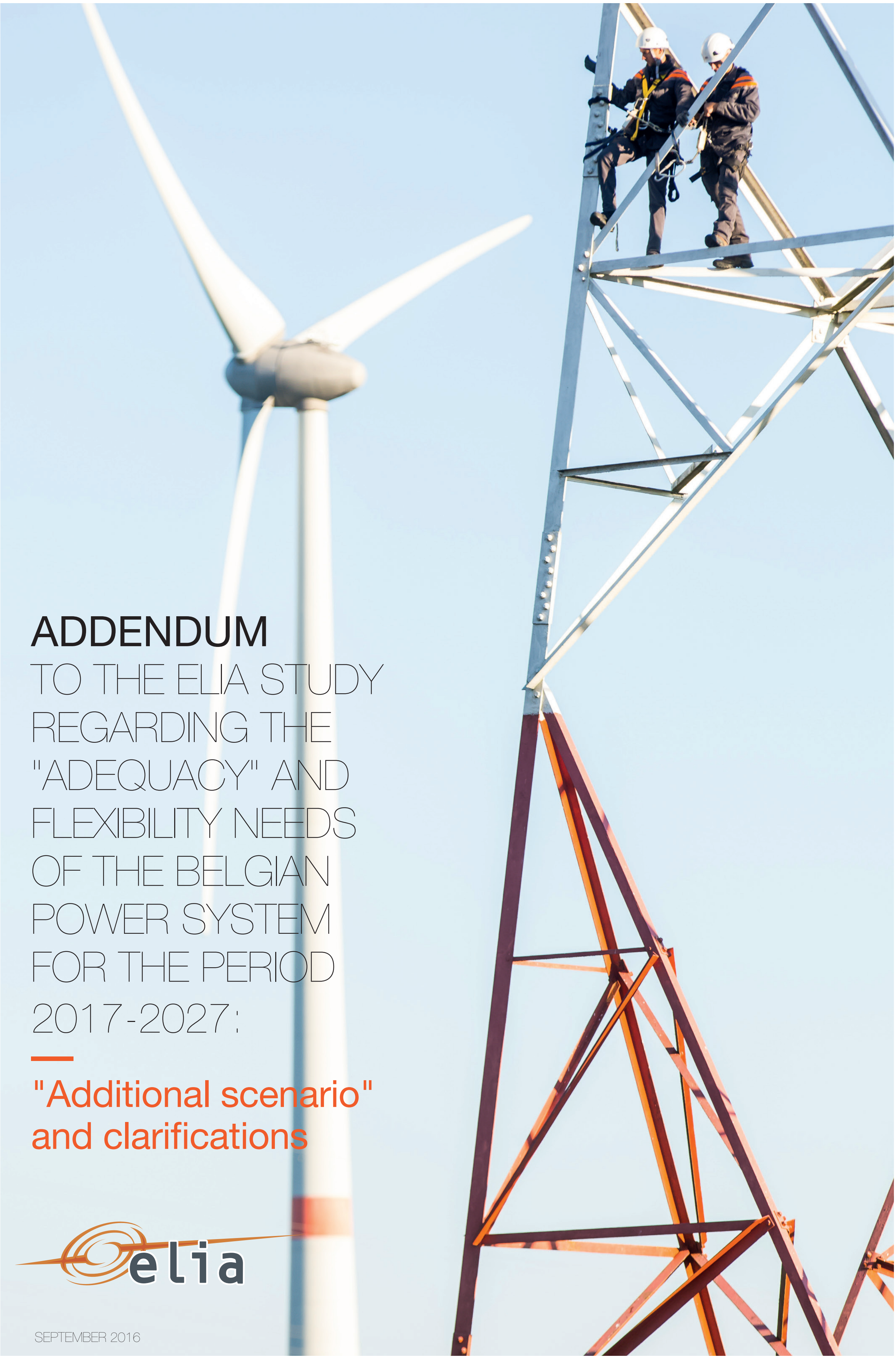


ADDENDUM

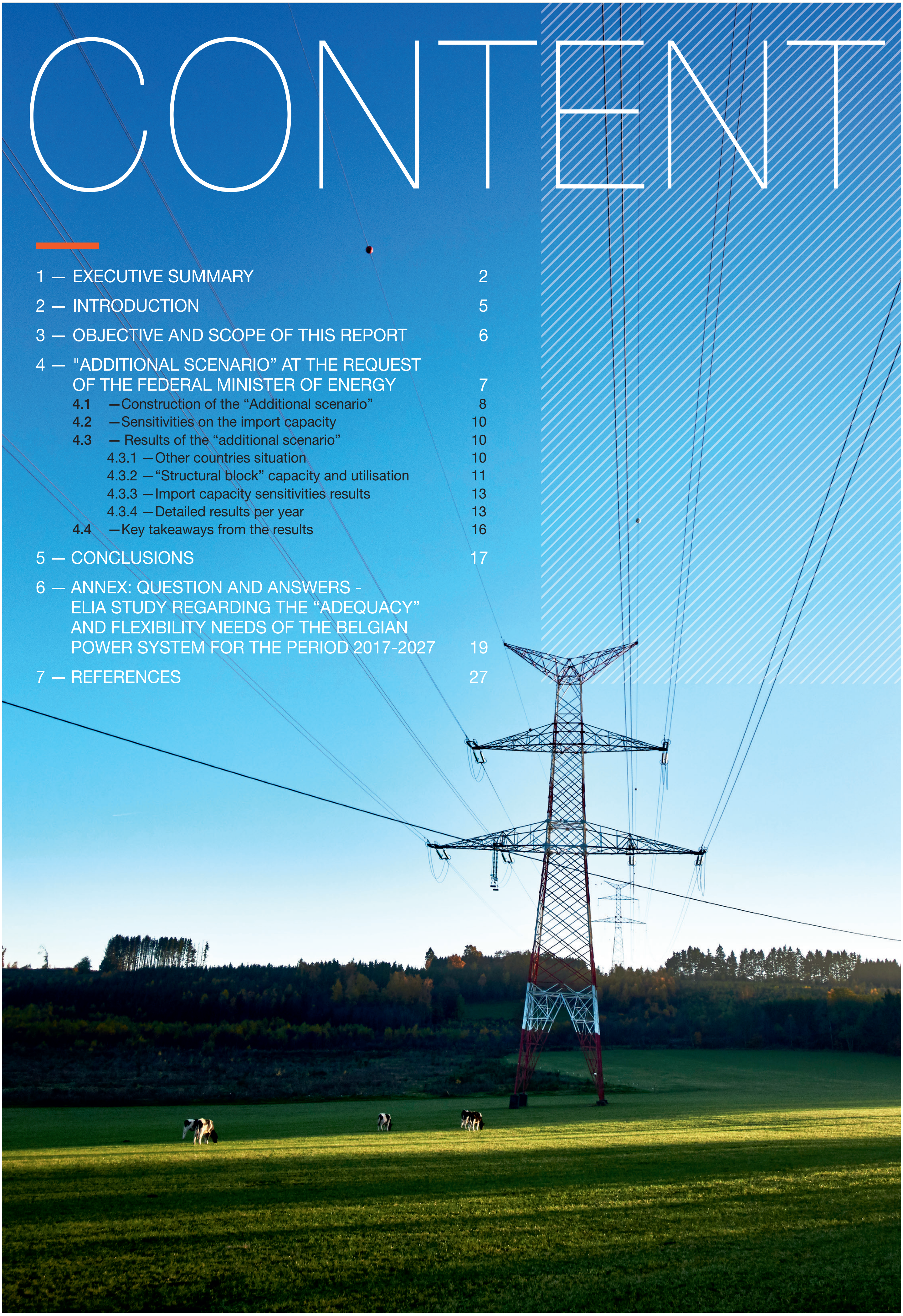
TO THE ELIA STUDY REGARDING THE "ADEQUACY" AND FLEXIBILITY NEEDS OF THE BELGIAN POWER SYSTEM FOR THE PERIOD 2017-2027:

"Additional scenario" and clarifications

elia

SEPTEMBER 2016

CONTENT



1 EXECUTIVE SUMMARY

On 20 April 2016, Elia published a study on the “adequacy" and flexibility needs of the Belgian power system for the period 2017-2027. Following that report, the FPS Economy's DG Energy organised a public consultation, at the end of which – on 25 July 2016 – the Federal Minister of Energy, Ms Marie-Christine Marghem, asked Elia to analyse a number of additional scenarios based on various new assumptions.

This report provides an overview of the assumptions Elia was requested to analyse and the resulting scenarios. The results are discussed in the context of the expected evolution of the power system in Belgium and its neighbouring countries.

The additional assumptions share the common feature that they are based on a drastic reduction of available generation capacity in Belgium's neighbouring countries. The new scenario takes as its starting point for those countries, the additional shutdown of coal- and lignite-fired power plants supplying 44 GW of capacity, on top of the previously announced shutdowns already incorporated into the “Base case” established in April 2016. The initial study already included such a “Low capacity” scenario with the same planned shutdowns. Therefore, it was expected (and it is confirmed here) that the results of the “additional scenario” would be similar to the “Low capacity” scenario from April, presented by Elia as a “stress test”.

Although such a mass shutdown of coal- and lignite-fired power plants cannot be ruled out a priori, the following caveat should be made. If such a mass shutdown would lead to a situation in which Belgium's neighbouring countries (in particular the UK, France and Germany) did not meet their “adequacy” criteria, then measures would be taken to meet the defined needs by other means (or to be able to meet these needs if necessary). Examples of such measures are:

the construction of open-cycle gas turbines (potentially even outside the market in the form of strategic reserve as planned in Germany), mothballing of power plants whose shutdown has already been announced (in the Netherlands), accelerated implementation of "demand-side" programmes, promotion of storage systems, and finally the introduction of Capacity Remuneration Mechanisms (in the UK and France). These measures should ensure that the "Low capacity" scenario will not materialise, as such avoiding the resulting dramatic decrease of exporting possibilities to Belgium, which emerges in this new scenario. This also underlines the fact that such a scenario must be considered an extreme stress test, which can be countered with other measures, some of them at a later stage.

As well as the other adjustments made to the scenario (in increasing order of significance: raising the consumption growth rate, replacing of biomass with Combined Heat and Power (CHP), slightly increasing storage capacity, etc.), it is important to mention the sensitivities regarding the import capacity. Alongside the reference value of 6500 MW, which Elia considers a reasonable estimate from 2021 onwards, Elia was requested to factor in import capacities of 3500 MW and 8000 MW in 2027.

In terms of this first figure, Elia would like to point out that the average commercial import capacity made available to the "day ahead" market during the first quarter of 2016 (excluding the ALEGrO and NEMO interconnections currently under construction) was 4400 MW. As regards the assumption of 8000 MW, such a commercial import capacity would require, to be continuously available, additional interconnection projects to be launched (in addition to those already planned), whose rollout during the time frame covered by the study could thus be compromised. For these sensitivities, a vital point to note is that each of the three import scenarios (3500, 6500 and 8000 MW) leads to the same level of the "structural block", namely 9000 MW each in 2027. The reason for this is that, given the very low generation capacity of Belgium's neighbouring countries, this generation capacity rather than the transmission capacity, that plays a crucial role in terms of import potential at critical peak times.

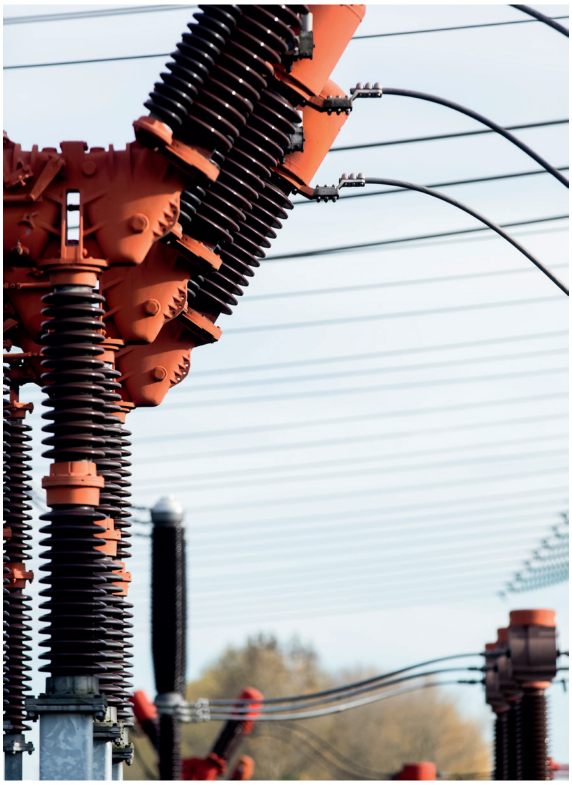
A good illustration of the radical nature of this scenario is Elia's calculation regarding the "adequacy" levels of Belgium's neighbouring countries. On the basis of this scenario, France scarcely meets the LOLE criterion of three hours due to mass use of the interconnections (for the country's adequacy, the Netherlands rely for 4940 hours per year on its neighbouring countries).

Of course the sensitivities with divergent import capacities differ significantly in terms of the annual use of the generation resources forming the "structural block". It is worth emphasising that the duration that emerges from the study represents the minimum use of the measures for "adequacy" purposes, on the grounds of the uncompetitive nature of the generation facilities within this "structural block". The economic deployment of these facilities primarily depend on their competitiveness in a European, rather than a purely national, "merit order" ranking.

Response to the public consultation

The Q&A list supplied as an annex to this study provides various clarifications as reply to the responses from the public consultation. A number of these elements are purely descriptive, such as the clarification of the "structural block" notion used in the initial study. The "structural block" is the identification of the additional energy and capacity required each year to meet demand, taking account of the known resources and the estimated, available import volume. The "structural block" can be made up of generation or storage measures or additional demand management. Elia maintains a completely neutral view on how the "structural block" is filled in.

The consultation also reveals that some respondents have the impression that there is an opposition between the development of interconnectors and of national generation resources. Some respondents rightly proposed to base building decisions regarding interconnectors on the general drive to optimise costs for society.



Indeed, since a couple of years ENTSO-E has developed a methodology that weights the social costs and benefits for the community for each building decision. The European Commission has validated this “Cost Benefit Analysis“(CBA) methodology. Elia has applied this CBA methodology when deciding to build the Elia interconnectors, which are included in the current development plan. Improving “adequacy” was never a predominant criterion in the current development plan. The main criteria is Belgian price competitiveness within a European “merit order” framework and the integration of renewable energy sources. The changes expected over the decades ahead will make the latter criterion considerably more important, as extensive wind and solar capacity systematically result in local surpluses or shortages that are best addressed by large-scale grids. A range of independent studies and experience in Denmark and Germany confirm this.

Although “adequacy” is not an objective as such when taking decisions on building interconnectors, they obviously bring a considerable contribution to ensure “adequacy” for both Belgium and its neighbouring countries. This also emerges clearly from the figures in the study (see Fig. 3). There is a broad consensus, in several independent studies, that fossil fuels will continue to form a key part of the energy mix until 2050, although renewable energy sources will make up a growing share of the overall picture. This makes strong interconnectors a necessity rather than a hindrance for regions with efficient gas-fired power plants, whether either already in operation or under development.

In practice, this means that efficient gas-fired power plants in Belgium, in spite of the country's 12-15 GW of renewable and other decentralised capacity, can achieve a high annual utilisation rate in the European “merit order” thanks to interconnectors. It must be acknowledged that currently this is not (yet) the case, as the “merit order” is mostly 'coal before gas' as a result of the low CO_2 prices. However, strong interconnectors are essential when it comes to this last factor (a “coal before gas“ merit order) in terms of keeping prices at an acceptable level for Belgian consumers compared with the neighbouring countries which do have coal- or lignite-fired power plants.

The same applies to the import volumes: a high level of interconnection does not necessarily lead to the country having a high level of net imports. By contrast, the further development of national renewable energy sources in tandem with interconnectors will contribute to the decarbonisation of the CWE region. Moreover, this can only be beneficial to the economic value of efficient power plants on the European market, but it does require a switch in the “merit order” from “coal before gas” to “gas before coal”, in line with European climate policy.

Next steps

The results of both the initial and the present study show that a significant capacity (production, storage, demand reduction) is necessary, but also that a large part of this capacity just has to be available for a very limited number of hours per year to ensure security of supply.

It is thus appropriate to start the discussions which will lead to decisions on appropriate measures or mechanisms. Here attention should be paid to:

— the possible filling-in and distribution of the defined “structural block” between the various segments and technologies (production, storage, demand reduction, etc. ...). Further technical-economic analysis on each of these segments must be carried out with its implications deriving therefrom for Belgium;

— any reflection on the appropriateness of the introduction of a capacity mechanism should not be isolated but should be coordinated and harmonized with the neighbouring countries (and implemented) given the high degree of interconnection of Belgium with its neighbours and its central position in Europe.

Therefore the timely commencement of these discussions is important in order to guarantee the availability of capacity at the start of the nuclear "phase-out" (2023). Action is needed in a timely manner in order to provide a clear and stable framework to market participants so that they can make the right decisions (based on the appropriate insights) and anticipate the expected evolutions in the Belgian energy mix.

2 INTRODUCTION

On 20 April 2016, Elia System Operator (hereinafter 'Elia') published a study on the "adequacy" and flexibility needs of the Belgian power system [1], after having it presented to the Belgian stakeholders during the Elia Users Group that same day.

The study was conducted at the request of the Federal Minister of Energy, Ms Marie-Christine Marghem, and has been developed in cooperation with the cabinet of the Minister and the Energy administration of the Belgian FPS Economy (hereinafter 'DG Energy'), as the methodology and assumptions were discussed and agreed upon with both entities.

Afterwards, during May 2016, DG Energy organised a public consultation regarding the possible introduction of a capacity remuneration mechanism in Belgium. The public consultation document, stakeholders' responses and the recommendations formulated by DG Energy are available on the website of DG Energy [2].

On 18 July 2016, to follow up on the results of the public consultation and the recommendations made by DG Energy, Elia received a new mandate from the Federal Minister of Energy to analyse an "additional scenario".

3 OBJECTIVES AND SCOPE OF THIS REPORT

The objectives of this report are twofold.

First and foremost, this report addresses the second formal request of the Federal Minister of Energy, to analyse an “additional scenario”. The assumptions used for this additional study are defined by the Federal Minister of Energy, at the suggestion of DG Energy. Chapter 4 focuses on this request and provides a description of the corresponding results.

Second, after reviewing the stakeholders’ responses to DG Energy’s public consultation, Elia is willing to provide stakeholders with some additional clarifications and explanations related to the initial study (as published on 20 April 2016). The additional information does not contain any modification to the methodology, assumptions, used data and/or results, but aims to provide further clarification to some recurring questions. This explanation is provided by a Question and Answers (Q&A) section and is annexed to this report.

"ADDITIONAL SCENARIO"

AT THE REQUEST OF THE FEDERAL MINISTER OF ENERGY

This chapter describes the assumptions, sensitivity analysis and results for the additional scenario as requested by the Federal Minister of Energy.

The assumptions of the "additional scenario" and changes in comparison to the base case are highlighted in **section 4.1**.

On top of this "additional scenario", a sensitivity analysis on the import capacity was also requested and performed. This is explained in **section 4.2**.

Section 4.3 provides the results in terms of structural block volume and characteristics.

Finally **section 4.4** highlights reflexions resulting from the new calculations.

4.1 CONSTRUCTION OF THE "ADDITIONAL SCENARIO"

The request aims to simulate an “additional scenario”, based on the stress test as constructed for the initial study called the “Low capacity” scenario. This scenario assumes a strong decommissioning of coal and lignite capacity in Central Western Europe leading to major adequacy issues in the region. Despite the extreme character and low likelihood of this scenario, some interesting reflections emerge from the calculations.

The “additional scenario” is based on the “Low capacity” scenario as assessed in the initial study published in April 2016. Other changes were also requested and are listed in **Figure 1** and further explained in this section.

CONSTRUCTION OF THE “ADDITIONAL SCENARIO“ (FIGURE 1)

		2017	2021	2023	2027	
"Low capacity" scenario as defined in the initial study published in April 2016 +	**Demand**	+0.6%/y				Demand of 0.6%/y instead of 0%/y growth
	CHP	=	+500 MW	+500 MW	+1000 MW	Additional CHP capacity considered
	Biomass	=	-600 MW	-600 MW	-600 MW	No new biomass considered. Constant capacity is therefore obtained for the timeframe
	Storage	=	+100 MW	+100 MW	+200 MW	Slight increase of the storage capacity (mixture of pumped storage and batteries)
	Market Reponse	=	+500 MW	+500 MW	+500 MW	Increase of market response capacity taking into account the limitations

The "low capacity" scenario is the starting point:

In the initial study, the "Low capacity" scenario was constructed by removing an additional 44 GW of coal and lignite capacity in neighbouring countries in 2027 (on top of the coal capacity already decommissioned in the "Base case"). The choice of removing coal capacity was arbitrarily chosen in order to test the effect of a lower adequacy level of neighbouring countries due to a massive coal phase-out in Western Europe. The scenario was created to test the robustness of the ability of neighbouring countries to provide energy during periods of structural shortages in Belgium. These assumptions are now taken as basis for the "additional scenario".

The extreme character of the scenario will lead to adequacy issues in Central Western European countries. The likelihood of such a situation is very low given the current mechanisms already in place or being implemented in the relevant countries.

A linear interpolation was used to build the assumptions for the other years as the "Low capacity" scenario was only defined for the year 2027. This leads to the following:

– 2017: no changes in the generation capacity;

– 2021: -17.6 GW removed compared to the "Base case";

– 2023: -26.4 GW removed compared to the "Base case";

– 2027: -44 GW removed compared to the "Base case".

Additional changes to the "Low capacity" scenario:

From the "Low capacity" scenario as calculated in April 2016, **five additional changes were taken into account as requested**:

– an **annual consumption growth rate** of 0.6%/year for Belgium instead of 0%/year;

– the **CHP** (Combined Heat and Power) capacity was increased by 500 MW in 2021 and by an additional 500 MW in 2027; this leads to a total CHP capacity of 3000 MW in 2027;

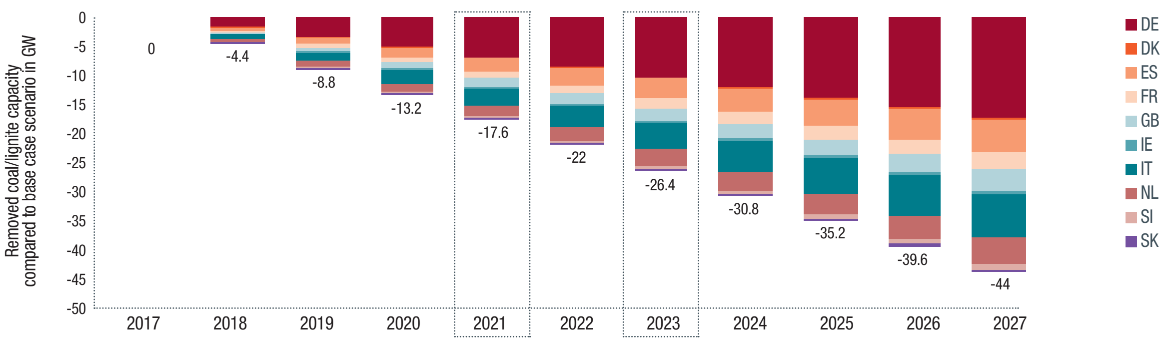
– the "Base case" assumed an additional 600 MW of **biomass** capacity from 2021; in the "additional scenario", such an increase is not considered for the entire timeframe; and the biomass capacity remains the same for the entire period;

– an increase in **storage capacity** by 100 MW in 2021 and an additional 100 MW in 2027were incorporated;

– the **market response** capacity has been increased by 500 MW from 2021; this will lead to 1600 MW of market response capacity being available from 2021 (with the same limitations on activations as in the "Base case" scenario).

Figure 2 shows the removed coal and lignite capacity by country from the "Base case" for the considered timeframe.

INTERPOLATION OF "LOW CAPACITY" FOR THE ANALYSED TIMEFRAME (FIGURE 2)



4.2 SENSITIVITIES ON THE IMPORT CAPACITY

The request also included some sensitivity analyses on the import capacity. The basic assumption is to consider the same simultaneous import capacity as in the "Base case" scenario, meaning:

– 4500 MW of simultaneous maximum import capacity for 2017;

– 6500 MW of simultaneous maximum import capacity in 2021, 2023 and 2027.

It is important to note that the investments planned in the Federal Development Plan [3] for 2015-2025 as approved by the Minister have not been changed and are still the baseline of the scenario. The only change introduced in these sensitivities is the value of simultaneous import capacity for Belgium.

Two sensitivities were requested considering **3500 MW and 8000 MW of simultaneous importation capacity.**

Given that today's simultaneous import capacity is already higher than 3500 MW and given the planned grid investments in Belgium and the neighbouring countries, a scenario with 3500 MW simultaneous import capacity is rather to be considered as a stress test of the system in cases of severe transmission incidents or malfunctions. Considering that such events have a low probability of occurrence, a limit of 3500 MW during the entire year is unrealistic.

4.3 RESULTS OF THE "ADDITIONAL SCENARIO"

The "additional scenario" shows a similar trend in terms of "structural block" needs to the "Low capacity" scenario already analysed in the initial study.

A decrease in the "structural block" capacity is observed in the first phase (2017-2021). Afterwards, in 2023, when the first nuclear power plants are scheduled to be decommissioned, the "structural block" will increase sharply and will reach 9000 MW in 2027.

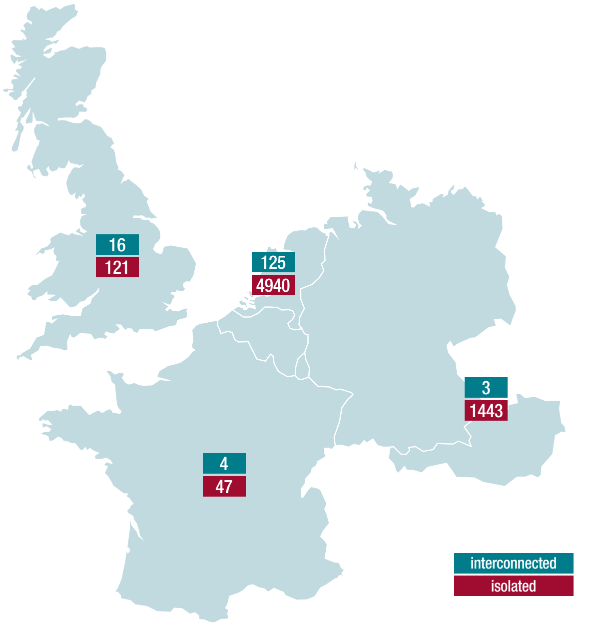
The fact that this "additional scenario" assumes that the neighbouring countries are not adequate drives the strong increase in the "structural block" capacity from 2023 to 2027. Further implications of a lower adequate scenario are explained in this section.

4.3.1 Other countries situation

Due to the removal of 44 GW of coal-fired units in Western Europe, the neighbouring countries are no longer "adequate" if one considers the adequacy criteria in place in those countries today. This will lead to an increase in moments when Belgium will not be able to find the energy abroad and therefore lead to a higher "structural block" level after the nuclear phase-out.

Figure 3 shows the situation abroad in terms of LOLE. The "interconnected value" indicated in the figure represents the LOLE when the country is considered connected to the other countries (the actual situation). The second value ("isolated") gives an estimation of the amount of hours when the country will depend on imports to remain adequate (the export margin of the country is null).

LOLE IN NEIGHBOURING COUNTRIES IN 2027- "ADDITIONAL SCENARIO" (FIGURE 3)



It can be observed that in this scenario, the neighbouring countries are not adequate and very dependent on the other countries (when comparing the LOLE observed to the current adequacy criteria in place if it exists):

– **United Kingdom:** LOLE of 16 hours on average. The capacity mechanisms in place today ensure that the country remains under 3 hours of LOLE;

– **France:** LOLE of 4 hours, the criterion in use today being 3 hours;

– **the Netherlands:** 125 hours of LOLE on average and more than 50% of the time relying on imports for its own adequacy;

– **Germany:** Although Germany's LOLE is 3 hours in the scenario, it relies on imports for its own adequacy for more than 1400 hours. There are mechanisms already in place and/or being implemented in Germany in order to guarantee the security of supply of the country.

It is worth mentioning that a scenario with a massive shutdown of lignite- and coal-fired plants, going up to 44 GW as indicated above, does not necessarily lead to an adequacy deficit of the same level. Examples are mothballing and the decision taken in Germany to install open-cycle gas turbines outside the market to maintain adequacy when facing plant shutdowns.

As a consequence, the situation as observed in the "Low capacity" scenario is to be considered as a stress test in case the measures which countries are taking in order to ensure their own security of supply were to fail. Moreover, national, regional and European studies are performed yearly in order to evaluate the mid- and long-term adequacy situation in most of these countries. This has led to different capacity mechanisms already in place or under development. This study is also being conducted within this framework.

Figure 3 clearly shows the benefit of interconnections to ensure some of the security of supply of a country. The difference between the isolated case (no interconnections) and the interconnected case in terms of LOLE highlights the benefits of having strong connections within Europe. This is further developed in section 4.4.

4.3.2 "Structural block" capacity and utilisation

The evolution of the "structural block" can be explained by the same drivers as the "Base case" scenario from the initial study for the first phase (2017-2021) and the "Low capacity" case for the second phase (2023-2027).

– **2017:** A "structural block" capacity of 2500 MW. As no changes were made to the assumptions for that year, the size of the "structural block" capacity remains the same.

– **2021:** A decrease in the "structural block" size is observed. This is explained by the additional CHP capacity considered (+500 MW), more offshore wind capacity and 2 GW of additional simultaneous import capacity considered. This even leads to a margin (negative "structural block") of 1000 MW in 2021. The "Low capacity" scenario considered for the neighbouring countries has no effect in 2021.

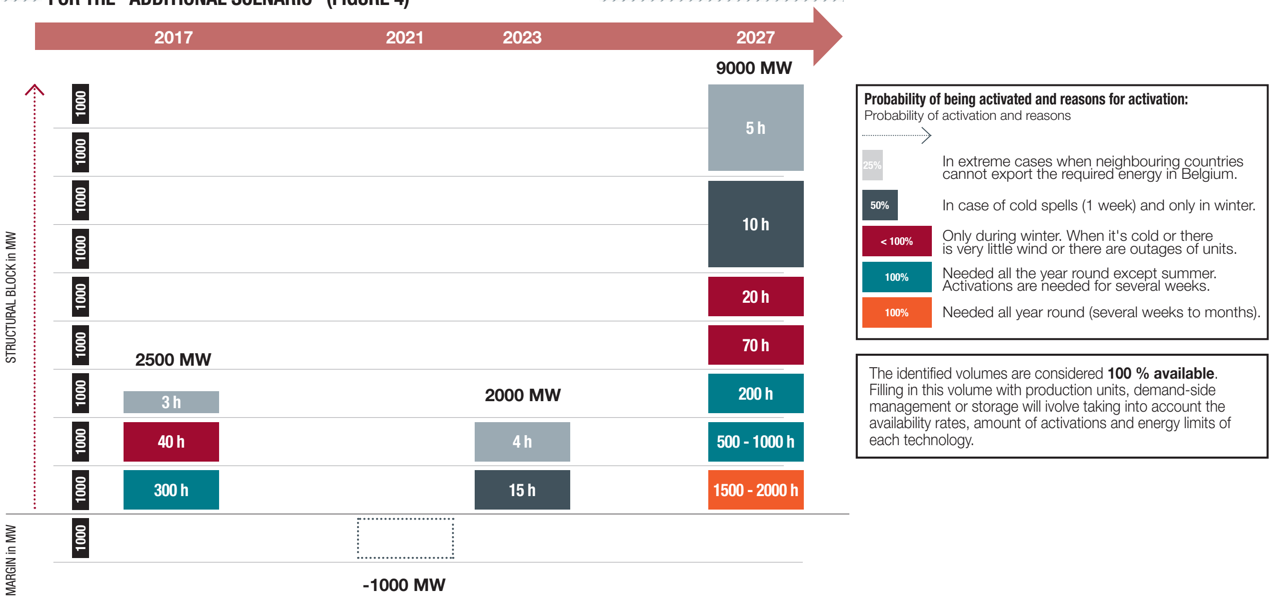
– **2023:** The loss of 2 GW of nuclear units and additional shutdowns of coal-fired units considered in Western Europe (assumption taken from the "Low capacity" scenario), results in a need of 2000 MW in 2023. A very limited number of hours when this capacity is needed can be observed (15 hours for the first 1000 MW and 4 h for the second block of 1000 MW). The probability of using this capacity for adequacy reasons is low (50% for the first 1000 MW and 25 % for the remaining 1000 MW). This capacity is only needed during cold spells and for a maximum of one week per year when activated.

– **2027:** The combination of the additional shutdowns of coal-fired units in Western Europe ("Low capacity" scenario assumption) and the loss of the remaining 4 GW of nuclear power plants in Belgium leads to a need of 9000 MW.

The first block of 3000 MW would be needed for the whole year with a 100 % probability of activation. The following block of 2000 MW would be needed only during winter in case of cold weather, low wind or forced outages of power plants. The last 4000 MW have a probability of activation of 50% and 25%. This capacity will only be needed during cold spells affecting more than one country and for a maximum of one week per year when activated.

Results in terms of capacity of the "structural block", hours when this block will be needed for adequacy purposes, drivers of activation and probability of activation are shown in **Figure 4.**

VOLUME AND CHARACTERISTICS OF THE "STRUCTURAL BLOCK" FOR THE "ADDITIONAL SCENARIO" (FIGURE 4)



Important note

The running hours shown in Figure 4 are not economical running hours but the hours during which the given volume is needed for adequacy purposes. An economically dispatched unit in the system will therefore run for at least that number of hours.
The "structural block" volume calculated is considered 100% available. Neither forced outages nor limitations on energy are taken into account.

4.3.3 Import capacity sensitivities results

Sensitivities on the simultaneous import capacity were performed as requested. Only the simultaneous import capacity was changed (no changes were applied to the exchange capacities between countries).

The two sensitivities with 3500 MW and 8000 MW simultaneous import capacity show the same "structural block" needs as for 6500 MW of simultaneous import capacity in 2027.

9000 MW are needed in both sensitivities in this "additional scenario" in 2027. The assumption of "Low capacity" in the neighbouring countries is the limiting factor in terms of available import capacity. Changing the simultaneous maximum import capacity has no impact on the volume needed given the assumption of the "Low capacity" scenario.

The number of running hours of the "structural block" units for adequacy reasons sharply increases when considering a lower import capacity.

4.3.4 Detailed results per year

4.3.4.1 Results for 2017

The results for 2017 are the same as for the "Base case" of the initial study as no changes were introduced to the assumptions for that year.

Figure 5 shows the number of LOLE hours when adding "structural block" capacity. The number of hours shown in this chart represents the average hours when this capacity is needed for adequacy purposes. This is different from running hours of economically dispatched units. Those hours can be interpreted as the running hours of the most expensive unit in Belgium.

LOLE BY "STRUCTURAL BLOCK" CAPACITY ADDED TO THE BELGIAN PRODUCTION PARK FOR 2017 (FIGURE 5)

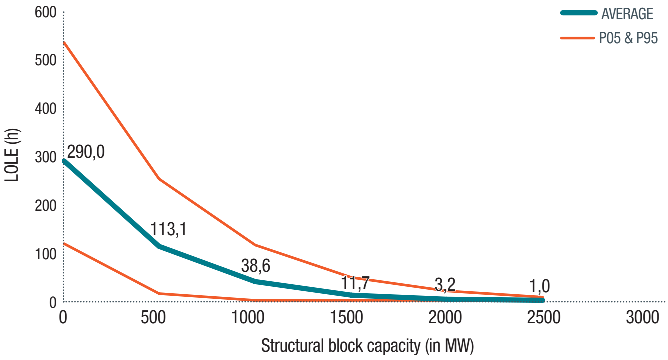
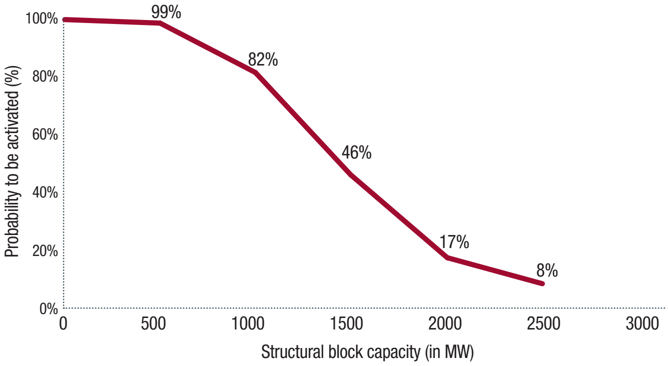


Figure 6 shows the probability of activating a given capacity. For each 500 MW block, the probability to be activated at least once a year is given. The last 500 MW block has a probability of 17% of being needed in a given year. Even with 2500 MW of "structural block" capacity, there is always a probability of a higher need (in this case 8% probability of higher need) as the remaining LOLE is not zero.

PROBABILITY OF THE "STRUCTURAL BLOCK" BEING ACTIVATED IN 2017 (FIGURE 6)



4.3.4.2 Results for 2021

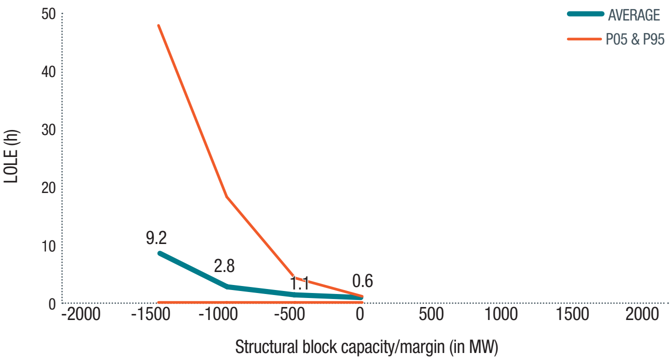
For 2021, the “structural block” margin is shown. A margin means that some “non-structural block” capacity could be removed and the adequacy criteria would still be met. The margin calculated for 2021 equals 1000 MW.

Figure 7 and **Figure 8** show the LOLE hours of the “structural block” margin and the probability of needing that capacity.

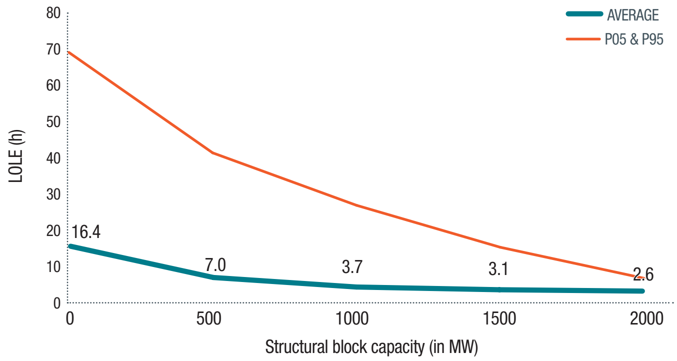
4.3.4.3 Results for 2023

Results for 2023 are shown in **Figure 9** and **Figure 10**. The “structural block” accounts for 2000 MW with a probability of activation of less than 100% for the entire block. The first block of 1000 MW is needed for less than 20 hours on average. The following block of 1000 MW is needed for less than 4 hours on average. The P95 values of the “running hours” are below 70 h for the first 1000 MW and below 30 h for the following 1000 MW.

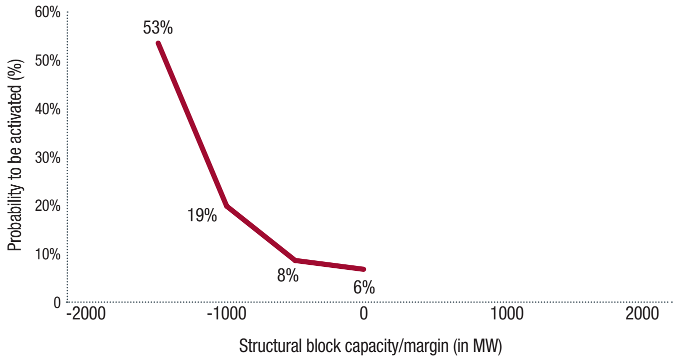
LOLE BY "STRUCTURAL BLOCK" CAPACITY ADDED TO THE BELGIAN PRODUCTION PARK FOR 2021 (FIGURE 7)



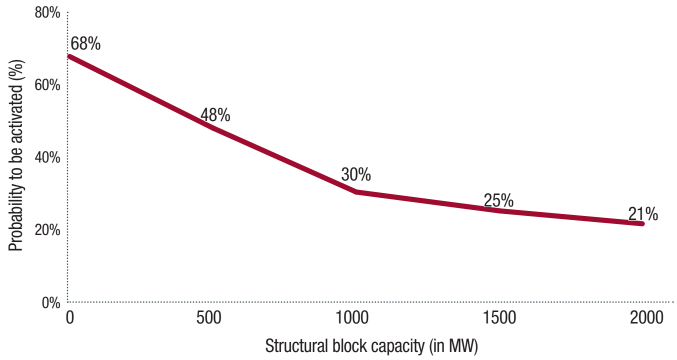
LOLE BY "STRUCTURAL BLOCK" CAPACITY ADDED TO THE BELGIAN PRODUCTION PARK FOR 2023 (FIGURE 9)



PROBABILITY OF THE "STRUCTURAL BLOCK" BEING ACTIVATED IN 2021 (FIGURE 8)



PROBABILITY OF THE "STRUCTURAL BLOCK" BEING ACTIVATED IN 2023 (FIGURE 10)



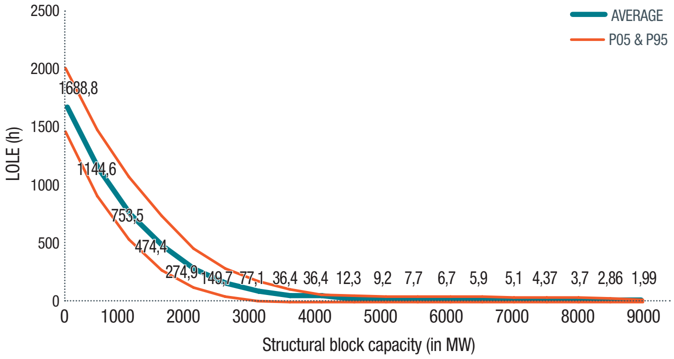
4.3.4.4 Results for 2027

Results for 2027 are very similar to the ones observed in the "Low capacity" scenario described in the initial study.

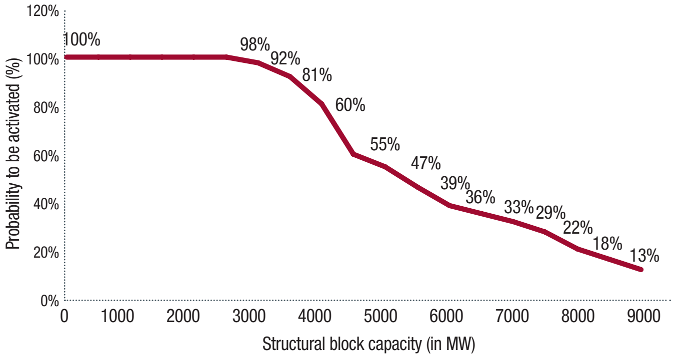
Figure 11 shows that the LOLE when adding "structural block" capacity can be divided into two parts. Until 4000 MW of "structural block" capacity is added, the LOLE reaches 19 hours on average. Afterwards, the next 5000 MW are needed to comply with the adequacy criteria.

Figure 12 showing the probability of activation of the "structural block" indicates that the first 3000 MW will be needed for at least one hour a year in any case. The probability decreases afterwards. Even after adding 9000 MW, there is still a probability of 13% of having at least one hour of structural shortage in Belgium.

LOLE BY "STRUCTURAL BLOCK" CAPACITY ADDED TO THE BELGIAN PRODUCTION PARK FOR 2027 (FIGURE 11)



PROBABILITY OF THE "STRUCTURAL BLOCK" BEING ACTIVATED IN 2027 (FIGURE 12)



4.4 KEY TAKEAWAYS FROM THE RESULTS

Despite the extreme character and low likelihood of the "additional scenario", interesting insights can be derived from the results. Some proposals on possible next steps and additional analyses are also given in this section.

The shape of the "structural block" curve over the next 10 years remains the same even with the "additional scenario"

The U-shape of the evolution of the "structural block" volume in the future (first phase showing a decrease in the structural and a second phase showing an increase after 2023) remains valid even in an extreme situation of massive decommissioning abroad. The main difference is seen in the volume needed in 2027 after the nuclear phase-out. In this situation a large amount of capacity is needed but with a low probability of being used and very few hours of activation for adequacy purposes.

Interconnections have a crucial contribution to security of supply

In such extreme scenarios, interconnections play an even bigger role in security of supply, allowing countries to import energy when it is not available on their territory. This can be explained by meteorological effects, different consumption behaviours and different production mixes in every country.

Weather has an impact on the intermittent renewable production, hydro production and consumption. Given the fact that some countries are more or less dependent on such production sources, they will be affected differently by weather conditions. As the thermosensitivity of consumption differ across Europe, colder weather does not have the same impact on all countries.

Moreover, weather conditions are never the same for the whole of Europe or a particular region. When there is little wind in a certain part of the continent, another part can have more favourable conditions for wind production. The same applies to consumption.

Interconnections therefore allow countries to contribute to the security of supply of the entire continent because most of the time, structural shortages are not simultaneous.

Simultaneous scarcity situations can still occur (shortages in two or more countries at the same time) and this is very clearly captured by the "additional scenario" assumptions. **Figure 3** shows that isolated countries (with no interconnections) would have shortages for a large number of hours while the benefits of interconnections mean that lower shortages levels are observed.

Given the high degree of interconnection of Belgium and its central position in Europe the above observations call for coordinated approaches with neighbouring countries as regards adequacy assessments and capacity mechanisms.

Possible solutions to cope with adequacy after the nuclear phase-out should be investigated

The "additional scenario" results do not change the reflections on possible options or measures which can be introduced for the investigated timeframe (see chapter 7 of the initial study published in April 2016).

Various solutions could be investigated in terms of how to ensure security of supply of the country after 2025. The regulatory framework and incentives should be defined.

An example of possible technology choices based on the identified characteristics of the "structural block" needs for adequacy purposes:

- 2000/3000 MW depending on the scenario needed for the whole year and will be activated every year regardless of the weather conditions. Thermal power plants could play an important role for this block.
- 1000/2000 MW depending on the scenario only needed during the winter period but will be used every year regardless of the weather conditions. Peaking units, storage or demand-side response could be investigated in this part.
- 1000 to 4000 MW depending on the scenario needed for a very short amount of time and with no guarantee of being used, being mainly activated for adequacy purposes during a cold spell. In particular, demand-side response could play a key role for this category. Strategic reserves could play also an important role.

It is worth mentioning that investment in further interconnections, driven by the need for a competitive Belgian price and by large-scale RES integration, also contributes to securing electricity supplies, and that any technology can play a role in filling in the "structural block". In order to find the most optimal solution and the impact of the technology choices, further analyses need to be conducted.

Further analyses should be conducted in order to test various technology choices and implications for Belgium

This report analysed an "additional scenario" as requested by the Minister of Energy. Now it is important to work out the various insights from all the sensitivities performed in the framework of these studies (the initial study and the current one) - and further analysis of the most optimal solution for Belgium's future energy mix.

A next step should be to define some scenarios for filling the "structural block" capacity, given the characteristics of possible technologies already listed in the initial study. Further analyses should determine the implications for Belgium.

5 CONCLUSIONS

Following the initial study published by Elia in April 2016 and the public consultation organised by DG Energy (Federal Public Service Economy), **the Minister of Energy asked Elia to evaluate an "additional scenario" and sensitivities**. Elia has performed the adequacy analysis of the requested scenario and derived the results and characteristics of the "structural block".

The **additional requested scenario** is based on the "Low capacity" scenario analysed in the initial study which **considers neighbouring countries as not adequate** due to the shutdown of a lot of coal-fired and lignite capacity in Western Europe. Although such mass plant shutdowns may be considered a possible scenario, the assumption that it would not be offset at national level by other adequacy measures, such as demand response, mothballing or adding "out of market" reserves, is a very strong one; such measures could dramatically reduce the likelihood of such a scenario.

Other changes include an increase in the CHP capacity, more market response, more storage, a higher level of demand, and no additional biomass capacity.

The adequacy analysis of the scenario was performed following the same methodology as the one of the initial study. The flexibility requirements of the system as identified in the initial study remain valid for this "additional scenario".

The **"additional scenario"** results show a similar trend in terms of "structural block" needs to the "Low capacity" scenario from the initial study.

A **first phase** where the **"structural block" decreases** from 2500 MW in 2017 to 0 MW in 2021 can be observed. This evolution can be explained by a higher CHP capacity being taken into account, more offshore wind capacity coming into the system and 2 GW of additional planned interconnection capacity.

The **second phase**, after 2023, will be characterised by **an increase in the "structural block" capacity**, reaching 9000 MW in 2027. This is mainly due to the planned nuclear phase-out in Belgium and the assumption made in terms of adequacy level of neighbouring countries (using the "Low capacity" scenario).

“**Structural block” characteristics** for 2027 show that:

- the first 3000 MW are needed for the whole year with a 100% probability of activation;
- the next block of 2000 MW is required only during the winter, but has a high probability of activation;
- the last block of 4000 MW will not be needed every year (activation probability of less than 50%). This capacity is only required during cold spells and for a maximum of one week when activated. The average number of hours when this capacity is needed is under 10 hours.

Changing the maximum simultaneous import capacity has no impact on the volume of the “structural block” calculated for 2027 as the limiting factor in this scenario is the energy availability in the neighbouring countries due to the assumption of “Low capacity” in those countries.

The results of both the initial and the present study show that a significant capacity (production, storage, demand reduction) is necessary, but also that a large part of this capacity just has to be available for a very limited number of hours per year to ensure security of supply.

It is thus appropriate to start the discussions which will lead to decisions on appropriate measures or mechanisms. Here necessary attention should be paid to:

- the possible filling-in and distribution of the defined structural block between the various segments and technologies (production, storage, demand reduction, etc. ...). Further technical-economic analysis on each of these segments must be carried out with its implications deriving therefrom for Belgium
- any reflection on the appropriateness of the introduction of a capacity mechanism should not be isolated but should be coordinated and harmonized with the neighbouring countries (and implemented) given the high degree of interconnection of Belgium with its neighbours and its central position in Europe.

Therefore the timely commencement of these discussions is important in order to guarantee the availability of capacity at the start of the nuclear "phase-out" (2023). Action is needed in a timely manner in order to provide a clear and stable framework to market participants so that they can make the right decisions (based on the right insights) and to anticipate the expected evolutions in the Belgian energy mix.

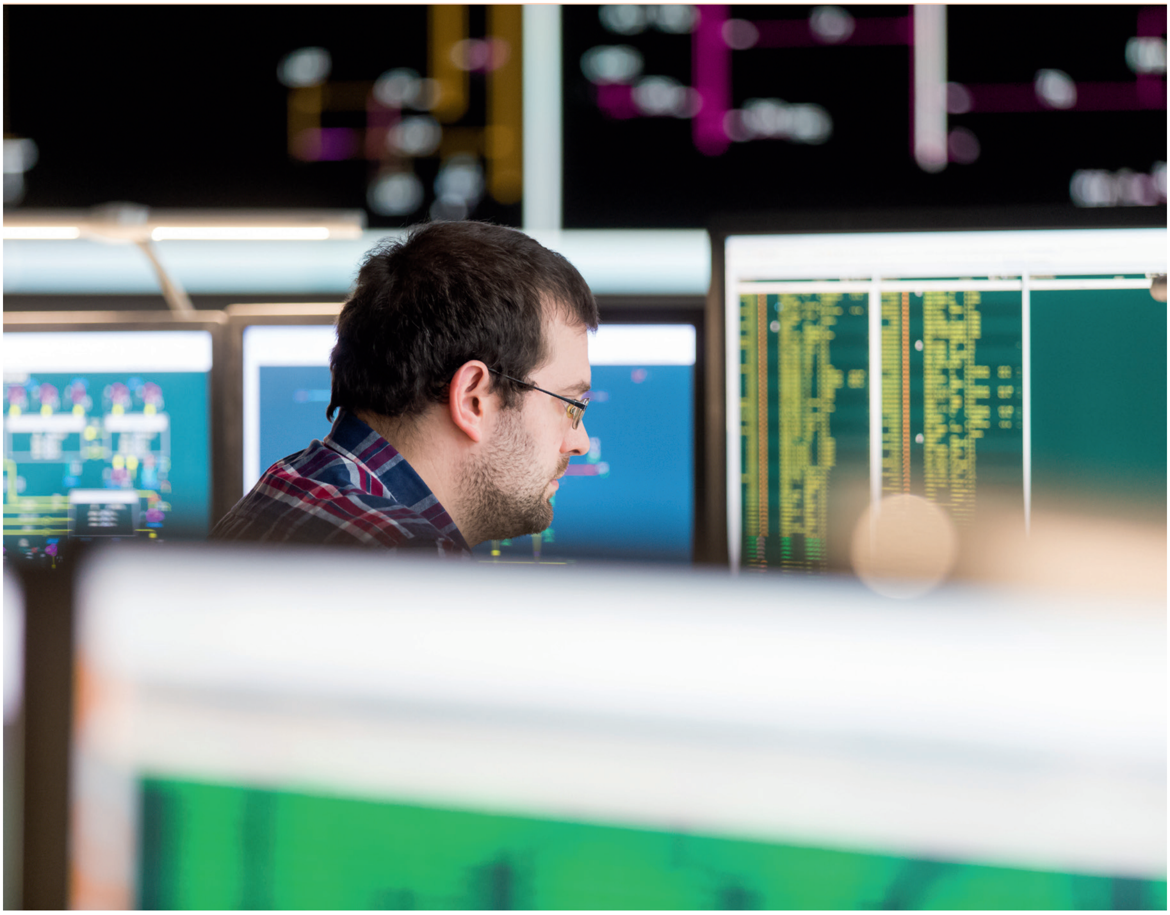


Table of contents

QUESTION AND ANSWERS
ELIA STUDY REGARDING THE "ADEQUACY" AND FLEXIBILITY NEEDS OF THE BELGIAN POWER SYSTEM FOR THE PERIOD

1. Introduction

As mentioned in the introduction, following the publication of the various stakeholders' responses and DG Energy's conclusions on its website, Elia took the initiative of producing this Q&A document to provide some additional clarification on the matter at hand. As a result, this document should be read in parallel with the initial study [1].

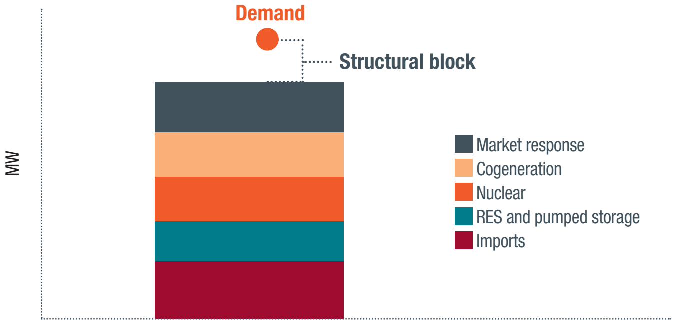
2. General questions

What is the "structural block"?

The "structural block" is the generation capacity, import capacity, demand-management capacity or storage capacity needed in Belgium in order to comply with the legal criteria on the adequacy of the Belgian electricity system while taking into account the "non-structural block".

It is important to point out that the "structural block" calculated in the study assumes an availability level of 100%.

DEFINITION OF THE "STRUCTURAL BLOCK" FOR A GIVEN HOUR (FIGURE 13)



What is the non-structural block?

The "non-structural block" is the generation capacity, import capacity, demand-management capacity or storage capacity considered to be in place on the Belgian market, regardless of the circumstances, in the timeframes set out in the study.

The technologies included in the "non-structural block" were considered to be in place either because they benefit from support measures or given that their presence is governed by other regulations or legislation.

We assumed that the following technologies would be in place in Belgium over the timeframe from 2017 to 2027:

– cogeneration or combined heat and power (CHP) capacity;

– renewable energy capacity in the form of wind and solar;

– renewable energy capacity in the form of biomass;

– nuclear capacity;

– pumped-storage capacity (Coo and Plate Taille);

– the import capacity of Belgium and the various other simulated countries (the exchanges between these countries depend on the economic dispatching model used - in other words, this model will assess the availability of capacity in the other countries that could supply this energy);

– the price-responsive market response (in essence, demand management) taking into account the activation limits inherent to this type of technology.

The existing gas-turbine capacities (combined-cycle gas turbine (CCGT) and open-cycle gas turbine (OCGT)), oil-fired power plants (turbojet) and coal-fired power plants are not included in the above list. This does not in any way imply that these power plants will be unavailable to the system in the relevant timeframe instead, they may be part of the identified "structural block".

More information on the assumptions is set out in section 4 of the initial study [1].

Which technologies could fill the structural block?

Any technology could be used to fill in this block, with each one contributing insofar as its specific technical/ economic and environmental requirements allow. The following technologies could be expected to fill in the “structural block” (the following list is non-exhaustive):

– existing or new gas-fired thermal power plants (CCGT, OCGT, etc.);

– nuclear power if authorisation is renewed;

– new pumped-storage power plants;

– batteries or other means of storage (whether central or decentralised);

– additional demand response on top of that already considered in the non-“structural block”.

– additional import capacity;

– additional renewable capacity;

– other means of generation, demand reduction or storage.

Why is the “structural block” considered to have 100% availability?

In this study the volume of the “structural block” is calculated on the basis of 100% availability in the absence of a choice of technologies to fill in the “structural block”.

If the “structural block” identified amounts to 2000 MW for a given year, more than 2000 MW will be needed to safeguard the “structural block” because any technology (whether involving generation, demand management or storage) entails limitations in terms of energy, forced outages or activation limits or depends on weather conditions.

Therefore it is important to mention that the “non-structural block” and the production park of the other countries modelled in the study are considered including their limitations in terms of energy, forced outages, maintenance and activation limitations.

How have the announced power-plant shutdowns been taken into account?

The “non-structural block” considered to be in place throughout the various timeframes does not include any thermal power plants (except the cogeneration, biomass and nuclear facilities). As a result:

– announced CCGT/gas-turbine (GT) or turbojet power plant shutdowns in Belgium will have no impact on the size of the calculated “structural block”.

– However, announcements affecting cogeneration or biomass facilities or the early shutdown of nuclear power plants will affect the calculated “structural block”.

3. Assumptions

What are the underlying assumptions of the “Base case”?

This study considers the following main aspects of the “Base case”:

– a zero growth in demand by 2027;

– further development of renewable energies (wind, photovoltaic) based on the forecasts for 2020; similar growth until 2027 for onshore wind and photovoltaic energy; no further development of offshore wind energy after 2021, by when it will have reached 2.3 GW;

– cogeneration capacity for Belgium remaining equivalent to the forecast for 2017;

– an extra 600 MW of biomass by 2021;

– the market response (in essence, price-responsive demand management) taken into account along with the identified volumes following a consultation of the market players in summer 2015; 1100 MW with activation limits for 2021, 2023 and 2027);

– 4,500 MW of simultaneous import capacity in 2017; 6500 MW of simultaneous import capacity for 2021, 2023 and 2027; developments in the interconnection projects as envisaged in the Federal Grid Development Plan [3];

– the fuel prices from the most recent forecasts of the International Energy Agency (IEA) and a "coal before gas" scenario for the whole timeframe in question;

– the fixed and variable costs of the power plants arising from the European Commission's Energy Technology Reference Indicator (ETRI) study (2014);

– the best estimate available of the installed generation capacity in the neighbouring countries based on their national studies and the data collected in ENTSO E for the System Outlook and Adequacy Forecast (SO&AF) study.

How can it be ensured that the assumptions considered in the “Base case” will actually occur?

Elia cannot guarantee that these assumptions will actually occur. Most of these developments do not fall within the direct remit of the grid operator.

However, the assumptions that were taken in account were established in consultation with DG Energy and the cabinet of the Minister of Energy on the basis of the most reliable information available in January 2016. Any changes in the assumptions will lead to different outcomes. As the last timeframe (2027) covered by the study is still a long way ahead, many sensitivity analyses were conducted, enabling an assessment of the impact of these various assumptions.

Minor changes in the assumptions should not have any major impact on the key results of this study.

Why assume that biomass will account for an extra 600 MW of capacity in Belgium by 2021?

Two categories of units running on biomass are included in the model:

– Units having a "Coordination of the Injection of Production Units" (CIPU) contract with Elia
This category accounts for 680 MW in total - this is assumed to remain constant throughout the timeframes. In the model these units are modelled individually (with random sampling in terms of unavailability).

– Units having no "CIPU" contract
601 MW was included from this category for the various timeframes. These units are modelled using hourly generation profiles (based on the historical generation data for this unit type).

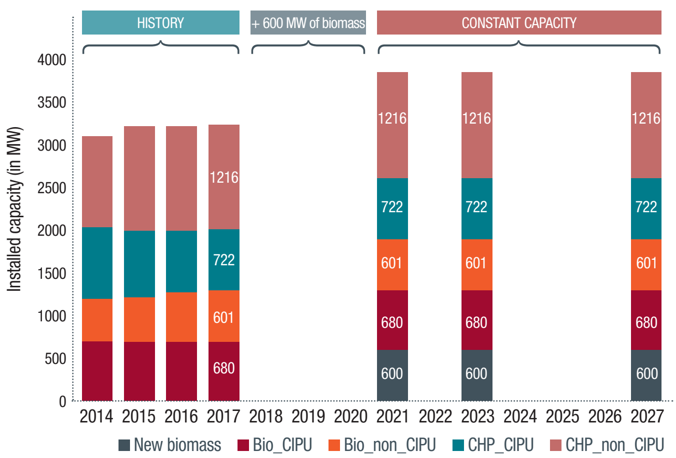
The same distinction is made between "CIPU" and "non-CIPU" units for cogeneration units.

The assumptions for this study were prepared in January 2016. Based on the information available to Elia, DG Energy and the cabinet of the Minister of Energy at that time, the decision was made to factor in an extra 600 MW of biomass by 2021 - this would involve:

– the reconversion of the power plant at Langerlo to biomass (approx. 400 MW);

– a new BEE power plant in Ghent (approx. 200 MW).

EVOLUTION IN BIOMASS AND COGENERATION (CHP) CAPACITY CONSIDERED IN THIS STUDY (FIGURE 14)



Why is the growth in demand 0% in the "Base case"?

Demand for electricity, once weather effects have been normalised, depends on various economic factors or technological developments.

– Economic growth has a considerable impact on demand for electricity. For example, a significant rise in economic activity will result in an increase in demand in this area. Conversely, an economic slump will have a negative impact on this demand.

– Enhanced energy efficiency of equipment, lighting, processes, etc… will result in a decrease in electricity consumption.

– In contrast, the development of new technologies using electricity (heat pumps, electric vehicles, etc.) will boost the consumption of electricity.

A zero growth forecast was taken into account in the "Base case" starting out from the assumption that energy efficiency would offset the increases due to economic growth and the development of new technologies using electricity.

A sensitivity analysis of this assumption with growth of 0.6% per year, based on the forecasts of the IHS CERA consultancy firm, was performed for the various timeframes. This sensitivity analysis shows that the level of the "structural block" remains steady from 2017 to 2021 and then rises 1,000 MW compared with the "Base case" for 2023 and 2027, bringing it to 1500 MW in 2023 and 5000 MW in 2027.

What does the 1100 MW volume of market response includes?

In the “Base case” for 2027, a volume of 1100 MW of market response was assumed. This figure is based on a study Elia conducted with the consultant Pöyry, which evaluated price-responsive demand-side management developments for 2020. The results showed that the market response was 1100 MW for 2020. This volume was included in the “non-structural block” and is therefore present in the system.

This volume is introduced into the model taking into account activation and energy limitations arising from the study conducted with Pöyry. These limitations result, among other things, from industrial processes.

RESULTS OF THE SURVEY CONDUCTED ON PRICE-RESPONSIVE DEMAND FOR 2020 (FIGURE 15)

260 MW
based on contracts with ARPs

622 MW
based on the price for consumers and generators connected to the TSOs

64 MW
based on the price for consumers and generators connected to the DSOs

150 MW
on a voluntary basis for consumers connected to the DSOs

Maximum # of activations
- Per day
  = 1 activation
- Per week
  = 3 activations

Maximum # of hours per activation
- 2 hours

It is important to point out that this volume does not include the capacities contracted for ancillary services.

Additional capacity to that considered may form an integral part of the “structural block” and contribute to the filling in of the “structural block”.

How did the study take into account the development in batteries?

The storage capacity factored into the model was limited to the current installed pumped-storage capacity (Coo and Plate Taille power plants).

Additional storage capacity in the form of batteries, pumped storage or any other technology may form an integral part of the “structural block”. A sensitivity analysis was conducted with an extra storage facility with 1000 MW of power and 4000 MWh of back-up.

4. Imports

Is a commercial import capacity of 6500 MW by 2021 a reasonable estimate?

In view of the reinforcements planned in Belgium's backbone grid, including the Brabo project and also the NEMO and ALEGrO projects, accounting for 1000 MW each, an import capacity of 6500 MW by 2021 is indeed a realistic assumption.

The figure of 6500 MW commercial import capacity is a best estimate by Elia, since the actual import capacity depends on the outcome of ongoing legal, regulatory and permitting processes, such as the Federal Grid Development Plan [3] and the various permitting procedures at federal and regional level. It also depends on design issues of the coupled “day ahead” market. So, the figure is a best estimate by Elia of the outcome of these processes in the years up to 2021.

Belgium's actual energy imports at times of structural shortages are not a priori considered equal to the import capacity. These imports are incorporated into the model, based on the availability of excess generation capacity in the production park in the neighbouring countries, which is also estimated by the model.

Will the energy be available during a cold spell affecting several countries at the same time?

Electricity consumption is sensitive to fluctuations in temperature. The colder it is, the higher the level of consumption will be. This is mainly due to the use of electric heating. Not every country has the same level of sensitivity to temperature in terms of its consumption. Some countries, such as France, are more susceptible to this, due to the high proportion of electric heating used there. This sensitivity also applies when temperatures are at the opposite end of the spectrum, i.e. when it is very hot, using cooling equipment increases demand for electricity.

However, cold spells are not confined to individual countries. This means that there is a correlation between the temperatures of different countries in the same region. Having said this, certain countries because of their size have a range of climates (France, Germany). It may be that a cold spell affects just one region of a country or that it is more restricted geographically to a particular part of the country. Using in the simulations 40 climatic years, featuring correlations between climatic conditions and geographic correlations between countries, means that the occurrence of cold spells can be evaluated and establishes the basis for system-adequacy calculations, taking probabilistic criteria as a starting point.

If the cold spell affects a number of Belgium's neighbouring countries at the same time, Belgium will be at significant risk of a structural shortage. Both the severity of the cold spell and the probability of these conditions are crucial.

Why consider, in the “Base case”, that the neighbouring countries will be adequate for the timeframe 2027?

The “Base case” assumes that Belgium's neighbouring countries (France, Germany and the UK) will be adequate in terms of their national adequacy criteria. This assumption is based on the fact that these countries will take appropriate measures to avoid any structural shortages. Indeed this is already the case for these three countries, following the introduction of various support measures (the establishment of a Capacity Remuneration Mechanism (CRM) in the UK, ongoing discussions in France about putting such a system in place there, and so on).

A sensitivity analysis regarding this assumption was conducted by removing 44 GW of generation capacity from the neighbouring countries. In this “Low-capacity” scenario, the demand in the “structural block” would grow from 4000 to 8000 MW, with the second 4,000 MW being required for an average of five hours per year. There is a 25% likelihood of having to use this second 4000 MW – in other words, this capacity might be needed in one out of four years for adequacy reasons.

Why do we observe that 50% of Belgian consumption will be imported in 2027 in the “Base case” scenario?

We find that almost half of Belgian consumption will indeed be imported in the “Base case”, following the shutdown of Belgium's nuclear power plants.

This is due to:

– the composition of the thermal generation facilities in Belgium (consisting for the most part of gas-fired power plants);

– the fact that the “Base case” takes as a starting point the assumption that the coal-fired power plants have a lower marginal generation cost than their gas-fired equivalents;

– the fact that there are still coal- and lignite-fired power plants in the neighbouring countries;

– the fact that there are still nuclear power plants with a lower marginal generation cost than gas- or coal-fired power plants (in particular in France);

– the increase in RES generation capacity.

Also, if Belgium today had no nuclear power plants, it would import almost half of the electricity it consumes.

This effect was felt in 2015 when the Doel 3, Tihange 2 and Doel 1/Doel 2 reactors (3 GW of 'must run' capacity) were unavailable for a large part of the year for various reasons, prompting Belgium to import almost 25% of its total electricity consumption.

Elia does not advocate a scenario in which Belgium imports 50% of its electricity consumption. The observation that in the “Base case” Belgium would be a net importer of almost 50% of its electricity consumption is a consequence of European market integration, Belgium's supply and demand curves and those of its neighbouring countries, and the political and economic decisions on energy exchanges between the various countries.

What can be done to limit Belgium's net import balance after the nuclear “phase-out”?

In their day-to day operations, under the “unit commitment” power plants are committed to running at around their marginal cost at European level (“merit order”), making optimal use of the available interconnection capacity between the various countries.

This implies that the various renewable sources, with zero (or close to zero) marginal cost, have priority, not only from a legal or regulatory point of view, but also from an economic dispatching perspective.

If the nuclear”phase-out” goes ahead, fossil-fired plants will compete for second place in the merit order after the renewables. The main driver here is the difference between the marginal cost of gas and coal. A CO_2 tax or the ETS-market CO_2 price can make the difference between a “gas before coal” and a “coal before gas” merit order.

In the case of a “coal before gas” merit order the interconnectors will be strongly used for imports, leading to a high import level for Belgium, but keeping the price as close as possible to the level of its neighbouring countries.

Following this, the measures to decrease the import balance are straightforward:

– further develop the country’s renewable sources;

– introduce CO_2 price measures leading to a “gas before coal” merit order at European level;

– operate efficient gas-fired power plants (centralised or decentralised CHP), with a favourable ranking in the merit order list, including using interconnectors for exports at the moments of high renewable generation.

What are the drivers for the development of interconnectors?

Since the liberalisation of the electricity market in 1996 and the establishment of Belgium's transmission system operator in 2001, there has been consensus on the need for the development of interconnectors with neighbouring countries. Consumers, the regulator and the authorities considered that this made a vital contribution to security of supply and access to the most competitive energy possible for the Belgian economy. Meanwhile, suppliers and generators regarded this as a chance to increase their opportunities abroad or replace their local generation capacity with more affordable generation capacity from outside Belgium.

These aspects have taken practical form in recent years.

Although the first interconnectors were built to ensure mutual assistance between countries in terms of operational security, adequacy in itself is not a main driver for the current development of interconnections. In this respect, there is no opposition between developing interconnectors and national generation capacity.

Firstly, cross-border interconnectors are playing a major role in bringing about the integration of the European electricity markets, thus boosting the competitiveness of the Belgian economy. Using interconnectors means that, based on the conditions prevailing at the time, the relevant parties can decide to replace their own countries' means of generation with more competitive energy sources abroad, or in the other direction, to promote the competitive Belgian units on the CWE regional market by exporting electricity generated in Belgium. In this way, the use of the various forms of generation can be optimised for the CWE region to achieve economic efficiency, for the benefit of all.

Secondly, further developing the interconnectors is key to promoting the integration of renewable energies, whose growth in Europe depends on local capabilities. With ever more ambitious targets emerging in terms of the integration of renewable energies, interconnectors should be upgraded and new projects should be taken forward. Boosting exchange capacities between countries will also facilitate the co-existence of central generation units and of generation using renewable energy sources, many of them of a variable nature such as solar or wind energy, as a result of the possibility of evacuating temporary surplus capacity or importing electricity to handle national generation shortages.

In this way, further developing the cross-border interconnectors has transformed the national markets into a regional or even European market. Pursuing these efforts is essential if we are going to meet the European energy and climate targets for 2020, 2030 and 2050.

Moving towards continental electricity highways

Various studies conducted by the transmission system operators, universities or research centres indicate that the interconnection development work must be pursued, supporting the constant drive to integrate renewable energy and the achievement of the greenhouse-gas reduction targets for 2030 and 2050.

- Studies by Elia [3] and other European power transmission system operators working together in ENTSO-E [6 and 7] have shown that additional interconnector upgrade projects should be scheduled for after 2025.
- The e-Highway2050 consortium, comprising research centres, universities and European grid operators, concludes that the pace of development of the interconnected transmission grid at European level is determined by the development of new capacity (especially renewable capacity). This study highlights the need for major North-South continental corridors, beneficially bringing together wind generation (northern Europe, the Mediterranean, etc.) and solar (mainly southern Europe) with storage facilities (Alps, Pyrenees and Scandinavia) [9].
- University experts [10] conclude that interconnectors are the most effective way to combine strong integration of renewable energies and maintaining a very high level of reliability of supply.

In summary, given Belgium's relatively limited potential in terms of renewable energy sources and yet highly-developed gas infrastructure, it should be possible to fully integrate the Belgian power transmission grid into the infrastructure rolled out at European level. As such, it will have access to renewable generation abroad and opportunities will open up for the most competitive Belgian power plants, in a sector that is no longer operating at Belgian but rather European level.

5. Results

Was the low number of “operating hours” of CCGT gas-fired power plants in the various scenarios investigated?

The choice of a power plant to generate electricity is based on its variable generation cost (fuel cost, emissions cost and variable operation and maintenance (VOM) cost). If the generation cost is higher than the market price, the power plant will not be used because it would generate electricity at a loss. Conversely, if the market price is higher than the generation cost, the power plant can be allowed to produce energy. This is how the electricity market works and so will determine whether a power plant should generate power or not.

Given the interconnected nature of the market, this means that consideration must be given to the possible exchange of energy between the various European countries (within the grid's exchange limits).

Which power plants have a lower variable production cost than CCGT facilities or generate electricity connected with heat or industrial processes?

– Renewable energies (wind, solar, hydraulic, biomass, etc.)

– Cogeneration power plants

– Nuclear power plants

– Lignite- and coal-fired power plants (in the “Base case” where gas-fired power plants are considered to be more expensive than coal-fired ones)

This means that a CCGT will only be activated if all the generation types listed above have already been used. Nuclear and lignite- and coal-fired power plants will not yet have disappeared from the European scene by 2027 according to the “Base case”. Moreover, the growing share of renewable energies will reduce the number of “operating hours” of thermal generation facilities.

What is the difference between the “operating hours” of the “structural block” and the “operating hours” of a power plant?

In the case of the “structural block”, "operating hours" refers to the number of hours when the most expensive unit on the Belgian market is being used.

Meanwhile, a power plant’s “operating hours” depend on its generation cost. Therefore, a power plant will be activated for more or fewer hours accordingly.

The "operating hours" of the “structural block” can be interpreted as a minimum number of “operating hours”, regardless of the generation cost of the technology or as the “operating hours” of the most expensive unit on the market.

Why aren't CCGT gas-fired power plants always cost-effective in the various scenarios investigated?

This analysis of the cost-effectiveness of a power plant included in the study is based only on the income of the unit on the electricity market and so does not take account of any additional income from ancillary or other services.

Therefore, the gross margin of a unit is the income from the power plant based on sales of the generated energy minus the cost of generating this energy.

This margin is then compared with the power plant's fixed operation and maintenance costs (excluding any capital repayment). A certain level of fixed costs is needed to keep a power plant open and ready for use. If the margin is below the level of these fixed costs, the power plant is not cost-effective.

We can see in the simulations that the margin of the CCGT power plants does not cover the fixed costs in most of the years which have been analysed.

Is the strategic reserve still necessary?

The strategic reserve, as defined by law, is a market mechanism established in Belgium in order to ensure security of supply for our country during the winter period.

Elia makes an evaluation of the volume needs of the strategic reserve before 15 November every year, based on the most recent assumptions discussed with DG Energy. Based on the opinion of DG Energy and Elia, the Minister of Energy may contract a strategic reserve volume for one or more winters.

Depending on changes in the production park and in demand, a strategic reserve may be needed for the years ahead.

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