BSTOR's contribution to the Public Consultation on the scenarios for the 10-year Federal Development Plans Electricity and Hydrogen

This document constitutes BSTOR's contribution to the Public Consultation on the scenarios for the 10-year Federal Development Plans Electricity and Hydrogen.

This contribution only focusses on the scenarios related to storage development and in particular large-scale storge.

BSTOR obviously remains at Elia's disposal for further elaborating in these topics.

BSTOR understands that the proposal is to design an electrical grid capable of catering 9.3 GW of large-scale storage by 2050. This includes 1.3 GW of existing pumped hydro and 1.5 GW of "existing + contracted under CRM" large scale batteries meaning that the Federal Development Plan would target creating only 6.5 GW of additional capacity for large scale projects by 2050.

On the most recent version of the grid hosting capacity map, Elia however reports a total reserved and allocated capacity for BESS of 9.6 GW by 2034 (9.4 GW additional).

In other words, BSTOR understands that Elia proposes to develop a grid by 2050 that cannot even host the capacity that Elia reserved or allocated to BESS projects by 2034, while it is fully certain that the reserved capacity with targeted energization by 2034 will even further significantly increase between now and 2034.

In BSTOR's opinion, this evidences that Elia massively underestimates the hosting capacity for large scale batteries that needs to be foreseen

- Both on a long run in the context of a net zero European grid ;
- As on the short run, to enable the exponential growth of battery projects that is expected to happen in Belgium, as it happened in countries where BESS development started earlier, and to unleash the benefits of such development, both from a grid and system cost perspective as from an economic value creation perspective.

This also stresses that, as BSTOR repeatedly stated, current assumptions and simplifications for modelling grid-scale BESS in grid studies fundamentally fail to capture the role that BESS can play in grid development and congestion management, by focussing exclusively on additional constraints caused by BESS on grid capacity and not on the benefits of those, although such benefits are very well documented.

BSTOR therefore requests:

- to fundamentally review and improve such methodology to better consider the additional constraints but also advantages that BESS projects create on grid flows and infrastructure capacity needs, by among others, relying on return of experience of systems with existing multi-GW BESS capacity and/or assuming that the necessary market incentives will be created to trigger such "congestion relieving" impact from BESS; and

- to fundamentally increase the ambitions in terms of "hosting capacity" for large scale BESS in the power grid towards 2050, but also already by 2035 – 2040 to avoid that Belgium would miss the potential and benefits from "the next big thing in the energy transition". 10-15 GW capacity by 2035-2040 and 30-40 GW capacity by 2050 seem very reasonable targets for not hindering the development of BESS potential and its benefits.
- To also foresee adequate and sufficient "local redistribution" of the targeted capacity for avoiding that reservation above a certain local (or total) potential in a certain area would prevent development in other areas.

On the point of the capacity to be targeted, BSTOR recommends splitting the question in two sub-questions:

1) long term-projections, for horizon 2050, top down, based on the needs <u>in a European context ; and</u>
2) short term-projections, for 2035-2040, bottom up, based on the connection requests currently received by Elia.

1 Long term projections

The long-term assumptions for the grid development plan should enable materialising European and specifically Belgian climate and energy commitments.

Normally, the compass for such exercise should be the National Energy and Climate Plan. Unfortunately, as rightfully pointed at by the European Commission in 2024, Belgian 2023 NECP fails to define targets in terms of storage capacity and measures to achieve this target.

In the absence of such guidelines, one needs to look at the need for storage in a broader context.

In its net zero roadmap from 2021, Elia perfectly set the scene:

- At European level, there is a very high adequacy, except for a couple of weeks per year, on daily intervals, between the available renewable resources and the electricity demand (including after energization of our energy needs);
- but given its limited renewable resources, Belgium would structurally remain an importer of power.

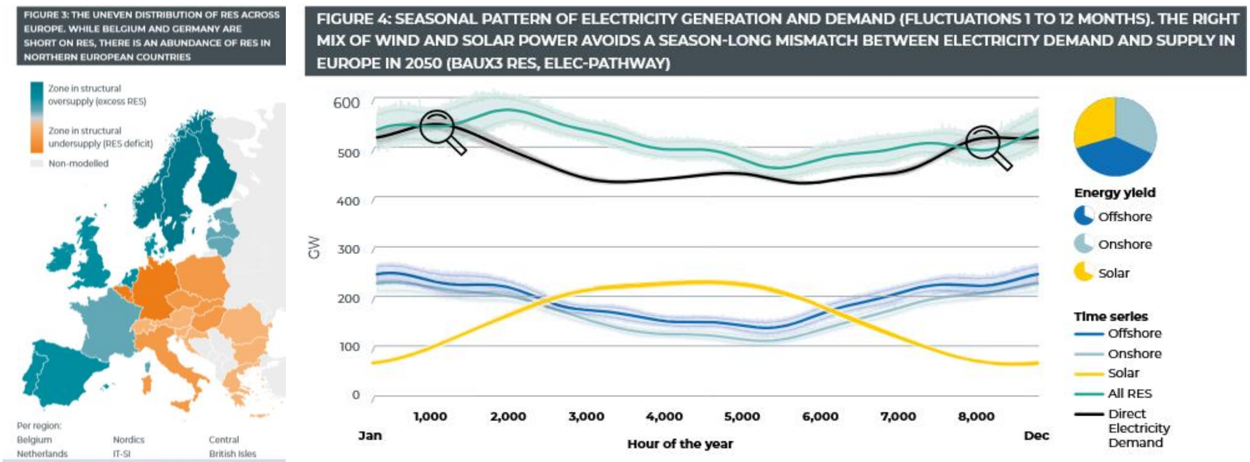

Figure 1: screenshot from Elia's "Roadmap to net zero" (Elia, 2021)

In other words, except for a couple of weeks per year, we can decarbonize our whole energy demand, and be fully energy autonomous, at European level, provided that:

- we develop sufficient renewable energy generation capacity;
- we develop sufficient interconnection capacity; and
- <u>**we develop sufficient within day storage capacity.**</u>

Batteries provide for a technically and economically fully viable solution for such “within day” storage. With a by Elia anticipated daily load of ~500 GW in a net zero context by 2050, the potential for battery development in Europe is therefore absolutely tremendous. Literally, “the sky is the limit” and the mindset should be “build (renewable generation capacities, and grid hosting capacity for projects), and they (large-scale batteries) will come”.

On top of this, large scale batteries are a fantastic Swiss knife for supporting TSOs in their challenges towards carbon neutrality. They are fully dedicated to flexibility, fast and very accurately ramping, they can massively contribute in a technic-economic optimal way to solving challenges such as vanishing inertia, voltage regulation, congestions, delays in grid investments, hitzeflautes, dunkelflautes, duck curves, incompressibility, etc... It should be literally any TSO’s and any grid user’s dream to have the largest possible BESS capacity connected to its grid to ensure that system adequacy and stability is guaranteed at the lowest possible cost.

It is for those reasons that a whole lot of European regulations and recommendations asks Member states, TSOs, NRAs to as much as possible facilitate the development of battery storage, recognized as one of the Key Net Zero technologies, not only by “cutting the red tape” for permitting process but also by as much as possible facilitating connection and access to grid to this technology.

From a Belgian perspective, it is also a no-brainer to develop the highest possible hosting capacity for large scale storage. While Belgium is “doomed” to structurally rely on imports for energy generation, it is ideally located for exporting flexibility services to surrounding countries and play a similar role to the one that countries with large (pumped) hydro capacity are currently playing in the Nordics or Alpine region: “becoming the big battery from central western Europe”. As a small country, very well interconnected to surrounding countries, “caught in between” a future massive offshore wind bloc in the North and Baltic Seas and the French nuclear bloc, Belgian has it all to play that role. And storage is one of the few opportunities that Belgium has to generate an economic surplus in the future electric system in the context of a net zero system.

In such context, in BSTOR’s opinion, a target of 6.5 GW of additional capacity by 2050 is a totally disappointing number and lack of ambition that would result in a gigantic missed opportunity, even when looking at the needs for the Belgian system only.

Elia’s Blueprint study and Energyville’s Paths2050 studies are relatively consistent in identifying a potential of ~10GW for battery storage (large and small scale) by 2050.

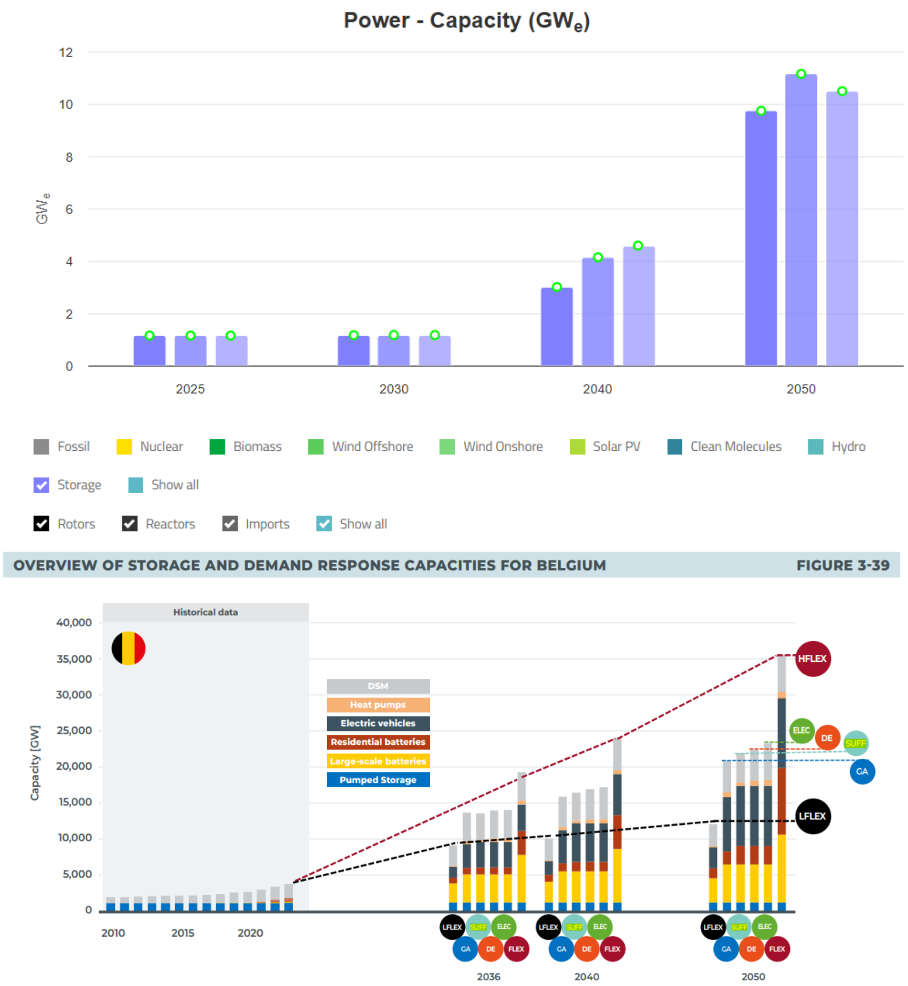

Figure 2: Screenshots Energyville Paths 2050 and Elia blueprint study 2035-2050

But these needs are only the "adequacy" related needs. Stability/flexibility related needs (flex that cannot be anticipated in day-ahead) come on top of those.

In the most recent AdeqFlex Study, Elia estimates the need for upwards flexibility by 2036 to 7.5 GW. In the first AdeqFlex study, Elia had estimated such need to be 3.7 GW in 2020.

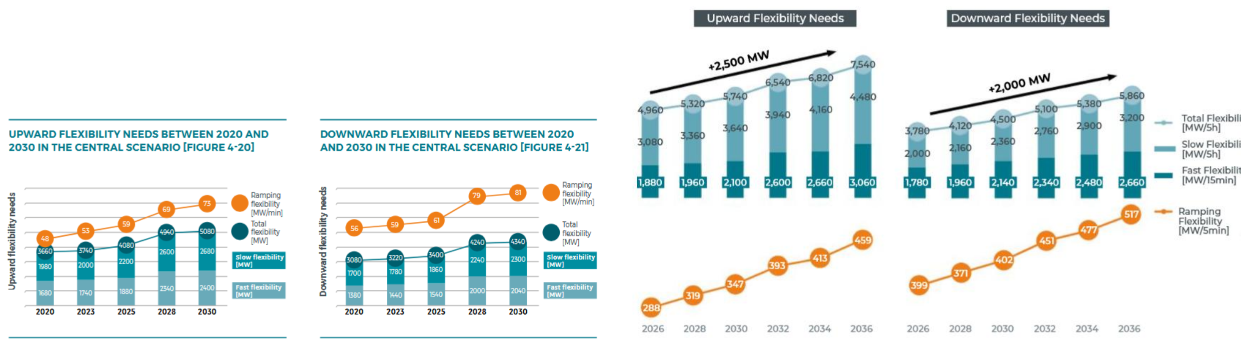

Figure 3: Snapshots AdeqFlex study 2020-2030 (left) and 2026-2036 (right)

This means that over a period of ~15 years, needs for flexible upwards regulation capacity will have more than doubled (206%)! Assuming that the needs would again double between 2036 and 2050 (which is a conservative assumption, needs for flexibility are expected to grow faster than the penetration of renewable energies), this would mean a total need for upward flexibility of 15GW by 2050!

Grid scale BESS are, here as well, the obvious optimal option to deliver those needs. In a net zero context such flexibility cannot come from spinning thermal generators (which is any way a very costly mean to provide flexible energy in a context of high RES due to high must run costs). If the system fails to develop sufficient large scale BESS capacity, such upwards regulation need can only be delivered by demand shedding, which comes with high and sharply increasing costs the closer we get to real time activation, and in general causes massive value destruction. Distributed batteries (including EVs) and flex will be most likely less prone to massively take part to this market given the “easier to grasp” opportunities on the more anticipable markets of the flexibility (spot/congestion management) and specific constraints of the “in the last 4-5 hours flexibility” (dependability and very accurate SOC management for instance). It is therefore of absolute paramount importance to make sure sufficient large scale BESS capacity is developed to prevent structurally relying on the industry production to keep the system balanced in the last 4 hours before delivery!

Of course, not all this potential market of 15 GW creates economic room for large scale BESS, part of it being needed too “exceptionally” to be captured by batteries. When looking at the part of contracted reserves by Elia currently creating a suitable market for BESS (~300 MW out of the ~1GW contracted reserves), we could conclude that about 1/3 of the upward flexibility market is also suitable for batteries. But batteries being energy limited, you also need 2 or 3 MW of batteries to fully supply one single MW of flexibility need. All in all, estimating the potential economic room for large-scale BESS for upwards regulation for Belgian needs only to 10-15 GW by 2050 seems totally realistic.

Taking into account a potential economic room for large scale batteries by 2050 of 5-10 GW for adequacy purposes and 10-15 GW for flexibility purposes, this would mean a total 15-25 GW large scale BESS for the Belgian needs only.

And this is for an optimally run system, without taking into account the hedging and opportunity value of batteries that are kept as an “insurance” for BRPs to exit from a long/short situation “if something even worse” happens.

In the UK for instance, Modo energy had evidenced that the BESS park was <u>never</u> operated at a load factor (computed on 15 min block) higher than 50% (and even close to 25% for 4h BESS) even under extreme price conditions.

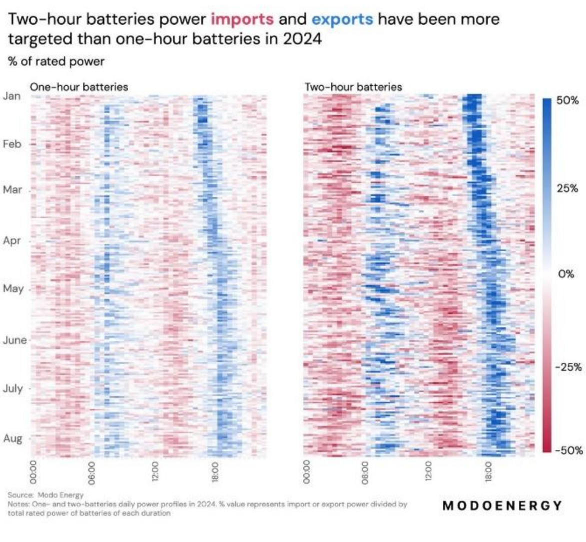

Figure 4: snapshot study of rate of use of BESS in the UK by Modo

Taking this component into account, this means that to capture Belgian needs only, a hosting capacity for 30-40 GW of BESS at least should be created by 2050, and ideally more if Belgium wants to position itself to supply flexibility services to much larger surrounding systems.

This is a multiple of the value proposed by Elia. BSTOR understands that with current methodologies used to model impact from BESS on grid capacity needs, this figure is "out of this world". Therefore, BSTOR urges Elia to:

- improve those methodologies to also account for benefits from BESS on grid capacity needs, assuming that appropriate triggers would be created to generate such benefits (and that in any case, there is no economic incentive to cause congestions or other grid instability with BESS); and
- target for 2050 a (much) higher capacity than the proposed 8 GW. BSTOR proposes a target in a 30-40GW range and suggests to work in a more bottom up approach by looking at additional margins that could be realistically, or in any case "at the least cost", created on top of the target value (consider installing cables/transfos with a higher capacity, substations with sufficient spare bays, pylons with double terns, etc.), instead of extrapolating current capacity requests per locations.

2 Short term projections

Elia has recently shown the interesting below figure on the "hockey stick shape" evolution of reserved capacity for battery storage. The allocated capacity by 2034 would now amount close to 10 GW (and 5 GW by 2027).

BSTOR understands that such reservation and allocations create a potential contractual obligation for Elia to deliver such a grid capacity (most likely with flexible access for a temporary period of maximum 15 years). And it also clear that between now and 2034, the reserved capacity with targeted energization by 2034 will further (strongly) increase.

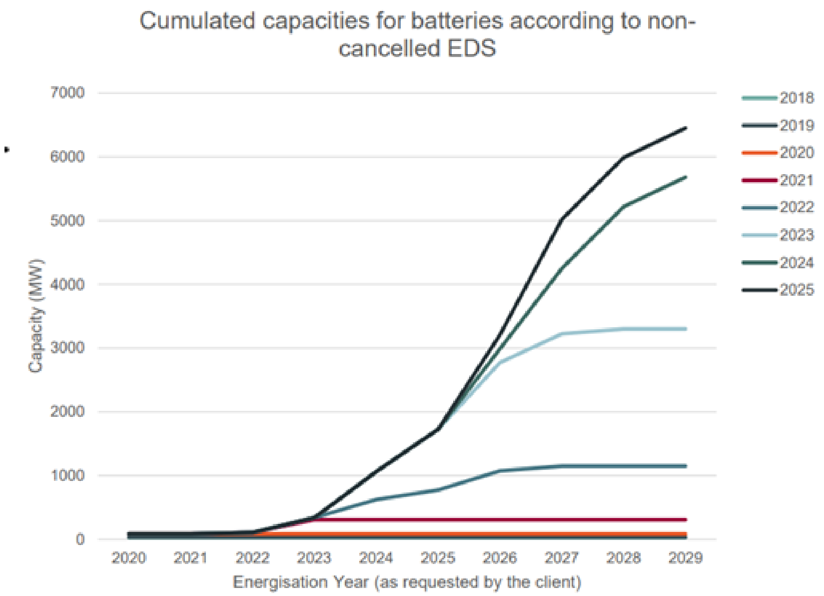

Figure 5: snapshot presentation WG Belgian grid 5/9/2025

BSTOR therefore cannot understand that Elia would only target creating grid capacity of 4 GW large scale BESS by 2035. The evolution depicted in the graph above is everything but unrealistic, just may be a little fast. In countries where BESS development kick started earlier than in Belgium (UK, California, Texas, Australia), battery development has known an exponential growth with doubling of the operating capacities every one to two years for periods as long as close to around 10 years. There is no reason that Belgium would not know the same evolution given its role as a pioneer in Europe, and given its ideal situation to also serve flexibility needs in surrounding countries.

More than a "contractual obligation" of making sufficient room for the reserved capacity, Elia should really see this as investments with highly positive cost-benefit balance. In pioneering areas such as UK, California, Texas, Australia, the early-stage BESS capacity already demonstrated very high added value. And recent black out examples in the UK system in 2019 and in the Iberic system this year also showed how large BESS capacity could have helped avoiding the situations or at least mitigating their impact.

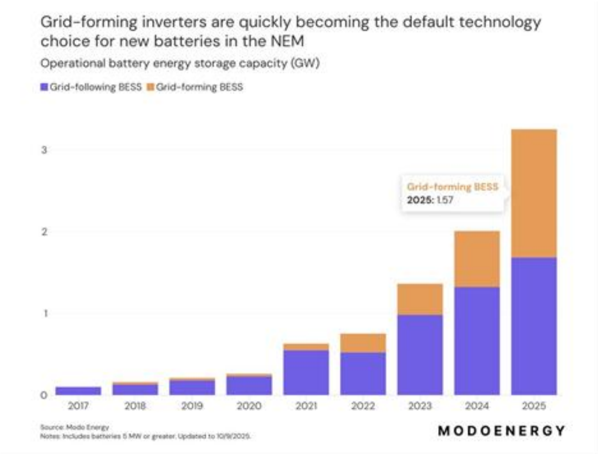

Figure 6: Early stage "hockey-stick shape" BESS capacity evolution on NEM system in Australia, leading to a multi GW fast ramping BESS capacity, from which half grid forming, in a few years. Who would not want that sufficient grid capacity is foreseen to make sure such an evolution can also happen in Belgium in light of future inertia and voltage stability issues expected in a world without large synchronous generators?

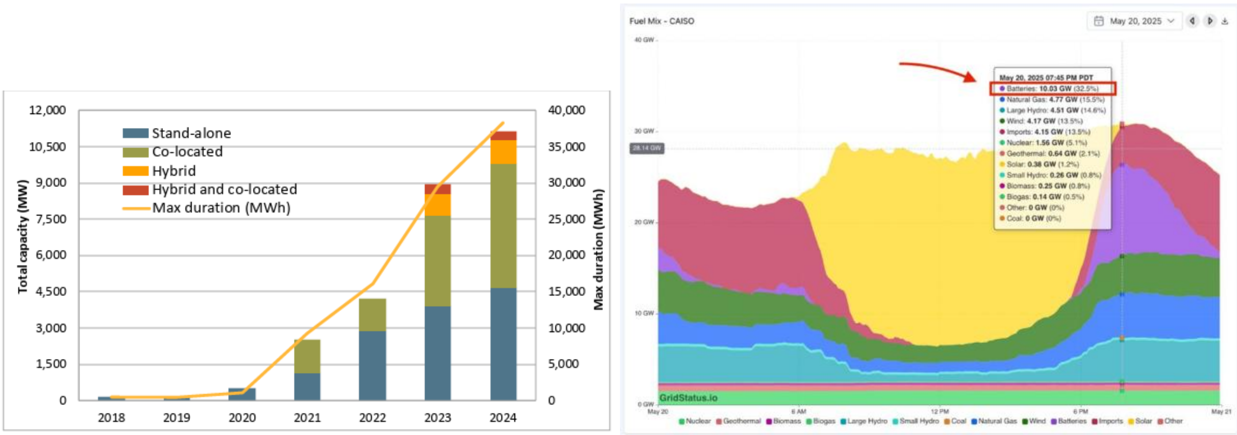

Figure 7: Early stage "hockey-stick shape" BESS capacity evolution on CAISO system in Australia, leading to a 15 GW BESS capacity developed in ~5 years and capable to seamlessly manage duck curves. No incompressibility issues and minimal curtailments around noon, minimal must run thermal capacity and no demand shedding to manage the fast-ramping residual load at unset. Who would not want that sufficient grid capacity is foreseen for this to happen in Belgium as well as we have seen the first "hitzeflautes" coming in 2025, as Elia for years warns for the incompressibility risk over the summer, and as our Dutch neighbours already see duck curves occurring for 8-9 months in a year?

Using such assumptions of doubling the BESS capacity every one to two years and based on publicly available information about projects under development, BSTOR estimates that a 4 GW capacity that Elia plans to make available by 2035 could already be reached by 2028-2030.

It is therefore essential that Elia foresees a significantly higher hosting capacity. BSTOR believes at least 10-15 GW large scale BESS (again, with adequate network integration methodology and relying on bottom-up definition of places where capacity can be created at least cost in the system) should be made available by 2035-2040 for not hindering further growth of BESS.

It is indeed essential to create hosting capacity on top of the reserved one. Obviously not all reserved capacity will be allocated, and all allocated capacity will not become operational but even with an efficient "Mechanism for avoiding sleeping capacity", it will take 3 to 4 years to clean up reserved capacity. And the fact that a project does not go through can also be related to impossibility or excessive difficulty to develop BESS projects where capacity was reserved.

If Belgium wants to avoid relying on import not only for generation but also for flexibility services, it is therefore essential to generate hosting capacity margin on top of the reserved one to enable developers to develop back-up capacity for the reserved capacity that in the end isn't developed, or at least that sufficient local potential is foreseen everywhere.

3 Miscellaneous

As for the other questions raised by Elia in the consultation document

- BSTOR does not believe it makes sense to foresee specific capacity for pumped hydro. Should project emerge (which BSTOR doubts) it should be using the capacity foreseen for large scale storage.
- BSTOR recommends assuming an average 3h storage duration for the future large-scale BESS, in line with global trend, where you see the coexistence of 2h and 4h systems in equal proportions.