

Belgian electricity market

-

Final implementation plan

22/06/2020

This document is to be regarded as the implementation plan from Belgium in accordance with article 20 of Regulation 2019/943 of 5 June 2019 on the internal market for electricity, both for the already approved strategic reserve (state aid measure SA.48648) as in the context of the ongoing state aid approval process for the introduction of a capacity mechanism of the type “reliability options” in Belgium.

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1. Introduction

1.1 Context

Electricity adequacy has been a recurring concern for Belgium during the last years. This can be taken back to, amongst others, the energy transition, resulting in a changing production mix and a high dependency on imports, and their associated risks. This is detailed in **chapter 2**, which also provides some key figures about the Belgian electricity system.

In **chapter 3** an overview is provided of the most recent adequacy assessments of Belgium, which demonstrate that, despite numerous improvements to the market functioning, a constant effort to open up the markets to new technologies and a robust network which is highly interconnected with the neighbouring countries, the adequacy concerns are aggravated in the near future. Belgium is thus facing serious electricity adequacy concerns, due to, amongst others, further changes in the production mix in Belgium and its neighbouring countries. Most notably, the nuclear phase-out in Belgium, which is planned to be completed by 2025, will bring about a major shock in the Belgian electricity system.

As is foreseen in article 20.3 of “Regulation 2019/943 of 5 June 2019 on the internal market for electricity”, Member States with identified resource adequacy concerns shall develop and publish an implementation plan with a timeline for adopting measures to eliminate any identified regulatory distortions or market failures as a part of the State aid process. Belgium currently operates a strategic reserve (state aid measure SA.48648) and intends to introduce a capacity mechanism of the type “reliability options”, and is therefore involved in such a “State aid process”.

The measures are listed in **chapter 4**. **Chapter 5** finally provides the overview of measures on a single timeline. These measures have been consulted through the appropriate bodies and procedures from the respective organisations. Indeed, all decisions from the regulator and market related measures from the TSO are consulted through extensive workshops and/or written (online) consultations¹.

Chapter 6 finally provides a short conclusion on the implementation plan.

1.2 Process

The Belgian state has submitted its implementation plan to the European Commission on 22 November 2019. Pursuant to Article 20(5) of the Electricity Regulation, the Commission is required to issue an opinion on whether the proposed measures and the timeline for their adoption are sufficient to eliminate any identified regulatory distortions or market failures. Belgium has received this opinion C(2020) 2654 in the course of May 2020 (see Annex I). Subsequently, the plan has been updated and adapted taking into account the comments of the Commission. This is

¹ See the websites of CREG and Elia (Users' Group):

<https://www.creg.be/fr/publications>

<https://www.elia.be/en/users-group>

the present document, the “**Final Implementation Plan**”. Belgium has published this amended plan on the website of the Federal Public Service Economy and has informed the Commission of its publication.

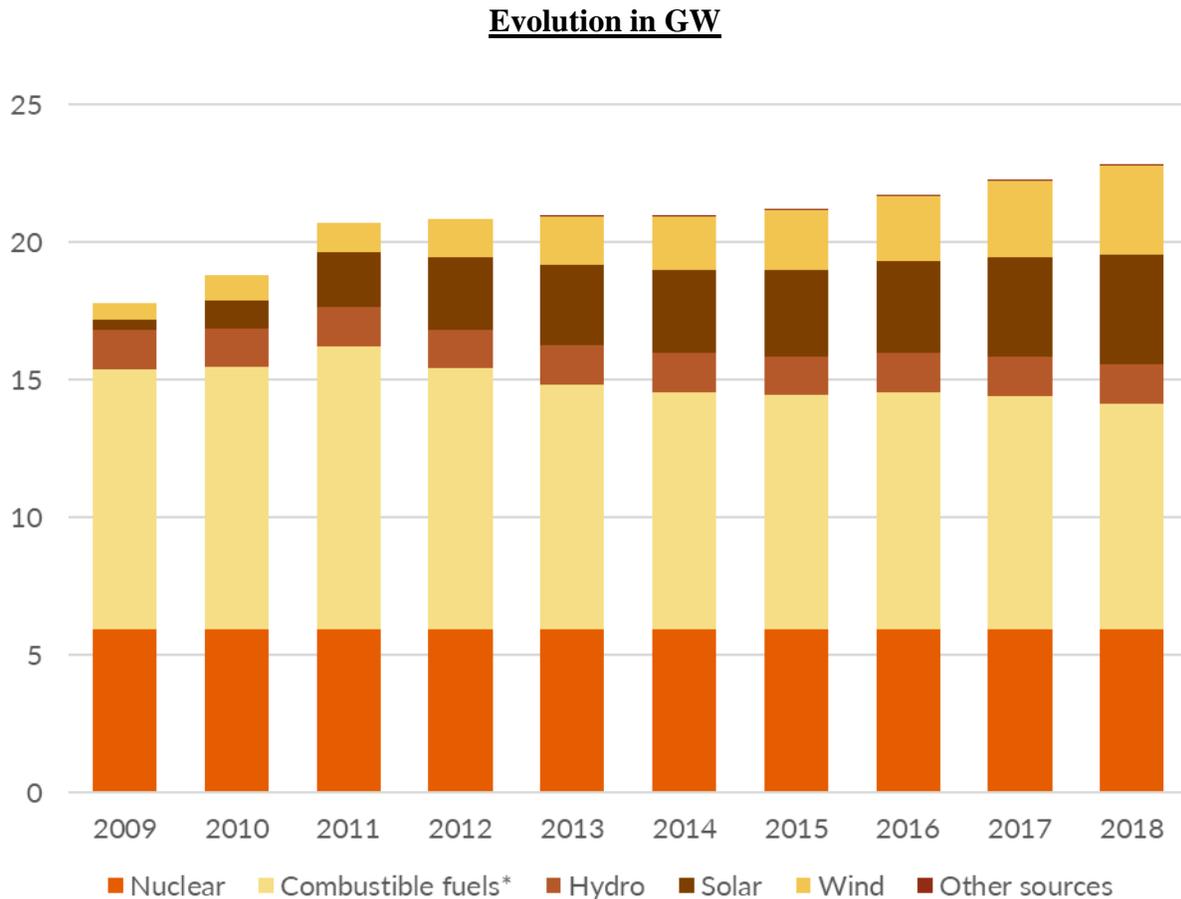
2. Policy context

This section aims to provide a non-exhaustive overview of the recent trends and expected developments in the electricity sector in Belgium.

2.1 Key facts about the Belgian electricity system

2.1.1 Production

According to the latest data available on Eurostat, the installed capacity in Belgium has reached 22,8 GW in 2018.

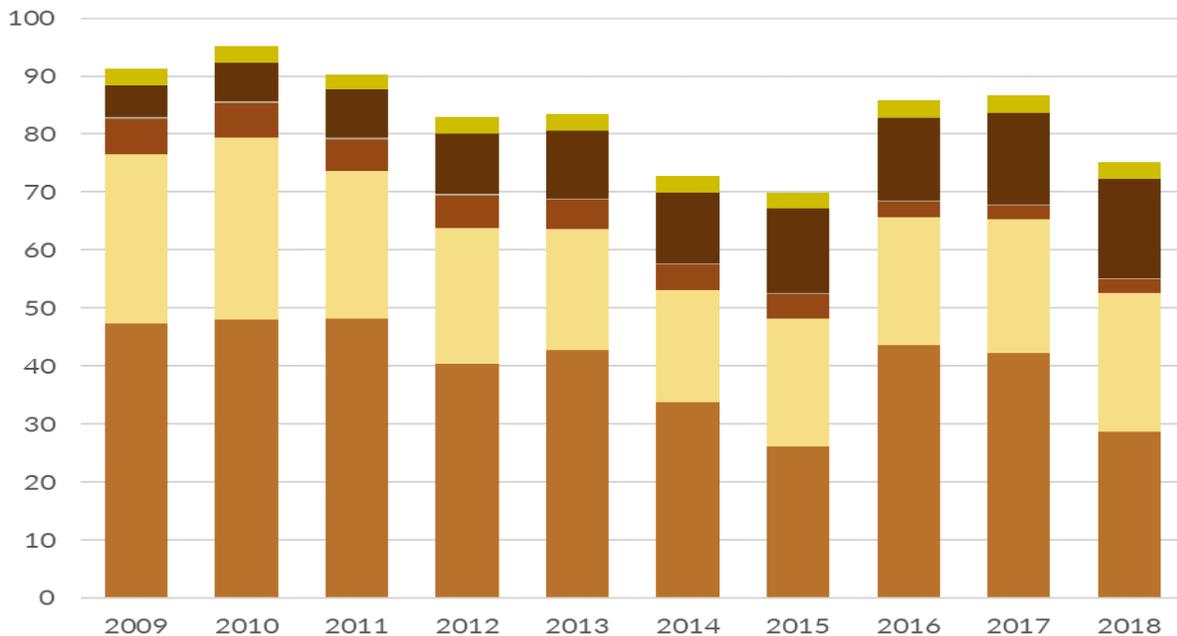
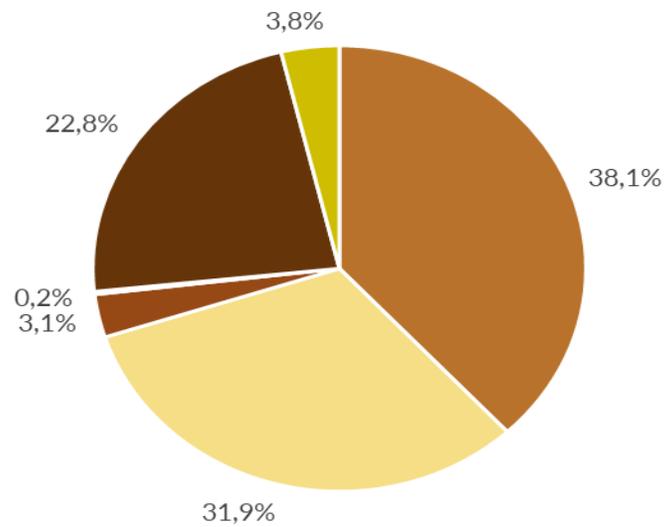


* Combustible fuels include solid fossil fuels, oil products, natural gas, renewable fuels (solid and liquid biomass, and biogas).

The Belgian gross electricity production in 2018 was the following :

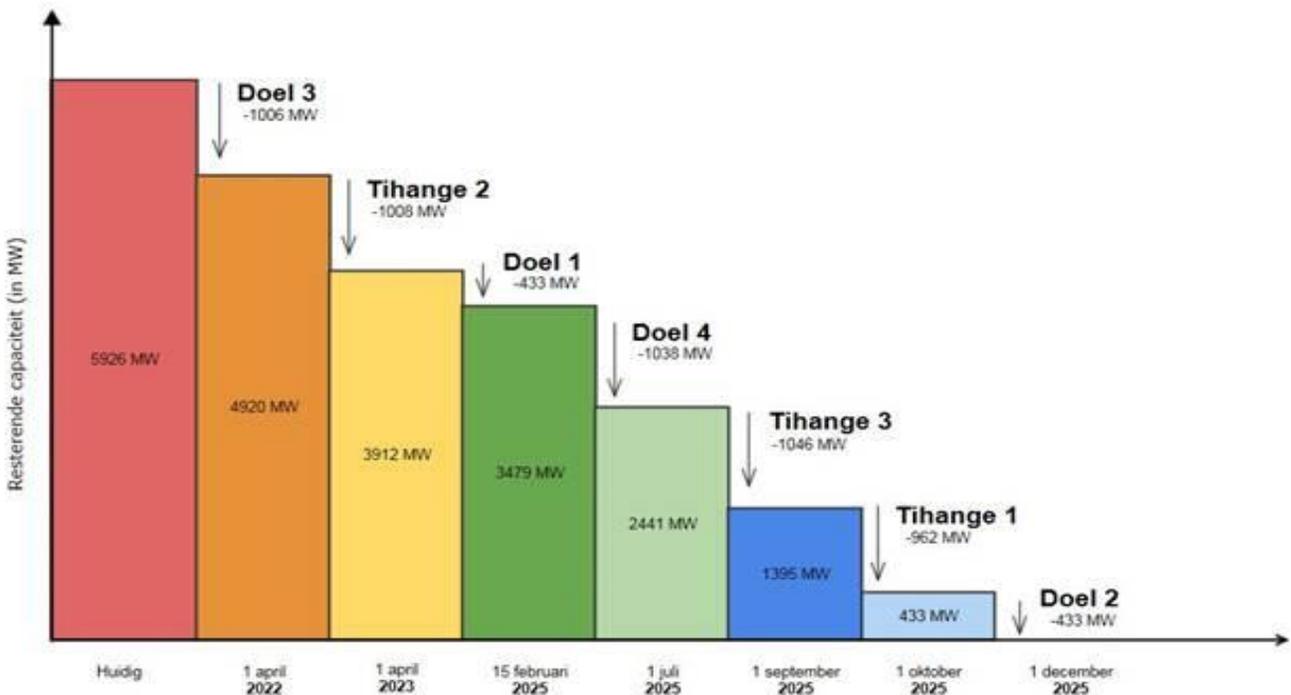
Electricity		TWh
Nuclear		28,6
Natural gas		24,0
Solid fossil fuels and manufactured gases		2,3
Oil products		0,2
Renewable energy		17,2
Other sources*		2,9
Total		75,1

*Other sources include pumped hydro, heat recovery, non-renewable waste and other



Belgium has been relying on nuclear energy for most of its electricity generation for more than 40 years. Nuclear generation represents around 50% of the electricity produced in the country (depending on the availability of the nuclear fleet). In terms of generation capacity, nuclear also represents around 50% of the thermal capacity of the country.

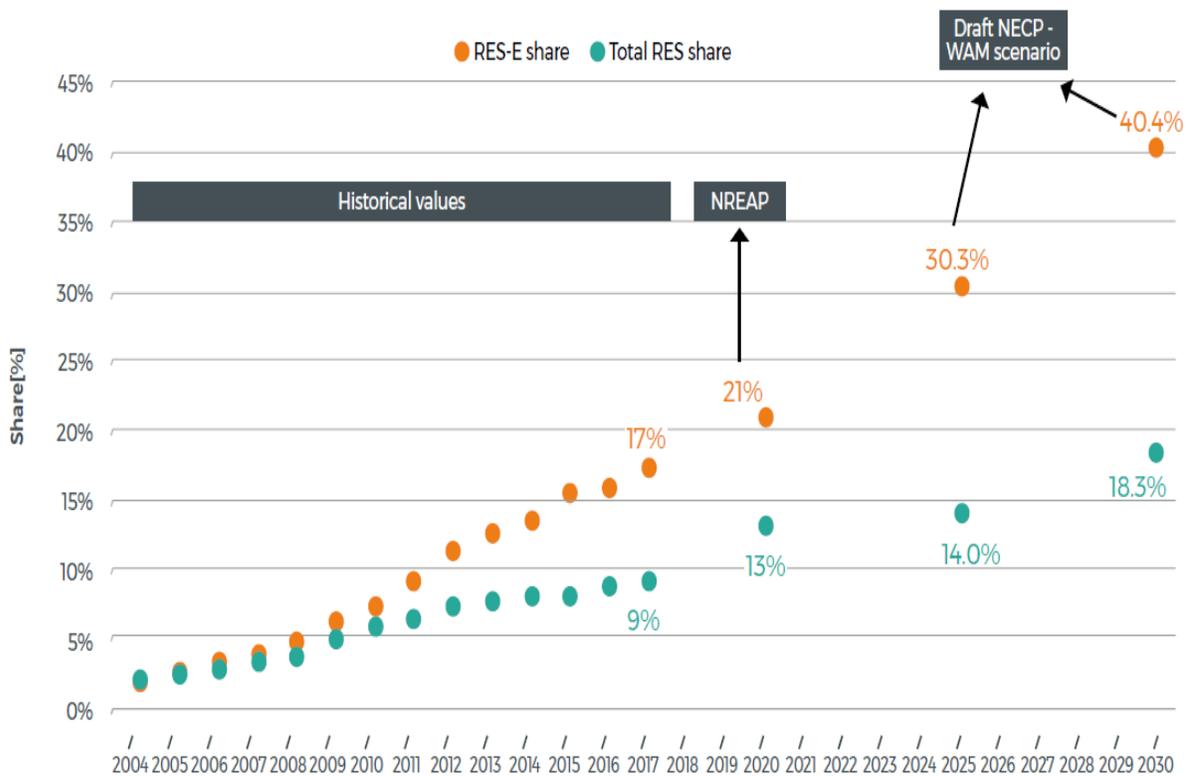
The government has decided to phase-out nuclear production in Belgium. Not surprisingly, this upcoming phase-out (which is to be completed by the end of 2025 according to the law) will lead to serious challenges to the security of supply.



Belgium has been relying on coal for its electricity generation for decades, but since 1990 the coal units have gradually been replaced by gas-fired generation. This evolution was completed in 2016 with the closure of the last coal-fired unit. Natural gas became the second-most used primary resource for electricity generation from 2000 and has gradually increased in importance to represent today around 30% of generated electricity.

The last decade, there was a considerable increase of renewable electricity generation capacity, mainly solar and wind. The installed capacity of these 2 renewable sources represents 7,1 GW or 31,8 % of the total installed electricity generation capacity in 2018. Offshore wind farms represent already 45,7 % of the total wind production. Despite the fact that Belgium has the smallest exclusive economic zone in the North Sea, offshore wind generation capacity will continue its development and will reach 2,3 GW by the end of 2020. Additionally, a future increase of this capacity to 4 GW is planned.

The RES-E share of the Belgian electricity consumption represented around 19% in 2018. This share is planned to at least double by 2030 (based on the draft NECP – WAM scenario). For 2020, a RES-E share of 21 % is expected, which will allow Belgium to achieve its total RES energy targets, based on the NREAP (National Renewable Energy Action Plan).



RES share of electricity consumption. Estimated target from the NREAP for 2020 and draft NECP submitted to the EC for 2025 & 2030

RES share of total energy consumption. Binding 2020 Target (from NREAP) - 13% 2025 & 2030 based on draft NECP submitted to the EC

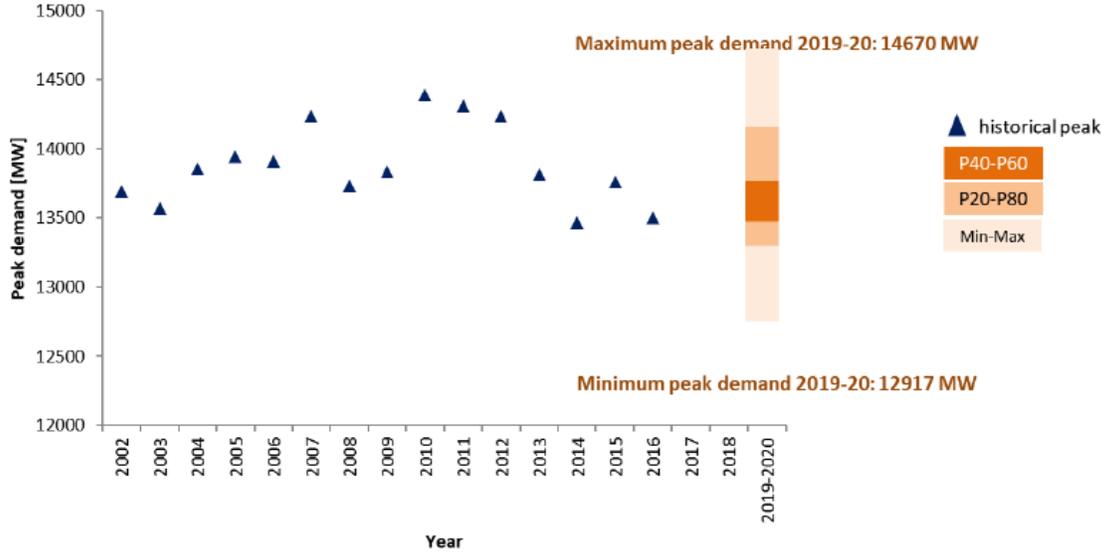
Source: “Adequacy and flexibility study for Belgium 2020-2030”, Elia

2.1.2 Total consumption and peak load in Belgium

The following values of the total annual demand were observed since 2012 :

		Historical values		
		Total demand [TWh]	Normalised total demand [TWh]	Growth rate
historical	2012	84.86	84.66	-3.97%
historical	2013	86.24	85.81	1.36%
historical	2014	83.73	85.14	-0.78%
historical	2015	85.01	85.64	0.58%
historical	2016	85.02	84.86	-0.91%
historical	2017	84.826	85.38	0.61%

The figure hereunder gives an overview of the historical peak loads in Belgium:



Source: “Adequacy and flexibility study for Belgium 2020-2030”, Elia

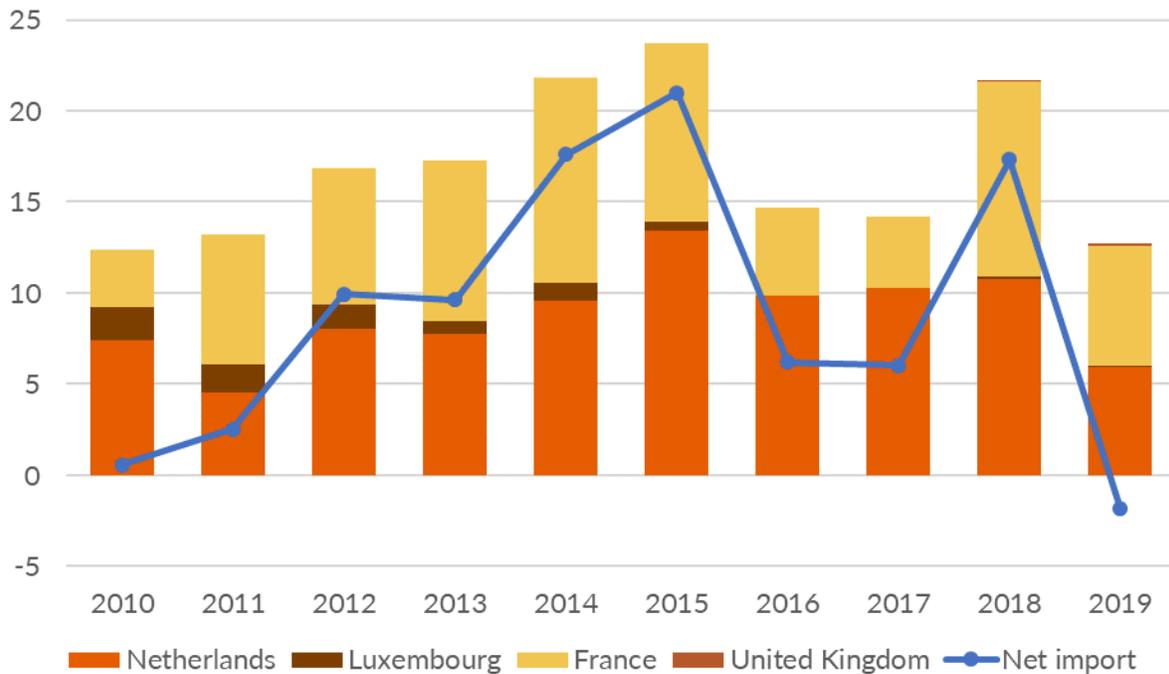
Electricity is seen as the major contributor to the decarbonisation of the economy in most long-term studies. According to the publication “Adequacy and flexibility study for Belgium 2020-2030 (IHS scenario), the Belgian peak load could grow from 13,7 GW in 2020 to 14,6 GW in 2030. This evolution is facilitated thanks to :

- Technologies are available to produce electricity from renewable sources (PV, wind, hydro, biomass, geothermal...);
- Mature technologies exist to easily convert electricity to any other form of usable energy (heat, movement...) and with high efficiency rates.

2.1.3 The Belgian grid

In order to meet the demand for electricity, Belgium has to rely on imports from the neighbouring countries. There is an inversely proportional relation with electricity production figures. Historically, years with low production (i.e. 2014 and 2015) know very high imports of electricity, and vice versa.

Evolution in TWh



In 2018, the maximum commercial import capacity was 5,500 MW. For 2020 this limit is set at 6500 MW, and it is set to increase even further to 7500 MW for further time horizons (2023) thanks to additional investments in voltage control.

An appropriate set of investments in the high-voltage grid is to be realized in order to enable even better market integration, as well as contributing to overall security of supply. At Belgian level, the Federal Development Plan builds on the scenarios developed in the TYNDP framework, and identifies the transmission capacity needs of Belgium's high-voltage grid (110 to 380 kV). Furthermore, the plan describes the investment program intended to satisfy these needs. The latest Federal Development Plan, targeting a horizon from 2020 to 2030, has been approved by the Federal Minister for Energy on 26 April 2019. For the extra high-voltage grid (380 kV), this plan contains projects that reinforce the internal grid (backbone), integrate additional offshore wind generation and encourage the international exchange of electricity through the further development of interconnections. For the transmission system (110 kV - 150 kV - 220 kV), the plan contains projects that, for instance, replace ageing grid infrastructure, cope with expected economic developments at local level and further integrate renewable energy.

2.2 European targets : long term strategy

On 28 November 2018, the European Commission presented its strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy by 2050. This strategy is in line with the 'Paris Agreement' aiming to keep the global temperature increase well below 2°C and pursue efforts to keep it under 1.5 °C. Such an ambition would require a reduction of greenhouse gas emissions by at least 85% (compared to 1990 levels) in 2050. This long-term vision has now been complemented with the 'Clean Energy for all Europeans' (CEP) package, which includes new targets for 2030 on renewable energy and energy efficiency, amongst others.

The EU has set intermediate goals to reduce greenhouse gas (GHG) emissions by 20 % in 2020 and by at least 40 % in 2030 (compared to the 1990 levels):

- The EU is responsible for the GHG emissions that fall under the EU Emissions Trading System (ETS). Electricity GHG emissions are part of the ETS;
- Each member state is responsible for the non-ETS emissions. Binding targets were set for each member state. For Belgium, the proposal is to achieve a 35% reduction for the non-ETS sectors in 2030.

For 2030, the EU has set the following targets at EU level :

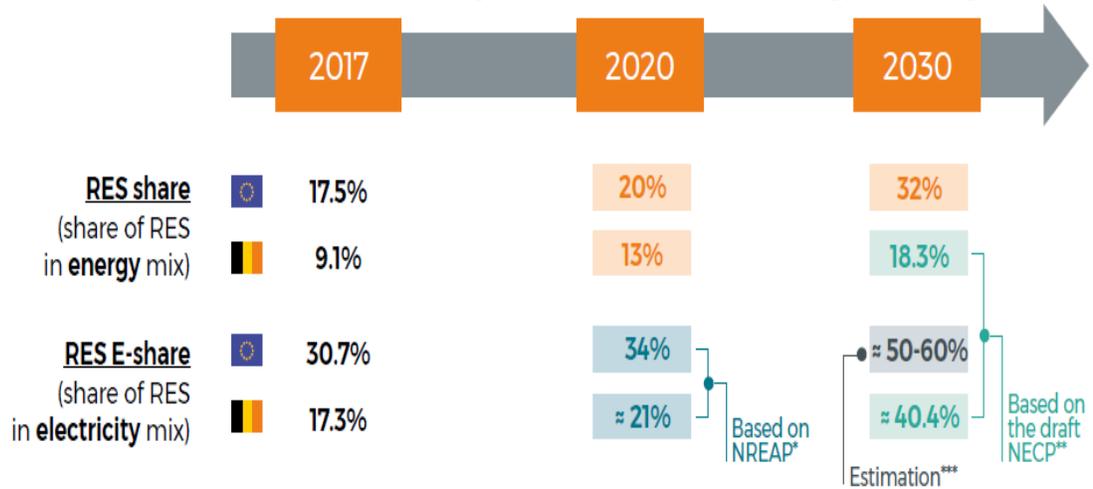
- At least a 40% reduction in greenhouse gas emissions (compared to 1990 levels). This target was agreed at the level of the Heads of State and government;
- Energy efficiency target of a minimum of 32,5% (reduction compared to 2007 modelling projections for 2030 which results in no more than 1273 Mtoe of primary energy consumption and no more than 956 Mtoe of final energy consumption);
- Renewable energy binding target (at EU level) of the final energy consumption of a minimum of 32 %;
- Interconnection targets for all member states of 15%.

On 24 December 2018, the Regulation (EU) 2018/1999 on the Governance of the Energy Union entered into force, which implies the obligation for all EU Member States to notify to the European Commission by the end of 2018 a first draft of the National Integrated Energy and Climate Plan 2021-2030 ("NECP"). Belgium has complied with this obligation and has sent its first NECP project on 31 December 2018. A final version of the National Energy and Climate Plan will have to be notified to the European Commission by 31 December 2019.

The Belgian NECP is largely based on the federal energy strategy approved by the Federal Government in 2018. The Inter-Federal Energy Pact sets out a common ambition for the energy transition in Belgium. It is recognised by the three regional governments and the Federal Government as a significant statement of intent regarding their determination to complete the required energy transition. The Energy Pact outlines objectives for Belgium's energy system by 2050, setting various energy transition targets. It serves as the basis for a coherent medium and long term strategy for changing Belgium's energy system, setting out key measures to accelerate the energy transition. The Pact also gives an insight into the 2030 energy mix. Lastly, it reaffirms energy's central role in government policy. Energy efficiency and the transition to sustainable energy consumption must be seen as horizontal measures. These should be integrated into the

various relevant areas of public policy, including tax, health, mobility, employment, training, land use and the circular economy.

For Belgium, the RES-E share proposed in the draft NECP accounts for 40 % in 2030 (share based on the total energy consumption). This value is subject to change (the RES-E share depending on developments in the other sectors as the final targets are set on the total energy consumption).



* The RES-E share target is an estimation as it depends on the developments in other energy sectors (transport, heat, ...), shifting between sectors (electrification, ...) and energy efficiency. Those data are based on NREAP that were submitted by each country [EUC-3], [EUC-4].

***based on [KOT-1]

**based on the draft NECP sent by Belgium end of 2018

3. Resource adequacy

Different studies, made by several entities (independent public entities, universities, consultants, TSOs)²³⁴⁵, have demonstrated major challenges related to adequacy for Belgium as from 2025, despite the ambitious intentions to further develop renewable energies, demand response, storage and interconnections. Those issues arise from an unprecedented supply shock linked to the Belgian nuclear phase-out, which accounts nowadays for more than half of the thermal generation capacity. Moreover, the studies that also performed an economic assessment, reveal that economic conditions on the electricity market will not ensure a sufficient level of investment to compensate this phase-out.

A complete overview on the state of play of the different adequacy studies was provided to the European Commission in the autumn of 2018. This separate note is attached again as useful background information (see Annex II).

Since that overview, the Belgian TSO, in collaboration with the Federal Public Service Economy (“FPS Economy”) and the Federal Planning Bureau (“FPB”), and in concertation with the National Regulatory Authority (CREG), has published a new adequacy and flexibility outlook for the period 2020-2030.⁶

As detailed in chapter 1 of that study, there has been a vast stakeholder involvement process. Not only via an established working group consisting of the TSO, FPS Economy, FPB and CREG, in which all relevant matters were presented and discussed, but also with the broader market stakeholders. Indeed, a public consultation was held on the input data and a specific request was made towards stakeholders to indicate their preference in terms of sensitivity analyses. More than 100 questions and remarks were received from 7 different stakeholders (associations). The non-confidential market input and a comprehensive consultation report are publically available on the TSO’s website⁷. The consultation (and discussion in the working group) allowed for a significant contribution to the final report. A summary of changes following the market interactions is also provided in chapter 1 of the study. In addition, the finally retained data-set for Belgium has been published together with the report (cf. supra, link in footnote), on the day of its presentation to the market actors. It is worth mentioning that the methodology (similar to the one yearly used and consulted upon for the strategic reserves) and data are aligned on regional/European level so that this national adequacy study for Belgium will be in line with the still to be finalized Mid-Term Adequacy Forecast 2019 of ENTSO-E (MAF 2019).

² Albrecht, Johan, Hamels, S., & Thomas, L. (2017). Le trilemme énergétique : une exploration du paysage Belge de l’électricité en l’An 2030. Gent: Skribis., <https://biblio.ugent.be/publication/8560302>

³ Study by Energyville: https://www.energyville.be/sites/energyville/files/downloads/2018/gp_bbl_iew_report_-_v2018_03_06_final.pdf

⁴ Study by the Federal Planning Bureau: <https://www.plan.be/admin/uploaded/201802260841090.OPREP201802.pdf>

⁵ MAF 2018 by ENTSO-E: <https://www.entsoe.eu/outlooks/midterm/>

⁶ <http://www.elia.be/en/about-elia/publications/studies>

⁷ http://www.elia.be/en/about-elia/publications/Public-Consultation/20190121_Public-consultation-on-the-data-used-for-the-study

The legal framework of this study is the Belgian Electricity Law, not the Clean Energy Package (CEP), as the latter is not yet applicable and the resource adequacy methodologies are not defined nor approved yet. However, to the maximum extent possible, the national adequacy assessment already integrates the CEP-modalities: probabilistic modelling, Flow-Based modelling of interconnection capacity, a central scenario with several sensitivities, an economic viability check, stakeholder interaction on the input data and sensitivities, etc.

Given the urgency of Belgium's adequacy problem it will be predominantly the most recent adequacy assessments that serve as a basis for this implementation plan, being a requisite to a continued application of the strategic reserve and to the ongoing state aid process for the reliability options mechanism.

The study contains a vast amount of information and the main conclusions of the study are based on the "High impact, Low probability" scenario ("HiLo scenario"), The three main conclusions regarding adequacy are:

- As of the nuclear exit (winter 2025-2026) there is a systematic need for new capacity of some 3.9 GW in the HiLo scenario and 2,4 GW in the Base case scenario. The HiLo scenario takes into consideration uncertainties in Belgium's neighboring countries (around 1.5 GW) over which Belgium has no control, such as the reduced availability of generation or interconnection capacity;
- Due to the accelerated coal phase-out in neighboring countries, the additional capacity that Belgium will require for the winters 2022-2023, 2023-2024 and 2024-2025 has increased. This new development means that even before the nuclear exit in late 2025, additional capacity of about 1.4 GW in the HiLo scenario and 0.3 GW in the Base case scenario will be needed, requiring further measures to be taken.⁸
- The economic analysis of the study confirms the need for a systematic intervention in any scenario, in order to provide the required investments to ensure that the full replacement capacity is available in time .

It is important to note that these conclusions are the result of a study that already integrates the ongoing and planned market developments and the most recent projected policy targets as described or referred to in this implementation plan. The amplitude of the supply shock in Belgium for the coming years and the according need for replacement capacity on the one hand and the interconnected and open character of the Belgian electricity system on the other hand, imply however that addressing market reforms in Belgium alone cannot solve the entire adequacy-issue. Indeed, Belgium is structurally dependent on its neighbouring countries for the import of electricity and thus also dependent on market reforms in these countries. While the entire list of measures as developed in this plan will surely contribute to alleviating the adequacy situation in Belgium, it is not expected to be sufficient to solve the adequacy issues entirely.

⁸ The potential additional measures to be taken for the period 2022-2025 are still under analysis. In either case, the actions listed in this implementation plan are ongoing, no-regret and are equally valid for the period before as after 2025.

Indeed, since 2014, a strategic reserve has been in place, keeping units that have left the market and demand response available to ensure adequacy. It has been approved by the European Commission until the winter period of 2021-2022. However, this measure is expected to be insufficient to address the needs identified in the aforementioned studies. This has spurred the government to start developing a capacity remuneration mechanism (“CRM”), which will be formally notified by the end of 2019 (cf. introduction).

4. The Belgian electricity market

4.1 Wholesale markets

4.1.1 Price limits

The day-ahead and intraday electricity prices on the wholesale markets are only limited by the harmonized technical price limits, applied by the NEMOs.

For single day-ahead coupling (SDAC), the harmonised technical price limits are set between a minimum price of -500.00 EURO/MWh and a maximum price of + 3,000.00 EURO/MWh. The decision No 04/2017 of ACER of 14 November 2017 states that in the event that the clearing price exceeds a value of 60 percent of the harmonised maximum clearing price for SDAC in at least one market time unit in a day in an individual bidding zone or in multiple bidding zones, the harmonised maximum clearing price shall be increased by 1,000 EUR/MWh.

For single intraday coupling (SIDC), harmonised technical price limits are set between -9,999.99 EURO/MWh and +9,999.99 EURO/MWh. The decision No 05/2017 of ACER of 14 November 2017 states that in the event that the harmonised maximum clearing price for SDAC is increased above the harmonised maximum clearing price for SIDC, the harmonised maximum clearing price for SIDC shall be increased to be equal to the harmonised maximum clearing price for SDAC.

4.1.2 Offers in the wholesale market

Generators have limited restrictions on their ability to freely price their offers in the wholesale market. Beside the fact that offers by generators have to be compliant with the above mentioned price limits, the offers should comply with REMIT-obligations (Article 2.2(a) and 2.3(a) and article 5). In order to have a functioning market, anti-competitive bidding is prohibited. Furthermore, generators wishing to offer in wholesale markets have to comply with admission criteria of the NEMO's in the relevant markets.

4.1.3 Generation reserves released by TSO

In the Belgian legislation, no rules or provisions require the TSO to release generation reserves in the market when market price rise above a certain level. Strategic reserves in Belgium, which are contracted by the TSO, can however be sold when day-ahead market prices hit the harmonised technical price limit (actually 3,000.00 EUR/MWh). This is referred to as the “economic trigger” in the functioning rules of strategic reserves. As this rule seems in contradiction with the provisions of the Clean Energy Package, functioning rules for strategic reserves will be adapted and the economic trigger will be abandoned.

4.1.4 CWE flow-based market coupling improvement

The CWE flow-based day-ahead market coupling has been gradually improved since its introduction in 2015. Particularly, in April 2018, the “minRAM 20%” rule has been implemented. This rule guarantees that, for all the elements considered in the capacity calculation, at least 20% is made available for cross-border exchanges within the CWE region. Since April 2020, more capacity is made available thanks to the implementation of the rules of the new Electricity Regulation (the “70% rule”, adapted at national level based on the approved derogation). By 2025, a minimum of 70% capacity should be available for cross-border exchanges.

4.1.5 Implementation of flow-based in the Core regions, and of the related methodologies

ACER took a decision at the beginning of the year with respect to the day-ahead and intraday capacity calculation methodologies. These methodologies are due to be implemented by 1st December 2020. They include small but significant differences with respect to the current approach in CWE, in particular by providing a solution to the issue of undue discrimination caused by the loop flows taking away a significant part of the thermal capacity of the lines before offering it to cross-border exchanges. The development and implementation of the coordinated redispatching and countertrading methodologies (including cost sharing) are expected to bring additional improvements with respect to the capacity offered to the market.

4.1.6 Integration of HVDC interconnectors in market coupling

The current and future HVDC interconnectors will allow an improved access to the cross border day-ahead and intra-day markets.

On Nemo Link, Elia (together with National Grid and Nemo Link Limited) has launched an explicit intraday capacity product on the BE-GB border. Once there is clarity on the Brexit, more specifically whether GB will remain in the Internal Energy Market (IEM), steps will be taken to integrate Nemo Link in the Single Intra Day Coupling (SIDC, formerly known as XBID) together with the other Channel interconnectors. The implicit day ahead allocation on Nemo Link (which currently takes place via the Single Day Ahead Coupling) will be replaced by an explicit allocation mechanism via JAO in case GB leaves the IEM.

Alegro will be integrated in the existing CWE processes through the implementation of the so-called Evolved Flow-Based approach. The intention is to make an ID product available on Alegro shortly after the go-live of DA allocation on the interconnector. This means that Alegro will open up access to the liquid DA and ID market in Germany via implicit coupling.

4.2 Balancing markets

The current rapidly changing environment driven by the development of renewables, more and more decentralization, digitalization and the associated emergence of new players and the regionalization of the electricity sector, implies that market players today face both challenges and opportunities in terms of flexibility needs and sources.

Under these changing conditions, the objective w.r.t. the design of the balancing markets for Belgium is twofold:

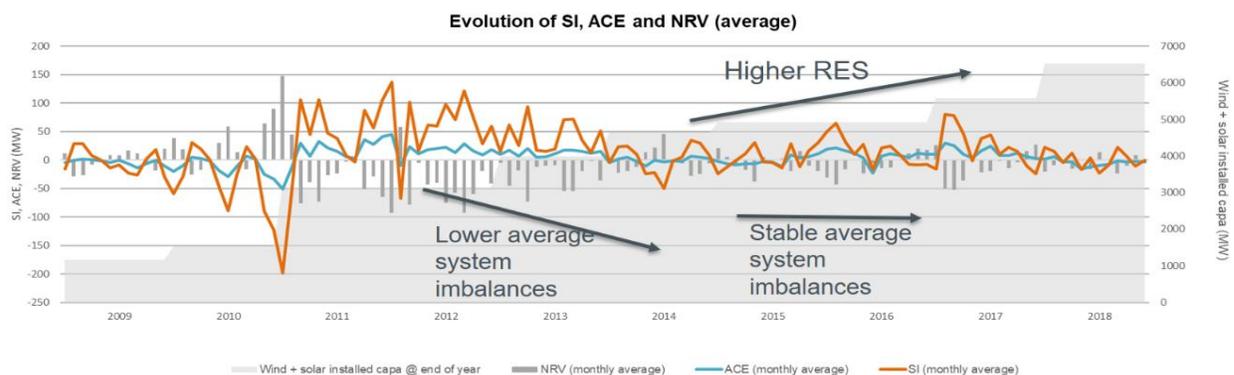
1. On the one hand, the aim is to limit the residual system imbalance to be resolved by the TSO following the principle that all known imbalances should be primarily resolved by Balance Responsible Parties (BRPs) and therefore BRPs should be exposed to adequate financial incentives to do so. Besides, the TSO has the legal obligation (as defined in the System Operation Guideline) to have sufficient reserves to cover 99% of the system imbalances and the dimensioning incident. By giving adequate incentives to BRPs, the Belgian TSO also aims to keep the required (future) reserve margins as low as possible;

2. On the other hand, it is strived for to cover the remaining needs efficiently by making optimal use of (newly) available flexibility sources. To this end, several developments have been undertaken in Belgium towards technology-neutral, open, non-discriminatory and well-functioning balancing markets and rules. The goal, as pursued by the Belgian TSO (i.e. Elia) in close collaboration with the regulator (i.e. CREG) and the market, is to evolve to a product design where all technologies on all voltage levels⁹ offered by independent Balancing Service Providers (BSPs) can participate and compete on equal grounds.

Most prominently regarding the first objective of limiting the residual system imbalance:

- In 2012, a single-pricing balancing mechanism with additional price incentives was introduced;
- In 2012 & years after Elia (encouraged by the CREG) made substantial efforts to improve balancing publications:
 - Solar and wind forecasting including real-time metering;
 - Real-time publication of system imbalance and activated volumes;
 - Real-time publication of infeed;
 - Real-time publication of balancing warnings;
 - Publication of imbalance tariff close to real-time after the concerned imbalance settlement timeframe.
- In 2018 the balancing market price cap has been increased to a dynamic price cap of 13.500 €/MWh, a value well above the current intra-day maximum clearing price.

So far, the objective to limit the residual system imbalance has been achieved successfully. The following graph shows that the average system imbalance has decreased since 2012 and then remained stable despite an important increase in intermittent renewables in the system. As a result, there has been no significant increase of reserve needs since 2012.



⁹ Irrespective of additional constraints imposed by DSOs.

Several further developments have taken place recently or are foreseen in the coming months and years to further improve the balancing market, contributing to one or both of the above mentioned general objectives w.r.t. the balancing market design in Belgium.

4.2.1 Improved balancing publications

Regarding the balancing publications, two evolutions were implemented in 2019. Firstly, as from September 1st 2019, an estimation of the imbalance tariff is being published in real-time on the Elia website, in addition to the current quarter-hourly publication, in order to be in line with the already in place real-time publication of the imbalance volume and NRV (Net Regulating Volume) of the Belgian control area. Secondly, as from the 1st of January 2020, based on a developed IT tool, Elia communicates within 15 minutes after the respective quarter-hour the aggregated DGO (Distribution Grid Operators) allocation position to each (registered) BRP, which is one of the components that ultimately determines the BRP's imbalance. The aim of this development was to provide BRPs yet a better view on their individual real-time portfolio balance which should help them in the prompt management of any imbalances.

4.2.2 Revision of the alpha component

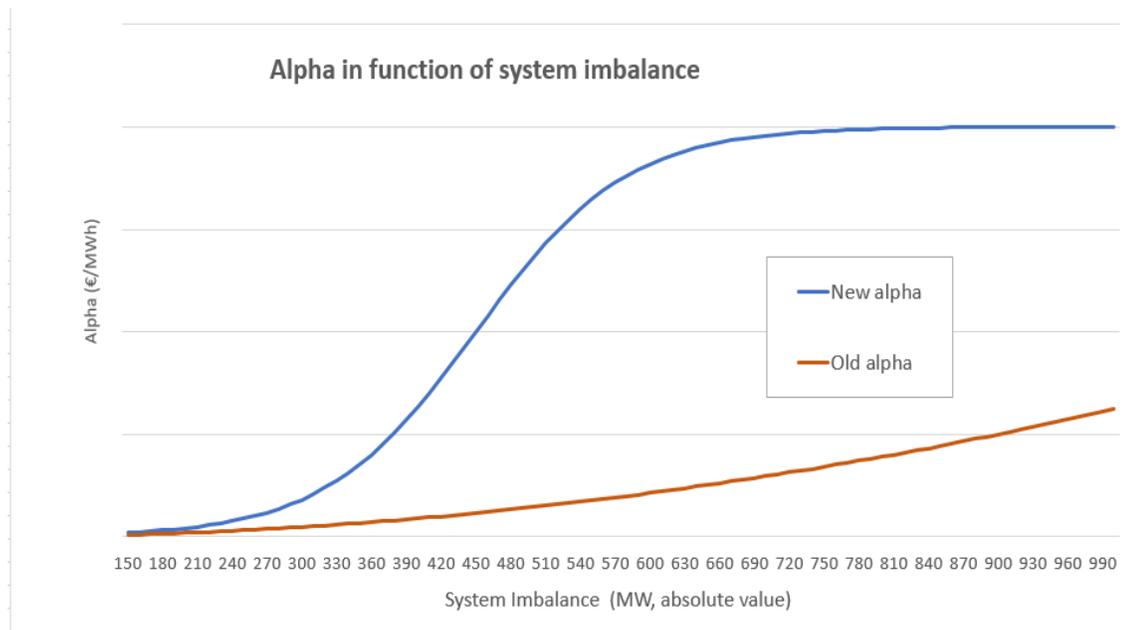
The imbalance tariff in Belgium was based on the activated balancing bids in a given quarter-hour and include an additional component in case of high structural imbalances. This so called "alpha component" came into play when imbalances reach 140MW (which is more or less the volume of contracted automatic Frequency Restoration Reserves). In general, the alpha component is a dissuasive incentive incorporated in the imbalance settlement process to ensure that BRPs maintain their balance and in particular to avoid large and structural imbalances that would otherwise lead to a future increase in reserve needs.

By 2020, the calculation and application of the alpha component has evolved, after consultation with stakeholders through the TSO's market interaction platform, i.e. the Working Group Balancing. The need for revision was triggered by the (planned) increase of installed renewable generation capacity (in particular offshore wind), resulting in an enlarged risk for substantial and persistent system imbalances within the Elia control zone.

Two modifications have been introduced as from 1/1/2020:

- Firstly, the calculation of the alpha component has changed, so that stronger incentives are given to BRPs during high and structural imbalances:
 - Alpha responds more quickly to changes in the system imbalance and particularly impact in case of structural system imbalance.
 - The impact of the alpha parameter in magnitude is in proportion to the System Imbalance: the impact of the alpha parameter on the imbalance tariff is larger for large imbalances than for small imbalances.
 - In case of low system imbalances the need for an additional incentive is low therefore the alpha parameter can be low as well.
 - In case of extremely high system imbalances the additional incentive of a continuously increasing alpha parameter is limited and should not serve as an unnecessary penalty.

The effects mentioned above are best met with an S-shaped alpha-function linked to the system imbalance as indicated in the graph below:



- Secondly, the revised alpha component applies symmetrically to all BRP imbalances so that the alpha component not only punishes BRPs acting against the system, but also rewards BRPs helping the system, as such evolving towards a fully single-pricing balancing mechanism. The imbalance tariff has been consequently defined as follows as from 1/1/2020:

		System Imbalance (SI)	
		Positive (net downward regulation)	Negative or zero (net upward regulation)
BRP imbalance	Positive (Elia → BRP *)	<u>Single price:</u> MDP - α	<u>Single price:</u> MIP + α
	Negative (BRP → Elia *)		

* Payment flow in case of positive MDP/MIP

MDP = lowest price of all downward activations ordered by Elia for maintaining the balance in the Belgian control area

MIP = highest unit price of all upward activations ordered by Elia for maintaining the balance in the Belgian control area

The value of alpha is determined as follows:

- If the absolute value of the system imbalance $\leq 150\text{MW}$: $\alpha = 0$
- If the absolute value of the system imbalance $> 150\text{MW}$:

$$\alpha = a + \frac{b}{1 + \exp\left(\frac{c - x}{d}\right)}$$

With the following parameters:

$a = 0 \text{ €/MWh}$; $b = 200 \text{ €/MWh}$; $c = 450 \text{ MW}$; $d = 65 \text{ MW}$

x = the moving average of the absolute value of ‘System Imbalance’ in $qh(t)$ and $qh(t-1)$

4.2.3 Further implementation of frequency-related ancillary service Product Roadmaps

To be able to cover the remaining needs efficiently and make optimal use of (newly) available flexibility sources, product roadmaps were defined for all frequency-related ancillary services that are used in Belgium, for the 2016 – 2020 period. In particular, the end goal of each roadmap includes:

1. single harmonized products as much as possible;
2. open participation for all technologies, all players, all voltage levels;
3. daily procurement.

Product evolutions are taken step by step and in close interaction with the market to safeguard market liquidity at all times and to allow other necessary developments in the meantime. To this end, market parties are consulted regularly on the product roadmaps through the Working Group Balancing, and all documentation is publically available on the TSO website.¹⁰ In what follows, an overview is provided of all frequency-related ancillary services used in Belgium, including a status of the current design and indications of planned future roadmap evolutions where relevant.

FCR (Frequency Containment Reserves)

- **Purpose:** Stabilization of the frequency in the European interconnected system, to ensure grid stability and avoid blackouts.
- **Reaction time:** 30 seconds.
- **Dimensioning:** Fixed volume of 3000MW to be contracted for the synchronous area CE (Continental Europe). Yearly split across TSOs based on electricity generation and consumption data for each control area.
- **Procurement:** Volume split between regional (FCR cooperation¹¹) and local procurement. Currently, Elia procures FCR via a weekly tender (combined with aFRR procurement – see below) and a daily tender in D-2 on business days. Move to daily tender and exclusively regional procurement planned and announced for July 2020.

¹⁰ http://www.elia.be/en/users-group/Working-Group_Balancing/Agenda-ad-hoc-werkgroep-balancing#15

¹¹ Since 1st August 2016 ELIA procures part of its FCR volume via regelleistung.net

- **Can be provided by:** All technologies (incl. demand response & storage), all players and all voltage levels.¹² Portfolio bidding is allowed.
- **Remuneration:** Payment for reservation (MW) only.

aFRR (automatic Frequency Restoration Reserves)

- **Purpose:** Automatic restoration of balance and frequency, relieving FCR in case of larger imbalances.
- **Reaction time:** 7,5 minutes.
- **Dimensioning:** Yearly sizing with regulatory approval of volumes.
- **Procurement:** Weekly tender. Move to daily tender planned and announced for September 2020 (part of the volumes will be procured in D-2 and the rest in D-1).
- **Can be provided by:** Currently only large assets with a power-scheduling obligation (“CIPU assets¹³”). Market opening towards all technologies, all players and all voltage levels planned and announced for September 2020.¹⁴ Portfolio bidding is allowed.
- **Remuneration:** Payment for both reservation (MW) and activation (MWh). Move to marginal pricing for activated balancing energy envisaged as from the moment sufficient liquidity has developed.

mFRR (manual Frequency Restoration Reserves)

- **Purpose:** Solution to cope with major imbalances
- **Reaction time:** 15 minutes.
- **Dimensioning:** Daily sizing since February 2020.
- **Procurement:** Daily tender since February 2020.
- **Can be provided by:** All technologies (incl. demand response & storage), all players and all voltage levels. Portfolio bidding is allowed.
- **Remuneration:** Payment for both reservation (MW) and activation (MWh). Marginal pricing for activated balancing energy since February 2020.

As a general outlook for the period after 2020, frequency-related ancillary service product evolutions will continue mainly in two ways:

- Firstly, a further inclusion of capacity connected on low-voltage/residential levels is strived for. This may for instance entail specific product design adaptations and alternative metering requirements (cf §4.2.6 on IO Energy hereafter);
- Secondly, a further regional harmonization and integration of frequency-related ancillary services is intended, e.g. through the EU balancing projects as discussed below.

¹² For low voltage levels, subject to DSO prequalification

¹³ <http://www.elia.be/en/products-and-services/ancillary-services/production-coordination>

¹⁴ https://www.elia.be/en/public-consultation/20200303_public-consultation-on-terms-and-conditions-for-balancing-service-providers

4.2.4 Participation in EU Balancing projects

As the Belgian TSO, Elia takes up an active role in the European balancing projects (i.e. IGCC¹⁵, PICASSO and MARI¹⁶) to elaborate the Imbalance Netting, aFRR and mFRR implementation frameworks developed in accordance with the EBGL (Electricity Balancing Guideline). The IGCC (Imbalance Grid Control Cooperation) project performs international imbalance netting¹⁷ of aFRR, enabling all participating TSOs to decrease the use of balancing energy while increasing system security. The PICASSO and MARI projects aim at a common activation platform for aFRR/mFRR and exchange of balancing energy on a regional scale. As a result, an economically efficient purchase of balancing energy is secured, next to harmonizing balancing energy products and at the same time also leading to an ever closer cooperation of TSOs on European level.

The PICASSO and MARI platforms are currently under development and are expected to be implemented by Q3 2021/Q1 2022.¹⁸ Since 2017, several public consultations and workshops took place with stakeholders via ENTSO-E on the future design of these platforms and frequent status updates are provided through the Electricity Balancing Stakeholders Group.

Elia integrates (expected) requirements of these implementation projects into its ancillary service product roadmaps where needed, in order to ensure a smooth accession to the European platforms when they are ready to operate.

4.2.5 Regional imbalance settlement harmonization

On a regional scale, imbalance settlement harmonization is ongoing regarding the calculation of imbalances, the main components to be used for the calculation of the imbalance price and the use of single imbalance pricing. A decision by ACER on this methodology is expected in the coming weeks. However, it is anticipated that current Belgian imbalance settlement design will already be in line with the final agreements regarding the regional harmonization process.

4.2.6 IO Energy

Within the changing energy landscape – with increasing development of renewable energy, decentralized production and the electrification of energy consumption, such as electric cars and heat pumps – consumers at all levels in the system want to and will be led to play an increasingly active role in the functioning of the electrical system. To make these developments possible, manageable and efficient, it is essential to develop a digital architecture capable of ensuring a more direct link between consumer behavior and the functioning of the electricity system as a whole.

¹⁵ https://www.entsoe.eu/network_codes/eb/imbalance-netting/

¹⁶ https://www.entsoe.eu/network_codes/eb/picasso/ & https://www.entsoe.eu/network_codes/eb/mari/

¹⁷ Imbalance netting is the process agreed between TSOs of two or more LFC areas that allows avoiding the simultaneous activation of frequency restoration reserves (FRR) in opposite directions by taking into account the respective frequency restoration control errors as well as the activated FRR, and by correcting the input of the involved frequency restoration processes accordingly.

¹⁸ https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/Network%20codes%20documents/Implementation/MARI/200424-EB_Reg_mFRRIF_MARI_Accession_roadmap.pdf

https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/Network%20codes%20documents/Implementation/picasso/200424-EB_Reg_aFRRIF_PICASSO_Accession_roadmap.pdf

In this context, the Belgian system operators have launched a collective innovation initiative, open to everyone, called the Internet of Energy (IO.Energy). This initiative aims to co-develop with consumers and market players this "digital architecture" necessary for a manageable and efficient management of the energy transition by:

- Providing any interested actor with a prototype platform for the exchange of information in near real-time that will continuously evolve according to the needs of consumers and service providers.
- Inventing, designing, testing and developing associated applications and alternative market designs that can support future energy services.

As such, IO.Energy aims to bring together market players or any interested party (energy players, universities, players from other sectors, regulators, etc.) to explore together new value proposals for the consumer, to share knowledge and to innovate together to develop prototypes of intelligent applications and alternative market designs that will be needed for these services.

The initiative was launched in Belgium early 2019 and more than 60 commercial partners from multiple sectors and more than 30 partners from institutions registered, resulting in a fairly dense and diverse ecosystem of partners. A more in depth description of the IO.Energy initiative can be found on <https://www.ioenergy.eu> whilst a complete list of current participants can be viewed on: <https://www.ioenergy.eu/members/>

4.3 Demand-side response

Belgium is one of the pioneers in the establishment of an adequate regulatory framework for demand response. Already back in 2013-2014, Belgium was considered by the Smart Energy Demand Coalition (SEDC) – the European industry association of demand response operators – as one of the three markets in Europe where the market design and environment allowed demand response to be commercially viable (cf. page 3 of report *Mapping Demand Response in Europe Today*¹⁹). Subsequently, in 2018, the *smartEn Map: European Balancing Markets Edition report*²⁰ identifies Belgium as one of the three highest scoring countries in terms of advanced balancing markets for demand response and distributed energy resources, showing a deep investment in market solutions provided by different technologies.

4.3.1 Transfer of energy

After analyzing the obstacles to demand-side participation in markets in 2016, it was concluded that a major obstacle to this participation was the absence of a legal framework that organizes the transfer of energy.

¹⁹ https://www.smartenergy.eu/wp-content/uploads/2014/04/SEDC-Mapping_DR_In_Europe-2014-04112.pdf

²⁰ http://www.smartenergy.eu/wp-content/uploads/2018/11/the_smartenergy_map_2018.pdf

In order to address this point, a new market model, hereafter "transfer of energy", aimed at allowing the final customer to value its flexibility by himself or by an intermediary of his own choice, regardless of his energy supplier while avoiding any negative impact on the latter as well as on the BRP of the concerned customer, has been adopted in 2017 (law of 13 July 2017 modifying the Law of 29 April 1999 on the organisation of the electricity market). This new legal framework foresees a gradual implementation of the transfer of energy to the FRR markets segments as well as to the DA/ID markets. This model is applicable for any kind of contracts between the final customer and his supplier.

Following this, the transfer of energy is in place in the market of mFRR since 2018. Together with the transfer of energy, alternative models such as the opt-out (flexibility service provider, electricity supplier of the final customer and their BRPs reach their own agreement) and recently the pass through model (only valid for some kinds of contracts), have also been proposed and implemented by the TSO after public consultations and approval of the regulator.

The planning for the operational implementation of this transfer of energy model as well as the alternative models in the other market segments is the following:

- Strategic reserve: 01/11/2019: transfer of energy and opt out; 1/11/2020: pass-through;
- Secondary control markets (aFRR): 2019: opt-out and pass through models; at the latest by mid-2021: reassessment of the need as well as of the technical feasibility and economic opportunity for the implementation of a transfer of energy model;
- Day-ahead and intra-day markets: study ongoing in 2019 and implementation foreseen before mid-2021. A positive CBA was performed in 2019.

This right conferred on the final customer is in itself a way to encourage the participation to these various markets insofar as it allows him to better negotiate his participation and so to potentially yield a higher income.

ToE is not yet applicable for low voltage consumers (notably as a 15' metering device is currently necessary).

4.3.2 Smart meters

Legal frameworks have been revised according to the different regional contexts to provide for the gradual and targeted roll-out of smart meters. This should give network users more insight into their (hourly) energy consumption so that they can identify ways of using less energy. Smart meters will also help households and businesses shift their energy consumption from times of peak demand to periods of surplus production without inconvenience or loss of productivity. Thanks to the smart meters, it is also expected that 'smart' energy contracts will be offered by the suppliers to the customers, e.g. to include dynamic price signals linked to wholesale spot market prices. Belgium commits to continue the rollout of smart meters with the necessary functionalities to facilitate the uptake of price-based demand response.

The roll out of smart meters will be progressive and the timing of implementation will be different in the three regions:

Wallonia:

Not later than January 1st 2023, systematic roll out in following cases :

For residential consumers in default of payment;

When meter has to be changed ;

For new connections to the grid ;

When the consumer request it.

Not later than December 31 2029 : 80% of smart meter installed for :

consumers with a consumption ≥ 6.000 kWh ;

prosumers, when the net developable electrical power is ≥ 5 kWe;

for charging points open to the public.

Flanders :

Full roll out foreseen in 15 years:

2023 : 33%

2028 : 66%

2034 : 100%

Brussels :

No large scale roll out. Progressive roll out:

Compulsory:

When meter has to be changed;

For new connections to the grid.

Roll out authorized:

For consumers equipped with a storage unit or a heat pump;

For prosumers, consumers with electric vehicle;

For consumers with a consumption > 6.000 kWh.

Moreover, Belgium will strive to put in place as soon as possible a simple and transparent framework for access to data by eligible parties, as well as consumers and those with their consent, to effectively operationalise the respective provisions (Articles 23, 24) of the Electricity Directive.

4.4 Regulated prices

Belgium has no exemptions from network or energy-related costs for specific classes of consumers which might affect demand response incentives.

Social tariffs exist since 2007 in their actual form²¹. The beneficiaries are vulnerable households. They cover 10% of the residential customers. The tariff is based on the lowest commercial tariff in the zone with the lowest network tariff. It follows thus the evolution of the market prices. The suppliers receive a compensation for the supply of electricity at social tariff to protected customers based on the Royal Decree of 29 March 2012. Customers can choose the supplier they want, but the social tariff is the same. To finance the system, every customer has to pay a fee.

Public intervention in prices for the supply of electricity to energy poor and vulnerable consumers as provided by Belgian Law falls under the article 5, (3), of Directive (EU) 2019/944. In line with these provisions, the Belgian system falls within both current EU case Law as well as the criteria described in article 5, (4), of the same Directive, including regarding limitation in time, since notably the beneficiary has to comply to a certain number of criteria to benefit from this public intervention in prices.

In addition, according to article 5, (5), of Directive (EU) 2019/944, a public intervention in prices implies that a Member State has to comply with articles 3, (3), d) and 24 of Regulation (EU) 2018/1999 independently as to how significant the number of households in poverty is. Belgium will in this respect set an indicative objective to reduce energy poverty and outline policies & measures to target energy poverty and monitor and report accordingly.

4.5 Interconnections and internal grid capacity

As mentioned in the draft National Energy and Climate Plan (page 18/136), Belgium has today already one of the highest interconnection rates of Europe and therefore already achieves the targets as put forward in point (d) of Article 4 of Regulation (EU) 2018/1999. Indeed, according to the current planning, Belgium will already have an electricity interconnection rate of $\pm 21\%$ at the beginning of 2020 and, with the projects already planned (see Federal Development Plan 2020-2030²²), will reach $\pm 30\%$ by 2030²³.

The Federal Development Plan 2020-2030 was recently approved by the Belgian authorities. On page 138 “- 4.2.1 Aperçu des projets de développements des interconnexions” an overview is provided of all planned interconnection projects in the 2020-2030 period. Besides, also reinforcements to the internal Belgian grid are foreseen, in order to be able to accommodate to a maximum possible extent a rising share of renewables (both offshore and onshore), new generation units and internal flows resulting from international power exchanges.

²¹ http://www.ejustice.just.fgov.be/cgi_loi/change_lg.pl?language=fr&la=F&cn=2007033058&table_name=loi

²² <https://www.elia.be/en/grid-data/grid-development/investment-plan/federal-development-plan-2020-2030>

²³ These percentages are based on the definitions used by the Interconnection Target Experts Group (ITEG), i.e. interconnection rate = Total import / Total generation capacity, with total import implying “maximum power flow that the cross-border asset can transmit in accordance with system security criteria”.

The Federal Development Plan 2020-2030 is the product of a consultative process involving the federal regulator (CREG), the Minister responsible for the Marine Environment, the Regional Governments and the Federal Council for Sustainable Development. A public consultation was held between October 15th and December 15th 2018, resulting in various reactions from all kinds of stakeholders. Finally, the Federal Development Plan is of course in line with the latest regional and European development plans. More specifically, the scenarios and storylines are aligned on ENTSO-E's 2018 Ten Year Network Development Plan (TYNDP). Note that also for the TYNDP a European public consultation was held.²⁴

Apart from the interconnection projects, the plan also provides an overview of all internal high-voltage grid projects. These projects are needed to replace some of the current infrastructure or to address new and upcoming needs (e.g. the reinforcement of the internal grid following the increase of offshore wind generation capacity, local economic development drivers, etc.). Two prominent internal grid projects are the "Ventilus" and "Boucle du Hainaut"-projects. Both are currently planned for the period 2026-2028.

"Ventilus" is the planned link between Stevin and Avelgem, an essential connection to complete the Stevin (Stevin-Horta) link, which is currently the only 380 kV link extending the transmission grid to the coast. This new 380 kV corridor with a capacity of 6 GW is, amongst others, essential to connect the additional offshore wind production (2.3 GW installed in 2020 increases up to around 4 GW in 2030).

The "Boucle du Hainaut"-project foresees the essential connection between Avelgem and central Belgium in order to complete the Avelgem-Mercator link, which is currently the only existing transmission link between west and central Belgium. This will also be a new 380 kV corridor with a capacity of 6 GW. This new link is essential to avoid internal congestions which may occur when large quantities of electricity will be imported simultaneously from France (after the reinforcement of the Avelin-Avelgem axis) and Great Britain (Nemo Link, 1 GW), in combination with a high production from offshore wind. These situations will occur more frequently after the completion of the nuclear power phase-out in 2025 in Belgium and planned increases in the shares of renewable energy in France and Great Britain. The capacity of this new axis also creates opportunities for the development of renewable energy in the North Sea and along the coastline.

Finally, the lower voltage level investments (≤ 70 kV) are a regional competence in Belgium and are therefore listed in regional investment plans. These also have a shorter outlook (3 to 7 years). All of these are publically available²⁵ and subject to regulatory and/or political validation.

²⁴ <https://consultations.entsoe.eu/tyndp/tyndp-2018-public-consultation/>

²⁵ <http://www.elia.be/nl/grid-data/grid-development/investment-plan>

4.6 Scarcity pricing

The CREG, in collaboration with the university of Louvain-La-Neuve (UCL), has published a first report on the subject in 2016, which proposes a methodology to calculate scarcity price-adders in a Belgian context, building further on scarcity pricing concepts originating from a US market system, particularly the ORDC approach as implemented in Texas (ERCOT).²⁶ Based on theoretical simulations, the CREG report highlights the potential of scarcity price-adders to improve the profitability of a CCGT unit, while stating that further study work is required to arrive at robust conclusions and recommendations.

As a next step, in 2018, Elia built further on the CREG report, by applying the methodology provided by CREG to calculate scarcity price-adders for a concrete Belgian dataset. Scarcity price-adders are ex post calculated for the entire year of 2017 and the main findings are written down in a report.²⁷ The report also emphasizes that applying the considered scarcity pricing model requires strong assumptions in terms of mapping it to the Belgian market design.

Considering scarcity pricing for the Belgian market, and particularly the concept as being applied in the Texan ERCOT market, triggers a number of reflections and questions:

- In general, it is important to reflect on which price signal would be provided by such scarcity pricing mechanism. For instance, an ERCOT-like scarcity mechanism building on real-time situations and prices relies essentially on back-propagating *flexibility* price signals. Those are not to be misunderstood as being equivalent to adequacy price signals. Not every balancing problem indicates an adequacy issue (e.g. balancing prices in summer could also rise significantly, while there is as such plenty of capacity in the system, but perhaps not dispatched due to a lower load than in winter). Consequently, and depending on the precise design, a scarcity pricing mechanism could be useful to create investment signals to solve flexibility problems. However, as indicated in the Adequacy and Flexibility study of the Belgian TSO of 2019, there seems to be little evidence for a need to provide extra investment incentives for flexible assets (notwithstanding the need to put in place and further develop appropriate market mechanisms as sketched out in section 4.2).
- From a legal perspective, Art. 20.3 of Regulation (EU) 2019/943 requires scarcity pricing to be considered in case of identified resource adequacy concerns. More precisely, a shortage pricing function for balancing energy is put forward and explicit referral to Art. 44(3) of the Electricity Balancing Guideline is made. The explicit referral to balancing energy on the one hand and on the other hand the precise scope of Art. 44(3) of the Electricity Balancing Guideline explicitly referring to the Balancing Responsible Parties (BRP) triggers questions on the boundary conditions for the design of scarcity pricing mechanism. For instance, it remains to be assessed whether scarcity price-adders on the Balancing Service Providers (BSPs) could be conceived in this framework. Note that the alpha-component already present in the Belgian imbalance pricing mechanism relates to balancing energy and applies to BRPs (cf. infra).

²⁶ <http://www.creg.info/pdf/Divers/Z1527EN.pdf>

²⁷ <https://www.elia.be/~media/files/Elia/users-group/Working-Group-Balancing/Projects%20and%20publications/Scarcity%20Pricing%20Report%20-%20Final%20PUBLIC.pdf>

- Being highly interconnected and fully embedded in the European energy market, it is to be investigated how such scarcity pricing mechanism implemented in Belgium would interact with the functioning of the European energy market. How does it impact market functioning (across time frames) when Belgium would adopt an ERCOT-like scarcity pricing mechanism, while neighbouring markets don't apply it? More concretely, how could such mechanism – especially when involving also directly BSPs – work in a context of cross-border frameworks related to aFRR and mFRR (i.e. PICASSO & MARI projects)?

Finally, while US markets can obviously provide good inspiration for European market design evolutions, one should remain cautious when addressing partial market design questions. Scarcity pricing mechanisms as conceived in the US markets are embedded in the larger US market design. It remains to be further analyzed to which extent it is possible and desirable to implement similar scarcity pricing designs on a different underlying European market design.

These reflections and questions highlight the need for further research before implementing scarcity pricing in Belgium.

In 2019, further study work was carried out, focusing on the one hand on the calculation of scarcity price adders closer to real-time and on the other hand on the compatibility with the Belgian and European market design. As from October 2019, parallel runs are executed and scarcity price-adders are published ex-post (day + one).

However, note that next to the above described study work, the existing alpha component in the imbalance price mechanism (cf. also described in §4.2.2 as the alpha component is up for revision) already exhibits quite some characteristics of a scarcity pricing mechanism. This extra imbalance price component laid upon BRPs increases the real-time price signal (which again could back-propagate to earlier time frames) when the system imbalance of the Belgian control zone increases. By doing so, it provides extra financial incentives to BRPs to avoid large and persistent imbalances. This implies therefore an investment incentive for BRPs to ensure sufficient flexibility within their portfolios. Furthermore, as the alpha-component will also apply symmetrically as from 1/1/2020 on BRPs helping the system when suffering from larger imbalances, the investment incentive for ensuring sufficient flexibility is not only given through the penalization of BRPs being short but also by rewarding BRPs being long in such situation. Note, additionally, that the alpha-component is not only targeting upwards flexibility but applies mutatis mutandis also towards downwards flexibility. In this respect the added value of alternative/additional scarcity price adders will therefore also carefully have to be assessed taking into account the already existing alpha component.

Building on the scarcity pricing function characteristics already exhibited in the alpha component, Belgium will consider further whether such function could not only apply to BRPs, but also to BSPs. It will also be considered whether to trigger this function based on the scarcity of reserves in the system and to calibrate the function to increase the balancing energy prices to the value of lost load when the system runs out of reserves. These considerations will be carried out in view of amending the scarcity pricing scheme accordingly by no later than 1 January 2022, nevertheless taking into account any feasibility constraints that may result from the planned analyses. In view

of these considerations to be made by Belgium, it is to be noted that both CREG and ELIA have already foreseen in 2020 to continue to work actively on the topic.

4.7 Self generation, energy storage and energy efficiency

4.7.1 Self generation

Many measures are foreseen in order to promote renewables and self generation. As this is a regional competence, measures differ between regions :

- a. In **Flanders**, according to the solar map, a potential 57 GWe has been calculated for the ‘ideal’ category, defined as sites with incident solar radiation of more than 1 000 kWh/m²/year. The potential of the ‘usable’ category, with incident solar radiation of between 800 and 1 000 kWh/m²/year, is 15 GWe. At the end of 2017, installed PV capacity was 2.5 GWe. The solar map shows that there is enough rooftop potential to deliver significant growth.

Additional annual growth of 300 MWe is forecast by 2030. Flanders will therefore have 6.7 GWe of solar PV capacity.

For wind energy, the objectives of the ‘Windkracht 2020’ wind plan are taken into account, with the construction of 280 additional wind turbines from 2016 to 2020. This corresponds to average annual growth of 50 to 60 wind turbines, or 150 MWe of additional wind power, mostly from projects that have already been approved. ‘Windkracht 2020’ thus equates to an installed capacity of 1.5 GWe by 2020. The average growth rate is projected to be about 51 MW per year lower for the period 2021-2030, due to the limiting factor of lack of available space. By the end of 2030, total installed capacity will rise to 2 GWe.

The potential of biomass and biogas for green electricity was determined in the Vito study entitled ‘Het potentieel van bio-energie in Vlaanderen in 2030, april 2017’ (‘Bioenergy potential in Flanders in 2030, April 2017’). For large waste-wood-fired biomass plants, it is assumed that the capacity forecast in the 2020 energy plan will be maintained until 2030.

- b. In **Wallonia**, the Green Certificates mechanism has been improved by:
 - tapering of support (reduction in production cost and lifetime support);
 - simplified operation;
 - transfer of support for heat generation to another mechanism in the context of high-quality cogeneration.

This type of mechanism is still necessary to offset the higher cost of production compared with other sources for which not all external factors are priced in. The trend for electricity prices in Europe will be decisive and should eventually lead to a reduction in support (the phasing out of nuclear in central Europe will push up electricity prices on the ENDEX market). The aim is to limit and avoid extra charges on electricity bills relating to energy generation.

Other measures are needed to provide the best framework for the development of renewable generation, including:

- improving and securing the overall framework and reducing costs (permits, guarantees, administrative procedures, etc.);
- implementing and strengthening wind energy policy;
- introducing a policy for large-scale deployment of photovoltaic power.

The use of wind and photovoltaic energy is expected to grow more substantially (by 58 % and 195 % respectively) than in the baseline scenario.

Based on these estimates, renewable electricity generation will make up around 37 % of final electricity consumption by 2030.

c. **The Brussels-Capital Region** plans to develop an investment strategy for renewable electricity in and outside the region with :

- Setting an example in public authorities (extending the SolarClick programme for the installation of photovoltaic panels on public buildings in the region; strengthening cooperating with social housing bodies with the aim of allowing investment in renewable energy by reviewing the management agreement; considering methods of recovering all or part of the biowaste and green waste collected).
- Regulatory measures (directly imposing a requirement for all new buildings to generate renewable energy; considering a requirement to install photovoltaics in indoor or outdoor car parks run by private operators).
- Economic stimuli (encouraging collective projects and better use of local renewable electricity generation).
- Cooperation measures (encouraging managers of public buildings at non-Brussels authorities with premises in the region to invest in renewable energy generation at their Brussels sites; signing cooperation agreements – starting with neighbouring regions – with a view to investing directly in renewable electricity generation outside the region).

With regard to land management, on 30 November 2016, the Flemish Government approved the White Paper on Strategic Land-Use Planning for Flanders. This sets out a series of principles, of which : a joined-up energy system through energy efficient organisation and use of space (building design and orientation, etc.), promoting energy exchange (e.g. residual value) at spatial level, prioritising renewable energy in close proximity to the final user and consolidating energy infrastructure.

Wallonia has finalised its Regional Development Plan (SDT). The plan includes a package of medium- and long-term measures to enable the region to forecast and meet the future needs of its population.

In practical terms, the plan will look to prevent urban sprawl, develop urban areas and wasteland, improve the mix of activities and functions in urban centres, support and encourage local councils in achieving self-sufficiency in energy (storage and production), increase housing and zoning density, and accentuate biodiversity in urban areas (less mineralisation, introduction of ‘cold zones’, etc.).

4.7.2 Energy storage

The different levels of government will ensure the continuous development of new centralised and decentralised storage systems, and that peak-load shifting is possible where the technical and economic potential exists. An increasing share of these different capabilities will contribute directly to security of supply, in that they will be readily available and can be activated via the market.

Residential storage, SME storage, local storage potential, electric vehicles in storage mode and local tools will increase further by 2030, as will the volume of daily demand shifts.

Distribution-level storage could be used to support the distribution network as an alternative to traditional network dimensioning based on peak power. In order to install individual home or neighbourhood batteries and to achieve demand management across a distribution network, a clear regulatory framework is needed. In addition, the focus is on large-scale, long-term storage to bridge seasonal differences and provide a solution for long periods during which the supply of solar and wind energy is not sufficient.

In view of its responsibility for security of supply, the Federal Government will consult with the Regions to identify the most flexible system available and ensure the stability of the system. To bolster (energy) infrastructure, the legal certainty and investment security of projects must be supported by a simplified permit application procedure and by optimising existing legislation on urban planning and the environment.

The Regions are furthermore working on a clear regulatory framework with a view to placing storage behind the meter or at the neighbourhood level and to delivering demand management across the distribution network.

Furthermore, the development of energy storage is encouraged at different levels. The Federal Government manages the Energy Transition Fund, issuing a call for R&I projects linked to areas under the federal government's responsibility (nuclear energy, transport networks, energy storage, offshore energy, etc.) every year. The scope of projects eligible for the fund will be extended to include regional competences. The fund is supported by an annual fee of EUR 20 million paid by the owner of the Doel nuclear power plant to the Federal Government in return for the extension of its operating licences, until 15 February 2025 for Doel 1 and 1 December 2025 for Doel 2.

In September 2016, Belgian Prime Minister Charles Michel launched a proposal for a National Investment Pact with the private sector to create a sound investment climate and sustainable and inclusive growth between now and 2030 through public-private partnerships. The report was published on 11 September 2018. Six 'strategic' sectors were identified, energy being one of them. The investment pact mentioned the development of storage facilities for heat and electricity as one of the investments required to enable the energy transition. These energy-related projects represent a total investment of EUR 60 billion between now and 2030 (versus EUR 150 billion for the six strategic sectors). In general, the private sector will provide around 55 % of the capital funding. Some of this funding will be spent on innovation, research and development.

In Flanders, VLAIO offers grants for R&D projects, including support for development projects at an advanced stage of the innovation process (pilot phase). In addition, VLAIO also provides support through advice and training and by stimulating coordination and networking. VLAIO's grants cover the entire spectrum of R&I projects, including energy and climate (energy efficiency, renewable energy technologies, energy systems, energy storage, carbon capture, use and storage (CCUS), etc.), and are awarded following an evaluation based on the precise innovation involved and the economic added value created for Flanders.

Energy research is also a core part of Wallonia's energy commitments and regional expertise. The energy storage technologies are one of the main fields of research : storage (daily and inter-seasonal), including batteries (and their recycling) and emergency power supplies; phase-change materials; compressed air storage; accumulators; hybrid batteries (lithium, redox-flow, etc.) and storage management tools.

4.7.3 Energy efficiency

The following target has been set for the period up to 31 December 2030, taking 2015 levels as a baseline: a 27 % reduction in primary energy consumption linked to the energy consumption of buildings.

The transmission and distribution system operators will endeavour to make efficient use of the existing grid by introducing intelligent network features and solutions (e.g. dynamic line rating, high-performance conductors). In addition to the meters supplied to final users, which are designed to allow the grid to be used and managed as efficiently as possible, the energy infrastructure will also evolve to facilitate the energy transition. Within this framework, the existing discrete energy networks will interact and become increasingly interdependent. District heating or a gas network (hydrogen/biogas) could thus serve as a back-up for the electricity grid, for example. Due to the increasing interaction and dependencies between existing discrete energy networks, operational cooperation will also be enhanced, both between transmission and distribution system operators and among distribution system operators.

More precisely, the transmission system operator (TSO) Elia applies the following principles to make its infrastructure more energy-efficient:

- Introducing technological innovations to make more efficient use of existing infrastructure;
- Rationalising 36 kV and 70 kV transmission systems at a higher voltage level;
- Offsetting network losses by choosing technology to meet network infrastructure requirements;
- Calculating Elia's annual carbon footprint (direct and indirect emissions). This includes energy consumption on site and at substations, as well as the energy consumption of IT equipment.

In Flanders, article 3.1.4/1(4) of the Flemish Energy Decree states that energy efficiency is one of the objectives that the energy market regulator (VREG) must pursue in developing networks. In practice, this is done by examining and approving grid operators' investment plans.

Under Article 4.1.19 of the Energy Decree, distribution system operators (DSOs) must submit an annual investment plan to VREG for their systems, highlighting key investments and the timescales associated with them.

On 26 February 2014, the Flemish Parliament approved a decree that provides a formal basis for including a requirement for the system operator to send VREG its assessment of the energy efficiency potential of its gas and electricity infrastructure under technical rules.

The study carried out by Synergrid under Article 15(2) of Directive 2012/27/EU on energy efficiency did not lead to additional projects and/or ideas for proactively limiting the energy losses of distribution systems or adjusting investments in existing infrastructure. The current investment policy already takes optimal account of energy losses in power grids and the cost-effectiveness of investments, given the failure rate of existing assets and the expected safety and reliability performance of those grids. However, some improvements could be made to grid operation.

Article II.1.1.1.1(3) of the technical Regulation for the operation of electricity distribution systems requires grid operators to send VREG their assessment of the energy efficiency potential of their electricity infrastructure each year, in particular regarding transmission, distribution, load management and interoperability, and connection to energy generating installations, including access possibilities for micro energy generators.

Flemish DSOs have therefore looked at various measures to improve energy efficiency in the operation of distribution systems. They report to VREG on the implementation of those measures.

In terms of low-voltage investment measures, three-conductor networks (3X230V) are converted into four-conductor networks (3X230/400V) whenever they are replaced.

For medium voltage, the optimal cable section is used. The choice is determined:

- 40 % by load (low load);
- 30 % by voltage drop (10 and 11 kV);
- 30 % through cables for losses (150 mm²).

To optimise the use of the distribution network, grid operators install switch-disconnectors and remote-controlled circuit breakers in their medium-voltage cabinets.

Operational measures:

- adjust the automatic transformer setting;
- dynamic line rating;
- reducing consumption at substations and cabinets, with power for own use generated on site;
- reducing travel using remote control/remote readings.

5. Overview of measures

The ongoing and upcoming measures are bundled in this section in a table, including a timeline. A choice has been made to depict a timeline up until 2030, which seemed the most appropriate given the measures included in the table. Of course, some developments might not be finalized in 2030. When appropriate, the timeline of these measures will be further specified in the yearly monitoring reports on the implementation plan.

Most measures included in the table are developed, discussed and followed-up in close collaboration with the market parties. In general, all energy market evolutions are discussed within Elia's user groups, consisting of representatives of the entire market. The network development evolutions are also subject to public consultation procedures, open for all market parties and explicitly foreseeing formal roles for some institutions. This also concerns consultations on the data and scenarios. Finally, also the policy objectives are subject to a public consultation, as was recently the case for the draft National Climate and Energy Plan.

Many of the above mentioned topics have also been discussed at European/regional level, in particular via ENTSO-E's working groups and consultation platforms. In addition, some aspects were also adjourned in the Pentalateral Energy Forum (PLEF), gathering Ministries, Regulators, TSOs, and power exchange representatives from Belgium, the Netherlands, Luxembourg, Germany, France, Austria and Switzerland.

The following table acts as a link between the measures taken in Belgium to improve the market functioning as they are mentioned in chapter 4, and the groups of measures which need to be considered by the Member State as mentioned in article 20.3 of Regulation 2019/943. As can be noted, the proposed measures go beyond the subjects listed in article 20.3:

Article 20.3	Measures
Price caps	See chapter 4.1 Wholesale markets
Shortage pricing function	See chapter 4.6 Scarcity pricing
Interconnections and internal grid capacity	See chapter 4.5 Interconnection and internal grid capacity
Self-generation, energy storage, demand side measures and energy efficiency	See chapter 4.3 Demand-side response and 4.7 Self generation, energy storage and energy efficiency
Balancing and ancillary services	See chapter 4.2 Balancing markets
Regulated prices	See chapter 4.4 Regulated prices
Regulatory distortions	See all of the above

	Status	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
a) Price caps	Dynamic price caps, consistent between different time frames												
b) Introduction of a shortage pricing function	Offline model for calculation of scarcity price-adders	Online publication of simulated scarcity price-adders (parallel run as from October 2019 for at least one year)											
c) Increase of interconnection and internal grid capacity	Interconnection rate of 15% by 2030 already surpassed	Extra interconnectors (BE-GB & BE-DE) and reinforcement of existing interconnection capacity (BE-NL & BE-FR)											
		Reinforcement of existing internal 380kV grid							Boucle du Hainaut & Ventilus				
d) Self-generation, energy storage, demand side measures and energy efficiency	Transfer of energy and opt out alternative model open on mFRR market	<p>Implementation alternative mechanism for the pass-through contracts for mFRR.</p> <p>Implementation opt-out and alternative mechanism for pass-through contracts for aFRR + reassessment of the transfer of energy model</p> <p>Opening of transfer of energy (and opt-out alternative model) to the strategic reserve market</p> <p>Study relative to the transfer of energy in the DA/ID markets</p>		Implementation of the transfer of energy (as well as the alternative models) for the DA and ID markets									
	Policy measures Self generation, energy storage and energy efficiency	Constant monitoring											

e) Balancing market developments		Single-pricing balancing mechanism	Improved balancing publications & revision of alpha			
	Balancing product roadmaps	FCR open to all technologies, all players, all voltage levels		Daily procurement & only regional procurement (July)		
		aFRR only open to CIPU units		aFRR open to all technologies, all players, all voltage levels & daily tender (July)	PICASSO (timing TBD)	
					marginal pricing activated energy (if sufficient liquidity)	
		mFRR open to all technologies, all players, all voltage levels		Daily sizing and tender & marginal pricing activated energy (February)	MARI (timing TBD)	
			Regional imbalance settlement harmonization			
		Internet of Energy				
f) Regulated prices		No regulated prices except for social tariff (households)	Compliance with Electricity Directive 2019/944			

6. Conclusion

Belgium is facing numerous challenges to its electricity adequacy, today and even more so in the future when its nuclear capacities will close. All governments, regulators, the TSO and DSOs and other market parties are committed to strive for an ever better functioning market and have many measures ongoing or planned. Many of these measures are listed in the present implementation plan. However, it has been shown through multiple studies that improving the market functioning alone will not be sufficient to address the challenges at hand and state intervention is deemed necessary.

Therefore and in accordance with article 20 of Regulation 2019/943, the opinion of the European Commission has been requested and integrated on the measures proposed in this implementation plan as part of the state aid processes concerning the existing strategic reserve and the planned reliability options mechanism. Belgium has published this final adapted plan and will monitor its application, publishing an annual report and submitting it to the European Commission, and finally, will adhere to the implementation plan even after the identified resource adequacy concern would be resolved.