsequently a potential increase in the need for pre-contracted reserves.

Similar to the case of FCR, the design and implementation of a common merit order will thus require strong commitment by TSOs and regulators alike. Moreover, attention will have to be paid to managing technical complexity and to deal with important technical and commercial risks. Failure to do so may otherwise result in deteriorating regulation quality and/or increasing costs.

Manual frequency restoration reserves (FRR) play an important role in Belgium. In contrast, the Netherlands often have a substantial volume of manual FRR available, which are not utilised. However, our analysis shows that the potential savings that could be achieved in this area are likely to be very small. Nevertheless, it seems useful to further analyse the feasibility of exchanging balancing energy from manual FRR since this is a precondition for joint contracting at a later stage.

Technically, manual FRR are a less complex product than automatic FRR. Moreover, our analysis has not identified any fundamental technical barriers towards further integration. Nevertheless, it would again be necessary to agree on certain changes, including the following:

- Need for product harmonisation (i.e. use of schedule- vs. directly activated reserves),
- Pricing of manual vs. automatic FRR,
- Risk of de-coupling between activation of manual FRR and system imbalance.

The harmonisation of pricing principles arguably represents the most serious challenge. Unless this issue was resolved, an integrated mechanism could lead to high and unpredictable costs for Belgium, or simply not be used in practice. Similarly, the third issue may undermine incentives for self-balancing in the Netherlands in certain situations, at least without any simultaneous changes to the pricing of imbalances.

These considerations indicate that, besides changes to the procurement of balancing energy, further changes may also be required the present arrangements for imbalance settlement. In this context, it will be important to closely assess the impact of different approaches on imbalance prices and the distribution of economic welfare between the two countries. Possible risk may specifically arise due to the link between the remuneration of automatic and manual FRR in the Netherlands, and the difference between the use of pay-as-bid and marginal pricing for balancing energy.

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## 1 INTRODUCTION

The Framework Guidelines (FG) on Electricity Balancing, which were approved by ACER on 18 September 2012, call for coordination of national balancing mechanisms and for an increased exchange of operational reserves and balancing energy between different TSOs. The FG on Electricity Balancing specifically address the roles and responsibilities of stakeholders involved in electricity balancing, the procurement of frequency restoration reserves and replacement reserves, activation of balancing energy from frequency restoration reserves and replacement reserves, and imbalance settlement. Currently there are different market designs in Europe to balance control areas.

The European TSOs shall, through the development of the Network Code on Electricity Balancing, implement the requirements of the Framework Guidelines on Electricity Balancing. ENTSO-E was formally requested by the European Commission to begin with the development of the Network Code on January 1<sup>st</sup> 2013. The final Network Code has to be delivered by January 1<sup>st</sup> 2014. A first draft of the Network Code for public consultation was published June 17<sup>th</sup> 2013. The public consultation will close August 16<sup>th</sup>.

Elia and TenneT have individually taken initial steps in the cross border cooperation of transmission system operators for the exchange of operational reserves and balancing energy from operational reserves. TenneT has joined the International Grid Control Cooperation Agreement as of February 1<sup>st</sup> 2012, Elia joined the cooperation as of October 1<sup>st</sup> 2012. Elia procures parts of its frequency containment / primary reserves from France.

Since Belgium and the Netherlands are having a same market based view on a balancing market design, a closer collaboration and a common project to analyse potential cross-border collaboration should give Elia and TenneT the opportunity to promote a market design where a common market solves the technical challenges economically more efficient than separated, national markets.

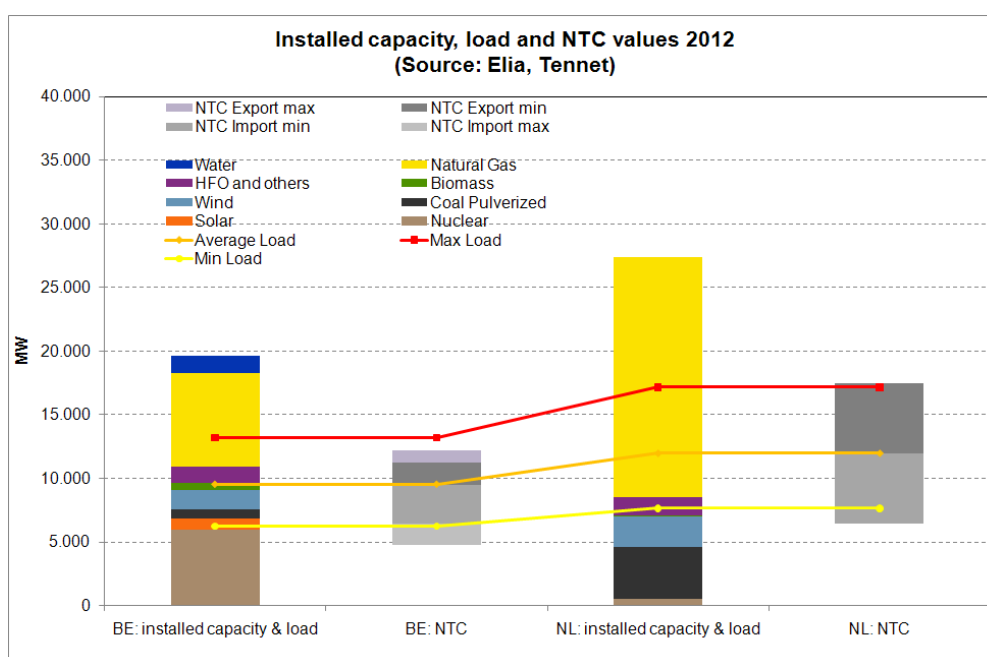
Subsequently and in anticipation of the upcoming European regulations, Elia and TenneT ordered DNV KEMA to conduct a qualitative analysis of potential cooperation models between the two TSOs. Elia, TenneT and DNV KEMA analysed jointly potential collaboration models, discarded a couple of them due to regulatory and / or technical constraints and came finally up with a couple of recommendations. These recommendations were presented to the stakeholders in a public workshop in Brussels on February 1<sup>st</sup> 2013. The invited stakeholders represented a broad range of market participants (balance responsible parties, balance service providers, generators, consumers, associations and NRAs).

The report in hand represents the work undertaken in the initial first phase of the project. The project will be continued in a second phase, in which the supposed feasible cooperation models will be evaluated quantitatively to assess economic welfare gains compared to today's situation and different cooperation models in their economic consequences compared.

## 2 GENERATION STRUCTURE AND BALANCING SERVICES IN BELGIUM AND THE NETHERLANDS

### 2.1 Structure of the Dutch and Belgian Power Systems

Figure 1 compares the Belgian and Dutch power systems with regards to installed generation capacity, load and available cross-border capacity (NTC, Net Transfer Capacity). Both systems are broadly comparable in size, although the Dutch is about one third larger than Belgium. In contrast, the two countries are rather different in terms of generation structure. In the Netherlands, natural gas represents more than two thirds of generation capacity, whereas the remainder is about equally split between coal-fired plant and other technologies. Conversely, natural gas and nuclear power each make up for about one third of total generation capacity in Belgium, whilst the remaining third is split across several other technologies. In addition, Figure 1 shows that both countries are strongly interconnected with neighbouring countries, allowing for substantial cross-border exchanges of electricity.



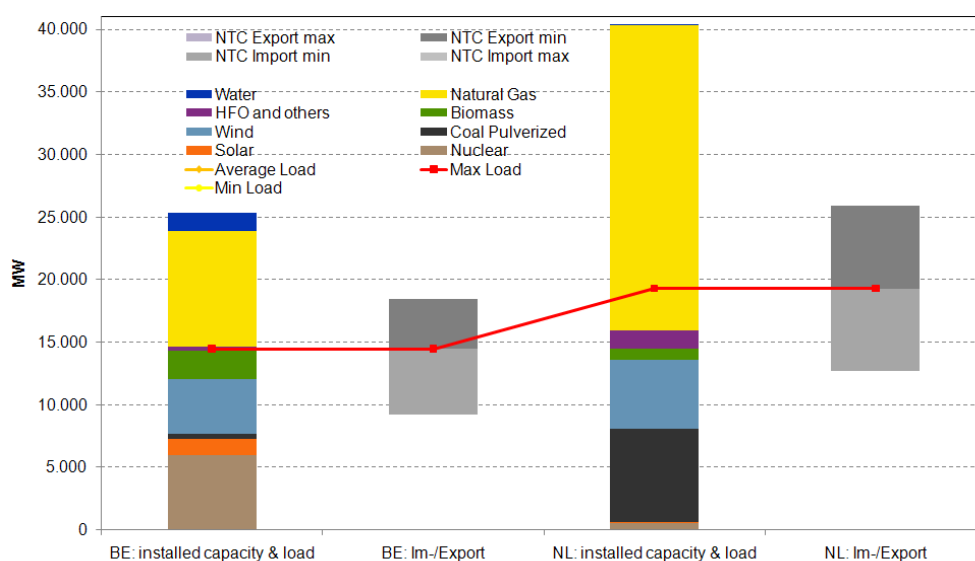
**Figure 1: Installed generation capacity, load and NTC of Belgium and the Netherlands (2012)**

Source: DNV KEMA, based on data from Elia and TenneT

With regards to system balancing and the provision of operational reserves, both countries have a similar share of fluctuating renewables (wind and solar power) at present. Conversely, the Belgian power system is characterised by a higher share of inflexible capacity (nuclear, coal) but comprises of less flexible plants (gas-fired and hydropower) than the Netherlands. This leads to a somewhat strained situation in the Belgium, with a limited volume of flexible capacity being available for the provision of operational reserves. In addition, automatic frequency restoration reserves (FRR), i.e. secondary frequency control, are mainly provided by combined cycle gas turbines (CCGTs).

Especially under current market conditions, the provision of automatic FRR often requires these plants often to operate under must-run conditions, which leads to increasing costs of capacity reservation.

According to Elia, the situation will improve in the next few years as additional gas-fired plants come on-line. At the same time, Belgium also expects a considerable growth of wind and solar power, which may increase the need for operational reserves and/or balancing energy. Yet, it should be noted that these expectations are highly insecure and depend on the economic operating conditions of existing and planned power plants in the future. This principally also applies to the Netherlands where installed capacity is expected to grow by almost 50%, i.e. far in excess of load growth.

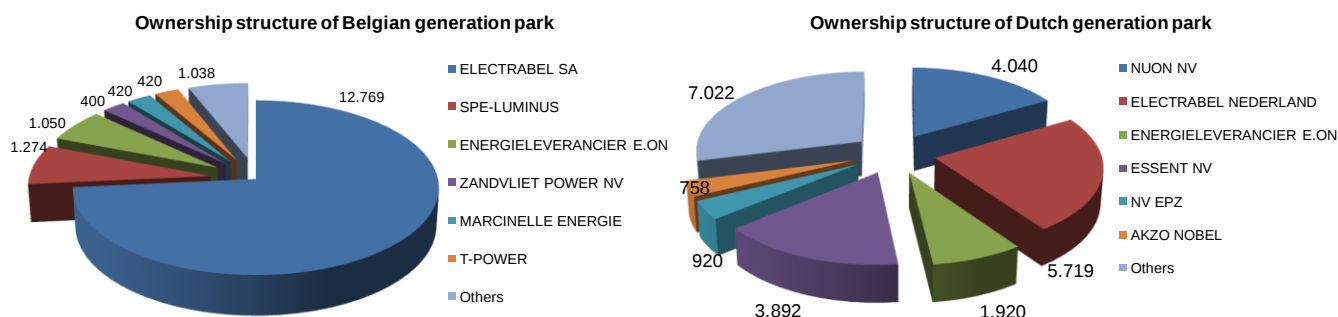


**Figure 2: Installed generation capacity, load and NTC of Belgium and the Netherlands (2019)**

Source: DNV KEMA, based on data from Elia and TenneT

Both countries are also quite distinct in terms of generation ownership, as is indicated in Figure 3. The Belgian market is characterised by a high level of market concentration. Electrabel owns around 75% of installed capacity, and no more than five generators are able to provide ancillary services<sup>1</sup>. In the Netherlands, the ownership landscape is more diverse. The largest three companies each own a similar volume of generation capacity (approx. 4 to 6 GW) and account for slightly more than 50% of total installed capacity. The next three largest companies represent another 15%, whereas ownership of the remaining 70% is dispersed over various other asset owners.

<sup>1</sup> Some of them with single sites for the provision of secondary control.



**Figure 3: Generation capacity ownership structure in Belgium and the Netherlands (2012 values)**

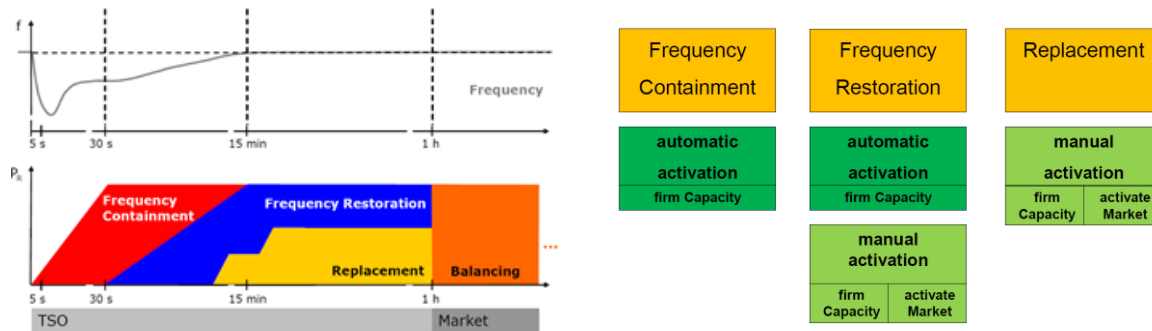
Source: DNV KEMA, based on Platts UDI

## 2.2 Balancing Services

The recently developed Network Code for Load Frequency Control & Reserves<sup>2</sup> (compare chapter 5.2) has introduced a set of harmonised control processes for load-frequency control for the entire EU. As shown in Figure 4 the NC differentiates between three processes, which are each supported by a dedicated set of operational reserves. The main purpose of the three different processes and the corresponding reserves are as follows:

- Frequency Containment Reserves (FCR) comprises of operational reserves which are activated to contain system frequency after an incident inside a pre-defined band. FCR are based on the automated, decentralised response of the governor controls on individual generators with a full activation time of 10-30 seconds.
- Frequency Restoration Reserves (FRR) are operational reserves used to restore system frequency to its nominal value and, where applicable, the power balance to the scheduled value. As illustrated by the right part of Figure 4 this process involve of manually-instructed services (manual FRR) as well as automatically-instructed services (automatic FRR). The latter are based on the centralised control of particular generating units (or loads).
- Replacement Reserves (RR) replace the activated reserves to restore the available reserves in the system or for economic optimisation.

<sup>2</sup> ENTSO-E. Draft Network Code for Load Frequency Control & Reserves. Working Draft. Draft V2. Brussels. 23.01.2013



Processes for frequency control

Reserves for frequency control

**Figure 4: Processes and instrument for load-frequency control**

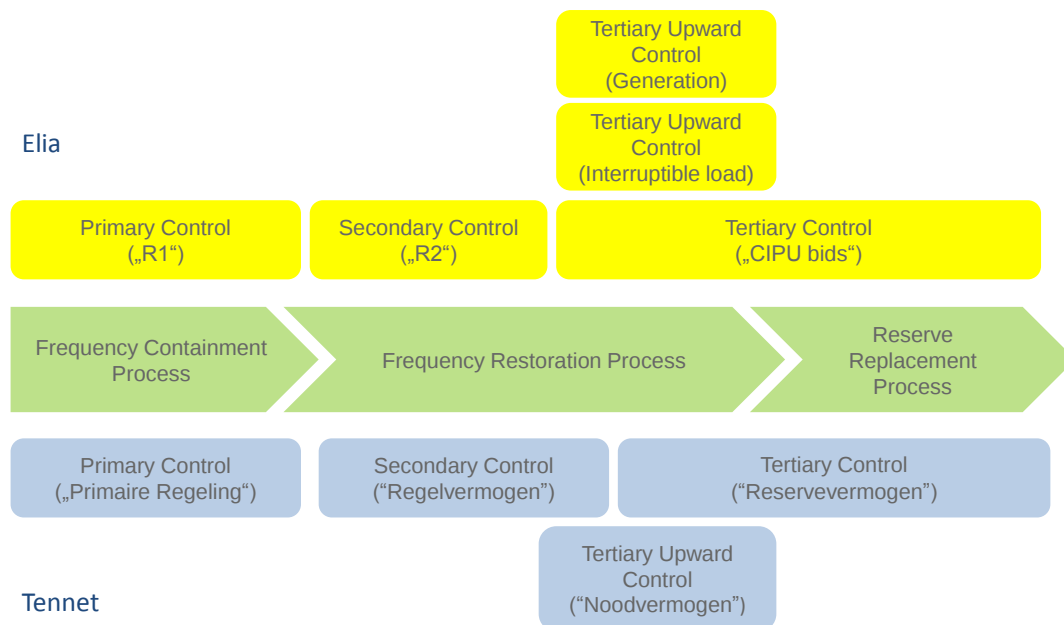
Please note that “firm Capacity” refers to balancing services activated by the TSO, whereas “activate Market” refers to the reaction of market participants on imbalance prices

Source: ENTSO-E

Figure 5 compares the services currently used in Belgium and the Netherlands against the three major processes. As illustrated by this picture both countries use a similar set of products and services. In detail, these services cover the following:

- For frequency containment, both countries use primary frequency control, known as ‘R1’ in Belgium and ‘Primaire Regeling’ in the Netherlands.
- For frequency restoration, both countries use a combination of automatically and manually instructed FRR:
  - Automatically activated and continuously deployed FRR, defined as secondary control and denominated as ‘R2’ in Belgium and ‘Regelvermogen’ in the Netherlands; which is achieved through the continuous activation of particular generating units or portfolios by a centralized controller.
  - Manually activated FRR, referred to as tertiary control and denominated as ‘R3’ in Belgium and ‘Reservevermogen’ in the Netherlands; which is based on manual and discrete instructions by the TSO.
  - In addition, both countries also rely on a special form of manual FRR for upward regulation that is provided (mainly) by interruptible load and that is used in exceptional circumstances only; known as ‘Interruptible Load’ in Belgium and as ‘Noodvermogen’ in the Netherlands; similar to mFRR, manual FRR are activated through manual and discrete instructions..
- In the Netherlands, the product ‘Reservevermogen’ extends beyond the scope of manual FRR and can principally also be used as replacement reserve (with a notice time of up to 1 h).

In addition to these reserve products, both TSOs can also rely on the mutual provision of emergency reserves between themselves and other TSOs that are provided under bilateral agreements between the individual TSOs.



**Figure 5: Overview of balancing services currently used in Belgium and the Netherlands**

Source: DNV KEMA

As indicated by this summary and as also shown in Figure 5, the current classification of operational reserves in Belgium and the Netherlands is effectively based on the requirements and definitions of the UCTE Operation Handbook<sup>3</sup>, i.e. with a differentiation between primary, secondary and tertiary control. Moreover, it is clear that current arrangements focus on FCR and FRR. From a conceptual point of view, tertiary control in the Netherlands represents the only product, which may also be used as a replacement reserve. However, we understand that it is virtually never used for this purpose such that it can basically be interpreted as FRR as well.

<sup>3</sup> Please note that the UCTE Operation Handbook is expected to be replaced by the set of European Network Codes and other applicable ENTSO-E rules and policies in the future.

### **3 CURRENT PRACTICES AND ARRANGEMENTS FOR THE PROCUREMENT AND USE OF BALANCING SERVICES**

#### **3.1 Regulatory Conditions and Restrictions**

Current regulatory requirements for procurement and use of balancing reserves in the two countries share some common principles. Both countries have principally chosen for the market-based procurement of balancing services. In addition, Belgium as well as the Netherlands use annual tenders for the procurement of operational reserves and operate a daily balancing mechanism with additional offers from capacities that have not been contracted in advance. Moreover, generators in both countries are principally obliged to make all capacity that has not been used in the wholesale market available to the daily balancing mechanism.

At the same time, the present arrangements are also distinctly different in other areas.

In the Netherlands, market and regulatory arrangements generally give clear priority to market principles and have been designed with a view to facilitating the market-based provision of balancing energy. Only the provision of frequency containment reserves (primary frequency control) at present represents an exception in this respect as this service has to be provided free of charge by larger generators. However, it is expected to be replaced by market based procurement shortly.

In Belgium, both FCR and FRR, i.e. primary, secondary and tertiary control must be procured through a market-based mechanism<sup>4</sup>, which currently requires the use of annual tenders. However, if offered volumes are insufficient or prices are considered as unreasonable by the regulator, prices or volumes may be set by the Minister of Energy. Although this procedure is principally foreseen as an exception, it is applied on a regular basis in practice. In addition, there are also restrictions on the price of balancing energy provided from automatic FRR (see section 3.3.3). Compared to the Netherlands, the procurement of operational reserves in Belgium is thus subject to several regulatory restrictions or possible interventions.

#### **3.2 Frequency Containment Reserves (FCR)**

##### **3.2.1 Product / Service Specification**

Both countries procure a similar volume of FCR (90 MW in Belgium, 117 MW in the Netherlands) in the form of primary control. In line with the current provisions of the UCTE Operation Handbook, these products share some key requirements, such as a maximum activation time of 30 s. But as shown

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<sup>4</sup> See Arrêté royal établissant un règlement technique pour la gestion du réseau de transport de l'électricité et l'accès à celui-ci. Brussels. 19 December 2002. Art. 236, 243 and 249

in Table 1, there also are several key differences between Belgium and the Netherlands with regards to product differentiation and the provision of this product to the TSO.

The key difference relates to the basic definition of this product. In the Netherlands, where FCR has to be provided by generators on a mandatory basis, provision is limited to a single standard product with a symmetrical regulation band provided by generators. In contrast, Belgium uses four different products, one of which can (and indeed is) provided by load. Generators may choose between providing symmetrical or asymmetrical regulation bands and may furthermore restrict their offers to peak or off peak times. Conversely, industrial loads may separately provide positive FCR, i.e. an asymmetrical regulation band for upward regulation.

Another difference relates to the allowance of a potential deadband of generator governors. In Belgium, no deadband is allowed for the provision of symmetrical FCR by generators. Conversely, providers of an asymmetrical regulation band for either positive or negative FCR are granted a deadband of 100 mHz. In the Netherlands, individual generators with a minimum unit size of 60 MW may only have a deadband if it is compensated by other generators of the same BSPs. In contrast, smaller units with a rated capacity of 5 to 60 MW are granted a deadband of  $\pm 150$  mHz.

It is worth noting that the choice of different products and the allowance of a deadband for asymmetric FCR in Belgium are related to participation of load or, more generally, the desire to ensure compatibility with the technical capability of different potential BSPs, such as CCGTs, nuclear power, or large electricity customers. Indeed, the asymmetrical regulation band from generation serves to supplement the provision of positive FCR from load, in order to obtain the same symmetrical regulation as otherwise available from generators. Similarly, the allowance of a deadband facilitates the participation of load, which might otherwise not be able to meet this requirement.

**Table 1: Main technical properties of FCR**

|                             | Belgium                                                                                                                                                               | The Netherlands                                                                                                                                          |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic product               | Symmetric or asymmetric band                                                                                                                                          | Symmetric band                                                                                                                                           |
|                             | 4 different products                                                                                                                                                  | 1 standard product                                                                                                                                       |
| Deadband                    | <ul style="list-style-type: none"> <li>Symmetric product: None</li> <li>Asymmetric products (<math>R_{1Up}</math> by Load, <math>R_{1Down}</math>): 100mHz</li> </ul> | <ul style="list-style-type: none"> <li>Units &gt;60 MW: only if compensated by other units</li> <li>Units 5 - 60 MW: <math>\pm 150</math> mHz</li> </ul> |
| Quantity held on the system | 90 MW (2013)                                                                                                                                                          | 117 MW (2013)                                                                                                                                            |

Source: DNV KEMA

### 3.2.2 Procurement of Reserves

The procurement of FCR in both countries builds upon fundamentally different approaches.

In the Netherlands, provision of FCR is mandatory for all generators with an installed capacity of more than 60 MW. These generators are required to make a volume equal to 1% of their installed capacity available as FCR whenever they are synchronised with the system. In addition, generators with an installed capacity of between 5 and 60 MW may provide FCR of up to 3% of their rated capacity on a voluntary basis. However, since generators are not currently remunerated for the provision of FCR, this option has not been relevant in practice so far.

In accordance with its legal obligations (compare section 3.1), Elia procures FCR through annual tenders. In practice, the total volume of 90 MW is procured through four different products<sup>5</sup>:

- +/- 30 MW symmetrical band provision from different sources (for deviations up to 100 mHz)<sup>6</sup>
- +/- 30 MW upward reserve load consumers (only for deviations > 100 mHz),
- +/- 30 MW downward reserve from nuclear (only for deviations > 100 mHz),
- +/-30 MW symmetric band provision based on cross-border agreement with French TSO RTE.

The specification of four different products, which have been explained above, facilitates participation of different BSPs, such as industrial loads. This in turn helps to increase the volume of potential offers as well as to reduce the cost of procurement. For similar reasons, BSPs may submit combined offers for FCR and automatic FRR on individual units.

The contracted capacity is remunerated at the offered price (pay-as-bid), whereas there is no remuneration for the energy deviations caused by the operation of FCR. Contracted reserve providers have to keep the committed reserve capacity available during the entire contract period of one year.

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<sup>5</sup> Please note that these numbers are indicative and reflect the split for the year 2013.

<sup>6</sup> In principle, upward / downward reserves may be procured separately. But in practice they are only contracted as a common reserve band for upward and downward regulation.

### 3.3 Automatic Frequency Restoration Reserves (aFRR)

#### 3.3.1 Product / Service Specification

As illustrated by Table 2 the product definitions as well as the use of automatic FRR differ significantly between Belgium and the Netherlands.

In Belgium, generators are required to guarantee a ramp rate of 15% of the capacity offered. In addition, Elia activates all available offers that have been pre-selected to provide aFRR in real time in parallel, i.e. on a pro rata basis. Conversely, providers of automatic FRR in the Netherlands have to ensure a minimum ramp rate of 7% of the capacity offered only. In addition, TenneT generally activates aFRR by merit order, although it may proceed to parallel activation of all available offers in case of larger system deviations.

Another difference relates to the differentiation of two different reserve products between peak and off peak periods by Elia, whereas TenneT procures a single standardised product.

These variations reflect a fundamental difference in the overall approach chosen by the two TSOs, although both approaches are ultimately aimed at reducing the cost of balancing. In the Netherlands, the use of a simple standard product facilitates the participation of different plants / technologies, which can be expected to increase the volume of offers from market participants. Similarly, the merit order based activation of aFRR serves to reduce balancing costs, with possible deviations in order to remain within the minimum standards of regulation quality to be fulfilled by the TSO.

In contrast, Elia focuses on an optimal use of available flexibility in Belgium and on minimising the volume of aFRR to be held on the system, in order to reduce cost for reservation of capacity. The separate contracting of aFRR for different time periods and the remuneration of contracted capacities at the offered price ('pay as bid') serves the same purpose. At the same time, parallel activation of all available capacity enables Elia to respect quality targets with a relatively small volume of aFRR that is below the level recommended in the UCTE Operation Handbook.

**Table 2: Main technical properties of automatic FRR**

|                             | Belgium                                                        | The Netherlands                                                                                                               |
|-----------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Ramp rate                   | 15% of capacity offered                                        | ≥ 7% of capacity offered                                                                                                      |
| Activation                  | Pro-rata                                                       | Sequential by merit order, but may be changed to parallel activation whenever required; re-optimization each PTU <sup>7</sup> |
| Products                    | 2 products (peak/ off-peak),<br>Separate for downward / upward | 1 product,<br>separate for upward / downward                                                                                  |
| Quantity held on the system | 145 MW (2013)                                                  | ≥ 300 MW (2013)                                                                                                               |

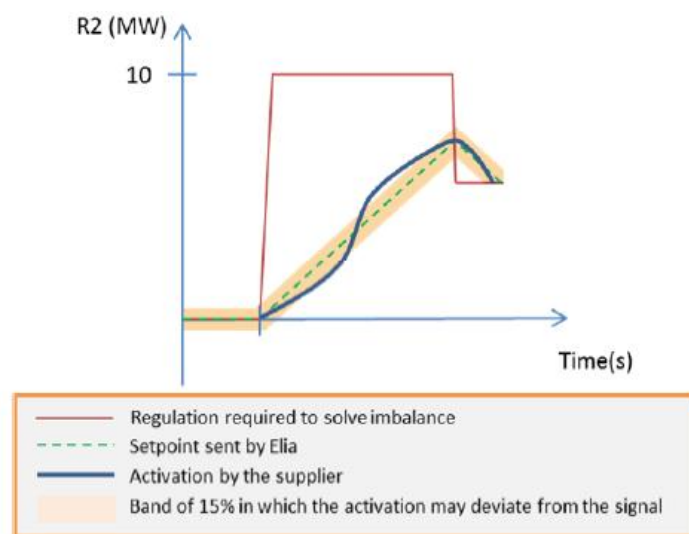
Source: DNV KEMA

Apart from the basic product specifications, the two countries also apply different principles with regards to the qualification and monitoring of BSPs. In Belgium, technical capability of each BSP (and his generating units) is testified and certified in a pre-qualification procedure. Conversely, there is no formal pre-qualification procedure in the Netherlands but only a requirement to have the right technical devices for processing activation signals.

In addition, Elia also monitors the provision of aFRR in real-time and compares performance against a quality standard. More precisely, and as illustrated by Figure 6, the volume of aFRR supplied at any point in time must not deviate by more than 15% from the dynamic setpoint sent by Elia. Please note that this condition applies to the aggregate (production) portfolio of a BSP but not to individual generating units.

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<sup>7</sup> This shall avoid excess margins from strategic bidding by setting a low price for PTU n and a much higher price for PTU n+1.



**Figure 6: Ramping requirement for aFRR in Belgium**

Source: Elia

### 3.3.2 Procurement of Reserves

The arrangements for the procurement of automatic FRR are quite similar in Belgium and the Netherlands. Both countries procure aFRR on an annual basis to ensure that the TSO has sufficient reserves available throughout the year. Service providers are allowed to offer aFRR on a portfolio basis and are remunerated at the offered price ('pay as bid') for contracted capacity. Once the providers are selected, they have to keep the contracted amount of reserve available for 100% of the time<sup>8</sup> from their entire portfolio and bid the corresponding volumes of capacity into the daily balancing market (see section 3.3.3 below)<sup>9</sup>.

As illustrated by Table 3, the main difference relates to the differentiation of different products. In Belgium, aFRR is separately procured for peak or off-peak hours, which may result in different contributions from different BSPs at different points in time. In contrast, TenneT contracts for a constant regulation band that has to be guaranteed for all hours of the year. Finally, it is worth noting that a reserve provider may not accumulate more than 50 MW of aFRR on a single unit in Belgium, in order to avoid risks for security of supply.

<sup>8</sup> 100% availability is required in Belgium as of 2013.

<sup>9</sup> In Belgium, service providers may exchange their reserve obligations with other parties in a secondary market.

**Table 3: Main arrangements for procurement of automatic FRR**

|                          | Belgium                                         | The Netherlands                                   |
|--------------------------|-------------------------------------------------|---------------------------------------------------|
| Procurement of capacity  | Annual tender                                   |                                                   |
| Availability requirement | 100%                                            |                                                   |
| Products                 | Volumes differentiated by time (peak, off-peak) | Constant volume over time, to be bid as R2 on MOL |
| Provision                | Portfolio-based                                 |                                                   |
| Remuneration             | Pay-as-bid for reserve ( MW)                    |                                                   |

Source: DNV KEMA

### 3.3.3 Procurement and Activation of Balancing Energy

For activation of aFRR, power both countries make use of a similar mechanism but apply different principles for activation and pricing.

To start with, both Elia and TenneT use an open daily balancing mechanism for the final selection and activation of aFRR. Pre-contracted reserve providers that were selected in the annual tender for aFRR capacity are required to place mandatory bids in accordance with their reserve contract. To facilitate an optimal use of available resources, the bid ladder is also open for additional bids from other interested parties who have the technical ability for providing aFRR as well as from pre-contracted BSPs who can offer additional volumes beyond their contractual obligations. In both countries, (mandatory) offers from contracted reserves and additional daily offers are then combined into a common bid ladder, from which the most economic ones are reserved and/or used for activation in real-time.

In the Netherlands, market participants are formally obliged to offer all unused capacity that is technically capable of providing aFRR. However, we understand that it is basically left to the discretion of market participants to decide whether they have corresponding capacity available, such that the provision of aFRR from uncontracted capacities basically is voluntary.

As illustrated by Table 4, one difference relates to the use of unit-based offers in Belgium vs. portfolio-based offers in the Netherlands. Nevertheless, the activation and delivery of aFRR is based on each BSP's entire portfolio in both countries, such that this difference arguably is of limited relevance.

In contrast, Elia and TenneT apply fundamentally different principles for the selection and activation of aFRR:

- In Belgium, Elia decides on the final selection of offers that can be activated in real time on the day ahead. Bids are selected by merit order and to the extent of Elia's need for aFRR<sup>10</sup>. During real time operations, Elia activates all aFRR that have been pre-selected on the day ahead in parallel.
- In the Netherlands, BSPs may adjust their offers for aFRR until one hour ahead of real time. Furthermore, TenneT does not select any offers in advance but activates the necessary volume of aFRR in real time. For this purpose, mandatory bids from pre-contracted reserve providers as well as voluntary bids are combined in a common merit order. During normal circumstances, the activated volume corresponds to the real time need for aFRR, although TenneT may also activate larger volumes in case of larger system imbalances.

In comparison, Elia thus always activates a constant volume of aFRR, which is basically equivalent to the volume of pre-contracted reserves. In contrast, the volume of activated aFRR in the Netherlands constantly changes in real time. Moreover, it is worth noting that the volume of aFRR that can be activated by TenneT is not limited to the volume of pre-contracted reserves, subject to the availability of additional voluntary offers.

Similarly, the two countries also use different arrangements for the remuneration of balancing energy delivered from aFRR:

- In Belgium, balancing energy from aFRR is remunerated at the offered price ('pay-as-bid'). In addition, offers for aFRR must comply with certain regulatory restrictions. More specifically, the price for upward regulation may not exceed the assumed fuel costs of a generic CCGT plant (with 50% efficiency) plus 40 €/MWh, while the price for downward regulation may not be negative (i.e. Elia does not pay to the BSP for downward adjusting production).
- Conversely, balancing energy is remunerated at the marginal price of combined automatic and manual FRR activation in each PTU in the Netherlands. For pre-contracted aFRR, offer prices furthermore have to remain within a certain range around the hourly market price in the DAM. Due to the principle of marginal pricing, however, this restriction appears to be of limited relevance in practice.

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<sup>10</sup> As further explained in section 3.4.3 any remaining offers are transferred to the merit order manual FRR.

**Table 4: Main features for procurement and use of automatic FRR balancing power**

|                                      | Belgium                                                                                                                                                             | The Netherlands                                                                                                                                                   |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Procurement mechanism (daily market) | <ul style="list-style-type: none"> <li>• Mandatory offers for contracted reserves</li> <li>• Free offers by other generators</li> <li>• Gate closure D-1</li> </ul> | <ul style="list-style-type: none"> <li>• Mandatory offers for contracted reserves and other ‘available capacity’</li> <li>• Gate closure H-1</li> </ul>           |
| Provision                            | <ul style="list-style-type: none"> <li>• Unit-based offers, but portfolio-based activation</li> </ul>                                                               | <ul style="list-style-type: none"> <li>• Portfolio-based (offers and activation)</li> </ul>                                                                       |
| Pricing restrictions                 | <ul style="list-style-type: none"> <li>• Price range around generic generation costs</li> </ul>                                                                     | <ul style="list-style-type: none"> <li>• Bid price range around DAM market prices (for contracted capacity only)</li> </ul>                                       |
| Activation                           | <ul style="list-style-type: none"> <li>• Parallel activation</li> <li>• Limited to pre-selected reserves (i.e. selected on D-1)</li> </ul>                          | <ul style="list-style-type: none"> <li>• Based on merit order for aFRR, with option of parallel activation whenever required; re-optimisation each PTU</li> </ul> |
| Remuneration                         | <ul style="list-style-type: none"> <li>• Pay-as-bid</li> </ul>                                                                                                      | <ul style="list-style-type: none"> <li>• Marginal pricing (combined for aFRR and mFRR)</li> </ul>                                                                 |

Source: DNV KEMA

As mentioned, Elia always activates all pre-selected aFRR in parallel, whereas the volume of activated aFRR depends on the PACE<sup>11</sup> in the Netherlands. This difference also influences the effective ramp rate of aFRR as well as the time required for correction of a system deviation in both countries.

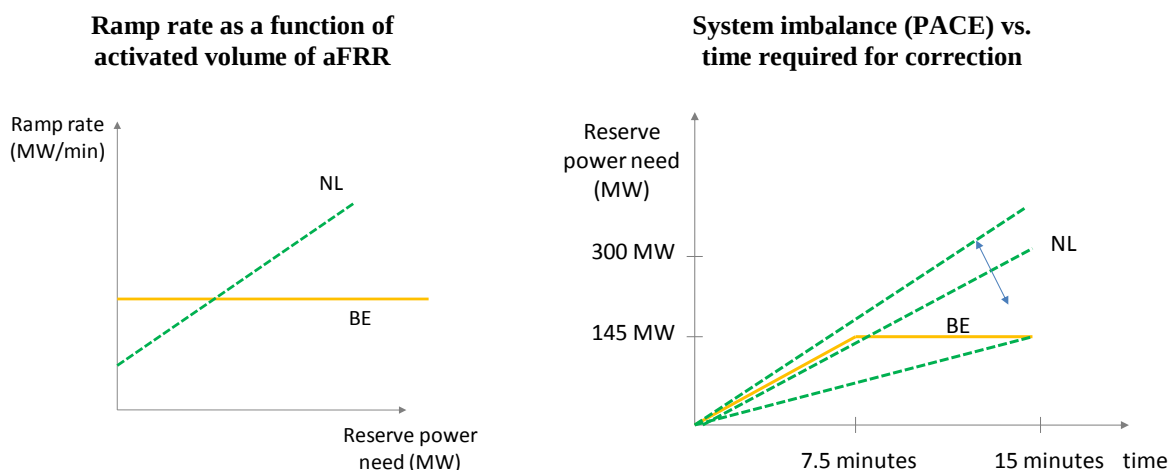
This effect, which is illustrated in Figure 7, can be explained as follows:

- Since Elia always activates the total volume of pre-selected aFRR (145 MW), aFRR reacts with a constant ramp rate of approx. 20 MW/min in Belgium.
- Conversely, the effective ramp rate in the Netherlands increases with the volume of activated aFRR. For instance, it will be as low as 7 MW/min when 100 MW of aFRR have been activated but will only reach a value of 20 MW/min when 290 MW of aFRR have been activated. As a result, the effective ramp rate in the Netherlands will normally be less than in Belgium, although it may also become larger, which is the case when TenneT activates more than 290 MW of aFRR<sup>12</sup>.

<sup>11</sup> Processed Area Control Error

<sup>12</sup> Please note that TenneT may decide to increase the volume of activated offers, in order to achieve the required ramp rate.

- In the Netherlands, the necessary correction will always be achieved after 15 minutes, at least as long as TenneT activates aFRR by merit order<sup>13</sup>.
- In contrast, the time required for correction of a system deviation depends on the size of the system imbalance in Belgium. For instance an imbalance of 30 MW will already be compensated within 1.5 minutes in Belgium, whereas it will take 7.5 minutes to compensate a deviation of 145 MW.



**Figure 7: Activation speed and ramp rate requirements in Belgium and Netherlands**

Source: DNV KEMA

These examples show that the combination of a larger minimum ramp rate and parallel activation allows Elia maintaining a high level of regulation quality even with a limited volume of aFRR. As already mentioned above, reducing the volume of contracted aFRR has the major advantage of limiting the costs of reserve contracts and thereby keeping the access tariffs for ancillary services at an acceptable level. However, the parallel activation of aFRR restricts the scope for establishing a real-time market in Belgium. Moreover, due to the predictability of the volume of accepted offers, it is more difficult to rely on free market-based pricing; which is one of the reasons why Belgium has decided for the application of price caps. In combination with the existing restrictions on the remuneration of balancing energy from aFRR, this furthermore reduces interest from market parties to bid additional volumes of aFRR into the daily balancing mechanism without receiving a capacity fee.

Conversely, the combination of a reduced ramp rate of individual bids and activation of mandatory and voluntary offers by merit order in the Netherlands provides for an attractive market and helps to attract additional volumes of aFRR into the daily balancing mechanism. As explained above, this advantage principally comes at the expense of a reduced system ramp rate at times when only a limited volume of automatic FRR is activated. Indeed, the existing arrangements allow TenneT

<sup>13</sup> And assuming that aFRR is always provided at the minimum ramp rate of 7% per minute.

complying with the applicable ENTSO-E requirements, which stipulate that an event has to be resolved within 15 minutes. Moreover, by activating additional volumes of aFRR or even changing to parallel activation in case of larger imbalances, TenneT is furthermore able to achieve the same, or even a higher, ramp rate as Elia where necessary.

### 3.3.4 Role of IGCC

In the course of 2012, both TSOs joined the International Grid Control Cooperation (IGCC) which is formed by various Central and Western European TSOs. It was initially designed by the four German TSOs to stepwise enhance cooperation on the use of aFRR in Germany (German Grid Control Cooperation - GCC).

The GCC was introduced gradually and comprises of four modules:

- *Module 1 – Avoiding counter-activation of balancing energy from aFRR*  
Module 1 serves the purpose of avoiding respectively minimising the activation of aFRR. This is achieved by netting the imbalances of the individual control areas, which will result in a reduced use of aFRR whenever the individual system imbalances have different signs.
- *Module 2 – Common dimensioning of operational reserves*  
The aim of module 2 is to jointly define the required reserve capacity requirements for the GCC. Due to stochastic averaging effects (similar to module 1), the combined volume of aFRR is expected to be smaller than the sum of the individual ones.
- *Module 3 – Common procurement of the secondary control reserve*  
The aim of module 3 is to lower the procurement costs, due to increased competition which providers of aFRR face in a Germany-wide market. As such, the required amount of operational reserves (commonly determined in module 2) is jointly procured from all four control areas.
- *Module 4 – Cost-optimal activation of aFRR bids*  
Module 4 aims to lower the costs of balancing energy by calling bids from a single merit order list (MOL) that covers all of Germany. This MOL is determined in module 3.

As said before, Module 1 has the aim of avoiding the counter-activation of aFRR. This is achieved by means of exchange of a virtual tie line between participating control areas, whilst the structure of the existing control areas remains intact. Since opposed system imbalances in different countries are compensated prior to activation of aFRR, the IGCC principally leads to a reduced activation of aFRR. Indeed, in the one year since the Netherlands have joined, the IGCC has allowed for a significantly reduced activation of balancing energy from aFRR.

TenneT and Elia joined IGCC module 1 in February and October 2012, respectively. Due to the absence of a direct link between Germany and Belgium, the Belgian control area is connected to the IGCC via the Netherlands. The other modules which have been implemented by the German TSOs have not yet been extended to the IGCC.

### 3.4 Manual Frequency Restoration Reserves

#### 3.4.1 Product / Service Specification

The product specifications of manual FRR differ significantly between the two countries, although there are some common features as well. To start with, generators principally are the main source of this product in both countries, but both of them also facilitate the participation of consumers. More specifically, Elia has introduced a tailored product for interruptible customers, whereas TenneT preferably tries to procure part of one of its products (“Noodvermogen”) from interruptible load. Moreover, and similar to the case of aFRR, both countries rely on contracted reserves as well as additional bids in the daily balancing market.

As shown by Table 5, there are some important differences with regards to activation and time till delivery. In Belgium, all mFRR are directly activated. For generators, the activated reserves must be available in 15 minutes. In contrast, mFRR from interruptible load must be fully activated within 3 minutes. All reserves may be partially activated and for any period of time, i.e. even for less than 15 minutes.

Thus, Belgium’s approach is to use products which are kept as flexible as possible but at the same time diversified and tailored to the technical capability and constraints of BSPs. For instance, upward tertiary reserve from interruptible load is possible under three different contract types which contain specific activation constraints.<sup>14</sup>

Conversely, the basic product definition of manual FRR in the Netherlands is based schedule-based activation, i.e. a simple, standardized energy product that corresponds to the settlement time unit and does not impose any requirements with regards to ramping and deactivation. As such, it can be easily procured and priced against the market. All schedule-activated mFRR have to be activated by the start of the next PTU, which means that the time between the call for activation and full delivery may vary between a couple of seconds (call at the end of the corresponding PTU) and almost 15 minutes (call shortly after the start of the corresponding PTU). Moreover, as activation is based on schedules,

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<sup>14</sup> At the maximum duration of a single interruption, the maximum aggregate duration of all interruptions, the maximum number of interruptions in the contract period, as well as the minimum time between two interruptions and times of non-availability.

balancing energy is always deployed for entire 15-minute intervals. Finally, bids may be activated in full only but cannot be called off partially.

However, it is worth noting that these conditions do only apply to the provision of basic mFRR in the Netherlands. Supplementary to the Merit Order List, TenneT has also introduced a special product (“Noodvermogen”), which is directly activated and which has to be fully delivered within less than 15 minutes. This additional product shall ensure a fast reaction in critical situations, i.e. where schedule-based activation is expected to be insufficient or not fast enough.

**Table 5: Main technical properties of manual FRR**

|                 | Belgium                                |                       | The Netherlands                   |                    |
|-----------------|----------------------------------------|-----------------------|-----------------------------------|--------------------|
|                 | Balancing bids and contracted reserves | “Interruptible Loads” | Balancing bids                    | “Noodvermogen”     |
| Activation      | Directly-activated                     |                       | Schedule-activated                | Directly-activated |
| Activation time | ≤ 15 min                               | ≤ 3 min               | next PTU<br>(“1 sec. to 15 min.”) | ≤ 15 min           |
| Min. activation | N.A. (also <15min)                     | N.A.                  | 15 min                            | 15 min             |

Source: DNV KEMA

### 3.4.2 Procurement of Reserves

For the procurement of manual FRR, the arrangements are quite similar in both countries, as is also shown in Table 6 below. Both countries use annual tenders to contract upward mFRR, while downward reserve is not contracted at all. Contracted reserves must be kept available for (close to) 100% of the time during the entire contract period. All pre-contracted reserves are remunerated at the offered price (‘pay as bid’). Finally, current arrangements provide for certain conditions on the pricing of balancing energy from contracted mFRR in both countries, with a cost-based approach in Belgium but a link to hourly wholesale market prices in the Netherlands.

Currently, Belgium procures 400 MW of reserve from generators and approx. 260 MW from interruptible load. In the Netherlands, mFRR is contracted in the form of “Noodvermogen”, with a total volume of 350 MW. Although Elia thus contracts for substantially more mFRR than TenneT, it is worth bearing in mind that Belgium contracts for 145 MW aFRR only, which is less than 50% of the 300 MW of aFRR contracted for in the Netherlands.

**Table 6: Main properties of process for procurement of manual FRR reserves**

|                                 | Belgium                                                         | The Netherlands                                    |
|---------------------------------|-----------------------------------------------------------------|----------------------------------------------------|
| Procurement mechanism           | 400 MW generation<br>261 MW load                                | 350 MW                                             |
| Procurement mechanism           | Annual tender                                                   |                                                    |
| Availability requirement        | Close to 100% for contracted resources                          |                                                    |
| Products                        | Only upward regulation; supplementary to MOL                    |                                                    |
| Remuneration                    | Pay-as-bid for reserve ( MW)                                    |                                                    |
| Pricing restrictions for energy | Cost-based for generators,<br>Belpex D-1 for interruptible load | Formula<br>(Marginal +, contractual minimum APX +) |

Source: DNV KEMA

### 3.4.3 Procurement and Activation of Balancing Energy

The arrangements for the daily balancing mechanism show many similarities as well as some key differences. In both countries, participation in the daily balancing mechanism is compulsory for pre-contracted reserves as well as for other large generators (with an installed capacity of 75 MW or more in Belgium and 60 MW or more in the Netherlands), whereas smaller parties as well as other consumers can participate on a voluntary basis. Similarly, balancing energy from mFRR is activated by merit order in both countries. Nevertheless, the merit order is initially limited to non-contracted reserves (whether offered on a mandatory or voluntary basis), whereas contracted reserves are only used once the former have been fully utilised.

Apart from these common principles, there are also some significant differences between both countries. For example, Belgium applies the principle of implicit bidding. This means that available volumes are determined by the TSO, based on the current production schedule of each generating unit, whilst the corresponding prices are derived from the price bids placed by the BSP. Conversely, bidding is explicit in the Netherlands, i.e. all bids contain both price and volume information.

**Table 7: Main properties of process for procurement and use of balancing energy from mFRR**

|                                      | Belgium                                                                                                                                                                                                                                                                    | The Netherlands                                                                                                                                                                                                              |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Procurement mechanism (daily market) | <ul style="list-style-type: none"> <li>• Mandatory for contracted reserves and other 'available capacity' from generators &gt;75 MW</li> <li>• Voluntary for smaller parties</li> <li>• Gate closure:<br/>D-1 for pre-contracted reserves<br/>H-1 for free bids</li> </ul> | <ul style="list-style-type: none"> <li>• Mandatory for contracted reserves and grid connected parties with a connection agreement &gt; 60 MW</li> <li>• Voluntary for smaller parties</li> <li>• Gate closure H-1</li> </ul> |
| Bidding                              | Implicit bidding<br>(Partial activation possible)                                                                                                                                                                                                                          | Explicit bidding<br>(Activation of full bids)                                                                                                                                                                                |
| Activation                           | By merit order<br>(sequential activation order for a) free bids and b) contracted reserves)                                                                                                                                                                                |                                                                                                                                                                                                                              |
| Provision                            | <ul style="list-style-type: none"> <li>• Unit-based offers, but portfolio-based activation for free bids</li> <li>• Unit-based activation for pre-contracted reserves</li> </ul>                                                                                           | <ul style="list-style-type: none"> <li>• Portfolio-based (offers and activation)</li> <li>• Regionally defined (for re-dispatch)</li> </ul>                                                                                  |
| Remuneration                         | <ul style="list-style-type: none"> <li>• Pay-as-bid</li> </ul>                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>• Marginal pricing (combined automatic and manual FRR) (pay as bid for re-dispatch)</li> </ul>                                                                                        |

Source: DNV KEMA

Other differences relate to the gate closure for bids and offers as well as to the principles for activation. In Belgium, the gate closure for daily bids is H-1 for free bids but on the day before for bids from contracted reserves. In the Netherlands, BSPs are always able to change their bids until one hour ahead of real time. Similarly, offers and activation are on a portfolio basis in the Netherlands, whilst Elia requires unit-based offers. Nevertheless, whilst pre-contracted reserves are bids and may be activated on a unit-basis only in Belgium, free bidders offer mFRR on a unit-basis but may use their asset portfolio to serve an activation request. Even more importantly, all activated bids are remunerated at the offered price ('pay as bid') in Belgium, whereas all activated bids are remunerated at the marginal price of all balancing energy provided from automatic and manual FRR in the Netherlands.

In addition, the actual use of mFRR is also rather different. In Belgium, Elia routinely uses manual FRR, especially in case of persistent or larger imbalances. Consequently, a considerable amount of total balancing energy is provided by manual FRR. In contrast, manual FRR is hardly used in the Netherlands. One of the reasons is that use of a schedule-based product may result in situations with a counter activation of manual and automatic FRR.

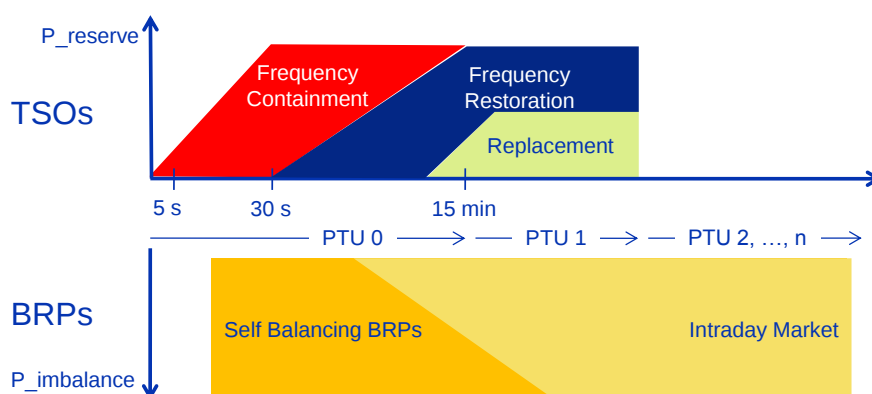
### 3.5 Replacement Reserves

In the Netherlands, offers for manual FRR may not only be called off for the next PTU but also for any of the following three PTUs, i.e. up to 1 hour before real time. Since the activation time is clearly greater than 15 minutes in this case, these cases may be considered as the use of replacement reserves. However, we have been informed by TenneT that this product is hardly ever used, except for reasons of re-dispatch.

In contrast, the Belgian system does not provide for an equivalent type of reserve. All reserves fall into the categories of FCR or FRR.

### 3.6 Imbalance Settlement

Prior to discussing the arrangements for imbalance settlement, it is important to note that Elia and TenneT pursue a 'reactive' balancing philosophy. Arrangements for imbalance settlement aim at providing clear and effective incentives for self-balancing of BRPs. In line with this approach, the time horizon of balancing services used by Elia and TenneT is principally limited to the current and the next consecutive PTU (see Figure 8), whereas BRPs are responsible for balancing themselves from PTU+2 at the latest, i.e. within a maximum of 30 minutes after an incident. Moreover, both TSOs try to incentivise BRPs to react immediately and reduce their imbalances, for instance by means of self-balancing or through the intra-day market, in order to resolve the deviations which have to be resolved by the TSO.



**Figure 8: Sharing of balancing responsibility between the TSO and market participants in Belgium and the Netherlands**

Source: DNV KEMA

For this purpose, imbalances prices are set equal to the marginal price of balancing actions, i.e. the activation of both automatic and manual FRR. However, whilst both countries try to reflect the system status as good as possible, they have chosen different structural options in terms of pricing.

As shown in Table 8 Belgium applies a single price scheme that is based on the net volume of balancing actions taken in any PTU. In addition, an additional incentive component is ‘added’<sup>15</sup> to the imbalance price in PTUs when the system imbalance<sup>16</sup> exceeds 140 MW (which corresponds to the volume of automatic FRR).

In contrast, the Netherlands use a hybrid pricing scheme, which changes between single and dual pricing, depending on the balancing actions taken by the TSO in each PTU. Whenever TenneT has taken balancing actions into one direction only, i.e. either upward or downward regulation, there is a single imbalance price, which is set equal to combined marginal price of all balancing energy activated from automatic and manual FRR in that PTU. Conversely, if the TSO has activated both upward and downward regulation in a single PTU, the system changes to dual imbalance prices. In the latter case, the price of positive and negative imbalances is set equal to the marginal price of all balancing actions for upward and downward regulation, respectively, in that PTU. In both cases, the resulting imbalance price(s) in the Netherlands may be adjusted by adding or subtracting an additional incentive component. This incentive is based on system performance over the last week and is adjusted weekly.

<sup>15</sup> I.e. the imbalance price is increased in case of positive balancing actions (system deficit) but decreased in PTUs with negative balancing actions (system surplus).

<sup>16</sup> Calculated as the difference between the Area Control Error and the net regulation volume

**Table 8: Summary of imbalance settlement regime**

|                              | Belgium                                          | The Netherlands                                                                         |
|------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------|
| <b>Basic scheme</b>          | Single price<br>(based on net balancing actions) | Single or dual price<br>(based on balancing actions)                                    |
| <b>Price basis</b>           | Marginal price of FRR                            |                                                                                         |
| <b>Additional incentives</b> | Based on total system imbalance                  | This incentive is based on system performance over the last week and is adjusted weekly |

Source: DNV KEMA

In both countries, the costs of capacity reservation are not taken into account for imbalance settlement but are recovered from network users through use of system charges. Any residual margins from the balancing mechanism are transferred back to network users through the use of system tariffs. This is especially relevant for Belgium where remuneration of balancing energy at the offered price (pay-as-bid) in combination with marginal pricing for imbalances may result in considerable margins for the TSO.

As mentioned above, the imbalance pricing regime in both countries is aimed at providing incentives for self-balancing by BRPs. In order to further strengthen these incentives and enable BRPs to assess the current status of the system, both TSOs furthermore publish price-relevant information close to real time. Nevertheless, it is worth noting that imbalance prices are mainly determined by manual FRR in Belgium, while they are predominantly linked to the activation of automatic FRR in the Netherlands. As further explained in section 4.1 below, this difference stems from a different use of manual and automatic FRR in both countries.

### 3.7 On-going Developments and Potential Changes

In the previous sections we have described the current practices and arrangements for balancing. In parallel, both countries are investigating changes to the national regulations, in order to present arrangements and the functioning of the balancing mechanisms.

Among others, the two TSOs are currently engaged in the following initiatives:

- Facilitate provision of FCR and aFRR from additional BSPs in Belgium
- Secondary trading of reserve obligations in Belgium
- Investigation of shorter procurement periods in Belgium

- Possibility to aggregate several power plants in Belgium
- Investigation of market-based procurement of FCR in the Netherlands.

In Belgium, Elia has diversified its sources for the provision of FCR and aFRR through product diversification (see above) and by adapting technical requirements, in order to facilitate the participation of technologies (e.g. nuclear, load), which did not normally provide the corresponding services in the past. In addition, Elia has been investigating how to attract new providers, such as the potential contribution aFRR by CHP units.

Increasing amounts of renewable generation in Belgium<sup>17</sup> in combination with a considerable share of generation from inflexible nuclear generation (5,500 MW) leads to minimum load problems (also referred to as ‘incompressibility’) and increases the need for downward reserves, especially manual FRR. Since 2012 Elia offers the possibility to use and aggregate power plants within the CIPU contract. Today, generators with a so-called CIPU contract<sup>18</sup> and an installed capacity of at least 25 MW represent the main source of daily offers for manual FRR. Elia’s latest initiative therefore aims at attracting more voluntary bids from generators without a CIPU contract. The latter comprises e.g. downward regulation from wind power and has been active since 2012.

In addition, Elia has introduced additional instruments to attract new balancing sources. Potential reserve providers may now offer primary and secondary reserve on the same unit.<sup>19</sup> For the same purpose, a secondary market for reserve obligations has been set up for FCR (and aFRR). This market gives pre-contracted reserve providers the opportunity to temporarily transfer part of their reserve obligation to other market parties on the day-ahead, provided that the latter are offer at least a technically equivalent capability to provide the corresponding service.

Apart from retrieving new balancing sources, Elia also investigates a transition to shorter procurement cycles, i.e. the introduction of shorter contract durations and procurement closer to actual delivery. The aim of this measure would be to facilitate the participation of smaller BSPs as well as to generally increase the attractiveness of the ancillary services market for both traditional and new BSPs. Indeed, the current use of annual contracts exposes BSPs to considerable risk, due to uncertainty on the development of fuel, CO<sub>2</sub> and electricity prices during the year. This may not only increase the price of operational reserves but can also limit the volumes, which market participants are willing to offer to the TSO.

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<sup>17</sup> Combined with incentives of the renewable promotion scheme to feed electricity into the system irrespective of the system status.

<sup>18</sup> This contract must be signed by any generator larger than 20 MW and directly connected to the transmission grid or with significant impact on the transmission network.

<sup>19</sup> Despite the potential risk of partial unavailability of primary and secondary reserve from an outage of the corresponding unit.

In the Netherlands, TenneT currently investigates a potential change to market-based procurement of FCR. Apart from a national mechanism, TenneT has also studied the general feasibility of other options, such as a common procurement mechanism for Germany and the Netherlands.<sup>20</sup> According to a recent study prepared in this respect, Dutch producers might be able and willing to provide a volume of FCR, which is far in excess of the local needs of the Netherlands. In practice, however, the exchange of FCR obligations between TSOs would remain subject to limitations pursuant to the Network Code on Load-Frequency Control.

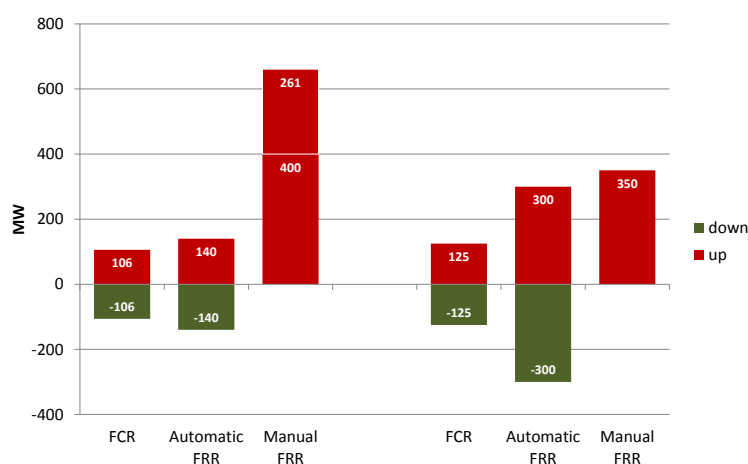
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<sup>20</sup> Consentec. Market Study on a Common Market for Primary Control Reserve in the Netherlands and Germany. Aachen. 2012

## 4 EXPERIENCES TO DATE

### 4.1 Brief Quantitative Analysis

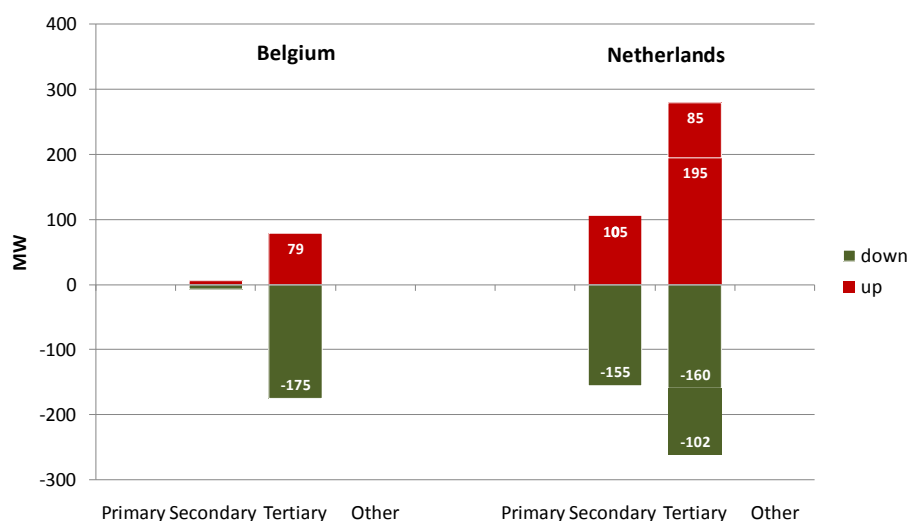
As explained in the previous chapter both countries make use of advance contracting, in order to ensure the availability of sufficient operational reserves. Figure 9 provides an overview of the corresponding volumes of different services contracted by Elia and TenneT. This figure shows that both countries procure a similar volume of FCR, reflecting the comparable size of both systems. In spite of this, the Netherlands contract for about twice as much automatic FRR as Belgium. Elia procures a much larger volume of manual FRR. The latter partially reflects the size of the nuclear plants in Belgium as well as operational constraints on the use of FRR provided by interruptible customers. Besides the volumes shown in Figure 9, both TSOs have bilateral agreements for delivery of emergency power with neighbouring TSOs, including an agreement for  $\pm 250$  MW between Elia and TenneT.



**Figure 9: Volume of operational reserves contracted by Elia and TenneT (2012)**

Source: DNV KEMA, based on data from Elia/ TenneT

As indicated above, both TSOs have access to additional volumes of FRR through the daily balancing mechanism. Figure 10 shows the average uncontracted volumes, which were available to Elia and TenneT in 2012. It is clearly visible that both TSOs had access to considerable volumes of additional manual FRR, partially owing to the compulsory provision of mFRR by large generators. Conversely, there were hardly any additional offers for automatic FRR in Belgium. In contrast, Dutch producers offered more than an average of 100 MW of both upward and downward automatic FRR in 2012, i.e. more than 30% of the volume of contracted aFRR. Yet, it is important to note that these volumes were not available at all time, i.e. TenneT often has additional volumes of positive aFRR available during off peak hours but much less (or even nothing) during peak hours. Similarly, additional downward regulation is mainly available during peak hours.



**Figure 10: Average Additional volumes of operational reserves available on a daily basis (2012)**

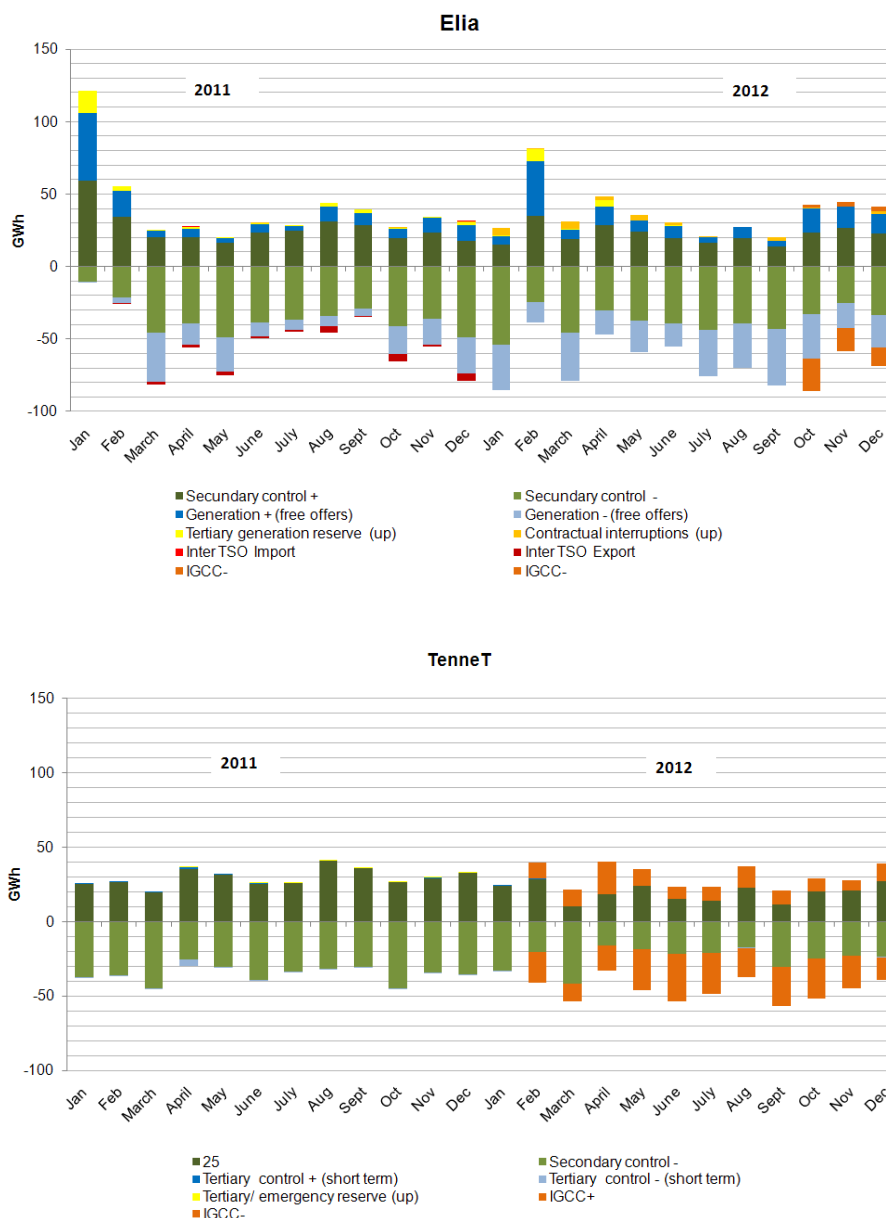
Source: DNV KEMA, based on data from Elia / TenneT

Figure 11 shows the volumes of balancing energy, which were activated by TenneT and Elia in 2012. This figure allows for several observations:

- Both power systems were consistently ‘long’ in 2012, i.e. there was a considerable surplus of energy. This is especially evident in Belgium since Elia activated almost twice as much balancing energy for downward regulation than for upward regulation. This effect is less marked for the Netherlands (factor 1.3), although the Dutch numbers are also influenced by the impact of the IGCC (see below).
- Although Belgium contracts for a similar volume or even less operational reserves than the Netherlands, the amount of activated FRR exceeds the corresponding volumes in the Netherlands considerably (240%), especially in terms of downward balancing energy.
- In both countries, automatic FRR represent the main source of balancing energy. However, whilst the Netherlands made almost exclusive use of automatic FRR in both 2011 and 2012, Elia also activated significant volumes of manual FRR. Indeed, manual FRR accounted for nearly 40% of all balancing energy in Belgium in 2012.
- In both countries, the volume of activated balancing energy has been substantially reduced since joining the IGCC. This trend is particularly visible in the Netherlands, but it can also be observed in Belgium in the last three months of the year, at least for downward regulation.

Although this is not shown in Figure 11, it is also interesting to compare the resulting financial impact, i.e. the total costs and revenues for the different services. In this context, we note that TenneT paid significantly more for the activation of automatic FRR in 2012 than Elia, although it activated considerably less energy. For example, TenneT paid € 28 million for the activation of approx. 207 GWh of upward regulation, whereas Elia paid some € 16 million for 262 GWh. Similarly, Dutch producers did only paid € 2 million for 269 GWh of downward aFRR, whilst Elia received € 22

million for 440 GWh. These numbers indicate that TenneT has to pay relatively more for balancing energy than Elia. This can be partially explained by the principle of marginal pricing in the Netherlands vs. remuneration at the offered price and regulatory restrictions on the price of aFRR in Belgium

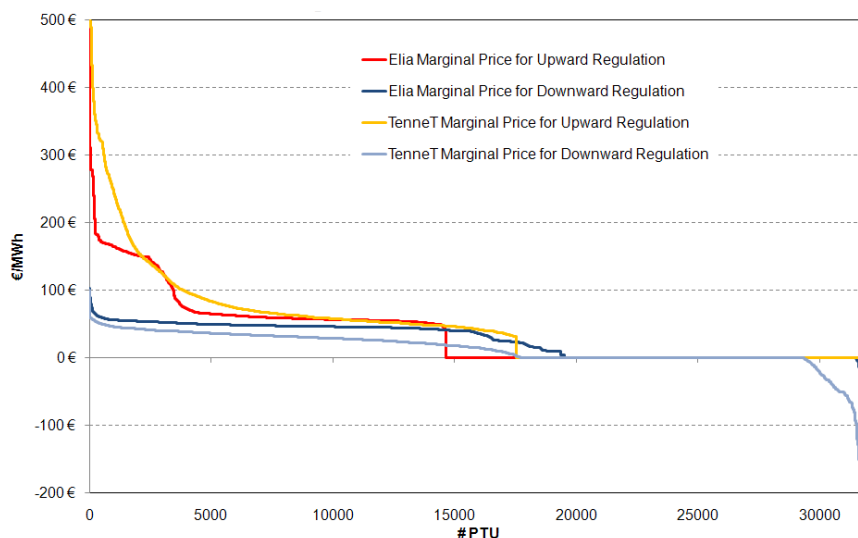


**Figure 11: Monthly aggregate volumes of activated balancing energy (2012, by type of service)**

Source: DNV KEMA

Figure 12 depicts the distribution of balancing energy prices, which BSPs received for activation of balancing energy in the two countries in 2012. This figure reveals two marked differences. First, the

price duration curve for positive balancing energy in Belgium shows a very peculiar structure, reflecting the use of capped offer prices<sup>21</sup> (which are linked to the generation costs of typical plants). But even when neglecting this effect, Dutch prices generally seem to provide for a larger spread between the price of upward and downward regulation, or between the price of balancing energy and the wholesale energy price. Moreover, one can observe a much higher share of very high or low prices at the extremes of the duration curve. These observations again indicate that BSPs seem to earn higher margin from the provision of balancing energy in the Netherlands than in Belgium.



**Figure 12: Duration curve of balancing energy prices in Belgium and the Netherlands in 2012**

Source: DNV KEMA

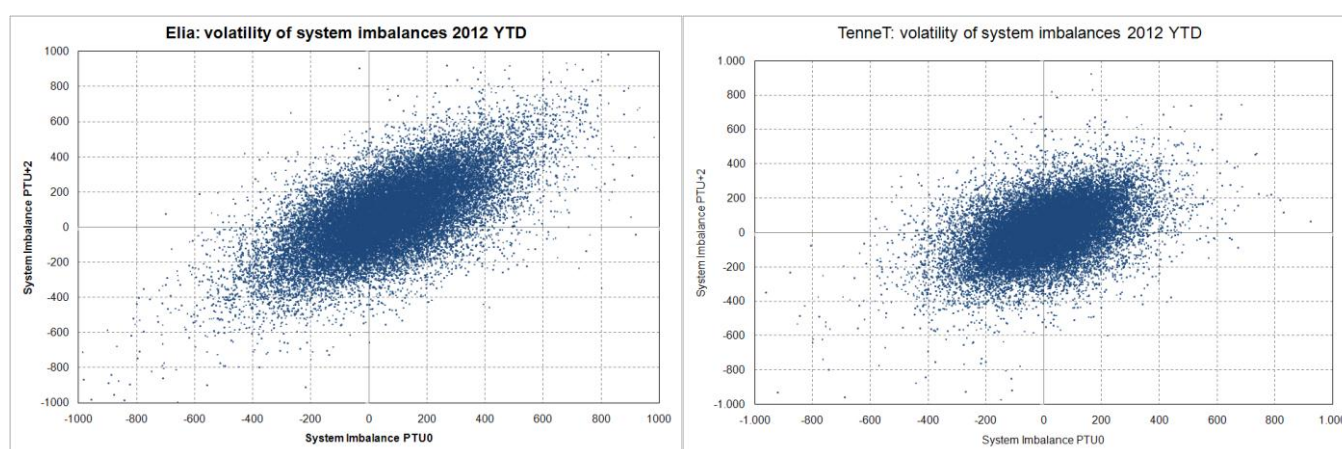
As mentioned above, Elia activates considerably more balancing energy than TenneT, as well as a significantly higher share of manual FRR. Apart from the balancing philosophy of each TSO, this difference may also be caused by the structure of system imbalances. For this purpose, Figure 13 compares the size and volatility of system imbalances in both countries in the year 2012. More precisely, the two scatter charts show the system imbalance in the current PTU on the horizontal axis in comparison with the system imbalances in the second consecutive PTU (PTU+2) on the vertical axis. Again, this figure allows for several observations:

- On first sight, both charts show a similar pattern, with a clear correlation between the system imbalance in the current PTU and the system imbalance in PTU+2. Moreover, there are fairly few larger swings from positive to negative system imbalances and vice versa, whilst this seem to be more frequent for limited system imbalances.
- Especially smaller imbalances seem to be quite volatile, whilst large structural imbalances can be observed more frequently in Belgium.

<sup>21</sup> Please note that conditions on activation prices have been revised in 2013, allowing for more “free” prices.

- Although the Belgian system is smaller than the Dutch one, Elia has to deal with a much higher share of large imbalances.
- In the Netherlands, system imbalances largely remain within the available regulation band of automatic FRR ( $\pm 300$  MW). Conversely, system imbalances exceed the volume of automatic FRR ( $\pm 150$  MW) much more frequently in Belgium.

In summary, these observations suggest that there may be a higher need for the use of manual FRR in Belgium. Conversely, the volatility of system imbalances in the Netherlands indicates a considerable risk that the activation of manual FRR may lead to counter-activation, i.e. situations where automatic FRR may have to be used in real time to partially offset manual FRR.



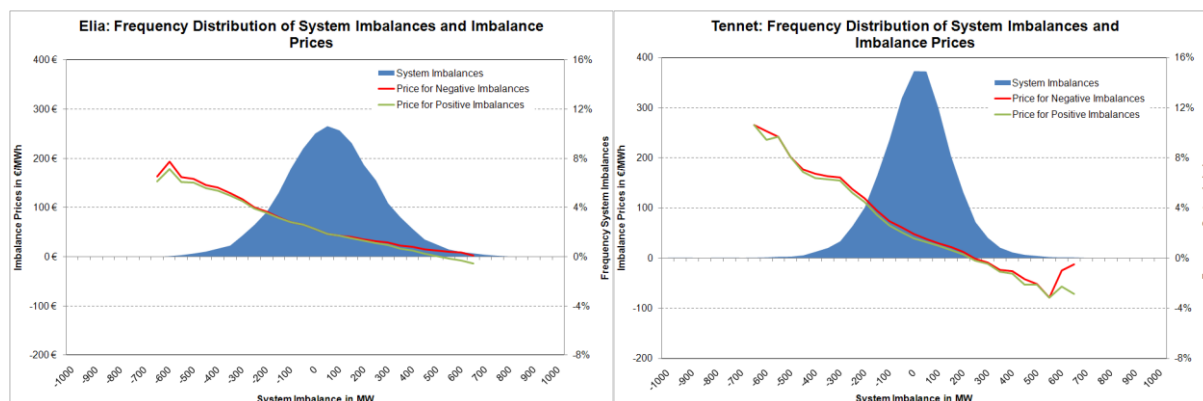
**Figure 13: Volatility of system imbalances in Belgium and the Netherlands in the year 2012**

Source: DNV KEMA

It should be noted that there might be several reasons for imbalances. One major driver clearly are the incentives from imbalance prices on BRPs to keep their portfolio in balance. In addition, differences in the generation and consumption structure should be taken into account. For example, there are around 2 GW of solar PV installed in Belgium, while PV is nearly absent in the Netherlands. The volatile, time-dependent generation profile of intermittent renewable sources may have a major impact on the need for balancing power. Similarly, industry structure and the consumption pattern of different consumer types may impact the probability of larger or persistent imbalances, such as sudden outages of large industrial consumers. Finally, the instruments available to BRPs to self-balance their portfolio may differ among countries but also by BRP (e.g. large, small, foreign and local).

Finally, Figure 14 compares the frequency distribution of system imbalances and imbalance prices in the two countries in 2012. It is clearly visible that the frequency distribution of system imbalances is much wider in Belgium, i.e. indicating a much higher share of larger imbalances. At the same time, the two charts also show that imbalance price curve is much steeper in the Netherlands than in Belgium. In other words, Dutch BRPs obviously have to pay (or receive) much less advantageous prices especially in case of larger system imbalances. This effect can be assumed to create much stronger

incentives for BRPs to self-balance their portfolios. Apart from structural differences, such as the share of certain industries (e.g. steel processing industry), the different distribution of system imbalances in both countries may thus also stem from different incentives on BRPs.



**Figure 14: Frequency distribution of system imbalances and imbalance settlement prices in 2012**

Source: DNV KEMA

## 4.2 Selected Observations

In summary, both countries share a set of common principles and philosophies for the procurement of ancillary services but exhibit also significant differences. These earmark the potential options for collaboration which and will be investigated in the following chapter.

Both countries procure a set of similar products through similar processes. They rely on market reactions and try to promote self-balancing by BRPs. Market participants are encouraged to, thus, provide for a passive contribution to balance the system. This stresses the importance of prompt transparency and information of imbalance prices for keeping the regulation quality high.

Moreover, both TSOs monitor the physical delivery of pre-contracted reserves in detail and apply penalties in case of non-compliance.

However, a closer analysis reveals important differences, e.g. with regards to different technical product specifications, different approaches for the procurement of FCR and the activation of automatic FRR. To this add significant discrepancies in the remuneration of balancing energy from automatic and manual FRR.

In addition, it may partially be explained from the limited flexibility and a high concentration in the Belgian generation market that Elia focuses on optimizing the use of limited resources and therefore uses specialised products to allow participation of various providers.

Conversely, as the Dutch system does not exhibit these disadvantages (or to a lesser extent) TenneT relies on a simple set of standardized products and market incentives as the primer means to ensure physical delivery of balancing services ('trading of imbalances').

More precisely, the Belgian balancing market is dominated by manual FRR bids. To this adds that Automatic FRR is only used to limited extent at prices which are capped and generally lower than manual FRR bids. Thus, high balancing energy prices occur mostly in case of complementary activation of manual FRR.

In turn, TenneT selects automatic FRR in accordance with the merit order and activates pre-selected bids in parallel. Manual FRR is only used in case of insufficient automatic FRR. Hence the balancing market is dominated by automatic FRR and high balancing energy prices only occur upon high imbalances.

## 5 OPTIONS FOR POTENTIAL CROSS-BORDER COOPERATION

### 5.1 Introduction

This section discusses some options for the cross-border exchange of balancing energy and operational reserves between Belgium and the Netherlands. TSOs may generally benefit from increased cooperation in this area for instance in the form of increasing reliability and reduced costs of balancing and ancillary services. Furthermore, TSOs will also be obliged to facilitate the cross-border exchange of balancing services by the emerging new regulatory framework, i.e. the Framework Guidelines and Network Codes, which are outlined in section 5.2. At the same time, any cross-border exchange of balancing services must obviously not endanger security of supply.

Furthermore, it is important to note that the TSOs are not the only stakeholders in the balancing market. Indeed, when assessing potential options for further coordination and integration, it is equally important to consider the interests of several others stakeholders:

- BSPs want to sell their products at a profitable margin,
- Balance Responsible Parties, which are responsible and are charged for imbalances, require manageable price risks from imbalance settlement,
- Final consumers, who finally have to pay for the costs of balancing cost through their electricity tariffs, have an interest in lowering or at least limiting the cost of ancillary services.

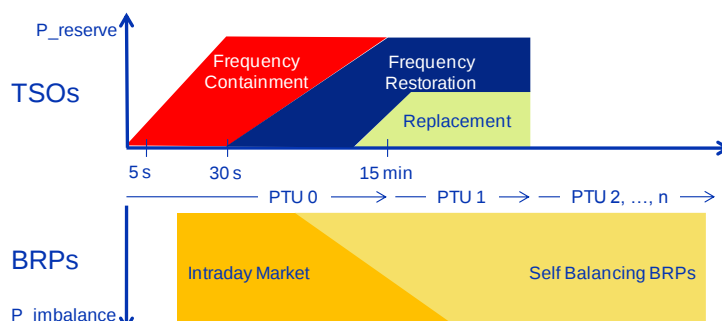
Further boundary conditions are caused by the fact that the TSOs must safeguard operational security at all times. In particular, the obligations for frequency containment and frequency restoration are mutually shared between all TSOs in the continental European synchronous zone such that both Elia and TenneT must fulfil their ‘insurance obligations’ in this respect. Most importantly, they thus have to comply with the performance obligation for the frequency containment and restoration processes as defined in the UCTE Operation Handbook today or the applicable Network Codes in the future. Against this background, it is essential that the cross-border exchange of balancing services does not distort the responsibilities of the local TSOs.

In this context, it is finally worth noting that Elia and TenneT principally rely on three different types of balancing services (compare Figure 15 and chapter 3):

- Frequency containment reserves (FCR),
- Manual and automatic frequency restoration reserves (FRR),
- Replacement Reserves (RR), but for PTU+1 only.

In contrast, neither of the two TSOs uses any form of ‘slower’ replacement reserves that are activated in PTU+2 or later. Instead, the responsibility for the replacement of reserves has effectively been assigned to market participants in both countries, i.e. market participants must balance themselves by self-balancing, trading in the intra-day market or ex-post nominations in the local control area. This in

turn implies that the cross-border exchange of balancing services must not distort incentives provided by imbalance prices.



**Figure 15: Responsibility and instruments for balancing in Belgium and the Netherlands**

Source: DNV KEMA

## 5.2 Relevant Requirements of the New European Regulatory Framework

To date, the arrangements for the procurement and remuneration of balancing services have been mainly governed by national legislation and regulation. Conversely, the role of European rules has been largely limited to technical conditions on the definition and provision of system and ancillary services, such as those stipulated in the UCTE Operation Handbook. This situation will change in the future. Indeed, the third energy package has introduced the concept of so-called Framework Guidelines (FG) and Network Codes (NC), which have to be developed by ACER and ENTSO-E, respectively. Whilst the Framework Guidelines establish a set of general principles, which the Network Codes shall comply with, the Network Codes themselves will create a comprehensive set of binding rules.

In total, ENTSO-E plans to develop a set of nine different network codes, which are basically matching a set of corresponding Framework Guidelines. Some of these documents will also impact the balancing process as well as the procurement and use of operational reserves, such as the Network Code on Load-Frequency Control and Reserves, the Network Code on Operational Security, or the Network Code on Operational Planning and Scheduling. For the scope of this study, the Framework Guidelines on Electricity Balancing (FG Electricity Balancing) and the associated Network Code (NC Electricity Balancing) are of primary importance. In the following, we therefore focus on briefly summarising some of the main targets, provisions and restrictions established by the FG Electricity Balancing.

The FG Electricity Balancing were developed by ACER in 2011/2012, and a final version was approved by ACER on 18 September 2012.<sup>22</sup> Subsequently, the European Commission formally invited ENTSO-E start developing the Network Code on Electricity Balancing on 21 December 2012. A first draft of the NC Electricity Balancing was published by ENTSO-E on 20 February 2013, and the final document has to be submitted to the Commission in December 2013.

The FG Electricity Balancing principally focus on three main areas, i.e.:

- Activation and cross-border exchange of balancing energy,
- Procurement and cross-border exchange of contracted reserves,
- Imbalance settlement.

In general, the FG Electricity Balancing specify that the TSOs shall balance the system in a coordinated way and ensure the most efficient use of efficient balancing resources, in order to increase overall social welfare and efficiency whilst taking into account operational security limits. To this end, the use and exchange of balancing services, which include operational reserves as well as balancing energy, shall foster competition, non-discrimination and transparency whilst safeguarding operational security<sup>23</sup>. Besides promoting cross-border exchange of balancing services, the rules of the NC Electricity Balancing shall also facilitate the wider participation of demand response and renewable sources of energy.

The FG Electricity Balancing clearly stipulate that the TSOs are responsible for organising balancing markets. Moreover, the TSOs shall be responsible for procuring balancing services from balancing service providers (BSPs), whilst they are not normally allowed to provide balancing services themselves. Conversely, BSPs are responsible to meet the terms and conditions adopted by the TSO.

In addition, the FG Electricity Balancing also establish some other requirements, which generally apply to the procurement and use of balancing services. Among others, the FG Electricity Balancing call for the use of standardised balancing products, although TSOs may still use specific local products if standard products prove to be insufficient.

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<sup>22</sup> ACER. Framework Guidelines on Electricity Balancing. FG-2012-E-009. 18 September 2012

<sup>23</sup> See ACER. Framework Guidelines on Electricity Balancing. FG-2012-E-009. 18 September 2012. Art. 2.1, p. 12

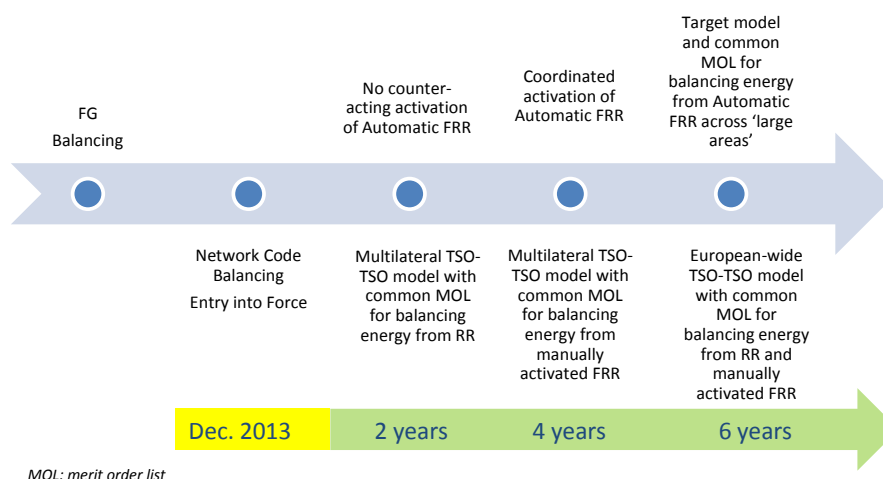
With regards to activation and cross-border exchange of balancing energy, the FG Electricity Balancing differentiate between RR and manual FRR, on the one hand, and automatic FRR, on the other hand. With regards to RR and manual FRR, the FG Electricity Balancing specifically provide for the following:

- Implementation of an ‘open’ balancing energy market that allows for the participation of free bids (in addition to contracted reserves),
- Maximum gate closure of 1 hour before real time for balancing energy bids,
- Implementation of a common merit order list for cross-border activation of balancing energy from manual FRR and RR (see below),
- Cross-border capacity that remains unused after the intra-day market can be used for the exchange of balancing energy without any additional charges,
- Balancing energy shall be paid at the marginal price (‘pay-as-cleared’), unless the TSOs have demonstrated that another approach is more efficient in achieving the general objectives of the FG Electricity Balancing.

Many of these provisions also apply to automatic FRR. But for this product, the FG Electricity Balancing does not strictly require the use of common European merit order but accepts the development of an alternative target model. In any case, the TSOs are obliged to ‘coordinate’ activation of balancing energy from automatic FRR and to avoid any counter-activation of balancing energy from automatic FRR.

To enhance coordinated cross-border exchanges of balancing energy, the FG Electricity Balancing furthermore establish a clear timeline for implementing the different mechanisms mentioned above, see Figure 16. For example, a (preliminary) TSO-TSO model for the activation of balancing energy from replacement reserves with a common merit order list shall be implemented no later than two years after the FG Electricity Balancing has entered into force. Conversely, the final model with a European-wide common merit order list shall be established within 6 years. Similar timelines apply for automatic FRR, subject to the different requirements and conditions mentioned above.

It should be noted, however, that these deadlines do apply to the exchange of balancing energy only. Conversely, the exchange of reserves is optional.



**Figure 16: Timeline for coordinated cross-border exchanges of RR and FRR.**

Source: DNV KEMA

Similarly, the FG Electricity Balancing have also introduced some general provisions for the procurement of contracted reserves:

- Upward and downward reserves shall preferably be procured separately,
- Preference shall be given to short-term procurement, in order to facilitate participation of demand response, renewable generators and other new entrants,
- BSPs shall be allowed transfer their reserve obligations to other BSPs (collateralisation),
- Cross-border exchanges of contracted reserves are possible only where no reservation of cross-border capacity is required or where reservation of cross-border capacity leads to a proven increase in social welfare (to be provided through a cost-benefit analysis).

It should be noted that these provisions apply to RR and FRR only. Conversely, the FG Electricity Balancing do not specifically address cross-border exchanges of Frequency Containment Reserves. However, it is assumed that FCR are exchanged within the Transmission Reliability Margin, such that no cross-border capacity has to be reserved for this purpose. Otherwise, the cross-border exchange of FCR would be subject to the same conditions as RR and FRR.

Finally, the FG Electricity Balancing include some provisions related to balance responsibility and imbalance settlement. Most importantly, BRPs shall be incentivised to be balanced in real time and help the system where possible. For example, the imbalance settlement period shall be consistent with the program time unit (PTU) used for scheduling, but not longer than 30 minutes<sup>24</sup>. Similarly, imbalance prices shall include the costs of activated balancing energy from FRR and RR in each imbalance settlement period. In addition, they shall take the cross-border netting of system imbalances

<sup>24</sup> The TSOs shall carry out a cost-benefit analysis on whether the imbalance settlement period shall be harmonised across Europe and report their results to ACER.

and unintentional deviations into account, whereas they may not include the costs of deviations from the merit order, for instance due to internal congestion management. In contrast to the pricing of balancing energy, however, the FG Electricity Balancing do not provide a clear preference for either marginal pricing or pay-as-bid. Finally, the Network Code on Electricity Balancing shall impose that the main features of the imbalance settlement are harmonised no later than three years after the entry into force of the Network Code on Electricity Balancing.

### 5.3 Principal Options for Cross-Border Exchange of Balancing Services

As explained in chapter 5.2, the provisions of the FG Electricity Balancing focus on the cross-border exchange of replacement reserves and frequency restoration reserves, as a first step towards deeper cooperation and alignment of balancing services among European TSOs. Conversely, the FG Electricity Balancing do not contain any detailed provisions for the cross-border exchange of frequency containment reserves, although they clearly prefer an increasing degree of regional integration in this areas as well.

In contrast, current arrangements in both countries focus on FCR as well as automatic and manual FRR, whereas replacement reserves do not play a substantial role in either country. Although corresponding products principally exist in both countries, the current market design favours self-balancing by BRPs in the intra-day market (see previous section). Among others, neither of the two countries procures any operational reserves specifically for use as replacement reserves. Moreover, the corresponding products are hardly ever called in practice. Any efforts towards increasing coordination in this area would thus be limited to the coordination activation of balancing energy.

Overall, the potential benefits from the cross-border exchange of replacement reserves thus appear as strictly limited, if not negligible. In addition, there is a significant risk that a corresponding product might ‘compete’ with the intraday wholesale market and hence the fundamental balancing philosophy of both TSOs. On balance, it therefore appears more desirable to facilitate intra-day trading until briefly before real time than to introduce a new product for RR.

Based on these considerations, we limit ourselves to potential options for increased cooperation in the area of frequency containment and restoration reserves in the remainder of this chapter.

As shown in Figure 17 once can basically identify four principal options for facilitating the cross-border exchange of FCR and FRR, which are briefly explained in more detail below:

- Netting of imbalances,
- Activation from a common merit order,
- Reserve sharing,
- Exchange of reserves.

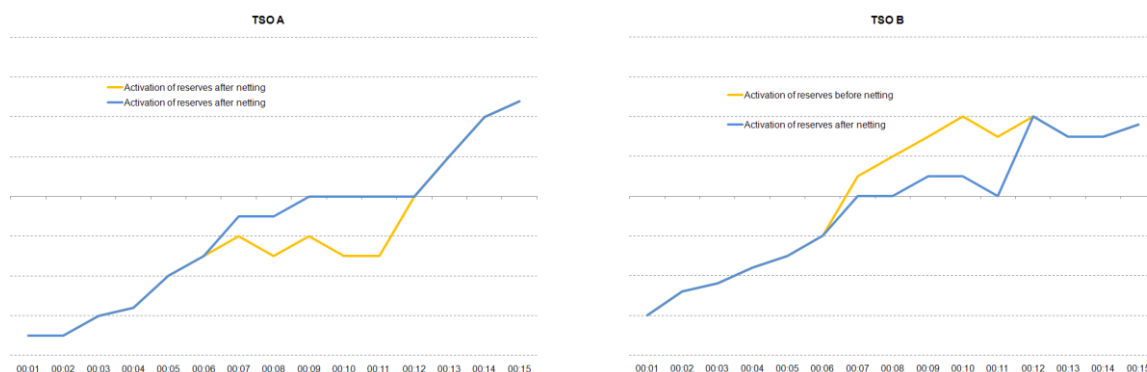
In principle, these options may be roughly classified into the exchange of balancing energy (top row) and the exchange of reserve capacity (bottom row). The former refers to the coordinated use (activation) of balancing power in real-time, whereas the latter refers to the coordinated dimensioning and/or procurement of operational reserves in advance, in order to guarantee the availability of a certain amount of balancing power in real time. Similarly, the two options on the left of Figure 17 impact the physical volume of the corresponding service(s), whereas the options on the right hand side have an influence on the price of the corresponding service(s).

| Netting of imbalances (ENERGY)                                         | Common merit order (PRICE)                                                                           |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Definition: avoidance of counter acting activation of balancing energy | Definition: integration of individual merit order of balancing energy offers into common merit order |
| Requirements: available transmission capacity                          | Requirements: available transmission capacity                                                        |
| Expected result: lower regulation volumes                              | Expected result: lower combined expenditures for procurement of balancing energy                     |
| Application: FRR                                                       | Application: automatic and manual FRR                                                                |
| Reserve sharing (CAPACITY)                                             | Exchange of reserves (PRICE)                                                                         |
| Definition: mutual provision of operational reserves among TSOs        | Definition: reserves are procured in a coordinated way (TSO-TSO, TSO-BSP)                            |
| Requirements: available transmission capacity                          | Requirements: available transmission capacity                                                        |
| Expected result: lower size of amounts of procured reserves            | Expected result: lower combined expenditures for procurement of control reserves                     |
| Application: compliance, mutual support                                | Application: FCR and automatic & manual FRR                                                          |

**Figure 17: Principal options for cross-border exchange of FCR and FRR**

Source: DNV KEMA

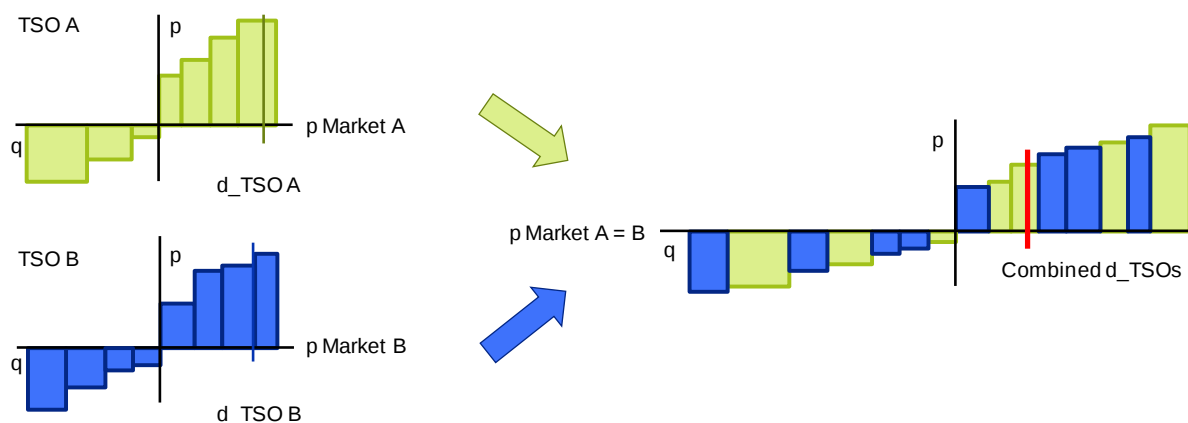
The netting of imbalances arguably represents one of the easiest steps for the cross-border exchange of balancing services. This measure is useful whenever the system imbalance and, hence, also the balancing need in one country is opposite to the one in the other country. In this case, both countries can simply refrain from activating the corresponding volume of balancing energy, thereby avoid counter-activation of balancing energy. This principle is illustrated in Figure 18 where, without netting, TSO A is regulating down whilst TSO B is regulating up at the same time. Through netting, TSO A can ‘export’ its positive imbalance to TSO B. This allows TSO A avoiding the use of downward regulation, whereas TSO B reduces its need for upward regulation.



**Figure 18: Principal Benefits of netting**

Source: DNV KEMA

Using instead a common merit order means combining offers (for balancing energy) from both countries into one merit order list (see Figure 19). Assuming a good mix of balancing bid prices from both countries, activation of balancing energy by merit order may reduce the combined cost of balancing energy for both countries since the most attractive bids can always be activated first. More attractive bids from one country would thus replace the activation of less attractive bids from the other country, which would otherwise be activated in a situation of two separate merit orders.



**Figure 19: Transition from two separate balancing markets to a combined merit order**

Source: DNV KEMA

Reserve sharing implies the coordinated dimensioning and mutual provision of reserves. It offers the advantage of reducing the aggregate amount of reserves required. This in turn can be expected to reduce the cost of reserves since each TSO will have to procure less reserves, i.e. BSPs will have to compete for lower volumes.

Obviously, reserves may only be shared as long as there is no congestion between the countries involved. Figure 20 shows one possible example where TSO A shares a certain amount of reserves with the neighbouring TSOs, i.e. TSOs B and C. In this example, it is assumed that congestion will occur at

one border at the time only but never simultaneously at both borders. Under these circumstances, TSO A can safely rely on the minimum of the shared reserves with TSOs B and C, which means that it can reduce the need for domestic reserves by a corresponding amount.



**Figure 20: Example of reserve sharing**

Source: DNV KEMA

Exchange of reserves refers to the coordinated procurement of operational reserves, e.g. through joint procurement (TSO-TSO model) or by allowing the other TSO contracting of residual reserves that are contracted for the local market (TSO-BSP model). Both options do not reduce the total need of reserve capacity. However, similar to the common merit order for balancing energy, they may reduce the total expenditures for procurement of operational reserves.

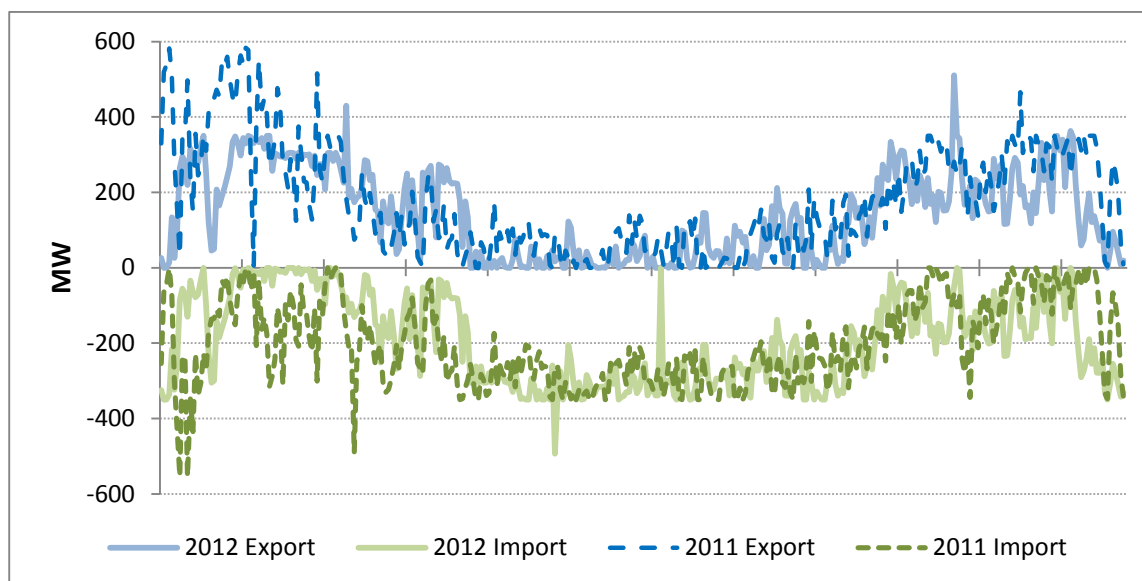
It is worth noting that all four options can be combined with each other in any possible combination. This is illustrated for instance by the four possible modules of the IGCC (compare section 3.3.4), which are equivalent to the four options identified in Figure 17. However, it should also be noted that all four options require the availability of sufficient transmission capacity, in order to make sure that each country can actually use the corresponding services when so required. In case of the two options related to the cross-border exchange of operational reserves, this precondition must be fulfilled in advance and for the entire procurement period. Similarly, balancing energy can only be exchanged across the border when there is sufficient transport capacity available. In this case, however, the exercise of this can be flexibly used, i.e. based upon the availability of cross-border capacity in each PTU (or any other relevant time period).

To illustrate the potential importance of this aspect, Figure 21 shows a summary of the average daily volume of cross-border capacity, which was available at the Belgian-Dutch border after the end of intra-day trading in the years 2011 and 2012<sup>25</sup>. This figure shows that there was substantial cross-border capacity available in both years, but with a clear seasonal profile. In both years, significant additional volumes of electricity could have been exported from Belgian to the Netherlands during the winter season, whereas there was a very limited potential in the summer. The opposite was true for

<sup>25</sup> Please note that the two TSOs have been able to increase intraday ATC compared to day ahead ATC since the end of 2012.

imports, with some 300 MW of capacity being available on average during the summer, but much less in the winter season.

In summary, Figure 21 thus shows that the availability of sufficient cross-border capacity cannot be taken for granted and that it may seriously constrain the potential for the cross-border exchange of operational reserves and balancing energy. In addition, it is worth noting that Figure 21 does show average daily volumes only, but that these values may very well fluctuate during the day as well.



**Figure 21: Available cross-border capacity available at the Belgian-Dutch border after the intraday market (from the perspective of Belgium)**

Source: DNV KEMA, based on data provided by Elia

## 5.4 Options for Exchanging FCR

To analyse the potential benefits and feasibility of cooperating at FCR, it should be borne in mind that the required volumes of FCR are determined for the whole synchronous area in continental Europe (former UCTE). According to the UCTE Operation Handbook, the total FCR volume has to be provided by all European TSOs in a coordinated action and each TSO has to keep a certain amount of FCR reserve always available. This individual amount is determined based on the split of the total volume across all TSOs pro-rata their share of annual consumption.

Although the cross-border exchange of FCR is principally possible, it would merely lead to a redistribution of the required volumes between different TSOs. More precisely, the total volume of FCR to be held by the two TSOs would remain constant, but the two TSOs would agree upon swapping part of their reserve obligation between each other, i.e. reducing the share of one TSO by increasing the share of the other by the same amount. As a consequence, there is no scope for reserve

sharing since the total volume of FCR cannot be reduced. Given that balancing energy from FCR is not accounted for and not remunerated in Belgium and the Netherlands, it follows that any cooperation in this area is limited to the exchange of reserves.

Having said this, and taking into the current arrangement, one may envisage the following two models for cross-border cooperation, which are described and evaluated hereafter:

- Individual cross-border procurement of reserves (by Elia)
- Coordinated procurement of reserve capacity.

To start with, Belgium could try to procure FCR from the Netherlands by means of the TSO-BSP model at least for a transitional period, i.e. as long as the Netherlands stick to the mandatory provision of this service. This approach would have the advantage of not requiring any harmonisation of the rules for the provision / procurement of this service between the two countries. However, it is not immediately clear whether the current remuneration scheme for FCR in Belgium would be attractive enough for Dutch BSPs.

Moreover, given that TenneT seems to have taken first steps to the procurement of FCR as a commercial service, it would seem more straightforward to immediately focus on the second option, i.e. the coordinated procurement of FCR by both TSOs. A major advantage of the latter approach would be that any future procurement mechanism in the Netherlands could be immediately designed with a view on facilitating the cross-border exchange of FCR and compatibility with Belgium, in particular with regards to product definition and the principles for selection and remuneration.

Given the use of different products in Belgium today, one could imagine that both countries agreed upon the exchange of either a single standardised product or multiple standardised products. The exchange of a single standardised product would not only represent the simplest solution. In addition, it could also be expected to attract the highest liquidity since all potential BSPs would compete for the same product. Provided that the technical properties of this product were not too demanding, we would furthermore expect sufficient scope for competition<sup>26</sup>. Perhaps the biggest disadvantage of a single product could be the risk that it might exclude some potential BSPs from the market, i.e. those not being able to fully satisfy the general requirements for the provision of FCR (compare section 3.2).

Ultimately, the decision between one or multiple standardised products represents a trade-off between limiting complexity, on the one hand, and the desire for maximising the technical potential of available technical resources, on the other hand.

In practical terms, the exchange of FCR might be constrained by transmission reliability margin and compliance with current as well as future regulations at the European level, i.e. Policy 1 of the UCTE

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<sup>26</sup> As mentioned before, a recent study has estimated that Dutch producers alone would be able to provide more than the combined need for FCR of Belgium and the Netherlands.

Operation Handbook and the (draft) Network Code Electricity Balancing. More importantly, however, it would be necessary to deal with the fact that Elia is legally bound to procure FCR through annual tenders. Even if it was decided to apply the same contract duration also for a common procurement mechanism, it would nevertheless be necessary to deal with the fact that the Belgian government may unilaterally impose the price of FCR under certain circumstances.

Overall, however, we do not consider any of these complications as a fundamental road block, such that we still consider the cross-border exchange of FCR as a feasible alternative.

## 5.5 Options for Common Utilisation of FRR

### 5.5.1 Netting of Imbalances

As explained in the previous chapter, FRR is the product, which is mostly used for real-time balancing in both countries. FRR accounts for the bulk of contracted reserves as well as balancing energy, and it is the major (if not exclusive) driver for imbalance prices. As a consequence, it may be considered as an optimal candidate for the cross-border exchange and activation of operational reserves.

Nevertheless, it is important to note that TenneT almost exclusively relies on the use of automatic FRR, whereas Elia uses both automatic and manual FRR for balancing.

As explained in section 5.2 above, netting of imbalances represents the first option for exchanging FRR across the border. As a result of netting, both TSOs might be able to reduce the volume of balancing energy they active, whilst maintaining or even improving the regulation quality through a reduced Area Control Error. In addition, netting would also offer advantages for other stakeholders. BRPs and consumers for instance might benefit from decreasing spreads of imbalance prices and more generally reduced cost of balancing. At the same time, however, Balancing Service Providers would incur disadvantages from a general reduction in the volume of balancing energy provided to the system.

On a more practical level, we note that netting would effectively remain limited to the use of automatic FRR. More importantly, however, both countries already participate in the netting of imbalances through the IGCC today. Hence, a significant part of the potential benefits of netting have already been reaped, as illustrated by the reduction of activated balancing energy since each country has joined IGCC (compare Figure 11 on p. 29). Still, Belgium and the Netherlands could principally decide to net their system imbalances bilaterally prior to IGCC, or even to replace their participation in IGCC by bilateral netting. However, we assume that the potential gains from any corresponding step would remain limited. Furthermore, we assume that the opportunity gains from the possibility to net imbalances across a larger group of countries within IGCC will outweigh the benefits from replacing IGCC entirely or partially by bilateral netting and limit the incentives to intensify bilateral sub-netting actions, at least for one country if not for Belgium and the Netherlands.

Overall, we therefore assume the benefits of engaging into sub-netting and/or to replace the current participation in the IGCC by a purely bilateral mechanism as limited.

### 5.5.2 Common Merit Order

With a common merit order for FRR, all offers for balancing energy from the two countries would be combined in a single merit order, from which the required volumes would be activated at the lowest possible costs. As already mentioned in section 5.2 above the use of a common merit order has the main advantage of reducing the overall cost of balancing for both countries, although it may still lead to higher costs for one of the two countries in exceptional circumstances. The latter may especially be the case if the merit orders of the two countries were significantly different<sup>27</sup>, for instance due to regulatory restrictions on the pricing of balancing energy. Moreover, the functioning of a common merit order may also be inhibited by congestion, which may limit the scope for the cross-border activation of balancing energy.

From the perspective of different stakeholders in the market, the use of a common merit order can be expected to have the following impacts:

- TSOs would ideally benefit from having access to a larger number of and more diverse offers, offering both increased reliability and more competition. These benefits would however come at the expense of more complex operational systems and a mechanism that is more difficult to handle and to coordinate among the two TSOs.
- From the perspective of BSPs, the effects would be ambiguous. Namely, whilst more competitive BSPs could expect to sell larger volumes of balancing energy, these volumes would come at the expense of offer bidders, which would see their market shares decline accordingly.
- For BRPs and end consumers, the potential consequences are difficult to forecast. In either country, the spread as well as the volatility of imbalance prices may either increase or decrease, depending on the profile of the resulting merit order. Similarly, more extreme situations may occur more often, in particular if the two individual merit orders have a very different structure. For similar reasons, the transition to a common merit order may potentially lead to a general shift of the price of balancing energy and/or imbalances in one country.
- As a result of these possible effects, consumers finally may experience an increase or decrease of the balancing component in the energy part of the retail price.

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<sup>27</sup> Assume for instance that bids in country A are generally less attractive than in country B. In this case, TSO A could expect to benefit from integration as it would get access to more attractive bids from country B. Conversely, TSO B might face higher costs of balancing since some of the local bids would now be used by TSO A, forcing TSO B to rely on more expensive bids. In practice,

Irrespective of these potential complications, it is generally accepted that the use of a common merit order will lead to a more economically efficient outcome overall. Nevertheless, the distribution of such welfare gains may be divided unevenly, or even lead to welfare losses for one country.

In addition, it is also necessary to consider the specific features of the products ‘trading’ in the market for FRR. In the two following sections, we therefore comment on some specific issues related to the cross-border exchange of automatic and manual FRR between Belgium and the Netherlands.

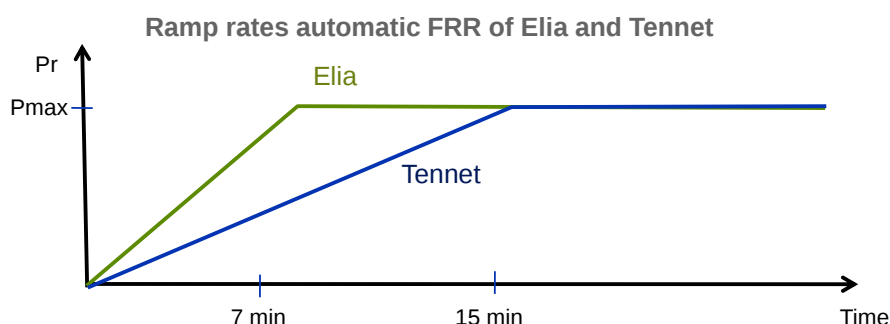
### 5.5.3 Practical Issues for Exchanging Automatic FRR

On first sight, the cross-border exchange of automatic FRR would be facilitated by the fact that both countries use advanced tenders and operate a daily balancing market. Moreover, due to the importance of automatic FRR for the balancing process in Belgium and especially the Netherlands, the cross-border change of aFRR can principally be expected to offer significant benefits.

A closer look, however, reveals substantial differences, which are related to the detailed product and market design. In summary, we especially note the following issues:

- Different product qualities,
- Different activation principles,
- Different rules for pricing and remuneration.

To start with, product qualities and requirements differ significantly between both countries. In Belgium, providers of FRR have to provide a ramp rate of 15% of the offered capacity per minute, whereas a ramp rate of 7% per minute is sufficient in the Netherlands (compare Figure 22). Hence, while both countries comply with European standard requirements, provisions for individual BSPs are more stringent in Belgium.



**Figure 22: Comparison of minimum ramp rates for automatic FRR**

Source: DNV KEMA

For the exchange of automatic FRR, various options can be conceived, ranging from the continuation of current practices to adoption of either of the two approaches. However, each of these options has its own drawbacks:

- If both countries decided to exchange aFRR as is, the parallel use of both products may result in uneven energy contributions from the two countries. As ramp rate requirements are higher in Belgium than in the Netherlands, the relative share of balancing energy delivered by Belgian BSPs could be higher than that of their Dutch counterparts on average, especially in case of smaller and medium deviations<sup>28</sup>.
- If both countries decided to align their technical requirements with Dutch practices, ELIA might face a risk of deteriorating regulation quality as the effective ramp rate of the system would decline. Alternatively, Elia could try to procure and use additional volumes. This might come at the expenses of higher absolute costs for reserve procurement, although this effect may also be offset by the fact that less stringent requirements could facilitate participation of additional volumes of aFRR.
- Thirdly, the Netherlands could decide to increase ramp rate requirements for individual bidders. However, the introduction of more stringent requirements might negatively impact the cost and availability of this service in the Netherlands since Dutch BSPs might ask for higher prices and/or offer lower volumes than today.

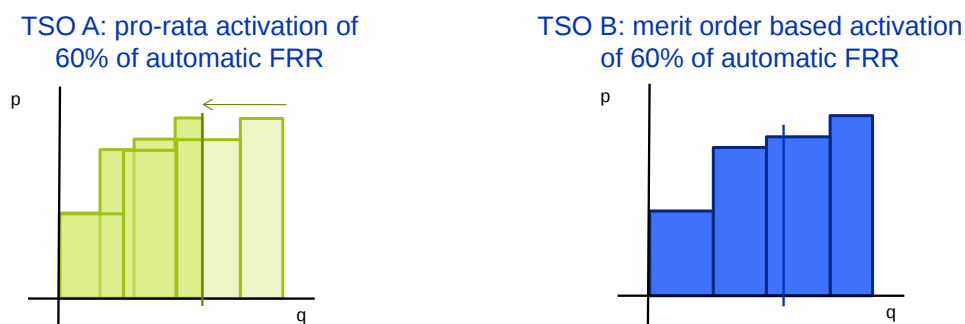
These considerations illustrate that the issue of different ramp rate is far from trivial and may influence the availability and cost of available volumes as well as regulation quality in both countries.

Secondly, Elia and TenneT apply very different principles for activation of automatic FRR. Whilst Elia activates all pre-selected offers in parallel (pro-rata), TenneT selects automatic FRR by merit order. As illustrated by Figure 23 this difference has two main consequences:

- First, the pro-rata activation of all available offers implies that Belgian aFRR is always activated at the same ramp rate. In contrast, activation by merit order normally results in fewer offers being selected, and hence a lower ramp rate. This feature may thereby reinforce the impact of different ramp rates as discussed above.
- Conversely, the pro-rata activation of all available (or pre-selected) offers results in a constant price. Consequently, the price of balancing energy does not depend on the system deviation in any given PTU but is merely a function of the price and volume of pre-selected offers, irrespective of whether BSPs are remunerated at their individual offer price or the marginal price. Furthermore, both the (weighted) average price and the marginal price will generally be higher than under activation by merit order.

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<sup>28</sup> This effect depends on for instance on the configuration of the secondary controller(s) and the profile of the underlying system imbalances over time.



**Figure 23: Impact of different activation principles**

Source: DNV KEMA

One of the main benefits of pro-rata activation of aFRR is that even smaller imbalances can be compensated quickly. This generally improves regulation quality of the system, although the latter also depends on the overall quality targets, which the TSO sets on the Area Control Error. Moreover, these benefits may be smaller than they appear on first sight. First, the effective ramp rate of a merit order based system will increase in line with the activated volume of aFRR. Arguably, the main disadvantage of a pro-rata scheme is that balancing prices are not representative of the system imbalance. This naturally limits the incentives for BRPs to remain balanced, at least to the extent that the price of balancing energy from aFRR influences the price of BRP imbalances.

In contrast, activation by merit order helps to reduce the costs of balancing energy since only the most economic bids or offers will be accepted at any point in time. Secondly, and perhaps most importantly, it may provide for a direct link between the price balancing energy and imbalance prices, thereby increasing incentives for passive contribution by BRPs. Moreover, as already mentioned above, a merit order based system can principally achieve a high regulation quality.

A third important difference between current arrangements in Belgium and the Netherlands relates to different rules for pricing and remuneration. Whilst Elia remunerates balancing energy according to the pay-as-bid principle, TenneT pays the marginal price of balancing energy based on the combined use of automatic and manual FRR. At the same time, energy offers from contracted reserves are subject to price caps in both countries.

In combination, these features lead to very different effects in the two countries:

- In Belgium, the use of the pay-as-bid principle arguably helps to reduce the cost of balancing energy. Due to the very good predictability of pre-selected volumes, which correspond to the (constant) need for aFRR, one would normally expect bidders to adjust their prices, in order to match the expected marginal price as closely as possible. In practice, the additional limitations to the energy price can therefore be regarded as essential as they limit corresponding behaviour.

- Conversely, in the Netherlands, marginal pricing potentially provides for an attractive market for additional bids in the daily market, i.e. from parties that do not receive a capacity fee for contracted reserves. This is deemed to be essential for attracting more bids to the balancing market. In addition, marginal pricing effectively over-rides price caps for contracted reserves, at least in those situations where the need for aFRR exceeds the volume of contracted reserves. At the same time, marginal pricing arguably also reduces the cost-limiting effect of activation by merit order mentioned above.

The different principles for activation and remuneration of aFRR again reflect a fundamentally different design philosophy of the balancing arrangements. Current arrangements in Belgium are focused on ensuring the physical provision of aFRR and achieving a high regulation quality at limited costs. Conversely, the design of the Dutch balancing mechanism focuses on achieving the most economically efficient use of aFRR in real time and incentivising participation in the market by BSPs, subject to compliance with the applicable technical standards and requirements within the synchronous system of continental Europe (former UCTE).

Similar to the use of different ramp rates, these differences also create potential issues for the cross-border exchange of aFRR in real time:

- A parallel operation of the two existing systems would effectively imply a constant price for balancing energy provided from Belgium. From the perspective of the Netherlands, this would correspond to a single offer with a volume of approx. 145 MW. There is a considerable risk that such a large and singular offer would distort the Dutch balancing mechanism as it would likely function as an effective price cap for aFRR also in the Netherlands, thereby potentially undermining the incentives to bid into the market. In addition, Dutch BSPs might be disincentivised to submit more economic (i.e. “cheaper”) offers as they would expect a much lower probability of higher prices for balancing energy.
- Depending on relative price levels, any coupling between the two mechanisms could result in a situation where either a major proportion of Dutch offers would be fully absorbed by Belgium frequently, or where aFRR would be almost exclusively provided by Belgian BSPs. It is important to note that, in a well-functioning market, both effects could still be economically efficient. Due to existing pricing restrictions in Belgium, however, there is a risk that the energy price for Belgian aFRR does not reflect its market value, in which case these two outcomes might be globally inefficient.
- Thirdly, it would seem difficult to enable the use of aFRR from the Netherlands by Elia without changing current activation principles in Belgium. Most importantly, it would hardly seem efficient to always call off a constant volume under parallel activation, i.e. without consideration of the current price of aFRR in the Netherlands.

#### 5.5.4 Practical Issues for Exchanging Manual FRR

Similar to the case of automatic FRR, there are also several practical issues, which may complicate the cross-border exchange of manual FRR:

- Fundamentally different product definitions,
- Remuneration of balancing energy at the combined marginal price of manual and automatic FRR in the Netherlands,
- Use of explicit bids in the Netherlands vs. implicit bidding in Belgium,
- Very limited use of manual FRR in the Netherlands.

To start with, manual FRR are based on directly-activated FRR in Belgium, but on a schedule-activated product in the Netherlands. In addition, Elia uses an activation time of 15 minutes (3 minutes for interruptible load), whereas manual FRR can be activated at any point time in time before the start of the next PTU in the Netherlands. As a consequence, the two products are not currently compatible with each other since both the activation time and the delivery period differ from each other.

Similar to the case of automatic FRR, the remuneration of balancing energy is an issue. Again, BSPs are remunerated at the price of their own offer (pay as bid), whereas TenneT remunerates balancing energy at the marginal price of all offers for automatic and manual FRR, which have been activated in a given PTU. In theory, this would not necessarily present an issue, provided that the decisions on the activation of FRR were based on one single merit order. Unfortunately, this may often not be case in practice, for several reasons:

- As mentioned, automatic FRR is remunerated at the marginal price of all balancing energy activated from manual and automatic FRR in the Netherlands. However, the decisions on the activation of automatic FRR are taken in real time only. At this stage, manual FRR can no longer be used, which effectively implies the use of a different merit order.
- The use of a common merit order by both countries is possible in the absence of network constraints only. Conversely, whenever the transmission capacity between the two countries is fully utilised, the TSOs will have to partially revert to the use of two separate merit orders<sup>29</sup>.

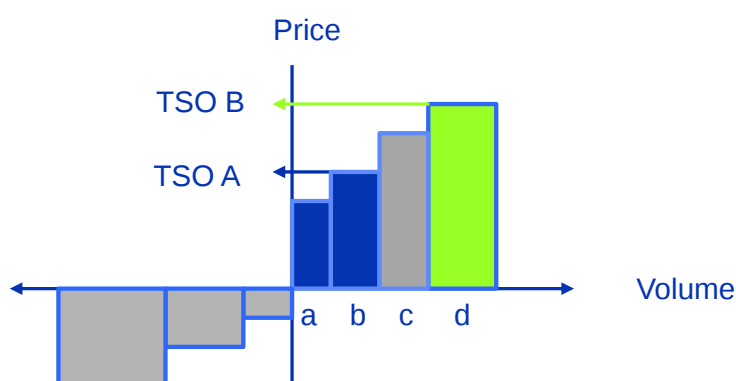
In either of these situations, it would be impossible for one or both TSOs to guarantee a cost efficient activation of balancing energy from a common merit order. This risk is illustrated in Figure 24. In this example, TSO A activates the two cheapest offers (a, b) for balancing energy from the common merit order. As indicated in Figure 24, offer is from the control area of TSO B, whereas TSO A does not activate the next cheapest offer from its own control area (c). Afterwards, TSO B activates a more

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<sup>29</sup> For example, if the export capacity from Belgium to the Netherlands was fully utilized, Elia would no longer be able to use additional bids for downward regulation from the Netherlands, whereas TenneT could no longer call offers for upward regulation from Belgium.

expensive bid (d) for the same PTU, assuming that TSO A can no longer access the offer 'c' for one of the two reasons highlighted above. When furthermore assuming that balancing energy is remunerated at the marginal price in country B, TSO A will now have to pay the price of offer 'd' for balancing energy activated from offer 'b'. At this stage, the original decision by TSO A will become inefficient, as it has called more expensive balancing energy from offer 'b' whilst not using offer 'c', which has now become cheaper.

Due to the different principles for remuneration of balancing energy, these risks are particularly critical for Elia, whereas they are hardly relevant for TenneT. From the perspective of Elia, they are further aggravated by the fact that the first two issues mentioned above (combined pricing of manual and automatic FRR in the Netherlands, different activation times for manual FRR) may both lead to higher prices for manual FRR in the Netherlands after the effective closure of the corresponding market in Belgium. This again is especially important for the case of automatic FRR, given that this service is almost constantly activated in real time and provides for almost all balancing energy activated in the Netherlands.



**Figure 24: Inefficient activation of balancing energy from a common merit order**

Source: DNV KEMA

Apart from these fundamental differences, it is worth noting that the Dutch balancing mechanism is based on explicit bids, whereas the Belgian mechanism works on the principle of implicit bidding. Namely, Dutch BSPs explicitly offer prices and volumes of balancing energy. Conversely, Belgian BSPs offer a set of prices only, whilst available volumes are derived from production schedules by Elia. Although this difference does not represent a fundamental obstacle for further integration, it nevertheless complicates the exchange of offers and may create additional risks for Elia.

Finally, we have pointed out above that manual FRR are hardly ever used in the Netherlands. This may restrict the attractiveness of this market segment for potential bidders and in turn lead to less competitive offers. Nevertheless, this issue does not preclude the use of offers for manual FRR by Elia. Furthermore, additional demand from Elia may very well increase the attractiveness of this market segment and hence lead to more attractive offers, and there are indications that TenneT does not use 'cheaper' offers for manual FRR, in order to minimise the risk of counter-activation of manual

and automatic FRR in real time. Overall, the limited use of manual FRR by TenneT does thus not appear as a critical barrier for the exchange of balancing energy from manual FRR.

## 5.6 Options for Exchanging FRR Capacity

As discussed in section 5.2 above operational reserves may either be exchanged by means of reserve sharing or in the form of a formal exchange of operational reserves procured from BSPs.

Starting with the sharing of reserves, we note that this option is already used by Elia and TenneT for manual FRR. As explained in section 4.1 both TSOs exchange a certain volume of so-called emergency reserves with their neighbours on a best endeavours basis. In theory, there might be scope for a further increase of the corresponding volumes, but these can be expected to be limited. Consequently, we do not consider the scope for sharing of manual FRR further in this document.

The sharing of automatic FRR is complicated by the fact that each TSO is bound to comply with certain performance standards within the synchronous system of continental Europe. These standards require a certain regulation quality, which is mainly determined by the behaviour of the area control error (ACE) in real time. In order to comply with these standards, both TSOs would thus have to rely on the (partial) provision of this service from the other country at all times. Given the limitations of available cross-border capacity (compare section 5.2), this precondition is unlikely to be met in practice. Moreover, it would probably be necessary to implement significant changes to the current structure and operation of the two control areas. In line with the scope of this study, we do thus not consider this option further in this document.

An exchange of contracted FRR potentially offers significant benefits for different stakeholders. From the perspective of the TSOs, it ideally provides access to more and more diverse offers for operational reserves and balancing energy. Apart from possible improvements in regulation quality and security, this may allow decreasing the cost of capacity reservation. This aspect seems to be of particular importance for Elia, which has taken various steps for limited the costs of capacity reservation in the past, and due to the more diverse supply of FRR in the Netherlands.

Similarly, network users may benefit from decreasing tariffs for ancillary services, whereas BRPs are likely to be neutral as they would not be exposed to any impact in terms of costs or income. Finally, BSPs may also benefit from access to a larger market, i.e. by selling more capacity. However, any additional sales will be offset by a corresponding decrease of the reserve capacity sold by other BSPs. Indeed, this model principally results in a redistribution of capacity sales and revenues between different BSPs in the two markets.

Despite these principal benefits, the exchange of contracted FRR would be complicated by at least three major issues:

- Need for sufficient compatibility of products, processes and remuneration principles,
- Lack of available cross-border capacity,
- Regulatory restrictions to the reservation of cross-border capacity for operational reserves.

The cross-border exchange of contracted reserves can only be effective to the extent that the corresponding volumes can also be used in real time. This principally requires at least some harmonisation of for instance product characteristics, selection and activation in real time, and pricing principles. In other words, it is subject to coordination and/or integration of the activation and use of these services in real time. Consequently, it seems reasonable to assume that the cross-border exchange of contracted reserves should only be considered as a second step after successful implementation of functioning arrangements for the exchange of balancing energy from FRR. As discussed in section 5.5 above, however, the latter requires some difficult decisions and possibly complex solutions. Consequently, the cross-border exchange of contracted reserves does hardly appear as a suitable choice in the short term.

Alternatively, Elia and TenneT might try to rely on the direct provision of FRR by individual BSPs to the foreign TSO (TSO-BSP model), at least for a transitional period. However, this could represent an interim solution only, since the FG Electricity Balancing clearly require the use of a common merit order in the future. Against the background of the deadlines outlined in the FG Electricity Balancing, it thus seems questionable whether it would be efficient to divert efforts on the development of such an interim solution, which might have to be replaced relatively soon.

Secondly, we have pointed out the limited availability of cross-border capacity in section 5.2 above (see Figure 21 on p. 43). This is less of an issue for the common utilisation of FRR since it is principally possible to account for the availability of cross-border capacity in real time, i.e. when deciding on the activation of FRR. In contrast, the exchange of contracted reserves clearly requires access to guaranteed cross-border capacity. In this context, it is furthermore important to consider the provisions of the FG Electricity Balancing, which do not generally support the reservation of cross-border capacity for the exchange of operational reserves. As explained in chapter 5.2 the FG Electricity Balancing require that need for reservation of cross-border capacity for this purpose must be proven by a solid cost-benefit analysis. These regulatory restrictions clearly represent an additional barrier for the exchange of contracted reserves.

## 5.7 Impact on Imbalance Settlement

Both countries apply a 'reactive approach' for imbalance settlement, i.e. they aim at providing incentives for self-balancing by market participants. As explained in section 3.6 such incentives do not only come from the price of imbalances, which is linked to (net) volumes and prices/cost of balancing energy activated in each PTU, but are also supported by close to real-time publication of relevant information on system imbalances and/or the costs of balancing energy.

Against this background, and considering the issues related to the possible exchange of balancing energy from FRR (see section 5.5 above), we have identified the following potential issues with regards to the impact on imbalance settlement:

- Reduced link between imbalance prices and the local system imbalance,
- Possible increase of imbalance prices,
- Different principles for pricing of balancing energy,
- Different treatment of balancing energy activated from automatic FRR.

In both countries, imbalance prices are principally linked to the marginal price of balancing actions undertaken by the TSO in the corresponding PTU. As such, imbalance prices are aimed at signalling the true cost of balancing and incentivising BRPs to not only limit their own imbalances but also react to the overall deviation of the local system. The cross-border exchange of balancing energy may reduce or even break this link, which is considered as important by both TSOs.

In a combined market, balancing energy may be activated in one country, in order to compensate the system imbalance of the other country. In the Netherlands, this can lead to an increasing frequency of dual imbalance prices (i.e. simultaneous activation of upward and downward regulation), especially if Elia activated manual FRR ahead of real time. In addition, the same effect may lead to situations where the net volume of balancing actions in Belgium is opposite to the prevailing system imbalance in the same PTU. Unless the current principles for the determination of imbalance prices were changed, Belgian BRPs might have to pay a high price for imbalances even at times of a system surplus, or vice versa. In this situation, BRPs would effectively face an incentive to increase rather than to reduce the local imbalance in the corresponding PTU. This would help to reduce the aggregate deviation of the two countries combined. However, it could still appear as counter-intuitive from a local perspective. Consequently, integration of the balancing mechanisms may require simultaneous adjustments the principles for pricing of imbalance in one or both countries.

One of the main advantages of regional integration clearly is the scope for reducing the cost of balancing. Under the current arrangements, however, there is a risk that the cross-border exchange of FRR may result in increasing imbalance prices. We have already commented on the risk of a higher frequency of dual imbalance prices in the Netherlands, which can be considered as disadvantageous from the perspective of BRPs and network users. In addition, cross-border integration may occasionally cause ‘price spikes’ in the balancing market, even though the average spread and/or volatility may decrease<sup>30</sup>.

From the perspective of Belgium, this issue is furthermore related to the two aspects already discussed in section 5.5 above, i.e. the use of different principles for pricing of balancing energy in combination

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<sup>30</sup> This may for instance be caused by a higher frequency of larger outages in the combined system, even if both systems benefitted from (partially) offsetting minor deviations under normal conditions.

with the different treatment of balancing energy activated from automatic FRR. In Belgium, fluctuations of imbalance prices are mainly related to the marginal price of manual FRR. Conversely, the settlement price of manual FRR in the Netherlands is by definition equal to the price of (automatic) FRR. Consequently, even very short and temporary deviations within a given PTU may result in a very high (or low) price for FRR, and hence in a corresponding increase (decrease) in the marginal price of balancing energy. In this context, we refer to Figure 14 on p. 32, which was showing significantly higher price elasticity in the Dutch balancing market than in Belgium. This indicates a certain risk that Belgian might generally face increasing imbalance prices in a combined and/or coupled mechanism as well as a potentially negative impact on the distribution of welfare gains.

It is difficult to assess the precise impacts without further quantitative analysis. Moreover, we note that revised rules on the pricing of balancing energy may influence the future structure of the price curve in Belgium. Nevertheless, these considerations highlight potential complications and the need for possible adjustments to the present arrangements for imbalance pricing and settlement in the two countries.

## 5.8 Summary

Based on the discussion in this chapter, we conclude that potential benefits of cross-border activation of balancing energy between Belgium and the Netherlands are mainly related to the frequency restoration process. Some additional benefits may be generated by facilitating the cross-border exchange of FCR. Conversely, we do not foresee any real benefits in the area of replacement reserves, which do not currently play a role in the balancing concept of both countries. Similarly, we conclude that the exchange of contracted FRR generally appears as difficult, not the least due to regulatory restrictions, such that we do not consider this an area of immediate attention for the time being.

With regards to the frequency restoration process, both countries profit from the sharing of manual FRR (300 MW), which is based on an existing agreement between TenneT and Elia. Similarly, both countries already participate in the IGCC and benefit from the netting of system imbalances. Overall, it thus appears that the most obvious potentials for benefitting from increased integration of the frequency restoration process have already been reaped.

Apart from the possible exchange of contracted FCR, any steps towards the cross-border exchange of operational reserves and balancing energy should thus probably be focused on the common utilisation of both manual and automatic FRR. Given the almost exclusive reliance on automatic FRR in the Netherlands, this product appears to be the obvious point of attention. Nevertheless, the Netherlands often have a substantial volume of manual FRR, which are not utilised, whereas this product plays an important role in Belgium.

For both products, the scope for cross-border activation of balancing energy will remain limited by available cross border capacity. Moreover, the discussion in section 5.5 has clearly shown that substantial changes would be required in both countries, in order ensure a minimum compatibility of product definitions as well as processes and principles for activation and settlement. In several areas, this will furthermore require trade-offs between the benefits of regional integration, on the one hand, and the advantages of products tailored to local needs and constraints, on the other hand.

Besides changes to the procurement of balancing energy, further changes may also be required the present arrangements for imbalance settlement. In this context, it will furthermore be important to investigate more closely the impact of different approaches on imbalance prices and the possible need for necessary methodological adjustments. Among others, it will be necessary to ensure an optimal cross-border use of manual FRR, even if the marginal price of manual FRR increased ex-post due to activation of more expensive automatic FRR. Similarly, the impact of cross-border activation of balancing energy on local imbalance prices should be analysed in more detail, in order to ensure that the latter provide efficient incentives to BRPs and other network users. From the perspective of Belgium, it finally seems essential to also consider the possible influence on the (marginal) price of balancing energy in both countries and the resulting distribution of economic welfare between the two countries.

## 6 RECOMMENDED OPTIONS FOR INTEGRATION

### 6.1 General

Based on the analysis presented above and separate discussions with Elia and TenneT, we believe that the following options for cross-border coordination in the area of operational reserves and balancing services are worth being considered by Elia and TenneT:

1. Exchange of frequency containment reserves (FCR),
2. Exchange of automatic frequency restoration reserves (aFRR),
3. Exchange of non-contracted manual frequency restoration reserves (mFRR); and

The following sections briefly explain and justify each these recommendations. After summarising the main benefits of each option, we also comment on applicable constraints and preconditions. In this context, we specifically consider the following aspects:

- Economic benefits,
- Ability to extend regional scope of proposed mechanism,
- Technical feasibility,
- Cost of implementation; and
- Required changes to the current arrangements.

Finally, we assess the risks associated with each of the measures proposed above. More specifically, this assessment considers the following risks:

- Reduced regulation quality and/or reliability, i.e. whether the proposed mechanism may create risks for regulation quality of reliability?
- Costs, i.e. whether there are any issues which may result in increasing cost?
- Implementation risks - Technical complexity, concerning the risk that implementation and/or operation of the proposed mechanism may be suffer from technical complexity.
- Implementation risks - Legal, regulatory and contractual framework, i.e. to which extent introduction of the proposed mechanism depends on a fundamental revision of the existing legal and/or regulatory framework, or other far-reaching changes of existing contracts etc.?
- Potential for extension, i.e. whether the proposed mechanism may be expanded to other countries in the future, or more generally facilitates integration with similar mechanisms in other countries; in both cases considering the specific requirements of the FG and (draft) NC on Electricity Balancing?
- Impact on BRPs, i.e. whether the proposed mechanism is compatible with the current principles of imbalance pricing in Belgium and the Netherlands and can be expected to promote incentives for self-balancing by BRPs?

## 6.2 Exchange of Frequency Containment Reserves (FCR)

### 6.2.1 Overall Feasibility and Benefits

In terms of product definition, FCR represent a relatively simple product, which furthermore does not require any real-time decisions and communication and control. We therefore propose to consider the establishment of a joint tendering mechanism for a single, standardised product. We emphasise that the total volume of FCR would remain unchanged but that the share of FCR provided by both countries would effectively be shifted from one TSO to the other.

The creation of a single FCR market with a standardised product entails the following advantages and key benefits to Elia and TenneT:

- Sufficient volumes of FCR being available and lack of cross-border constraints,
- Reduced costs due to increasing efficiency and competition between BSPs,
- Limited complexity and cost of implementation,
- General compatibility with future extension to other countries,
- Ability to maintain or develop specific conditions relevant from a local perspective.

Two fundamental preconditions for the establishment of a joint tendering mechanism are the technical availability of sufficient volumes, and the ability to exchange these volumes between both countries. Present arrangements in Belgium have been substantially driven by the intention to make additional volumes of FCR available at reduced costs. This does not imply that Belgium would face a physical deficit. But it indicates that there may be limited scope for Belgian BSPs taking over part of the FCR obligations of the Netherlands. In contrast, technical rules in place in the Netherlands suggest that Dutch producers should be capable of providing more than the combined need for FCR in Belgium and the Netherlands taken together<sup>31</sup>. This assumption is also supported by a consultation of Dutch market participants, which has recently been carried out in the context of investigating the scope for a common market for FCR between Germany and the Netherlands.<sup>32</sup>

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<sup>31</sup> In the Netherlands, generating units with a minimum installed capacity of 60 MW must provide FCR equal to at least 1% of their rated capacity whenever being synchronized with the system. In addition, they must be able to provide at least 5% of their installed capacity as FCR. With about 19 GW of generating units with a minimum unit size of 60 MW installed, these requirements correspond to a potential supply of up to 190 MW or 950 MW of FCR, respectively, compared to a combined requirement of 217 MW of FCR for Belgium and the Netherlands.

<sup>32</sup> Consentec. Market Study on a Common Market for Primary Control Reserve in the Netherlands and Germany. Market Study. Final report. Aachen. October 29, 2012

In contrast to other operational reserves, the cross-border exchange of FCR does not involve a direct physical exchange between the countries concerned. Instead, it effectively implies a (partial) shift of each TSO's obligation to contribute to the total provision of FCR in continental Europe.

Nevertheless, there are several regulatory constraints to be taken into account:

- First, the ENTSO-E Operation Handbook<sup>33</sup> (hereafter referred to as 'ENTSO-E OH') limits the amount, by which the local provision of FCR in any control area can be increased to cover the obligations of other control areas, to 30% of the original local obligations, subject to a minimum of 90 MW<sup>34</sup>.
- Secondly, article 42(2) of the draft Network Code on Load-Frequency Control and Reserves stipulates that 30% of the total FCR requirement in each control block has to be provided from local sources.
- Thirdly, the FG on Electricity Balancing<sup>35</sup> require a positive cost-benefit analysis in case the cross-border exchange of FCR requires an increase of the transmission reliability margin (TRM).

The first condition limits the volume of FCR that can be exchanged between Belgium and the Netherlands to 90 MW. This would be sufficient to cover the full needs of Belgium, or about 75% of the current Dutch obligations. Conversely, the second condition limits the potential imports of FCR by each country to 70% of local FCR obligations, or about 63 MW and 82 MW for Belgium and the Netherlands, respectively. Consequently, the second condition clearly represents the more stringent constraint. Still, both countries would principally be able to import more than two thirds of their local FCR obligations. In light of the previous comments on available volumes, neither of these constraints does appear as critical.

The key question then is whether TRM is sufficient to enable a corresponding exchange of FCR? TenneT currently applies a TRM of 300 MW for cross-border exports and imports (across all borders)<sup>36</sup>, whereas Elia reserves 250 MW for this purpose at each border<sup>37</sup>. Due to the distributed nature of FCR, we expect the unintended physical flows that may result from the activation of FCR will remain small compared to other variations that are being considered when determining the TRM for each country. This would suggest that that a common mechanism for the procurement of FCR

<sup>33</sup> European Network of Transmission System Operators for Electricity. Operation Handbook, P1 – Policy 1: Load-Frequency Control and Performance [C]. [www.entsoe.eu](http://www.entsoe.eu). sub-section A-S3.1

<sup>34</sup> This requirement has basically been maintained by the draft Network Code on Load-Frequency Control and Reserves, but subject to a minimum of 100 MW (see article 42(2)).

<sup>35</sup> ACER. Framework Guidelines on Electricity Balancing. FG-2012-E-009. Ljubljana. 18 September 2012. section 4.3

<sup>36</sup> See [www.tennet.org](http://www.tennet.org)

<sup>37</sup> See [www.elia.be](http://www.elia.be)

would hardly be limited by cross-border constraints. However, when taking into account the maximum permitted exchange of FCR obligations as determined above, the possible export of electricity due to the activation of FCR from Belgium and the Netherlands may then increase to some 172 MW and 180 MW<sup>38</sup>, respectively. Consequently, it appears that the impact of exchanging FCR between both countries on the dimensioning of the TRM, or alternatively additional limitations on the possible exchange of FCR, may deserve further study before deciding on implementation of a corresponding mechanism.

By definition, a single market will increase the efficiency of the procurement process and the resulting allocation of FCR commitments to individual producers. Most importantly, a common mechanism will allow more costly offers from one country being replaced by more economic offers from the other country. In turn, this will lead to a more economic allocation of FCR commitments to different providers in both countries and hence reduce overall cost.

These effects may generate significant cost savings compared to the present situation. Providers of FCR in Belgium at present receive a remuneration of 45 €/MW/h.<sup>39</sup> Conversely, the same product was available for approx. 15 – 17 €/MW/h in the first few months of 2013 in Germany, and average prices have been consistently between 25 €/MW/h for the last 18 months. Due to the mandatory provision of FRC in the Netherlands, it is difficult to estimate the prices, which TenneT might have to pay if it decided to proceed to commercial procurement of FCR. However, it seems reasonable to assume that Dutch producers might ask for similar prices as in Germany<sup>40</sup>. Even if prices increased in a common market between Belgium and the Netherlands, there may thus still remain sufficient scope for substantial cost reductions compared to the present situation in Belgium.

In order to estimate the possible benefits, we take the assumption that prices in a common market would range somewhere between 15 and 30 €/MW/h under current market conditions. Under these assumptions, Elia may benefit from savings of between 15 and 30 €/MW/h, or about € 12 to 24 million

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<sup>38</sup> Assuming that each country would take over the maximum possible share of FCR as explained above. For example, Belgium might have to contribute an additional 82 MW of FCR in addition to its own local share (90 MW), or a total of 172 MW. Similarly, the Netherlands might contribute a maximum of 180 MW to the total volume of FCR in continental Europe (117 MW local + 63 MW on behalf of Belgium).

Belgium BSPs would provide the maximum permitted share of Dutch FCR, i.e. 30% of 117 MW or 82 MW

<sup>39</sup> Arrêté royal imposant des conditions de prix et de fourniture pour l'approvisionnement en 2013 du réglage primaire et du réglage secondaire par différents producteurs. Brussels. 18 Décembre 2012

<sup>40</sup> Indeed, a recent study on the potential for the joint procurement of FCR by Germany and the Netherlands has reported that three of the six larger producers in the Netherlands had confirmed their principal ability and willingness to supply FCR (representing up to 200 MW of potential supplies) at market prices for FCR ( $\pm 15\%$ ) observed in Germany in the 12 preceding months.

See Consentec. Market Study on a Common Market for Primary Control Reserve in the Netherlands and Germany. Market Study. Final report. Aachen. October 29, 2012

per annum for the entire capacity of 90 MW currently contracted by Elia<sup>41</sup>. Please note that this estimate is based on the assumption that the introduction of a common mechanism would coincide with a shortening of the contracting period.

Conversely, and as discussed in more detail below, we believe that the joint tendering of a single, standardised product could be implemented at limited costs and complexity. Notably, we do not foresee a need for major modifications of existing product definitions or for significant investments into additional operational or IT systems that would not be required otherwise. In this context, it is important to note that the tendering of FCR in the Netherlands would effectively start from a 'greenfield' basis, avoiding the need for modification and/or replacement of existing rules and systems. Similarly, FCR are currently procured on an annual basis in Belgium such that Elia does not yet operate a structured process for the regular tendering of FCR at short time intervals.

The joint tendering of a single standardised product can be expected to facilitate extension to other countries in the future. Indeed, a corresponding mechanism would bear many similarities with the procurement process currently applied in Germany. Similarly, the symmetrical FCR product in Belgium as well as the present technical requirements in the Netherlands can be considered as broadly compatible with the German product definitions, which should also facilitate a coupling or even integration of both mechanisms in the future. One key difference between current arrangements in Belgium and Germany relates to the contracting period. Whereas FCR are currently procured on an annual basis in Belgium, the German mechanism is based on weekly tenders. However, we generally recommend a transition to shorter contracting periods, such that we do not necessarily consider this as an important barrier in the longer term.

Last but not least, the establishment of a joint tendering mechanism within the framework of an ENTSO-E pilot project under the Network Code on Electricity Balancing would obviously increase the chances of reflecting specific conditions that may be considered relevant from a local perspective. This may be considered as particularly relevant for Elia, due to the limited volume of competitive offers from local sources as the steps already taken towards facilitating the provision of FCR from other sources, such as industrial consumers. One possible option could for instance be to separately procure part of the total FCR obligations in the form of a special product in one or both countries. Alternatively, a joint mechanism could be based on two asymmetric products, i.e. for separately for upward and downward regulation, although the latter would no longer be compatible with present arrangements in France or Germany.

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<sup>41</sup> In contrast, it is not possible to specify potential savings for the Netherlands since there the provision of FCR is not remunerated at present.

### 6.2.2 Preconditions and Constraints

As discussed in the previous section, the cross-border exchange of FCR would be subject to the constraints imposed by the ENTSO-E OH and the FG on Electricity Balancing. However, assuming that it would not be necessary to increase the current levels of TRM, the resulting effects would be limited to constraining the shift of FCR obligations from the Netherlands to Belgium, and vice versa. Since this covers about 75% of the total obligation of the Netherlands, we do not consider this constraint to be particularly restrictive. Moreover, for the reasons discussed above, it appears unlikely that this constraint would have a major impact in a common market for FCR.

Nevertheless, the design and implementation of joint mechanism for the procurement of a single, standardised FCR product would require:

- Development of minimum product specifications,
- Implementation of (new) IT systems for the procurement and settlement of FCR,
- Adaption of the existing legal, regulatory and contractual framework.

A common mechanism for the exchange of FCR will require a common set of minimum product specifications, in order to create a level playing field and ensure that the services procured meet the minimum requirements of both TSOs. But as already mentioned a common mechanism will not result in the physical exchange of FCR between both countries but merely in an exchange of FCR obligations between both TSOs. Consequently, the detailed product specifications in both countries may potentially differ as long as they enable the local TSO to satisfy its (revised) FCR obligations under the ENTSO-E OH.

Among others, this relates to the potential continuation of separate local products, like the asymmetrical FCR in Belgium. Similarly, 'standard' symmetrical FCR from larger units in Belgium and the Netherlands currently have to be provided without a deadband. In contrast, current regulations allow for a deadband of 100 mHz for asymmetric FCR in Belgium but  $\pm 150$  mHz for units with an installed capacity of less than 60 MW in the Netherlands. To a certain extent, the decision whether to accept such exceptions and/or product differentiations may remain at the discretion of each TSO.

Whilst being potentially acceptable from a technical point of view, such variations may also influence the cost of FCR provision. In order to create a level playing field for potential BSPs from both countries, it therefore appears desirable to strive for a minimum of harmonisation and review any variations with respect to their potential impact on the costs of providing FCR. Apart from strict technical requirements, this also applies to other preconditions, such as availability requirements.

Both Belgium and the Netherlands do not currently carry out regular tenders for FCR with a limited contract duration. Assuming that both countries will eventually proceed to regular short-term tenders, they will be forced to design and implement IT systems mainly for the procurement (i.e. tendering) and settlement of FCR, irrespective of whether they proceed to an isolated national mechanism of an integrated approach with cross-border exchange of FCR. Moreover, when assuming that a single

standardised product is procured, we assume that the latter could be integrated into the necessary IT systems at strictly limited costs. Consequently, we do not foresee the need for complex and hence costly additional systems, in order to enable the cross-border exchange of FCR. Indeed, the introduction of a common mechanism can even be expected to reduce the costs of necessary IT systems in comparison with the establishment of two separate markets on a national basis.

Starting from the current situation, some institutional changes to current arrangement would be required. For instance the Netherlands would need to update the System Code, in order to replace the current regime of mandatory provision by provisions allowing for the commercial procurement of FCR. Similarly, legislation in Belgium would need to be adapted to ensure that the results of a regular market-based mechanism are binding and cannot be easily over-ruled by regulatory and/or governmental decisions. Similarly, the regulatory framework in both countries may need to be adapted, in order to ensure that fluctuations in the cost of FCR that the results of changing market conditions do not create any undue financial risks for the TSOs but can be generally passed on through tariffs.

On a practical level, the TSOs (and regulators) in both countries would finally need to develop the necessary contractual framework. Apart from relations between the local TSO and local BSPs, this also applies to the relation between both TSOs, in order to clearly specify the rules and principles for the exchange and remuneration of FCR.

### 6.2.3 Risk Assessment

Table 9 assesses the exchange of FCR against the risks identified in section 6.1 above. In principle, we do not expect any substantial risks in most areas, with the following exceptions:

- Insufficient offers and/or market power, leading to uncompetitive prices and high costs,
- Time for implementing necessary changes to legal, regulatory and contractual framework,
- Financial risks for TSOs.

**Table 9: Risk assessment for joint contracting of FCR**

| Risk                                          | Assessment |                                                                                                    | Mitigating measures                                                                                                 |
|-----------------------------------------------|------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
|                                               |            | Explanation                                                                                        |                                                                                                                     |
| Reduced regulation quality and/or reliability | +          | - No issues expected                                                                               |                                                                                                                     |
| Costs                                         | 0          | - Risk of insufficient offers and/or market power                                                  | - Introduce suitable safeguards and/or fall-back options                                                            |
| Implementation                                |            |                                                                                                    |                                                                                                                     |
| - Technical complexity                        | +          | - Not fundamentally different from local mechanism                                                 |                                                                                                                     |
| - Legal, regulatory and contractual framework | 0          | - Time required; remaining financial risks for TSOs<br>- Similar to implementation of local market | - Requires commitment by TSOs and regulators alike<br>- Consider possible short-term fluctuations in tariff setting |
| Potential for extension                       | (+)        | - Depending on detailed design                                                                     | - Focus on standardisation; use additional local products where necessary                                           |
| Impact on BRPs                                | +          | - No issues expected                                                                               | -                                                                                                                   |

Source: DNV KEMA

To date, both countries lack experience with a (fully) market-based mechanism for the procurement of FCR. Whilst Elia already procures FCR through annual tenders, this process is complicated by the fact that the regulator has to assess each time whether offered prices were reasonable. Conversely, TenneT does not yet procure FCR on a commercial basis, even though our analysis above suggests that Dutch producers may be able and willing to provide sufficient volumes of FCR at competitive prices.

Against this background, there remains a risk of tight margins and increasing prices in a joint market, in particular with a view to the large market share which Electrabel may maintain even in a combined market. In contrast to the wholesale market, potential market power would not be mitigated through regional integration with other markets. It may therefore be necessary to introduce suitable safeguards and/or fall-back options, in order to prevent and/or deal with corresponding issues. In practice, this could for instance already be achieved by initially limiting the joint mechanism to the amount of symmetric FCR, which Elia currently procures locally (30.5 MW) and then gradually increasing this volume as the market for FCR matures. Apart from restricting potential market power in the initial stages of the new market for FCR, this would also facilitate market monitoring and comparison with developments in other countries.

Secondly, implementation of a joint mechanism might be delayed by the time required to agree on and approve necessary changes to the legal, regulatory and contractual framework. To a large degree, however, the corresponding issues are not different to the isolated introduction of a market-based mechanism with shorter contracting periods within each country. Given that we generally recommend shorter contracting periods, the additional risks for the joint contracting of FCR are thus limited to coming to a common agreement between the relevant stakeholders in both countries. Hence, this risk will mainly require sufficient commitment not only from the side of the two TSOs but also by the respective regulators (and governments), in order to prevent undue delays.

A third issue finally relates to possible financial risks for the TSOs, i.e. where tariffs are based on the expected costs of FCR. In this case, procuring FCR through a short-term basis market mechanism may create significant financial risks for a TSO since actual prices may substantially deviate from expectations. Again, this issue is not specifically related to the cross-border exchange of operational reserves but more generally applies to the short-term procurement.

## 6.3 Exchange of Automatic Frequency Restoration Reserves (FRR)

### 6.3.1 Rationale for Proposed Solution

Automatic FRR represent the main product for real-time balancing in Belgium and the Netherlands. Focusing on the cross-border exchange of this product therefore seems to be a natural choice as it can be expected to generate substantial benefits. Furthermore, the FG on Electricity Balancing require the TSOs to coordinate the use of automatic FRR. Whilst this may initially be achieved by avoiding the counter-activation of automatic FRR by means of ‘netting’, the FG on Electricity Balancing additionally call for the establishment of a common merit order list.

Today, TenneT and Elia already participate in module 1 of the IGCC, which involves the netting of the area control area (ACE) before activating automatic FCR. In practice, IGCC may result in situations where the potential benefits of netting between Belgium and the Netherlands are not fully exploited, i.e. where both countries remain with a residual ACE into opposite directions<sup>42</sup>. In line with the minimum requirements of the FG on Electricity Balancing, TenneT and Elia could therefore implement sub-netting. In this case, the ACE of both TSOs would first be netting in isolation, with only the residual net volume being considered in IGCC.

However, there are several arguments why we believe that it may be more beneficial for TenneT and Elia to refrain from isolated sub-netting and focus on the design and implementation of a more comprehensive approach that is based on the use of a common merit order for automatic FRR:

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<sup>42</sup> This may happen since IGCC considers radial connections only.

- We assume that the incremental benefits of sub-netting for TenneT and Elia would remain limited<sup>43</sup>, in particular when taking into account pricing effects within IGCC and the fact that Elia will be integrated in IGCC through its own virtual tie-line soon.
- Sub-netting would substantially increase complexity.
- The benefits of sub-netting are implicitly also captured when using a common merit order after IGCC, whereas the common merit order potentially offers significant additional savings to both countries.
- Sub-netting will likely be insufficient to comply with the future requirements set by the FG on Electricity Balancing, i.e. regional sharing of available resources. Rather than taking a reactive position and be forced to introduce another system in a few years into the future, it may therefore be more beneficial for both TenneT and Elia to take an active role and develop an option that takes account of local conditions and their own balancing philosophy.

Please note that we do not advocate the joint contracting of automatic FRR at this stage. Although this step may potentially generate even larger savings, this is only possible after harmonising the activation of balancing energy in real-time, including the adjustment of the necessary products, rules, processes, and timelines. It therefore appears more logical to initially focus on the first step, i.e. on the activation of balancing energy from automatic FRR. In addition, the cross-border exchange of reserve contracts would likely be seriously constrained by the preconditions required under the FG on Electricity Balancing to enable the reservation of cross-border capacity for exchanging operational reserves.

### 6.3.2 Overall Feasibility and Benefits

The establishment of a common mechanism for the exchange of balancing energy from automatic FRR principally offers the following benefits to Elia and TenneT:

- Reduced costs due to increasing efficiency and access to larger resource base,
- Initiation of a pilot project for the cross-border exchange of automatic FRR that takes account of local conditions and balancing philosophy of Elia and TenneT.

As already mentioned for the case of FCR, one of the key advantages of the cross-border exchange of balancing services is the chance to benefit from a more efficient utilisation of available resources. In the case of automatic FRR, this aspect is of particular importance due to differences in the generation structure of Belgium and the Netherlands. Similarly, cross-border integration may also improve the scope for competition. This advantage may be considered as especially relevant for Elia, which currently procures this service from a limited number of local providers.

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<sup>43</sup> Please note that a detailed quantitative assessment of the potential benefits is beyond the scope of this study.

As further discussed in section 6.3.3 below, the exchange of balancing energy from automatic FRR requires several issues to be resolved, which are mainly related to product definitions and activation principles. In this context, we principally assume that a corresponding mechanism will be based on activation of automatic FRR by merit order as already applied in the Netherlands today. The reasons for this assumption are two-fold. First, from a theoretical point of view, this approach appears as the only option for reaping the full economic benefits of diverse offers in an enlarging regional market. In addition, the FG on Electricity Balancing explicitly refer to this principle as the desired target model for the exchange of balancing energy from automatic FRR. In order to avoid unnecessary and potentially costly changes in the future, it therefore appears beneficial to aim at designing and implementing a corresponding mechanism from the start.

Similar to the case of FCR, the initiation of a pilot project for the cross-border exchange of automatic FRR along these principles furthermore has the advantage that it allows Elia and TenneT taking a proactive role in the development of the future ‘target model’ in this area. Hence, rather than being forced to adopt a different system in the future, the two TSOs can steer the process to make sure that it takes account of local constraints and conditions and supports the ‘reactive’ balancing philosophy of Elia and TenneT. In addition, choosing for activation by merit order would facilitate integration with other countries at a later stage, noting that for instance module 4 of the grid control cooperation (GCC) in Germany is already based on the use of a common, nation-wide merit order.

Assuming that the barriers for implementing a corresponding mechanism are overcome, the exchange of balancing energy from automatic FRR can be expected to lead to decreasing of cost. Such savings may result from quantity effects, i.e. in a similar way as for sub-netting, as well as from the use of the most economic bids and offers at any point in time.

In order to quantitatively estimate the corresponding benefits, it would principally be necessary to consider, for each PTU, the detailed merit order of available automatic FRR as well as the ATC remaining available after the end of the intra-day market. A detailed numerical analysis would extend beyond the scope of the current qualitative assessment. Moreover, the value of a corresponding analysis would be limited by the fact that Elia and TenneT currently procure two different products such that prices in a joint mechanism may be different. As an alternative, we have used a simplified approach to derive an estimate of the savings, which may result from the exchange of automatic FRR.

As a starting point, we assume that the cross-border exchange of automatic FRR will have a limited impact on the size and distribution of physical imbalances<sup>44</sup>. Based on this assumption, our subsequent analysis is based on the quarter-hourly (net) activation of automatic FRR by Elia and TenneT in the period January to November 2012. This furthermore implies that we neglect the fluctuating use of

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<sup>44</sup> This assumption may not hold perfectly in practice as cross-border exchange of automatic FRR may result in ‘lower’ imbalance prices, which in turn may reduce incentives for self-balancing by BRPs.

automatic FRR within each PTU, which is likely to under-estimate the potential benefits of cross-border integration.

Based on the relation between physical imbalances and imbalances prices in each PTU in 2012, we furthermore assume the same function for the price of activated automatic FRR in both countries. More specifically, this function assumes a price of 50 €/MWh for an imbalance of zero and increases (decreases) by 20 €/MWh for every 100 MW of upward (downward) regulation activated<sup>45</sup>. Under these assumptions, the marginal price of balancing energy for instance amounts to 80 €/MWh when 150 MW of upward regulation have been activated, or 20 €/MWh for 150 MW of downward regulation.

In order to take account of limitations caused by network congestion, we assume that Belgium can import of up to 250 MW of aFRR during the summer but up to 50 MW during the winter season. For exports from Belgium to the Netherlands, we take the opposite assumption, i.e. 50 MW during the summer but 250 MW in the winter. Moreover, we assume that any opposite need for aFRR is offset through IGCC, such that only the residual volume of aFRR has to be provided from the combined merit order.

As shown by Table 10, these assumptions lead to potential savings of approx. 11.5 M€/a as a result of exchanging balancing energy activated automatic FRR, or about 56% of the original costs.

**Table 10: Estimated benefits of cross-border activation of automatic FRR**

|                     | Local provision | Combined provision | Change |      |
|---------------------|-----------------|--------------------|--------|------|
|                     | M€              | M€                 | M€     | M€   |
| Upward regulation   | 36.8            | 21.5               | -15.3  | -42% |
| Downward regulation | -16.2           | -12.5              | 3.7    | -23% |
| Total               | 20.6            | 9.0                | -11.5  | -56% |

Source: DNV KEMA

### 6.3.3 Constraints and Preconditions

In contrast to FCR, the exchange of automatic FRR requires cross-border capacity to remain available after the end of the intra-day market. Consequently, a joint mechanism will not be able to exploit the full theoretical potential, which could be achieved with unconstrained interconnector capacity. Our simplified analysis described above suggests that this may in particular reduce the scope for the

<sup>45</sup> This assumption holds true for a range of  $\pm 300$  MW in both countries. In 2012, the activation of automatic FCR under consideration of possible cross-border exchanges remained within  $\pm 300$  MW during 99% of all PTU's.

exports from the Netherlands to Belgium, whereas the impact on exchanges in the opposite direction is more limited.

Due to complex nature of automatic FRR and the existing differences in product definitions and activation principles, the exchange of automatic FRR will require several changes to be made, such as:

- Decide on treatment or harmonisation of current product specifications (ramp rates),
- Harmonisation of activation principles,
- Design and implementation of new and/or adaption of existing IT systems,
- Adaption of the existing legal, regulatory and contractual framework.

The use of different ramp rates arguably represents one of the two key differences between Belgium and the Netherlands today. Any combination of the existing products would result in an uneven activation of offers, i.e. with a relatively higher utilisation of automatic FRR from Belgium that is offered for the same price as automatic FRR from the Netherlands. Although this effect can be considered acceptable from a technical point of view, it may be regarded as discriminatory from the perspective of BSPs. Conversely, a harmonisation of ramp rate requirements would obviously imply changes to current product definitions in at least one of the two countries. This indicates that the corresponding changes and decisions would be far from being trivial.

As discussed above, we assume that a common mechanism would most likely be based on activation by merit order<sup>46</sup>. Whilst the Netherlands already activate balancing energy bids by merit order, the introduction of merit order based activation would require larger changes in Belgium. For instance, Belgium would have to adapt current processes and technical systems (incl. AGC) and take into account potential implications on the pricing of balancing energy and imbalances.

Due to the principle of combined marginal pricing of automatic and manual FRR in the Netherlands, it might furthermore be necessary to provide for a ‘real time’ adjustment of bids and offers for aFRR. More specifically, whenever any manually instructed FRR or emergency reserves from the Netherlands were activated, the price of all (remaining) offers for aFRR from the Netherlands might have to be “artificially” increased accordingly, in order to properly reflect their true position in the combined merit order of both countries.

As a result of these changes, the exchange of balancing energy from automatic FRR can be expected to require significant changes to existing systems, or the adaptation of existing ones. Besides procurement and settlement, this also applies to operational systems. Most importantly, Elia would

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<sup>46</sup> Alternatively, Elia and TenneT could attempt to develop a hybrid mechanism which maintains different activation principles in both countries, or to apply a common pro rata mechanism. Apart from the possible complexity of the former approach, however, both approaches would likely lead to significantly lower economic efficiency.

need to adjust its AGC. Although it is beyond the scope of this study to investigate the feasibility of corresponding changes, this represents a potentially critical issue.

In addition, it would also be necessary to design and implement a 'regional' controller which coordinates the exchange of balancing energy between both countries. For instance both countries might agree upon the implementation of a single controller acting as master for both systems. Alternatively, a more hierarchical solution might be chosen.<sup>47</sup> This is directly linked to the question how the ACE/PACE are adjusted in real time for the exchange of automatic FRR.

Apart from technical issues, both countries would need to adapt the existing legal, regulatory and contractual framework for the procurement and use of automatic FRR. These changes would be related to the principles of activation and remuneration and, possibly, the pricing of imbalances. In addition, it would be necessary to harmonize product definitions. But in contrast to the exchange of FCR (see section 6.2.2), there would be no need to harmonize the advance contracting of operational reserves or to deal with any deviations between expected and actual cost of reserve procurement.

#### 6.3.4 Risk Assessment

Table 11 assesses risks related to the exchange of balancing energy from automatic FRR, using the different categories of risks identified in section 6.1 above. As illustrated by this table, this option is associated with several risks, which would need to be taken into account when designing and implementing a corresponding mechanism:

- Reduction of regulation quality,
- Risk of increasing costs due to insufficient scope for competition and/or as a result of increasing ramping requirements,
- Risks and costs related to the implementation and/or adaption of real-time systems,
- Time for implementing necessary changes to legal, regulatory and contractual framework,
- Reduced incentives for self-balancing due to decreasing imbalance prices.

The first two items arguable are the most critical. In addition, they are related to each other, i.e. decisions that help to mitigate one issue may potentially aggravate the other. For instance extending the current ramp rate requirements from Belgium to the Netherlands may help to preserve regulation quality in Belgium but lead to less and more expensive offers in the Netherlands. Conversely, reduced ramp rates may either result in deteriorating regulation quality in Belgium and/or the need for the contracting of additional volumes of automatic FRR. Consequently, we recommend investigating the possible impact of different ramp rates and activation principles on the Belgium control area in

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<sup>47</sup> In our opinion this should also be further explored in subsequent analysis.

particular, in order to identify suitable options and solutions. Simultaneously, this analysis should also cover expected impacts on the availability and price of automatic FRR.

Lack of competition represents another potential risk, which has to be taken into account, especially if it was decided to apply the more stringent Belgian requirements on ramp rates in the Netherlands as well. However, we expect it to be of limited relevance due to the volatile use of automatic FRR in real time. Nevertheless, it may certainly become an issue when large volumes of automatic FRR have to be activated, or in case of network constraints between both countries, noting that the latter aspect is not related to cross-border integration.

As already mentioned, the exchange of automatic FRR will require the implementation of new and/or the adaption of existing systems, including real-time systems such as SCADA / AGC. Corresponding changes may be costly. In addition, they will require careful design and testing to minimise any risk for real-time system operations.

**Table 11: Risk assessment for exchange of automatic FRR**

| Risk                                          | Assessment |                                                                                                                                                                                                                                                                                                     | Mitigating measures                                                                                                                                                                                            |
|-----------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                               |            | Explanation                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                |
| Reduced regulation quality and/or reliability | (-)        | - Possible reduction of effective ramp rates in Belgium                                                                                                                                                                                                                                             | - Investigate possible options for dealing with reduced ramp rate and related cost effects                                                                                                                     |
| Costs                                         | (-)        | <ul style="list-style-type: none"> <li>- Risk of increasing cost in case of higher ramping requirements in the Netherlands and/or due to larger contracted volumes in Belgium</li> <li>- Risk of insufficient offers and/or market power</li> <li>- Cost of changes to real-time systems</li> </ul> | <ul style="list-style-type: none"> <li>- Investigate possible options for dealing with reduced ramp rate and related cost effects</li> <li>- Introduce suitable safeguards and/or fall-back options</li> </ul> |
| Implementation                                |            |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                |
| - Technical complexity                        | (-)        | - Requires introduction and/or adaption of real-time systems                                                                                                                                                                                                                                        |                                                                                                                                                                                                                |
| - Legal, regulatory and contractual framework | 0          | - Time required                                                                                                                                                                                                                                                                                     | - Requires commitment by TSOs and regulators alike                                                                                                                                                             |
| Potential for extension                       | (+)        | - Depending on detailed design                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>- Focus on standardisation</li> <li>- Consider foreign practices</li> </ul>                                                                                             |
| Impact on BRPs                                | (-)        | <ul style="list-style-type: none"> <li>- Reduced costs of balancing may decrease incentives for balancing</li> <li>- Deviation between local system imbalance and activation of balancing energy</li> </ul>                                                                                         | - May require adjustment of imbalance pricing system                                                                                                                                                           |

Source: DNV KEMA

In our view, the risks related to changing the legal, regulatory and contractual framework in both countries are mainly related to the time required to agree on the necessary changes of products, processes and regulations. Moreover, it is important to consider that changes may not only be required in the area of aFRR, but also with regards to the pricing of imbalances (see below). In order to successfully deal with this issue, sufficient commitment will be required especially from the side of the TSOs and regulators.

Last but not least, the exchange of automatic FRR may influence incentives for self-balancing by BRPs. One of the key advantages of this option is a more efficient use of available balancing

resources. Apart from reducing the costs of balancing, this may also lead to ‘decreasing’ imbalance prices and hence reduce incentives for BRPs to avoid imbalances. In addition, the exchange of balancing energy may lead to situations where the activation of balancing energy seems to ‘contribute’ to the system imbalance, creating potential issues with regards to the pricing of imbalances.

We note that these issues represent a fundamental choice between minimising the costs of either the local or the combined system, which will by definition occur in any integrated system. Indeed, most of the issues principally already appear in case of netting within the IGCC, although to a lower extent. Nevertheless, they indicate a possible need to harmonise the principles of imbalance pricing, at least to the extent as required to avoid perverse incentives and maintain incentives for supporting the ‘reactive’ balancing philosophy of both Elia and TenneT.

## 6.4 Non-contracted Manual FRR

### 6.4.1 Overall Feasibility and Benefits

As mentioned above, automatic FRR represent the main balancing tool in both countries. In addition, Elia activates substantial volumes of manual FRR, whereas TenneT does hardly ever use this product in real time operations. Nevertheless, TenneT has access to significant volumes of a manual FRR on a daily basis, which could principally be made available to Elia. We have furthermore been informed by TenneT that manual FRR are often competitive with automatic FRR, which suggests that an exchange of manual FRR may also be attractive from an economic perspective.

In addition, it is important to note that the FG on Electricity Balancing put a lot of emphasis of the exchange of manual FRR. Consequently, it appears reasonable to assume that Belgium and the Netherlands will eventually be requested to join a corresponding system. There is a risk, however, that such a solution may not adequately consider the interaction between automatic and manual FRR in Belgium and the Netherlands, and their impact on imbalance prices in both countries (compare section 3.6). Rather than waiting for other countries to ‘impose’ a mechanism on them, it may therefore be more advantageous for Elia and TenneT to take an active part in this process and aim at developing a model that best suits their needs, reaps available benefits and can be extended and/or coupled with other countries or regions at a later stage.

We furthermore note that it would seem reasonable to at least initially limit the scope for cross-border exchanges to non-contracted manual FRR, i.e. to additional bids and offers that become available to Elia and TenneT on a daily basis. Conversely, there seem to be limited benefits of including contracted reserves since these are used under exceptional circumstances only.

To estimate the possible economic benefits, we principally apply the same approach and assumptions as described for the case of automatic FRR before, but in this case based on the activation of manual FRR in the period January to November 2012<sup>48</sup>. As shown by Table 12, the exchange of manual FRR offers delivers savings as well. However, these savings are much lower savings than for the other two options discussed before. This indicates that priority might have to be given to the exchange of automatic FRR and the sharing of FCR. However, we expect that the exchange of operating reserves for manual FRR may deliver much larger savings. Consequently, it may still be worth to facilitate the exchange of manual FRR, as a precondition for exchanging operating reserves at a later stage.

**Table 12: Estimated benefits of cross-border activation of manual FRR**

|                     | Local provision<br>M€ | Combined provision<br>M€ | Change<br>M€ | Local provision<br>M€ |
|---------------------|-----------------------|--------------------------|--------------|-----------------------|
| Upward regulation   | 13,2                  | 11,8                     | -1,3         | -10%                  |
| Downward regulation | -3,3                  | -3,2                     | 0,0          | 0%                    |
| Total               | 9,9                   | 8,6                      | -1,3         | -13%                  |

Source: DNV KEMA

#### 6.4.2 Constraints and Preconditions

Whilst we believe that the exchange of manual FRR should principally be feasible, it would clearly require certain changes to be made. In particular, we note the following:

- As mentioned, Belgium and the Netherlands currently rely on two different products that are not directly compatible with each other, i.e. directly activated FRR in Belgium and schedule activated FRR without a defined notice time in the Netherlands. In our view, it would be necessary to harmonise these products, i.e. choose one of the two options, in order to enable an efficient use of this product that is not limited to very specific points in time.
- Secondly, the compatibility of the current principle of combined marginal pricing for automatic and manual FRR in the Netherlands with cross-border integration appears questionable. This implies that it might be necessary to either adjust the pricing principles in the Netherlands in general, or at least for manual FRR that are activated on behalf of a foreign TSO.
- Similarly, it may also be necessary to adjust the pricing of imbalance settlement in the Netherlands, in order to avoid the risk of dual imbalance prices in PTUs when Elia has

<sup>48</sup> Please note that we have not considered the simultaneous use of cross-border capacity for both automatic and manual FRR in our calculations.

activated manual FRR from the Netherlands, even if there was no counter-activation of automatic FRR in the same period.

Overall, we do not believe that any of these issues represents a potential barrier from a technical perspective. Although Elia and TenneT would obviously have to adjust their systems for the selection and settlement of manual FRR, we assume that these could be implemented at limited costs. Nevertheless, it would obviously be necessary to decide on substantial changes to the current market framework, i.e. in terms of product definitions and the pricing principles. As a result, we furthermore see the need to adjust the applicable regulatory and contractual framework in both countries, although these would again appear limited.

#### 6.4.3 Risk Assessment

Table 13 assesses risks related to the exchange of manual FRR, using the risk categories identified in section 6.1 above. In summary, we mainly see the following risks:

- Need for product harmonisation (i.e. use of schedule- vs. directly activated reserves),
- Pricing of manual vs. automatic FRR,
- Risk of de-coupling between activation of manual FRR and system imbalance.

As discussed, we believe that it will be necessary to harmonise current product definition, i.e. mainly with regards to notice times for activation. This in turn may have implications on the existing system for selection, activation and settlement of manual FRR. Similar to the case of automatic FRR, this also relates to real-time systems, although we consider the associated risks to be less critical in this case.

Conversely, the current principles for pricing of manual and automatic FRR in the Netherlands represent a potentially serious barrier. Unless this issue is resolved, an integrated mechanism may either lead to high and unpredictable costs for Belgium, or simply not be used in practice. Both outcomes would be highly undesirable and should be avoided.

The third risk finally relates to the relation between the activation of balancing energy and imbalance prices. As already identified above, this may have undesired consequences on imbalance prices in the Netherlands, i.e. by reducing incentives to support the system in PTUs when manual FRR have been activated.

**Table 13: Risk assessment for exchange of automatic FRR**

| Risk                                          | Assessment |                                                                                                                               | Mitigating measures                                                                      |
|-----------------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|                                               |            | Explanation                                                                                                                   |                                                                                          |
| Reduced regulation quality and/or reliability | +          | - No issues foreseen                                                                                                          |                                                                                          |
| Costs                                         | +/-        | - Depending on link between pricing of manual and automatic FRR                                                               | - Consider options to de-link price of exported volumes from activation or automatic FRR |
| Implementation                                |            |                                                                                                                               |                                                                                          |
| - Technical complexity                        | (-)        | - Need to adjust product definition and activation in at least 1 country<br>- Resulting changes to IT and operational systems |                                                                                          |
| - Legal, regulatory and contractual framework | 0          | - Time required                                                                                                               | - Requires commitment by TSOs and regulators alike                                       |
| Potential for extension                       | (+)        | - Depending on detailed design                                                                                                | - Note very different practices in other countries                                       |

Source: DNV KEMA