Elia's recommendation for the reference scenario for the CRM parameter calculation for the Y-4 Auction with Delivery Period 2026-27

July 2021

Elia's recommendation

This section aims to provide Elia's recommendation, as mentioned in article 5, §3 of the Royal Decree. This recommendation is formulated to provide a robust, realistic and balanced reference scenario, taking into account the received feedback from stakeholders and ensuring the security of supply of the country against a limited, but realistic subset of unexpected events, referred to as 'sensitivities' in this report, in line with the denomination set in the Royal Decree. Those sensitivities are therefore part of the reference scenario. The received feedback and detailed comments can be found in the next chapter.

This recommendation holds for the calculation of one single reference scenario for the determination of the capacity to be procured reflected in the demand curve and the other parameters necessary for the organization of the Y-4 auction for delivery year 2026-27.

As illustrated in Figure 1 the overall starting point that Elia recommends is the dataset as used in the latest European adequacy study, MAF2020. Regarding Belgian data, the dataset was updated according to the latest available public data and submitted to public consultation, following article 3, §3 of the Royal Decree. Concerning the other countries, the dataset from MAF 2020 has been updated following the European methodologies. In line with the latter, the countries with a market-wide capacity mechanism will be set at their reliability standard by iteratively adding or removing generation capacities in the relevant countries. Such a process ensures that those countries respect their reliability standard (which is the intended objective of their capacity mechanisms) and that additional capacities which are not viable nor required to respect the standard do not benefit from capacity mechanism revenues. Secondly, an economic viability verification is performed for the countries without market-wide capacity mechanisms to determine whether additional new capacities would be viable in the market. If additional new capacities are deemed to be viable (on top of the already assumed existing and new capacities from the initial dataset), those capacities will be added to the respective country's assumptions.

Elia's recommendation for the reference scenario

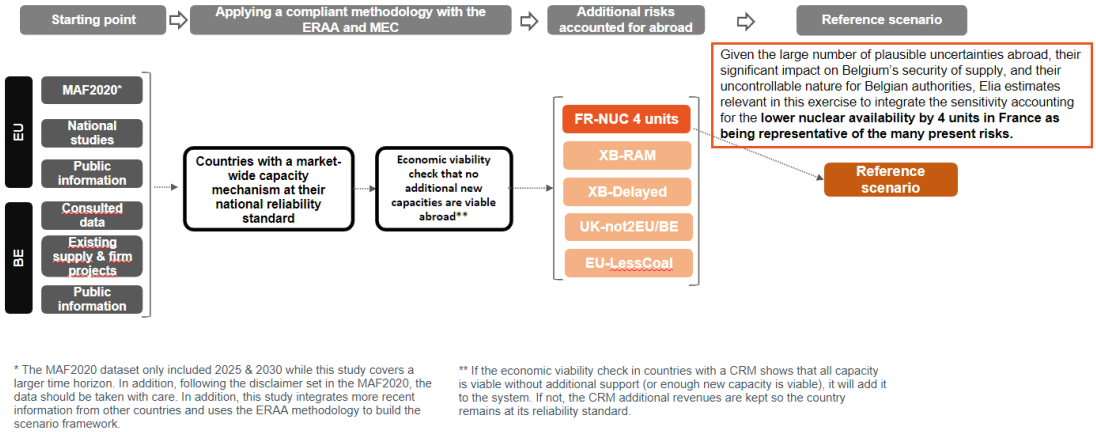

Figure 1

Elia recommends to integrate in the **reference scenario** at least one sensitivity affecting the availability of imports from neighboring countries, being (I) the higher unavailability of French nuclear units, (ii) a lower RAM (iii) delays in cross border investments, (iv) no contribution from UK to the Belgium's security of supply and (v) the acceleration of the coal phase outs in Europe (see Figure 1). Indeed, given the high dependency on imports for Belgium any event happening abroad can have a significant impact on the adequacy requirements of the country. Given the large number of plausible uncertainties abroad, their significant impact on Belgium's security of supply, and their uncontrollable nature from a Belgian perspective, Elia estimates relevant in this exercise to integrate the sensitivity accounting for the **lower nuclear availability by 4 units in France**. Doing so allows Belgian security of supply to be hedged against the occurrence of one of these identified risks (which are also detailed hereunder).

Please note that this proposal is also in line with the assumptions taken in the Adequacy and Flexibility Study for Belgium 2022-2032 which was published end of June 2021.

1. Availability of the French nuclear fleet

The first identified risk and considered the most meaningful for Belgium's security of supply according to Elia concerns the unavailability of nuclear units in France. Indeed France and Belgium are highly correlated in terms of scarcity situations making this risk very relevant for adequacy purposes. Moreover the risk of additional unavailability of French nuclear reactors is an uncertainty that has already been realised and observed historically.

1.1 MAF2020 assumptions

The MAF2020 study is the latest published European adequacy study (on which this scenario should be based on according the Royal Decree). The MAF2020 takes the assumption that it follows the 10-year average French nuclear availability as is depicted on Figure 2.

MAF2020 models the nuclear availability in a deterministic approach which leads to overestimating the nuclear availability.

The MAF2020 study takes only 1 availability profile for the French nuclear capacity (deterministic approach). Such deterministic approach has the drawback to underestimate situations where one or more nuclear units would be unavailable at the same time. This is clearly mentioned by RTE (in the MAF country comments, see below) as leading to significantly under-estimate the adequacy issues. Figure 2 illustrates this historical range over the past 10 years compared to the deterministic availability used in the MAF2020. As can be observed, the availability of the MAF2020 follows the 10 year average but does not take the variations around that average into account. In addition, the values from the MAF2020 are based on one expected availability for the French nuclear fleet which can be seen as optimistic when looking at the past 5 years and expected 3 next years. Indeed, the future expected availabilities for the next 3 winters of the French nuclear fleet are also indicated on the same figure. The experience of the past years have shown important discrepancies which justify a more prudent and realistic approach. The reasons will be further explained below.

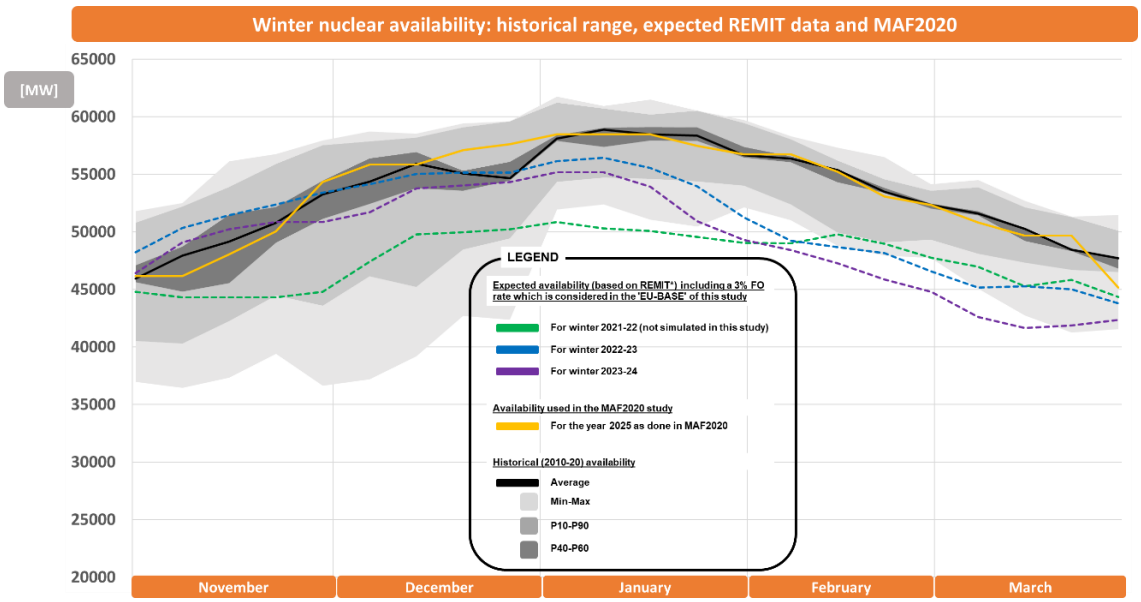

Figure 2

Note also the comments made by RTE[1] in the context of the MAF2020 country comment:

"*The nuclear availability in France is also taken into account differently in both resource adequacy assessments. The French generation adequacy study combines a deterministic approach for the ten year inspections (information shared via the official transparency channels - REMIT) for which each duration is probabilistically extended consistently with what has been observed in the past years, and a probabilistic one for the other outages. In the MAF, the simulated availability of nuclear power plants do not model the uncertainty on the extension of duration of outages, but take it into account only in a deterministic manner instead of probabilistically. This can lead to underestimate the occurrence of some simulated situations with very low availability of the nuclear generating fleet.*"

The model used by Elia is fed with historical availability data that allows to draw the unavailability in a probabilistic manner, to fall within the historical observed range while keeping the historical average the same.

1.2 French TSO modelling and assumptions

The French TSO takes into account additional unavailabilities compared to those included in public unavailability forecasts published by EDF or planned decennial inspections.

Several reasons can explain such unforeseen planned outages or unexpected prolongations of planned outages: for example some 'common mode failures' due to discoveries of anomalities in one or several reactors, life-extension works that require more time than initially planned, the COVID-19 pandemic which has led to a heavy rescheduling of maintenances over the coming years, etc. Finally the ageing nuclear fleet might require additional maintenance works that could lead to longer unavailabilities than initially expected.

As highlighted in the technical appendix of the latest *Bilan prévisionnel*[2], RTE has observed looking at the past availability data, concluding that maintenances last longer than previously observed. Several elements can be put forward:

The oldest French nuclear units are reaching 40 years of operation. Every decade, each nuclear unit needs to undergo a major inspection called 'visite décennale – VD'. The duration of these inspections is always uncertain, given increased safety measures and depending on the issues detected during it. The inspections could also lead to required life-extension works that can last several months. RTE stated that VD's duration were on average underestimated. Moreover the French nuclear safety authority (ASN – Autorité de sûreté nucléaire) has taken a position concerning the prolongation beyond 40 years of operation of the 32 reactors of 900 MW under several conditions. Besides major improvements in safety measures already planned by EDF, additional requirements were also prescribed by the ASN. Those will be applied on a unit per unit basis taking

[1] ENTSO-E Mid-term Adequacy Forecast 2020: Appendix 3 – Country Comments (entsoe.eu)
[2] Bilan previsionnel 2021 - annexes techniques.pdf (rte-france.com)

into account unit specificities. In addition ‘common mode failures’ are not to be neglected as those reactors were all built with the same technology meaning that any defect discovered in one reactor could also be present in many others.

Moreover the units of 1300 MW will undergo their fourth VD starting in 2026, making it relevant to still take into account such observed underestimate of planned outages in the context of the CRM DY 2026-27.

Forced outages or late planned outages independently of the refuelling cycles have appeared to represent an average decrease of the availability.

Finally variations in the maximal power effectively available have been observed. Depending on various technical constraints (e.g. fuel wear at the end of the cycle, for example), variations in yields linked to climatic conditions (summer/winter in particular), or environmental constraints (maximum temperatures of cooling water discharges allowed in rivers, for example), the maximum available power of the units may indeed vary affecting downwards the average availability of the nuclear units.

As illustrated in the country comment, RTE's modelling of the unavailability is different from the MAF2020 and hence takes additional unavailabilities in its 'Bilan prévisionnel' in order to take into account the elements listed above.

Despite having a market-wide CRM, the French TSO expects that its reliability standard would not be met in the coming 3 winters

The latest ‘Bilan Prévisionnel’ of RTE published in 2021 has identified in its reference scenario that the system would not be adequate according to their reliability standard. Such results indicate that even though the country has put in place a mechanism to guarantee a certain level of reliability, it is not always guaranteed that the system will be able to cover it. Indeed, there might be externalities that are not covered by the design of the mechanism or the development of new capacities might not be feasible in the required timeframe.

1.3 Analysis of the French nuclear availability

Despite efforts from French nuclear producers to maximise availability of their units, and to perform the necessary works in due time, there are several reasons to consider a more prudent and realistic approach with regards to French nuclear availability. These are listed below, alongside analysis which justifies the approach taken.

Over the past 5 years, the availability of the French nuclear fleet significantly decreased during winter periods.

As can be seen in Figure 3, the French nuclear fleet has experienced significantly higher unavailability rates when compared with the deterministic maintenance profiles used centrally by ENTSO-E. This discrepancy justifies the sensitivities proposal for the reference scenario. The reasons for the higher observed unavailabilities were exposed in the previous section.

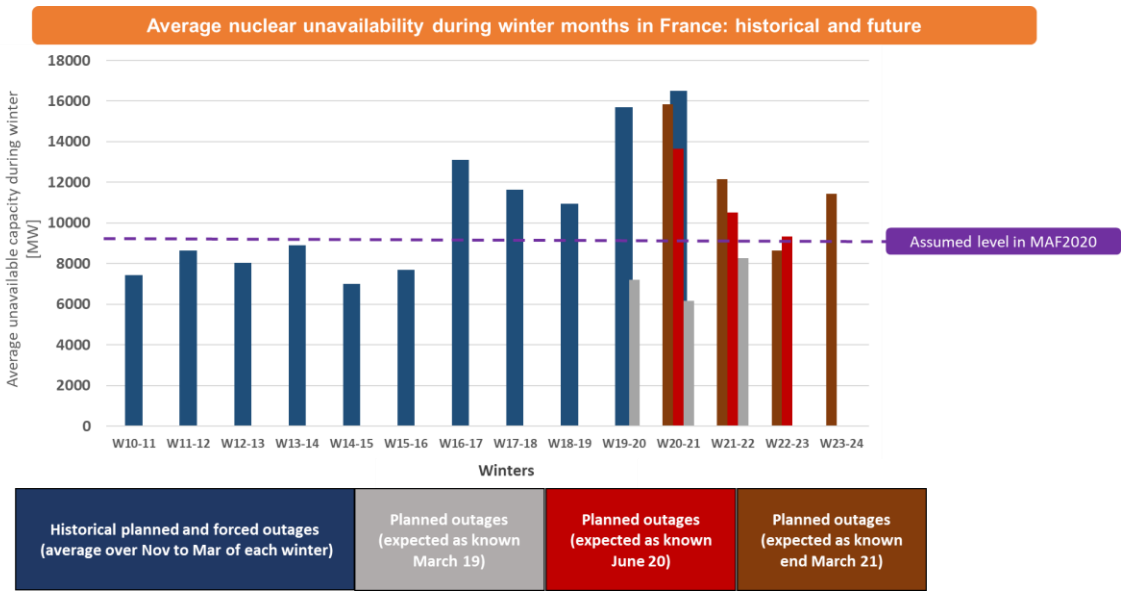

Figure 3

The nuclear unavailability was also underestimated when looking at the forecast made by the French producer for at least the past 5 years.

When looking at REMIT availability data from the past 5 years (which provides information related to the expected unavailability of each nuclear unit), it is clear that unavailability rates were consistently underestimated when published one or two years in advance. In order to perform the analysis, publicly available data from EDF was used. This data contains the announcements of planned unavailabilities for each unit. Figure 4 illustrates the expected planned unavailability for each month based on REMIT data, which was published at the beginning of each calendar year.

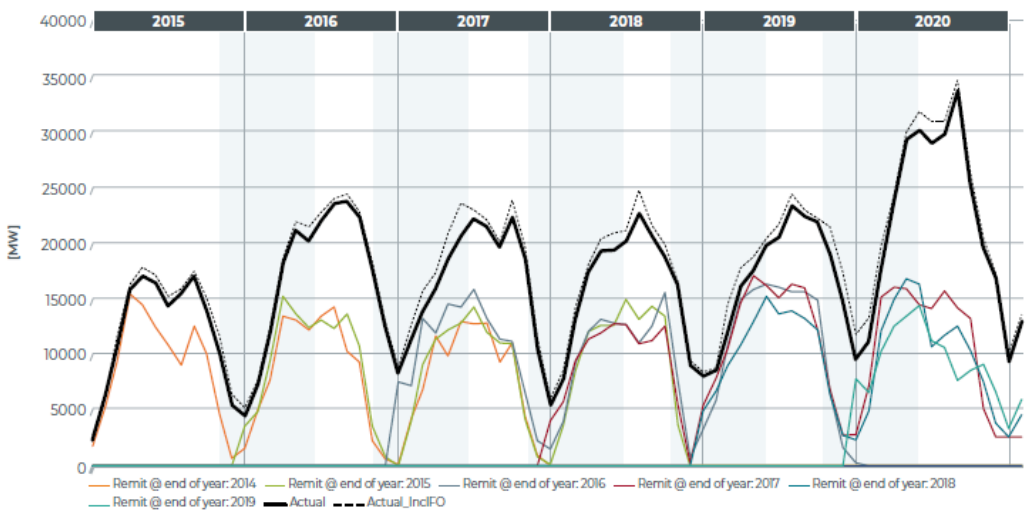

Figure 4

Each curve (in colour) relates to the predictions made at the end of a specific year in terms of expected planned outages for the upcoming 3 years. The black curve represents the realised planned unavailability across the years. The dotted black curve includes the forced outages (on top of the planned outages already included in the black curve). It is

obvious from the graph that the planned unavailabilities were severely underestimated. This underestimation was worse during the summer months, although a very significant amount of capacity was also unavailable during the winter months, due to outages that were not predicted.

In order to illustrate the average amount of capacity that was unavailable but not predicted as part of planned outages, the average difference between actual planned unavailabilities was calculated, focusing solely on the winter months (November to March included). Figure 5 illustrates this 'forecasting error'. The figure also indicates how many units these differences correspond to. Over the last 6 winters, the underestimations have amounted to at least 4 units. This underestimation further increased over the last three winters to reach an equivalent of more than 6 units.

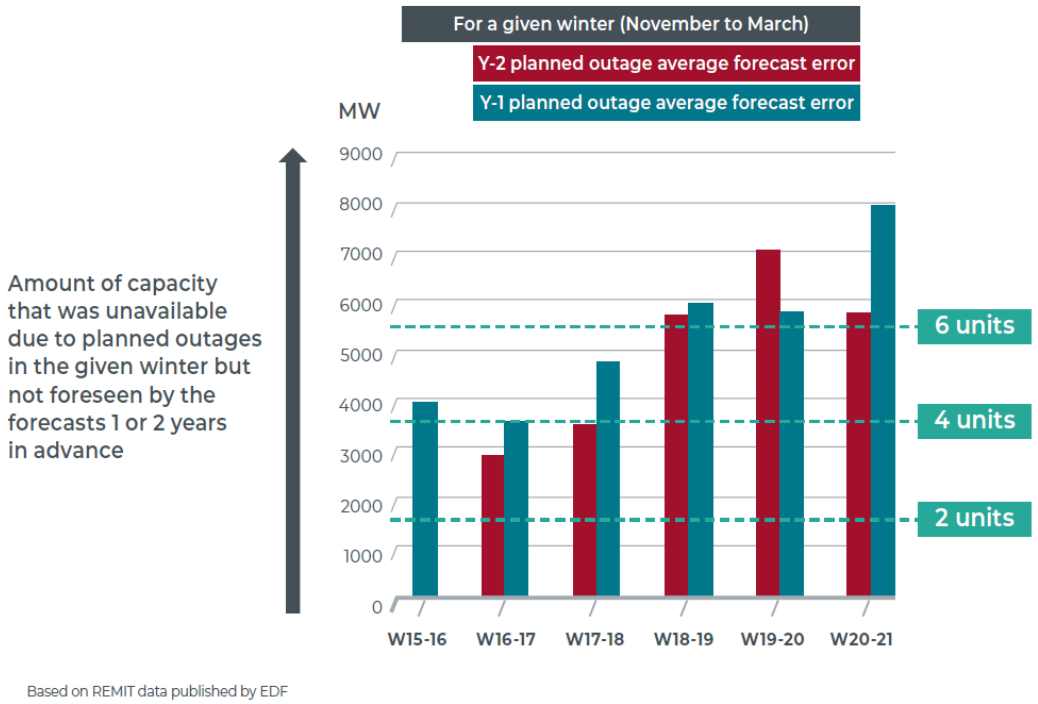

Figure 5

Additional uncertainties around the French nuclear fleet commisionnings/decommisionnings could arise

In addition to the ageing fleet, the new 'European Pressurized Reactor' (EPR) in Flamanville is now estimated to be online for beginning of 2023 and only 50% of its capacity would be available for its first winter in service. The go-live date of this unit was originally planned for 2012, and has been postponed several times over the past years. Note also that the planning foresees maintenance works in the second year making it unavailable for the second winter. Knowing the history of the project and the maintenance planning detailed above, if any further delays in the commissioning of the unit would arise, this could still create a risk for the unit availability for winter 2026-27.

In addition, the PPE (Programmation Pluriannuelle de l'Energie) considers the possibility to close two additional nuclear reactors between 2025 and 2026 (under certain conditions). This could also lower the availability assumed for the period 2026-27 as no additional closures were assumed.

1.4 Recommendation regarding the French nuclear capacity

The assumptions regarding the availability of French nuclear generation are based on a 10-year average availability distribution (these corresponding to the MAF2020 assumptions on average). This is modelled in a probabilistic way by recreating the same distribution as the one obtained on the 10-year average availability data.

As the 10-year historical average was found to be an under-estimation of the expected availability (given that the most recent 5 years experienced much lower availabilities) and that there are many reasons to consider that this availability will not be better in the future (ageing fleet, stricter safety measures, lifetime extensions,…), it is key to consider additional unavailabilities than those considered in the MAF2020 study. Such approach is also used by RTE as detailed in their latest 'Bilan Prévisonnel'.

In order to reflect the situation historically observed over the last 5 winters and to take into account the consistent underestimation of French nuclear outages in the forecasts as also identified by RTE, Elia hence recommends to take into account 4 nuclear units in France to be considered 'additionally unavailable' for the whole winter in the reference scenario of the CRM Y-4 auction for the 2026-27 delivery period.

2. Other risks that could further affect Belgium's capacity to rely on import during scarcity situations

In addition to the French nuclear risk that Elia recommends to include in the CRM reference scenario, Elia would like to highlight that other risks might also arise in the future which can also greatly impact the adequacy requirements of Belgium.

1. **Lower RAM in exceptional circumstances & cross border investments delayed (see also paragraph 3.5.8 in the Adequacy and Flexibility study 2022-32)**

This concerns the risks related to the available cross border exchanges. Several reasons can be put forward to justify the addition of sensitivities on the applied cross-border exchange capacities, both focusing on events that might happen at relative short notice, making it difficult for the market, or for countries to handle these short notice risks in a reactive way, and hence requiring some form of anticipation.

The first part of the explanation focusses on the assumptions related to the available RAM for the cross-border market in the flow-based region. There are several assumptions that were taken when constructing the so called 'flow based' domains which could be lead to a (very) optimistic view of the expected available cross border exchange capacities. In addition, in exceptional circumstances, the minRAM factor can however be set below the targeted legal threshold by a TSO if required to maintain operational security (see CEP article 16.3). This type of event cannot be excluded and a 70%

minRAM can therefore not be guaranteed at every hour and on every CNEC. The impact of delays to planned grid investments throughout Europe completes the justification.

2. **Accelerated coal phase out (see also paragraph 3.4.6.3 in the Adequacy and Flexibility study 2022-32)**

In the context of climate change and in line with European ambitions, several countries have announced coal phase-out dates across Europe. Most countries in Western Europe would be coal free by 2025; however quite some countries remain which did not announce a coal phase-out date yet or plan to complete it after 2030. Indeed, some regions across Europe are heavily relying on the coal and lignite industry and socio-economic plans (e.g. related to the loss of jobs) or compensations are being put in place. With the recent increase of carbon prices in Europe, several closure announcements from producers (such as in the UK) show that it becomes less interesting (from an economic point of view) to operate coal units.

Another driver is the increased ambitions of several countries, including the European Union, which will further increase the renewable share in the future electricity mix. This will once again reduce the operating hours of coal and lignite units putting further pressure on their profitability. Figure 6 illustrates an analysis performed by BloombergNEF highlighted that more than 20 GW of coal capacity could be at risk of closing earlier than current national ambitions.

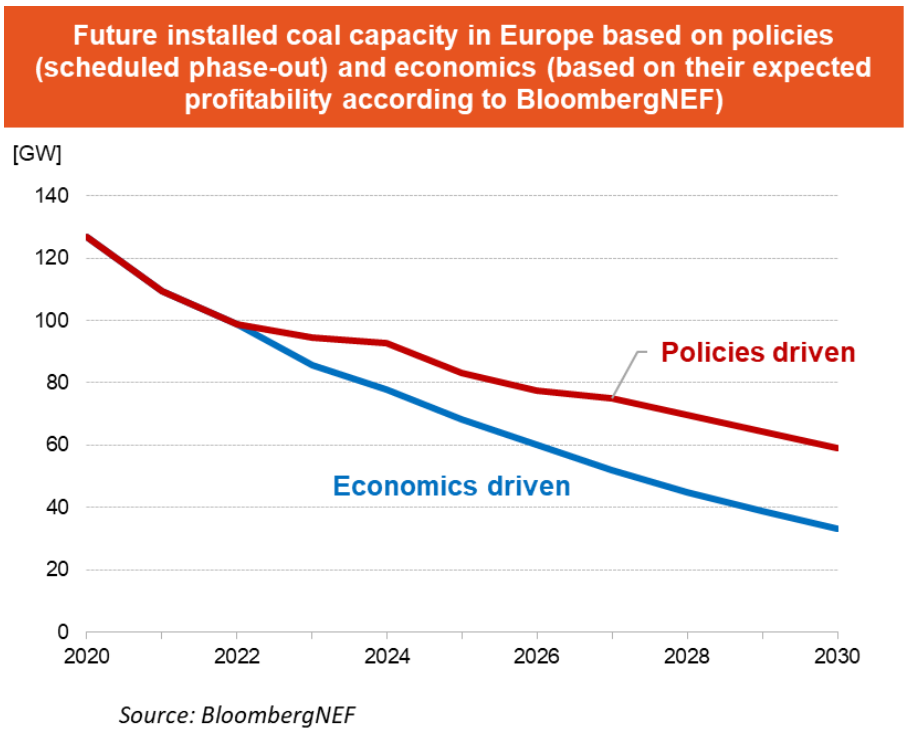

Figure 6

3. **No contribution from UK to Belgium's security of supply (see paragraph 3.4.6.2 in the Adequacy and Flexibility study 2022-32)**

The last uncertainty identified is related to the contribution from UK to Belgium in scarcity situation. The foreign assumptions taken into account have a significant impact on the results for Belgium as the country is very well interconnected and relies heavily on imports. While these assumptions are based on the most up-to-date public information and policies, important uncertainties around these hypotheses remain. The uncertainty around support from non-EU countries – and the United Kingdom in particular – to EU countries during scarcity events could also impact Belgium's security of supply. Indeed in the U.K. a recent announcement also highlights the important risk of over-estimating the contribution from foreign capacity to Belgium. According to BBC[3]: Electricité de France SA is shutting its Dungeness nuclear power station with immediate effect, seven years sooner than planned.

[3] Dungeness B: Kent's last nuclear power station closes early - BBC News