Balancing incentive 2022
Compensation network losses

WG Balancing – Workshop Losses

17/11/2022

Agenda

Introduction + storyline

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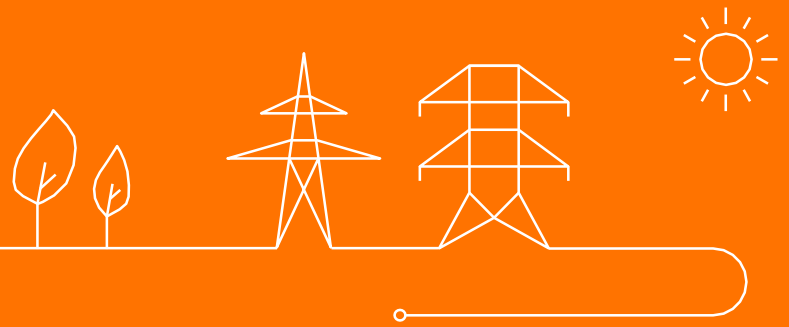
Results of the POC

Implementation plan

Conclusion

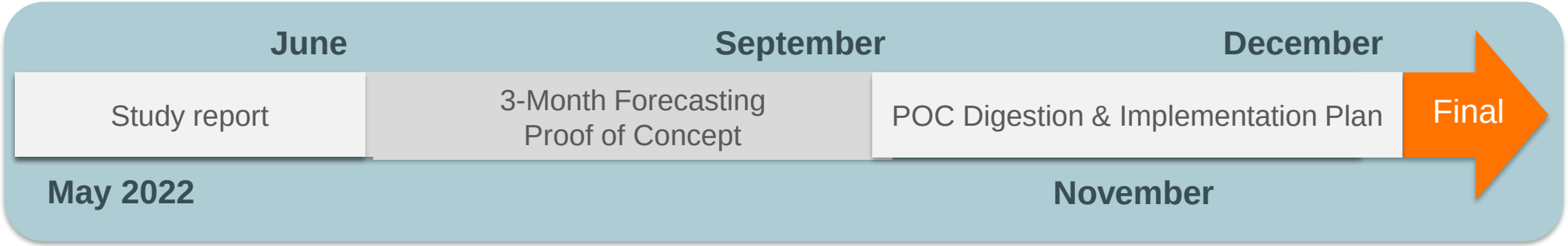


In order to meet the target of the balancing incentive 2022, regarding the compensation of the network losses, Elia was asked to fulfill a set of deliverables.

Generally said, **<u>two research questions</u>** were raised by CREG :

1. To what extend is the **procurement by Elia on both federal and regional losses** more efficient compared to today's setup?
2. What is the relevance of developing a **short-term procurement component based on short-term forecasting** as part of the compensation approach?

<u>Deliverables</u>



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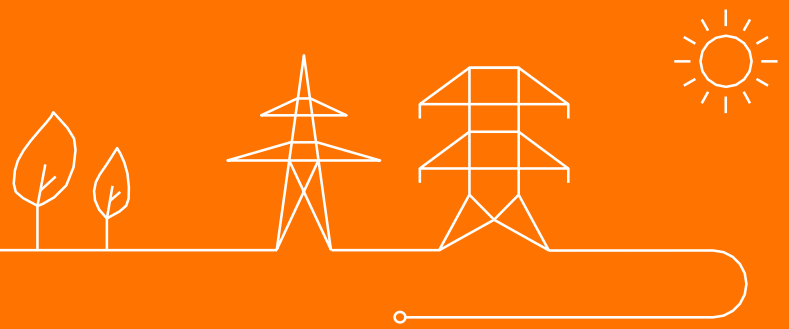


About the 30/6 study report

The 30/6 study report (available on elia.be) contains the following elements:

1. Analysis of the **current forecasting method** of federal grid losses
2. Analysis of the **efficiency of the current method** for compensation of the grid losses (compensation in kind for the federal grid losses and LT procurement by Elia for regional grid losses) in comparison with a **compensation via procurement for both regional and federal losses**.
3. A **benchmarking** with methods of 5 other European TSOs (RTE, Amprion, Swissgrid, REE, National Grid)

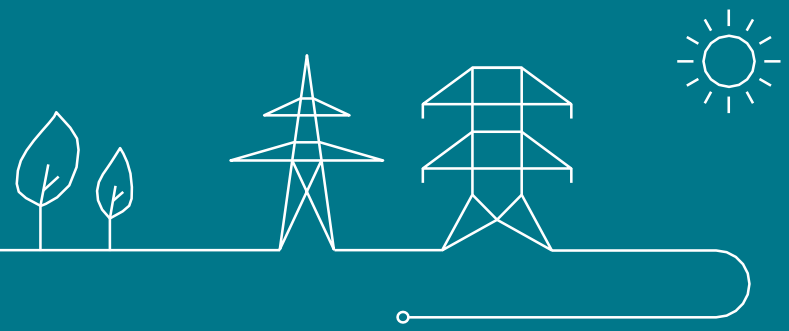
Based on the above analyses:

- Elia formulated an answer to both research questions
- The report allowed to prepare the context for the POC more accurately

In what follows in this presentation, key elements (capita selecta) from the report are highlighted in view of the report's conclusions. The full report, however, provides a more elaborate analyses and insights.

Balancing incentive study

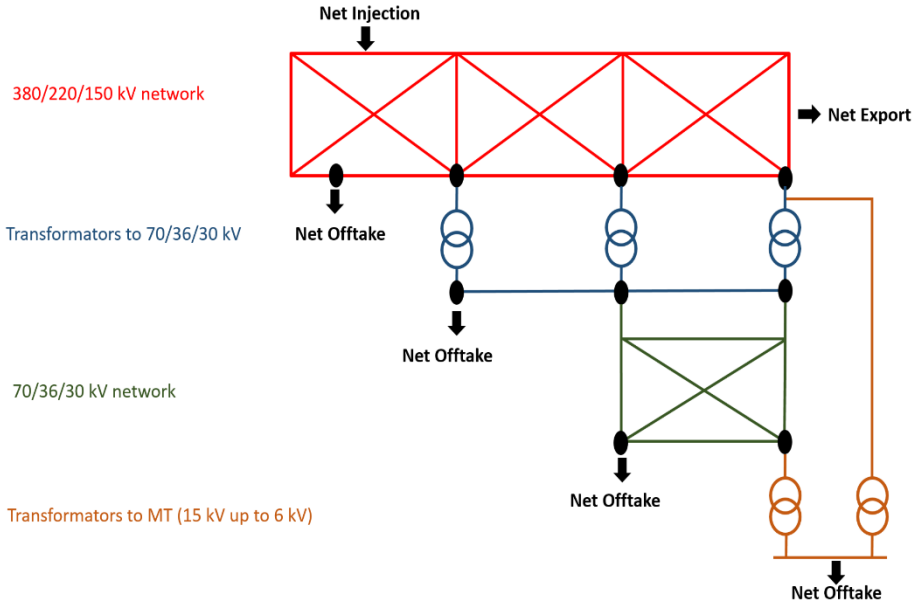
Introduction



The electricity network for Belgium can be divided in both a federal and regional part, with both of them encompassing different elements resulting in a separate losses classification.

"From a mathematical point of view, the power losses are described as the amount of heat per second that develops in a wire carrying a current. These power losses are proportional to the electrical resistance *R* of the conductor and the square of the current *I*"

$$Power\ Losses = R \cdot I^2 = \rho \cdot \frac{l}{a} \cdot I^2$$



Classification of losses & elements considered:

- Federal losses: Overhead lines, underground cables, HVDC interconnections, power transformers and power shift transformers operating at nominal voltage of 380, 220 and 150 kV.
- Regional losses: Overhead lines, underground cables and power transformers operating at nominal voltage of 70, 36/30 kV and MT.

➔ Only the elements up to the connection point are considered.

As a reminder: a two-fold compensation of network losses is today applied in Belgium

- Regional losses
  - Compensation by Elia
  - By means of LT contracts (yearly/quarterly/monthly & peak/off-peak)
  - Procurement by Elia through tendering process
  - Financed through the access tariffs.

- Federal losses
  - Compensation “in kind” by BRPs
  - Yearly set percentage applied on a BRPs physical net offtake
  - Aims for long-term financial neutrality

Balancing incentive study

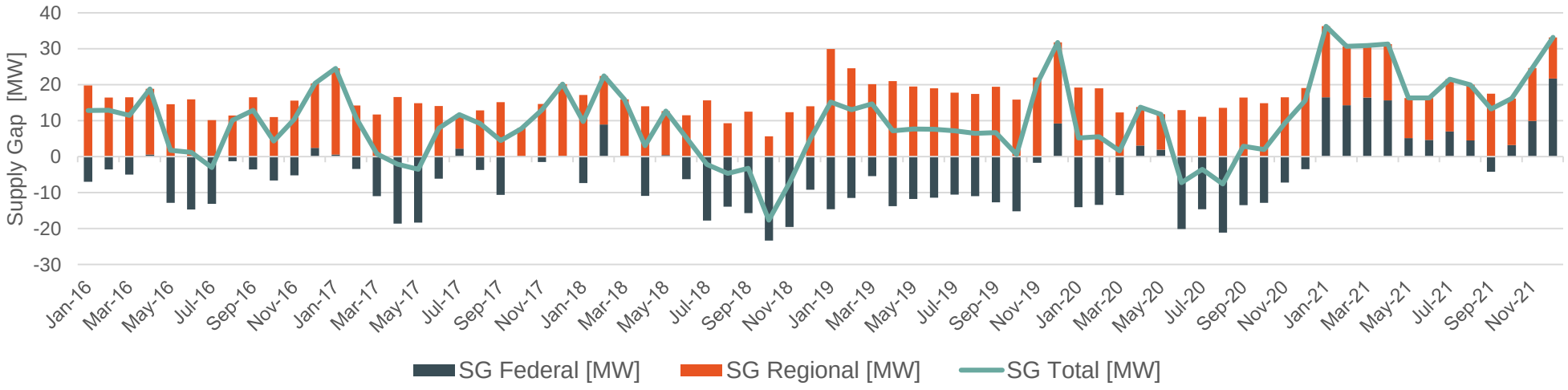
What is the relevance of developing a short-term procurement component based on short-term forecasting as part of the compensation approach?

The supply gap, made up of the difference between the forecasted losses and the actual losses, varies over time and differs for federal and regional losses.

The **supply gap** is an interesting indicator for assessing the performance of a compensation approach. It represents at a given moment the delta between the actual volume of the network losses and the compensations provided by the different mechanisms.

Evolution of the monthly average Supply Gap: 2016 – 2021

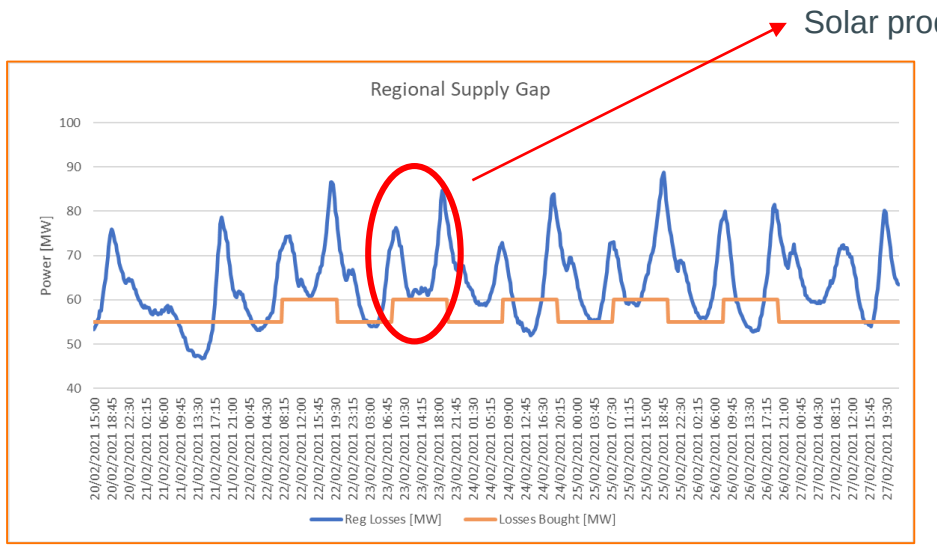
(postive values mean a shortfall or gap in losses compensation, negative values mean a surplus in compensation)



A historical overview shows a differentiation between the compensation approach and the supply gap impact for both the federal and regional losses (1).

Regional losses

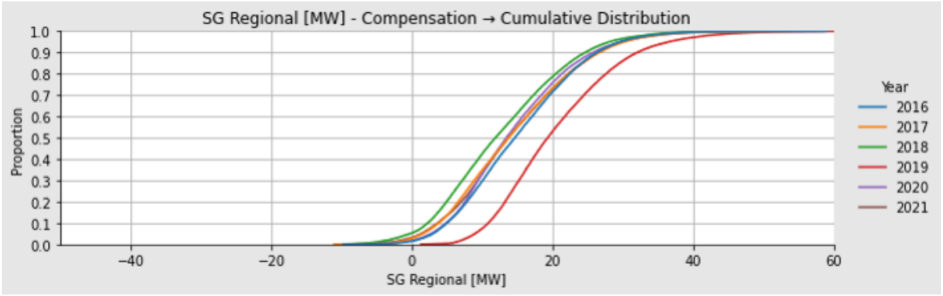
One challenge is covering losses during peak period, as they depend on weather conditions and decentralized production



➔ Hard to forecast long before real-time and difficult to tune with the current degree of freedom (lack of granularity)

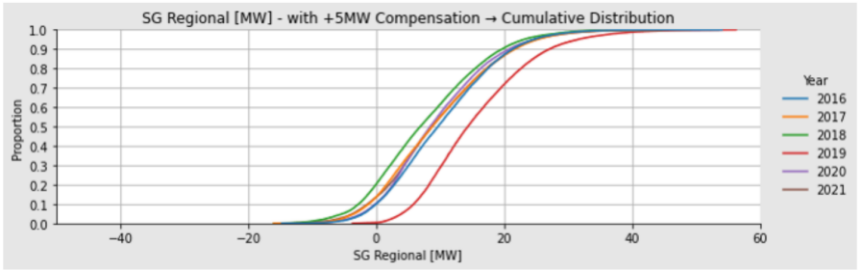
➔ More and more difficult as the share of RES increase

A cautious compensation strategy has been followed, given the available degrees of freedom overcompensation has been generally avoided (<5% on yearly basis) in order not to inflate costs and impact on market functioning.



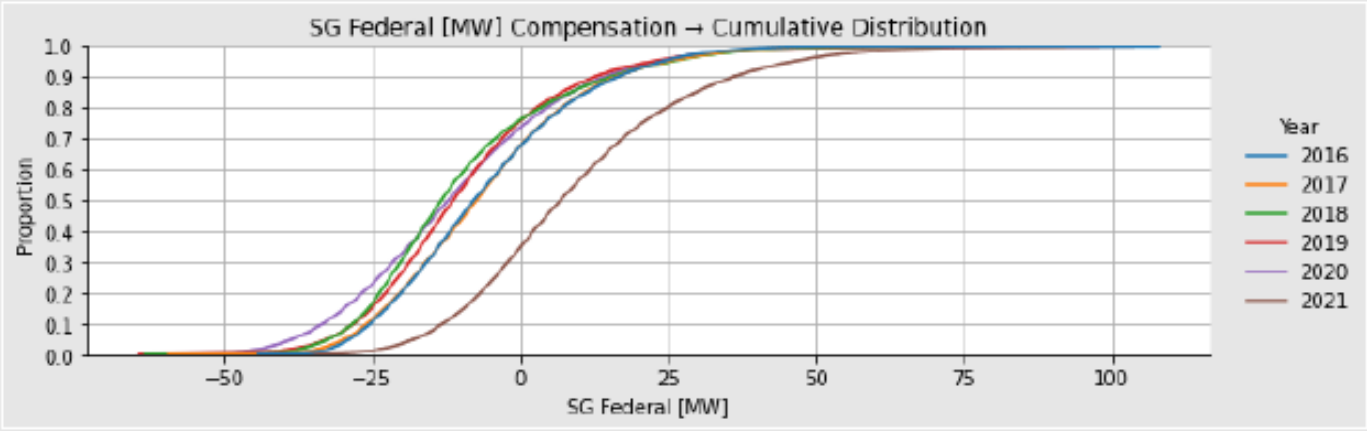
E.g. 5 MW extra compensation (baseload) quickly results in leaving the tail of the distribution causing significant overcompensation e.g. 20% of time in 2018)

+ 5 MW



An historical overview shows a clear differentiation between the compensation approach and the supply gap impact for both the federal and regional losses (2).

Federal losses



- The **trend in federal losses is increasing** due to several factors :
  - Wind offshore
  - HTLS
  - International flows (Nemo, Alegro)
- In the last years (2016-2020), the general trend was an over-compensation of the BRP leading to more moderate % and limited increases
- In 2021, the trend is an under-compensation of the BRP contribution due to the net increase of the federal losses (mainly due to XB flows compared to previous year).

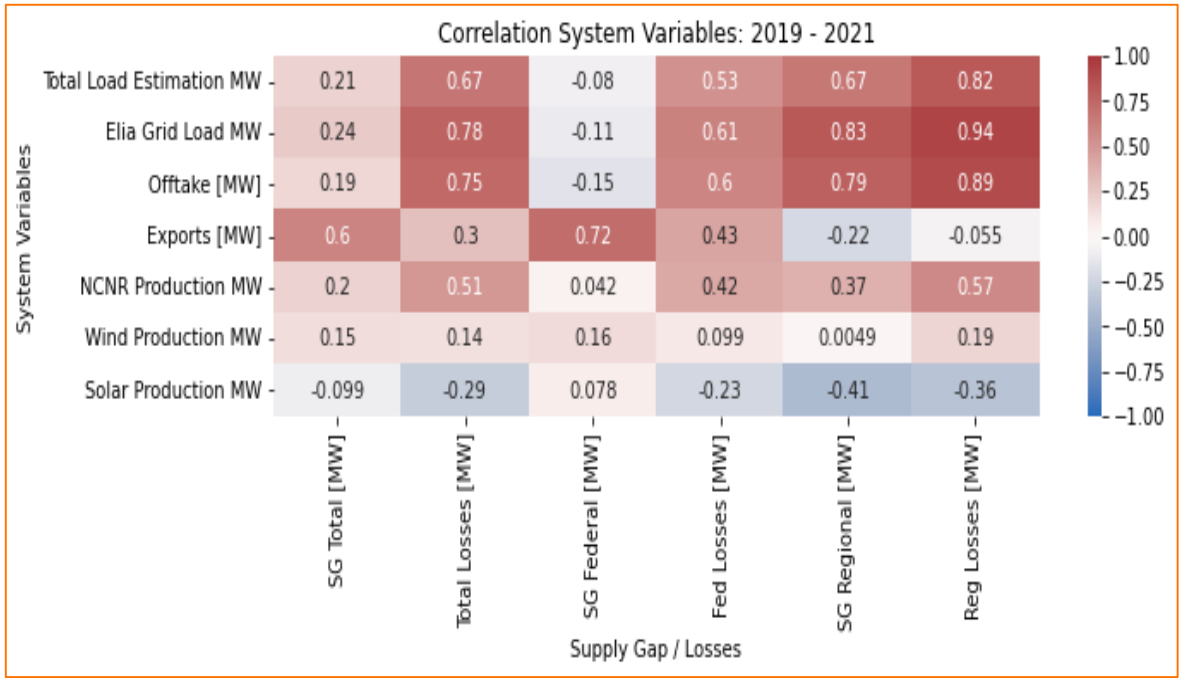
- With the major objective to ensure the **long-term financial neutrality**, Elia determines once per year the percentage of the compensation in-kind.

➔ **The percentage of compensation in-kind takes into account the expected evolution of the federal losses and the "forecast error" of the previous years.**

What is the relevance of developing a short-term procurement component based on short-term forecasting as part of the compensation approach?

- One limitation of the current compensation approach is the **time granularity** while the volatility increases significatively from day to day.
- There are **several factors driving grid losses** :
  - Local centralized/decentralized production
  - Local consumption
  - Energy exchange with other countries

  → These factors show **strong volatility from a shorter term (hours or days) perspective.**



Increasing system volatility has made the forecasting of losses more complicated.
From a forecasting point of view, it seems opportune to complement the procurement approach for the losses with a short-term component, e.g. day-ahead. The aim being to catch the information contained in the latest forecast of the volatile factors driving the grid losses.

* The period was characterized by corona.

TSO benchmarking study by SIA Partners confirms the relevance of developing a short term procurement component based on short-term forecasting as part of the compensation approach

Other TSOs found that a short(er)-term forecasting approach in combination with a sufficient dynamic compensation approach helps to limit the supply gap.

TSO	Short-Term Forecasting	Intra-Day	Day Ahead	Weekly	Long-Term Forecasting	Monthly	Quarterly	Yearly
elia		/	/	/	●	○	/	○
Rte	●	○	○	/	●	/	/	○
swissgrid	●	○	○	/	●	○	○	○
nationalgrid		/	/	/		/	/	/
amprion	●	○	○		●		○	○
RED ELÉCTRICA DE ESPAÑA		/	/	/	●	○	/	/

- About half of the benchmarked TSOs are **combining short term and long term forecasts**
  - **Long term forecasting** decreases the price risk but struggles with low accuracy (exposure to price-risk).
  - **Short term forecasting** helps to provide a more granular coverage whilst limiting the supply gap. Also here, accuracy is still seen as a challenge (XB flows) causing potential financial risk.
- The TSOs' forecasting approaches are **aligned** with their procurement strategies

Note: this is only a part of a broader benchmarking study performed by SIA which also impacted other parts of the report. The benchmarking is fully available in annex to the report.

In order to decrease the price risk in the long and short term procurement strategies, most TSOs use short term and long term forecasting models to support their decision making process.

Balancing incentive study

To what extend is the procurement by Elia on both federal and regional losses more efficient?

To what extend is the procurement by Elia on both federal and regional losses more efficient? (1)

Firstly, **not a straightforward question** as any counterfactual (quantitative) analysis It is very hard and remains arbitrary (e.g. which costs to assume for BRP procurement, how to compare with Elia's procurement?)

However, a number of **important reflections** can be made:

1. **Being confronted with more constraints, Elia is *at best* as efficient as a BRP in sourcing volumes to cover losses**

   - **Elia does not have a better market access** (rather more constraints than a BRP…) nor does it have clear advantages with regards to trading positions. BRPs have more possibilities to source the volumes, giving them more opportunities to outperform Elia.
   - **Elia can only go to the market to procure**, a BRP with production assets, and notwithstanding arbitrage at system level, has in principle more option to consider to deliver on the obligation.
   - **Elia would only procure the losses volumes**, while a BRP can obviously source volumes as part of a larger portfolio (the losses component overall being rather stable over time (1-2%) and known up to 6 months in advance)

To what extend is the procurement by Elia on both federal and regional losses more efficient? (2)

2. Elia picking up the responsibility for the federal losses would change the market role **from BRP to ACH for financing** the federal losses

3. **Uncertain end consumer effect:**

   - Elia procuring federal grid losses would result in a (transparent, CREG-controlled, etc. … but significant) **Elia tariff increase.**

   - **However, Elia is not in a position and unable to verify that a ceteris paribus reduction of the consumer invoice from the BRP would take place.**

4. **Elia is not the only TSO doing compensation in kind,** the international benchmarking showed that UK and Spain also apply an approach based on a compensation in kind by BRPs (without any known plans to change).

In any case, if Elia would have to source the federal losses, **a multi-year advance notice is required and appropriate**:

- **End consumers and BRPs** should have enough time to re-negotiate contracts related to the abandoning of the compensation in kind
- **Allow Elia to apply a risk diversification** approach (like today starting with 3yr ahead procurement)

To what extend is the procurement by Elia on both federal and regional losses more efficient? (3)

Conclusion

- Elia considers that at least for the **short to mid-term (≤ 2027) changing the compensation in kind by BRPs to a procurement by Elia is not possible nor recommendable.** At least a **multi-year advance notice** is needed, next to foresee the implementation and a clear and stable framework.
- For the **longer-term (≥ 2028)**, Elia has assessed from a broad perspective whether such switch would be useful.
  - It remains to **be confirmed whether forecasting of federal losses can be done in such accurate way** that changing the approach would yield a sufficient advantage (also in view of what could be achieved already on the shorter to midterm). (→ Cf. infra on POC results)
  - **Elia also identified boundary conditions** that should be fulfilled in order to avoid or mitigate potential negative effects linked to such switch. **Unlike other entities, Elia - by the nature of its role and position in the system - is not well placed to further assess these boundary conditions**.

Note that the already ongoing discussion to improve the mechanism in case of **multiple BRPs active on a single access point** should be further continued and when deemed useful integrated in the mechanism.

Balancing incentive study

Further optimizing the losses compensation approach

Further optimizing the losses compensation approach

Taking into account the above findings and conclusions, **on the medium term (≤ 2027):**

- A **more granular approach by means of more degrees of freedom** offered through **short-term procurement** could clearly help to overcome the limitations of the current approach. To be confirmed by the POC.
- Also short-term procurement based on short-term forecasting could help **mitigating the effects on the balancing market functioning and price formation in real-time** caused by the supply gap and lead to closer coverage of the losses

Also, the approach should consider:

- **Continue already foreseen evolutions**, cf. the multiple BRPs active on a single access point
- **Allow for improving the sustainability of the losses compensation** by making sure that design changes do not block potentially useful strategies (e.g. GoO, Green PPAs,…), cf. Elia's ActNow ambitions.

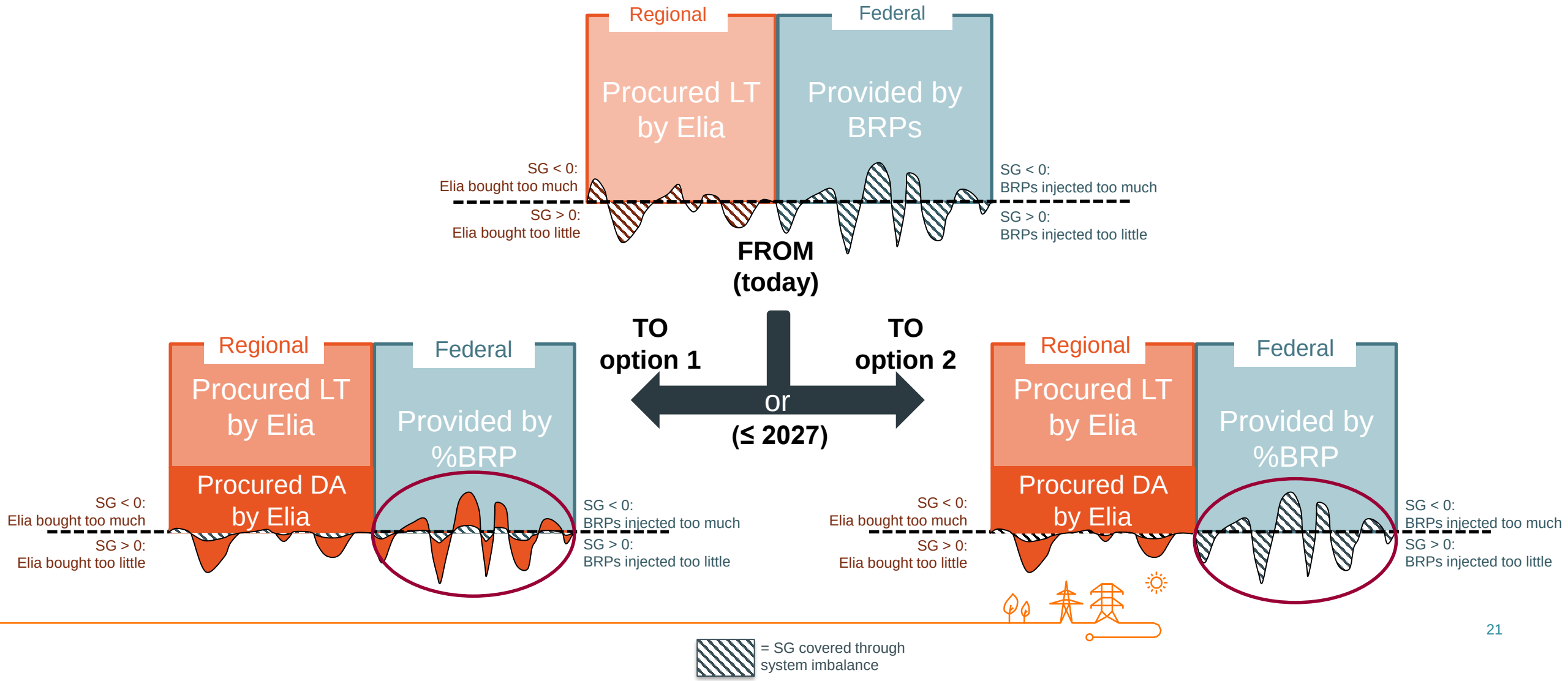
Based on the short term-forecasting in view of short-term (DA) procurement, Elia put forward two options:

1) Elia procures the volume in DA necessary to minimize the total supply gap
2) Elia procures the volume in DA necessary to minimize the regional supply gap only

.

Further optimizing the losses compensation approach

While in option 1, Elia would procure in DA volumes targeting to minimize any supply gap for both regional and federal losses, in option 2 Elia targets only the regional part staying closer to the contours of the responsibilities (and tariff context).



Further optimizing the losses compensation approach

The two options proposed to further optimize the losses compensation approach for the future imply a trade-off on different dimensions

	FROM (today)	TO - Option 1	TO - Option 2
Regional	• LT procurement through tenders of baseload/peak contracts in 5-10 MW blocks • From Y-3 to Q-1, potentially complemented with M-1	• LT procurement (Y-3 to Q/M-1), like today • To match with DA procurement (only buy, no sell) • *Potentially* complemented with initiatives to reduce carbon footprint (cf. ActNow, e.g. Green PPA) • **Complemented with ST (DA) Sourcing (cf. supply gap)**	
Federal	• In kind compensation by BRP based on Y-1 percentage • Aim for LT neutrality by correcting the percentage based on historical under/overcompensation	• In kind compensation by BRP based on Y-1 percentage • **Improved arrangement for multiple BRP at one access point** • Aim for LT neutrality by correcting the percentage based on historical under/overcompensation	
Supply gap	Any surplus or shortfall in compensation is dealt with via the system imbalance	• **DA procurement (based on ST forecasting) to finetune both *regional and federal* compensation and limit supply gap** • Remaining (total) supply gap is dealt with via the system imbalance	• **DA procurement (based on short-term forecasting) to finetune *regional* compensation and limit supply gap** • Remaining (total) supply gap is dealt with via the system imbalance

Key benefits:

Option 1

✓ ST procurement targeting the entire losses scope and thereby aiming to limit the total supply gap.

Option 2

✓ Cleaner split between regional and federal grid losses compensation in terms of R&R

✓ Avoids higher difficulty linked to forecasting impact international flows

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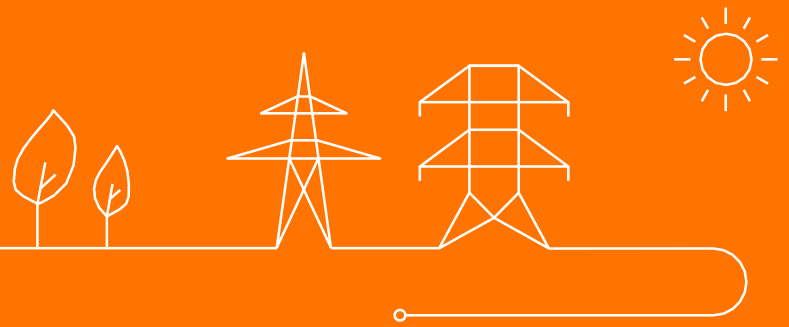


A proof of concept (1/7 → 30/9) was set-up in order to test the creation of a short term forecasting for both regional and federal grid losses.

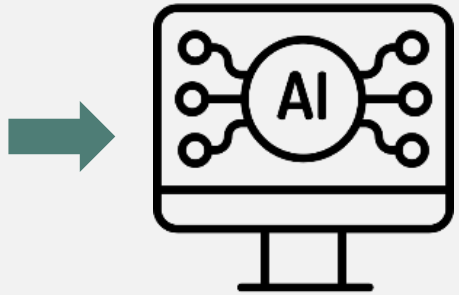
- The proof of concept (POC) has the aim of testing the possibilities for forecasting on short term of both the federal and the regional losses.
  - Requirements set out by the incentive covered
  - We set up the POC to allow to also test performance of both design options
- POC worked on **two axes**:
  - **Forecasting quality:** aiming for a good quality model, especially knowing that for federal losses this would be tougher
  - **Operational process:** daily (working days only) process with output being sent to CREG
- Note that **no robust, full IT implementation** was done for the POC:
  - a strong reliance to manual intervention
  - accepting stronger risk of data unavailability
  - less built-in checks and balances
  - process design not guaranteeing 7/7 availability.

→ In a POC context the product/service and the management of any risks are obviously not at the same level of running a real-life business process with operational and financial consequences

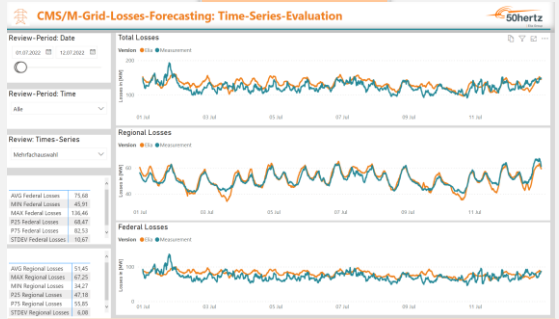
A POC-scale set-up integrated the feeding of several data sources, which were deemed to have high correlation to the system losses, into an AI-model enabling the possibility to create a forecast which would be more granular.

Actual (live) data input

- Solar forecast
- Wind forecast
- Total Load
- CIPU Load (Coordinating injection of Prod. Units)
- NCNR Production (Non CIPU/Non-renewable)



Prediction output



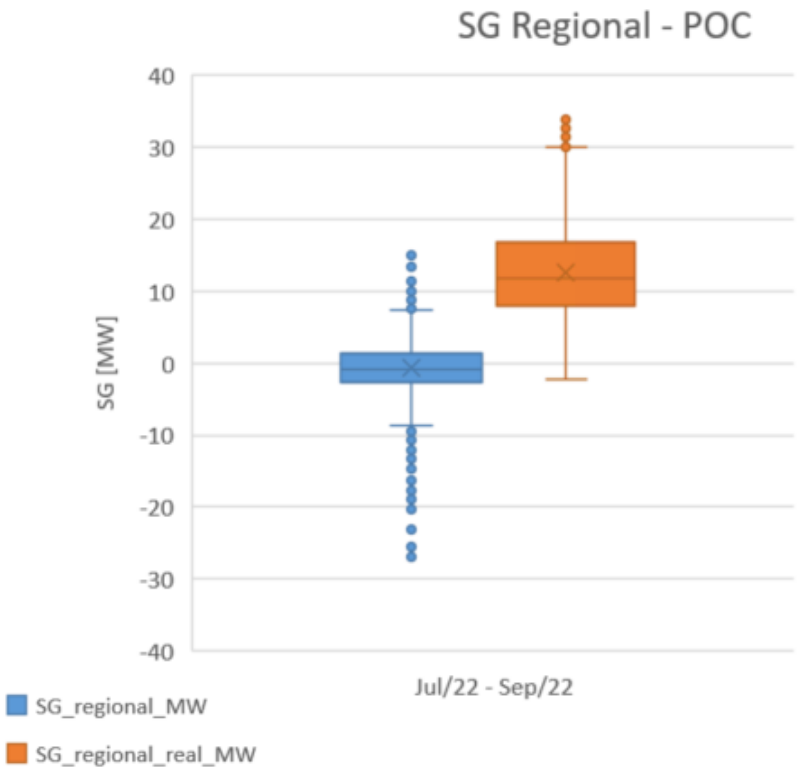
A machine learning based losses forecast

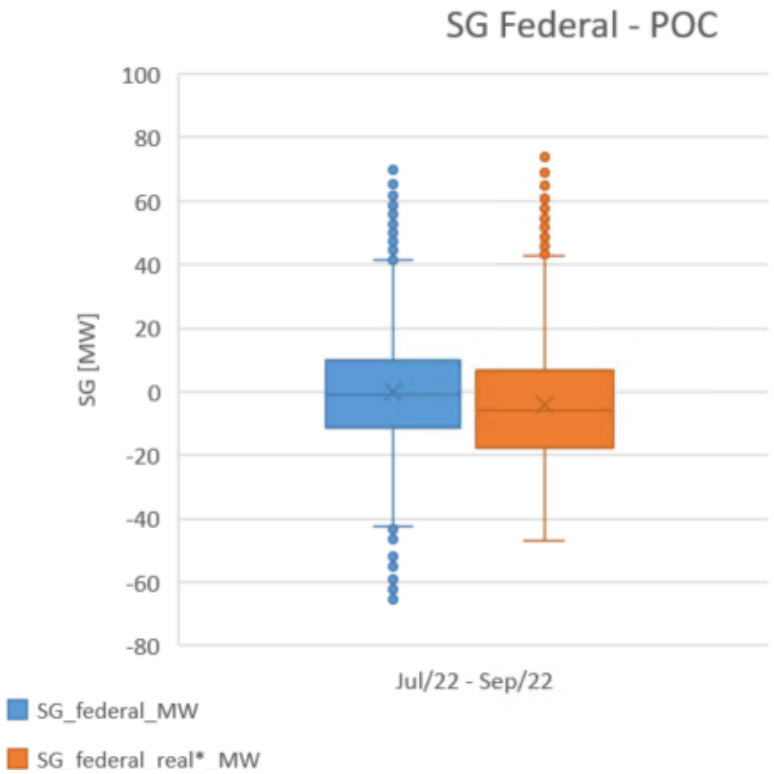
Challenges

Currently the data input is still subject to future optimizations as not easily forecastable variables, such as the international flow effect, are difficult to forecast.

* The period was characterized by corona.

Overall, for the considered period, ST procurement based on DA forecasting allows to reduce the supply gap both for the regional and the federal losses.

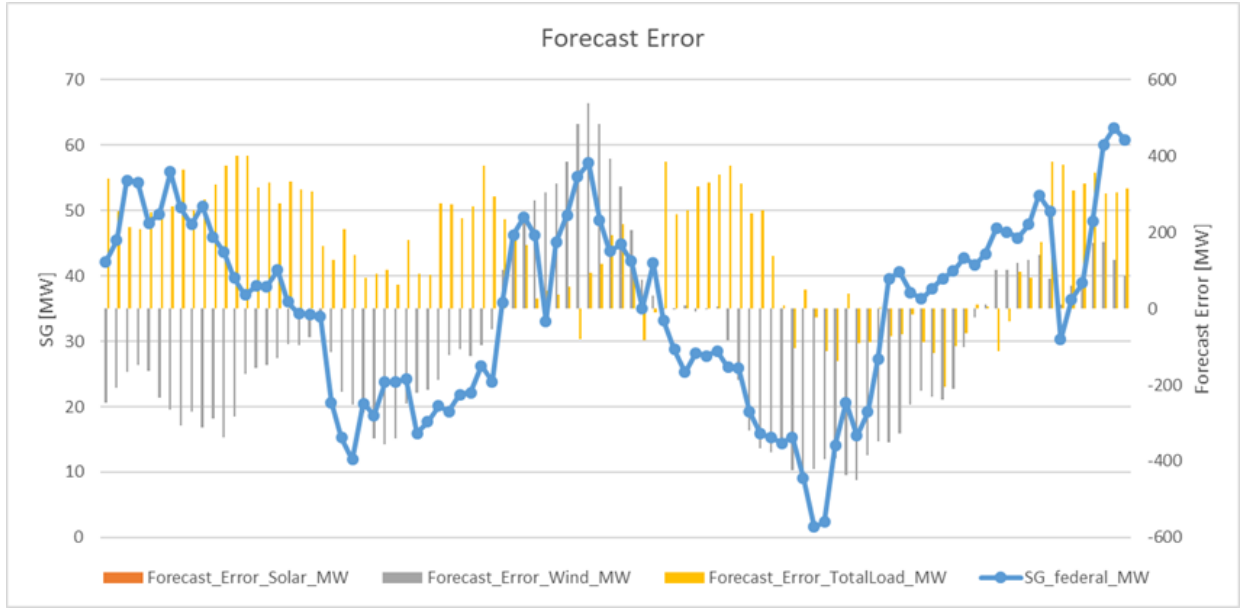


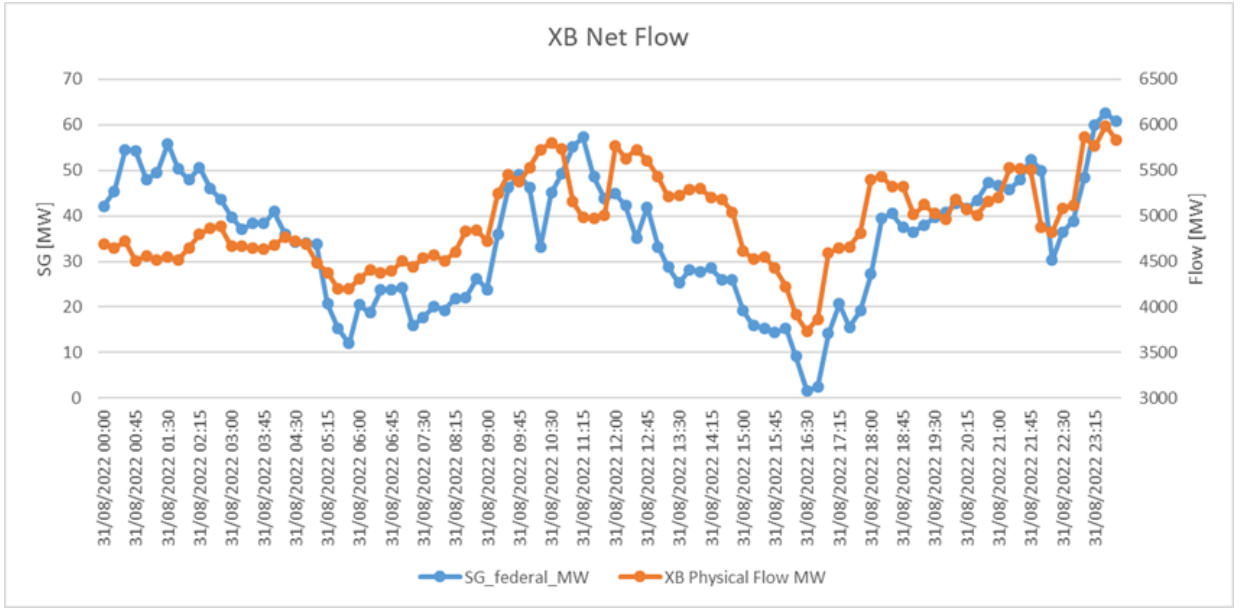


SG = Real losses - Forecast losses
SG < 0 : Over-procurement
SG > 0 : Under-procurement

- For **regional** losses, compared to today's approach, the supply gap can be structurally reduced with a rather limited remaining forecast error.
- For **federal** losses, an improvement can be observed, i.e. more centered around 0 MW and with lower variance. However, there remain significant tails which can be attributed to several factors (cross border flows, seasonal,…) of which their impact merits further study.

Factors affecting federal losses forecasting – Analysis of a day (31/08) with a larger supply gap than for the other days





The higher supply gap observed during the day can be **partially** attribute to :

- Wind forecast error
- Total load forecast error
- (Limited) solar forecast error
- The inability to have a complete view of the XB flow

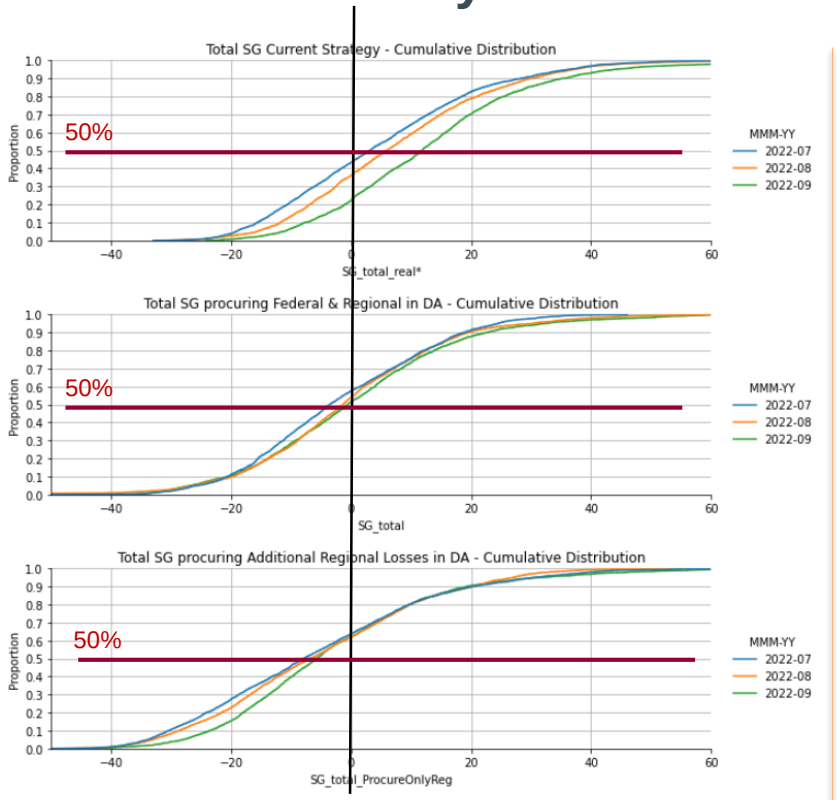
While further study may help improving the forecasting outcome, it is important to realize that ‘bad days’ do happen. While on average forecasting can be good, days with large errors (and resulting supply gaps) cannot be avoided.

Comparing the Supply Gap (SG) statistical distribution for both design options and the ‘as is’-scenario, option 1 shows a clear improvement whilst the effects towards the overall system are more limited and less beneficial in option 2.

AS IS

Option 1

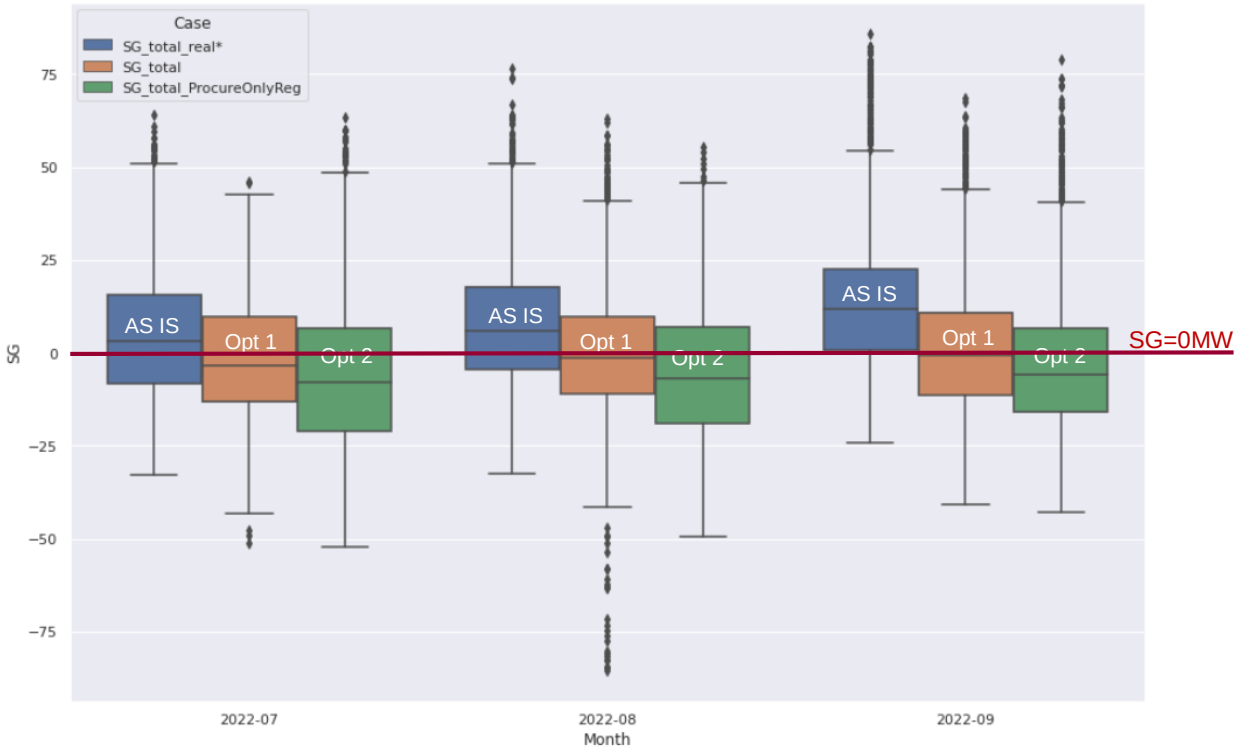
Option 2



SG < 0 MW
“Long” position

SG = 0 MW

SG > 0 MW
“Short” position



SG_total_real*: AS IS strategy computing the compensation in kind from the estimated OFFTAKE DA values.

SG_total: Considers the complete losses forecasted in DA (Federal + Regional)

SG_total_procuredOnlyReg: Acting in DA only on the regional losses. The federal part of the SG remains AS IS.

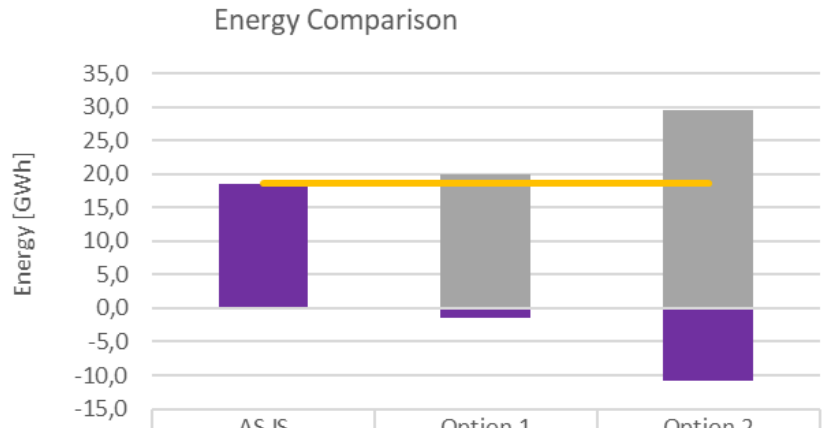
Option 1 allows to best target the minimization of the total supply gap.

Only targetting the regional supply gap (**option 2**) does not grasp the full potential of ST forecasting as the ‘unhandled’ federal supply keeps adding significant noise. The variance is not significantly reduced compared to an AS IS situation

Note, however, that this conclusion is based on a 3-month (summer) period only.

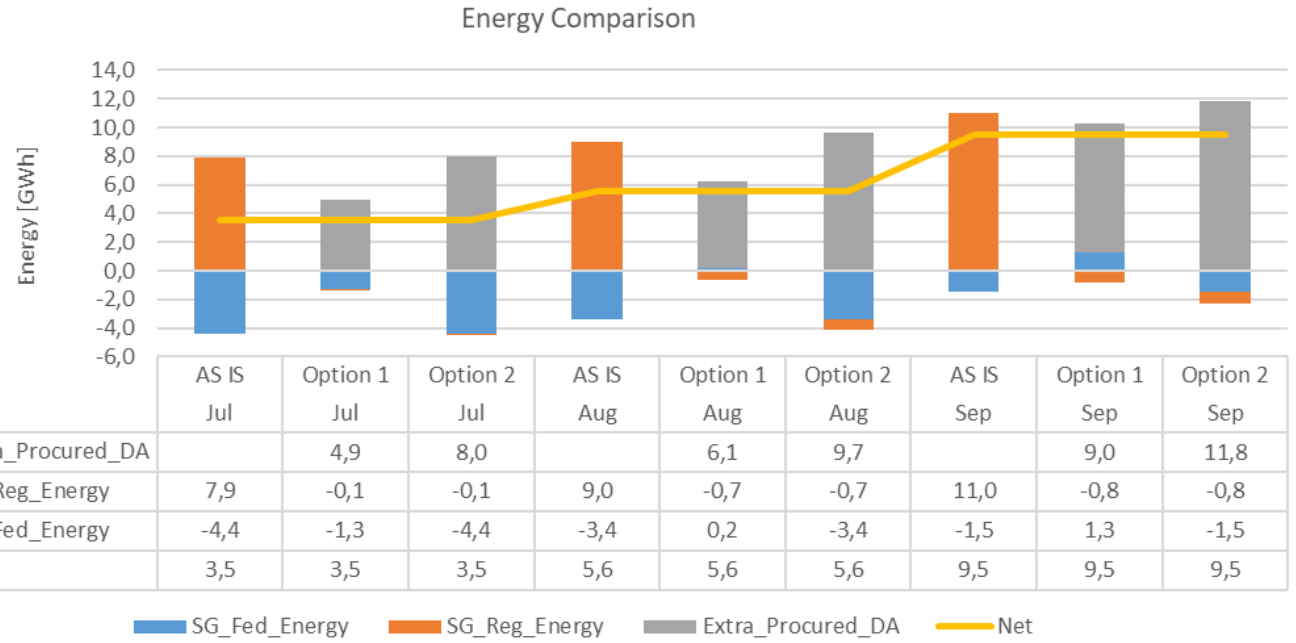
Impact analysis: in terms of impact the design options behave differently compared to AS IS, with option 1 outperforming option 2.

3-month overall view



	AS IS	Option 1	Option 2
Extra_Procured_DA		20,0	29,5
SG_Energy	18,6	-1,4	-10,9
Net	18,6	18,6	18,6

Monthly breakdown, SG breakdown



	AS IS Jul	Option 1 Jul	Option 2 Jul	AS IS Aug	Option 1 Aug	Option 2 Aug	AS IS Sep	Option 1 Sep	Option 2 Sep
Extra_Procured_DA		4,9	8,0		6,1	9,7		9,0	11,8
SG_Reg_Energy	7,9	-0,1	-0,1	9,0	-0,7	-0,7	11,0	-0,8	-0,8
SG_Fed_Energy	-4,4	-1,3	-4,4	-3,4	0,2	-3,4	-1,5	1,3	-1,5
Net	3,5	3,5	3,5	5,6	5,6	5,6	9,5	9,5	9,5

- Option 1, allowing to “net” regional and federal supply gap in the forecasting and procurement, results in lower volumes bought in DA and a lower remaining supply gap. In option 2, the efficiency of DA procurement for regional losses only is somehow undermined by not touching on the federal supply gap
- On the one hand, ST DA procurement will lead to more volumes bought by Elia compared to today. This impacts on costs in the tariffs.
- On the other hand, the remaining supply gap can be reduced, impacting positively the real-time context in terms of system imbalance and resulting imbalance price.

Lessons learned from the POC

- Forecasting **regional losses is feasible** with limited, and acceptable, forecast error.
- Whilst already indicating a clear potential for improvement, **forecasting federal losses is feasible, *but*** leaves the question on whether the outcome is sufficiently good to progress with the current model. Further study, especially related to the XB aspect, is recommended.
    - This result goes hand in hand with the results that we gained from the SIA international benchmarking, indicating other TSOs, such as Swissgrid and Amprion, struggeling with the optimization of their forecast linked to cross-border interactions, etc.
    - The short period that the POC ran only gives a limited insight and prudence in conclusions is needed, especially given no seasonal effects are tested (only 3months in summer so far), cross-border flows proved hard to include well etc.,...
- **The POC reveals that it is possible to make a solid contribution to reduce the supply gap** through ST procurement
    - Notwithstanding the recommendation to further investigate improvements to the federal losses forecasting, already now Option 1 (targeting total supply gap reduction) seems to provide the most interesting way forward from a system perspective.
    - Option 2 suffers from the noise created by the 'unhandled' federal supply gap, also leaving significant variance (similar to AS IS) in the supply gap. While the effect towards the overall system is clearly more limited and less beneficial compared to option1, there remains a principles-advantage in simply better covering regional losses.
- In terms of **impact**, the POC results not only indicate a **better coverage of losses,** but also indicate that **more volumes will be bought by Elia** to closer cover the regional losses compared to today. The resulting **smaller supply gap should be beneficial in the context of the real-time imbalance** of the zone and the imbalance pricing.
- **Operationally, the POC entailed shortcomings**, organizationally (e.g. back-up process, manual action, 5on7 days) but also technically (e.g. streamlining data access). The nature of the problems are linked to the POC-context, **but can be overcome when moving to a robust implementation in terms of IT and process**.

Notwithstanding the limitations of the POC, both in terms of operational perspective and the needed prudence in generalizing any results, Elia deems the results sufficiently 'promising' to indeed proceed to the incentive's next step of looking into an implementation plan.

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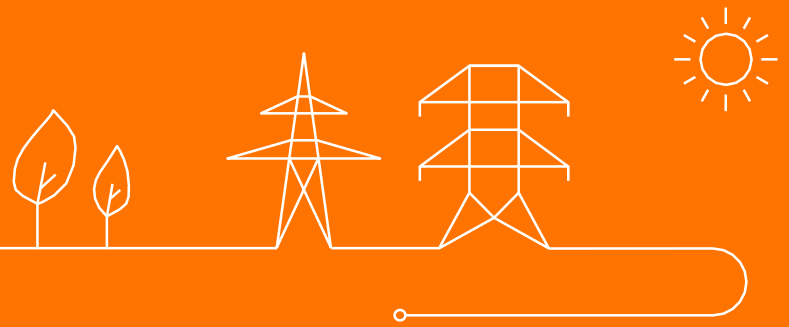
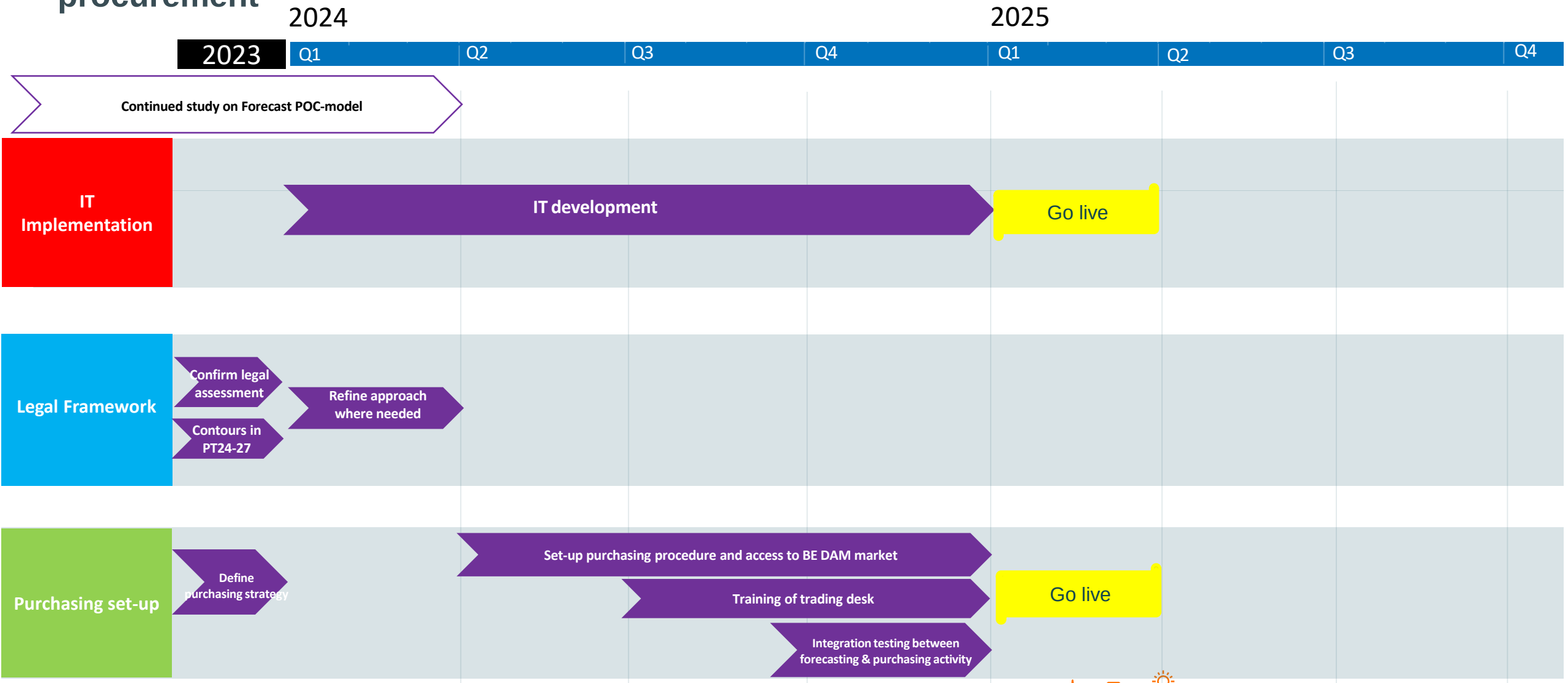


Estimated implementation timeline for the short-term forecasting and DA procurement



! The discussion to improve the mechanism in case of **multiple BRPs active on a single access point** should be further continued
The implementation is closely linked to other topics.

Putting in place a robust IT framework requires an estimated development time of 12 months.

- The IT framework should provide a tool with a robust IT and underlying data architecture in order to provide the ability to procure the losses in the day-ahead market on a daily basis.
- The necessary tooling should facilitate a close follow-up, alerting, link with a front office for the purchasing, but should also allow for the necessary back-up solutions. This should be able to run smoothly on a 7 on 7 basis.

➔ Taken into account a few assumptions with regards to resource management, the tool architecture and data security, the **estimated time to the technical go-live would be 12 months**.

Is the legal and regulatory framework fit-for-purpose?

- For the **potential addition of the federal grid losses to the Elia procurement** Elia considers that at least for the **short to mid-term (≤ 2027) changing the compensation in kind by BRPs to a procurement by Elia is not possible nor recommendable.** At least a multi-year advance notice is needed, next to foresee the implementation and a clear and stable framework.
- However, for the potential **mid-term evolution towards short-term (DA) procurement,** the framework is to be assessed on its feasibility:

A. Legal framework

1. The current legal framework is not perceived as blocking for this evolution.
2. Elia sees the current legal framework as sufficiently supportive for day ahead procurement but the contours for operating such mechanism benefit from being further aligned with CREG
3. Monitoring of evolutions of the legal framework at the European level

B. Regulatory framework (Here: Tariff framework)

1. To be agreed with CREG that the (tariff) framework would not be blocking to facilitate option1, i.e. where Elia targets both the federal and regional supply gap at once.
2. Elia sees the PT 2024-2027 as the best opportunity to align with CREG on the approach and set the contours.

Purchasing approach: A ‘simple’ buying strategy operating through 50HzT Front Office seems most appropriate given Elia’s role on the matter

- DA procurement requires Elia to be active on the DA Spot market, requiring a buying strategy, at least answering following questions:

	Suggested approach
Target volume?	Minimize Supply Gap (Total – Option 1, or Regional only – Option 2)
Price?	At any price, at all times → no price-setter, losses have to be covered.
Buy and/or sell?	Buy ‘only’ (reducing risk of ‘long’ position by means of prudent LT position)
Which NEMO?	Limit transaction costs, e.g. linked to the fact that 50HzT is already active on DA market

➔ Such basic approach seems most appropriate.

- Operating through the **50HzT front office**, which is already active in DA procurement of losses on spot market, seems an efficient solution.

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The incentive description underlying the study, the proof of concept and the implementation exercise raised two questions which were to be answered by Elia to the best of its abilities with the results obtained throughout the process:

> “ What is the relevance of the development of a short-term procurement component based on short-term forecasting as part of the optimization approach?”

- The POC indicates that a short-term DA procurement approach complementing the LT procurement is sufficiently promising, making use of either the design option 1 (most promising from system perspective) or option 2 (clearer cut in R&R/tariff), as an effective means to help mitigate the supply gap and sees the development of the process and IT tool possible starting in 2024.
- The resulting targeted go life is Q1 2025.
- Further study is however recommended, e.g. to better understand and try to improve federal losses forecast, to assess effects on a full year, etc.

> “ To what extend can Elia provide a more efficient procurement of both the federal and regional losses?”

- See slide 19 on the conclusion of the 30/6 final report.

Next steps:

- 15/12: POC results and implementation plan deliverable to CREG