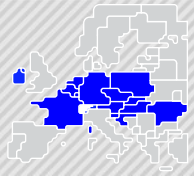
Core Net Position Forecast (NPF) aproach

What is NPF



Regulatory Context

- Article 13 of the Core Day-Ahead Capacity Calculation methodology 3rd Amendment prescribes how non-Core bidding zone borders are to be considered in the Core Day-Ahead Capacity Calculation process
- In particular, Article 13(3)(a) states:

  *"In the standard hybrid coupling, the Core TSOs shall consider the **electricity exchanges on bidding zone borders outside the Core CCR as fixed input to the day-ahead capacity calculation**. These electricity exchanges, **defined as best forecasts of net positions and flows for HVDC lines**, are defined and agreed pursuant to Article 19 of the CGMM and are incorporated in each CGM. They impact the F_ref and F_(0,Core) on all CNECs and thereby increase or decrease the RAM of the Core CNECs in order for those CNECs to accommodate the flows resulting from those exchanges. Uncertainties related to the electricity exchanges forecasts are implicitly integrated within the FRM of each CNEC."*
- The Net Position Forecast (NPF) is the vehicle to forecast **both Core net positions and commercial exchanges on non-Core bidding zone borders** and provides the **'best forecast'** as required by Article 13(3)(a) of the Core Day-Ahead Capacity Calculation methodology 3rd Amendment

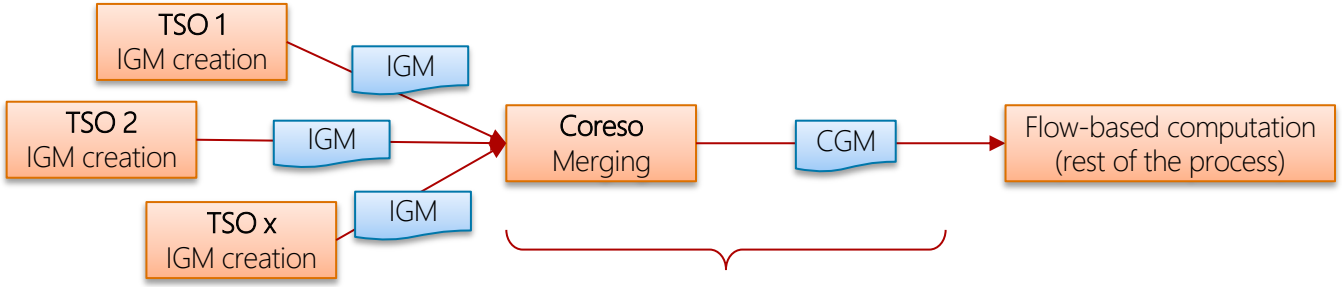
What is NPF?

- NPF is a tool that forecasts Core net positions and commercial exchanges on non-Core bidding zone borders
- NPF is a machine learning based model:
  - Learns from historical data (like past net positions, cross-zonal exchanges, temperature, load, PV, wind)
  - Predicts exchanges in D-2 (inputs = forecasts of temperature, load, PV, wind)
- NPF is used in the Core day-ahead capacity calculation process as a reference for Individual Grid Model Generation and during merging
- NPF is operated by Coreso, one of the RCCs in Core CCR

Core Net Position Forecast (NPF) approach

How is NPF used

Core DA CC



TSOs create IGMs that reflect the NP forecasted by NPF

In the merging, the bidding zones are adjusted to reflect the NPF*

Benefits:
- Representativity of CGM is improved
- One harmonized forecast used by all TSOs → coherent set of NPs.

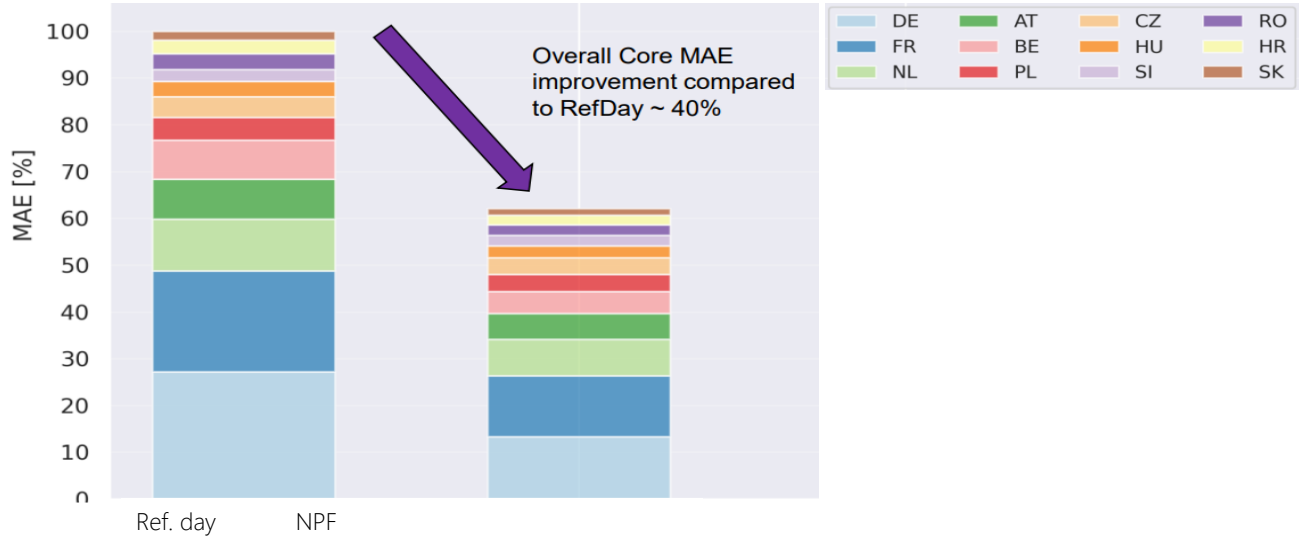
* Modified where needed to respect "feasibility ranges" defined by TSOs (**B**ase **C**ase **I**mprovement)

Core Net Position Forecast (NPF) approach

How good is the forecast

Comparison to the Reference Day Approach

- Before NPF, the merging was performed according to net positions of the reference day (previous working day/Saturday/Sunday).
- Analysis of MAE (mean average error) is done of the reference day approach and NPF:



- NPF is a clear improvement compared to reference day approach
- A detailed analysis shows that NPF:
  - Works better for all Core bidding zones
  - Reduces high error situations (NPF has smaller errors for high/low quantiles than reference day approach)
  - Also performs better for forecasting on non-Core borders (e.g. HVDC links)

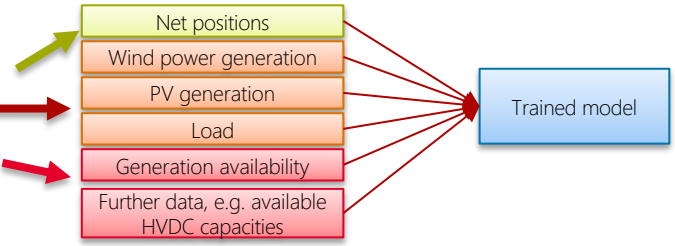
Core Net Position Forecast (NPF) approach

How does it work?

The machine learning algorithm works in two steps that are executed independently for each forecasting item (i.e. each forecasted net position or cross-zonal exchange)

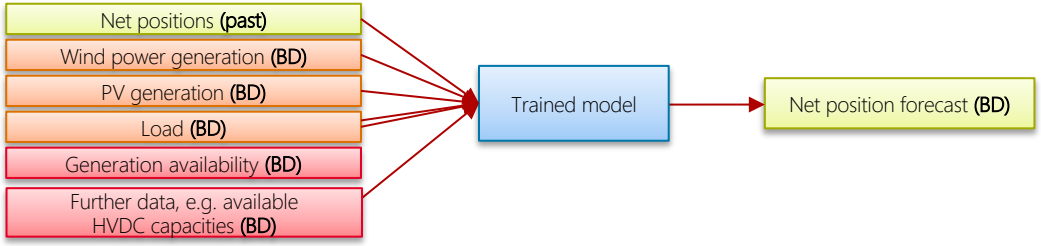
Step 1: Model training

- A forecasting model is trained via machine learning based on past data, i.e. it "learns" from historical data, using:
  - Realised values of the forecasting item (i.e. what the model tries to forecast)
  - Forecasts of weather-dependent fundamentals from a dedicated provider
  - Additional power system-relevant data available on TSO systems/platforms



Step 2: Prediction

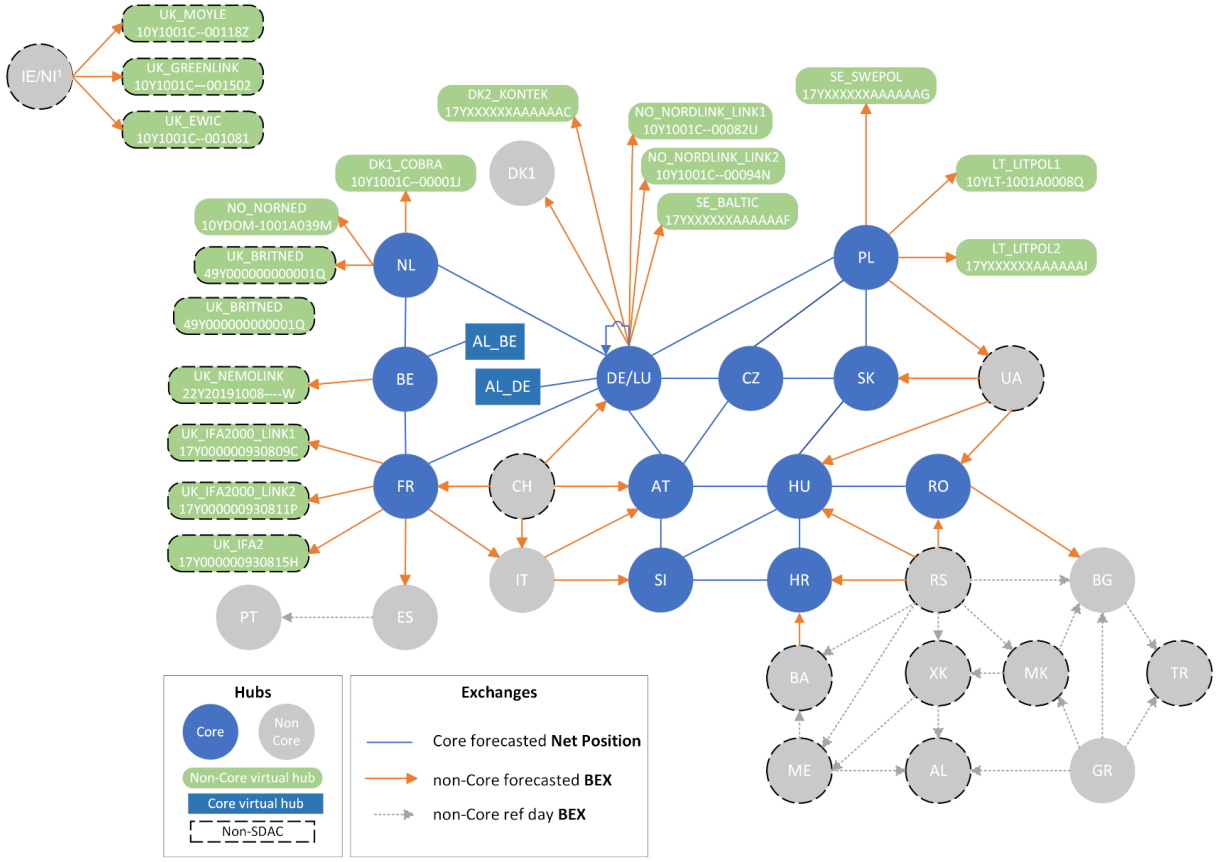
- The trained model is supplied with latest available information for forecasting the new business day (e.g. forecasts of wind power/PV generation and load, as well as on the realized values of the forecasting items in the past), and then makes a prediction for the new business day:



Core Net Position Forecast (NPF) approach

Geographic scope

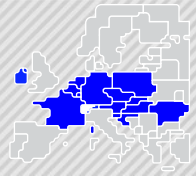
- This figure shows which forecasting items are currently present in NPF (inclusion of Ireland and Northern Ireland planned in Q1 2026)
- Each arrow corresponds to one time series in the NPF output file
- Reference day bilateral exchanges (grey arrows): instead of a forecast, the realized exchange of a past day is provided.



[1] NPF is used to forecast exchanges between GB and SEM first from go-live of of Celtic interconnector

Core Net Position Forecast (NPF) approach

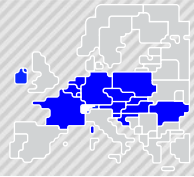
Forecasting approach per non-Core BZB 1/2



Core Non-Core BZB	Core TSO	Pre AHC	Post AHC	Forecast assessed against NPF (where relevant)	Forecast document (where relevant)
BE-UK	Elia	Own forecast	own forecast	yes	see Annex
BA-HR	HOPS	NPF	NPF		
CH-AT	APG	NPF	NPF		
CH-DE	TBW/AMP	NPF	NPF		
CH-FR	RTE	NPF	NPF		
DE-DK1	TTG	NPF	NPF		
DE-DK2	50Hz	NPF	NPF		
DE-NO2	TTG	Own forecast	Plan to use NPF by end of 2026	no	
DE-SE4	TTG	Own forecast	Plan to use NPF by end of 2026	no	
FR-ES	RTE	NPF	NPF		
FR-IT	RTE	NPF	NPF		
FR-UK	RTE	NPF	NPF		

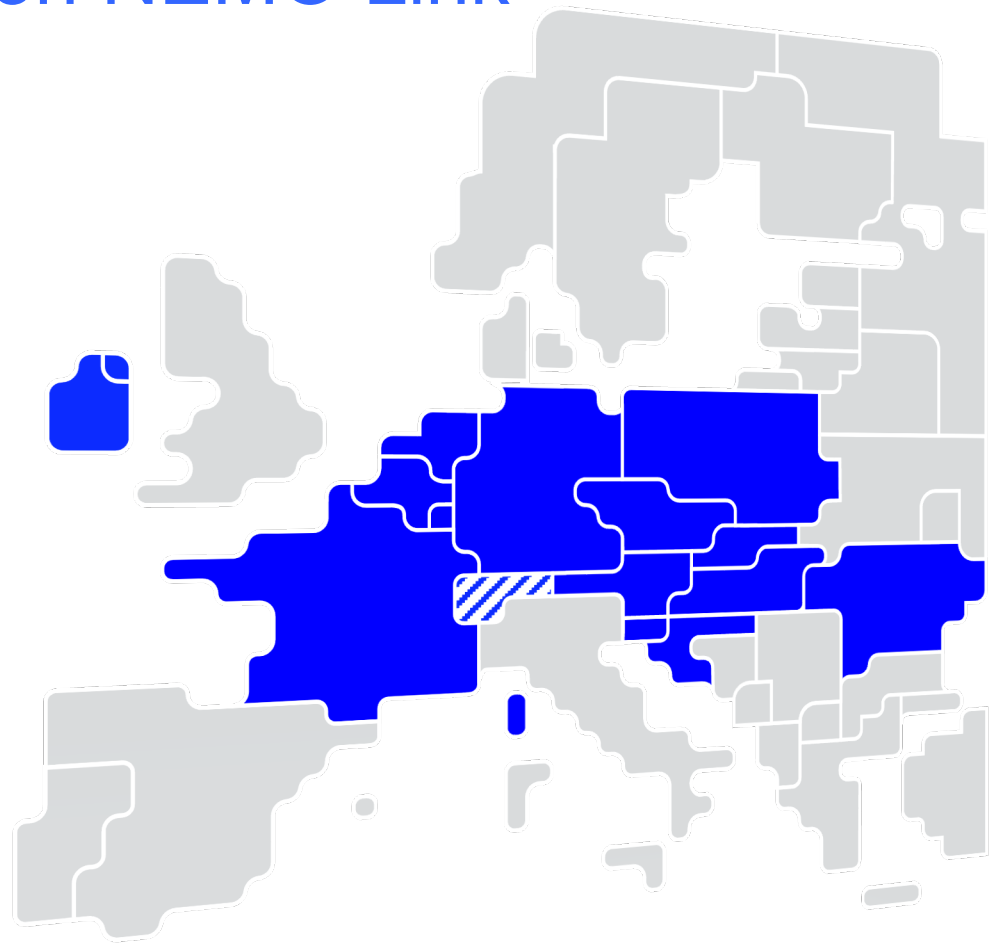
Core Net Position Forecast (NPF) approach

Forecasting approach per non-Core BZB 2/2



Core Non-Core BZB	Core TSO	Pre AHC	Post AHC	Forecast assessed against NPF (where relevant)	Forecast document (where relevant)
IT-AT	APG	NPF	NPF		
IT-SI	ELES	NPF	NPF		
NL-DK1	TTN	Own forecast	Own forecast		
NL-NO2	TTN	Own forecast	Own forecast		
NL-UK	TTN	Own forecast	Own forecast		
PL-LT	PSE	NPF	NPF		
PL-SE4	PSE	NPF	NPF		
PL-UA	PSE	NPF	NPF		
RO-BG	TEL	NPF/own forecast	NPF/own forecast		
RO-RS	TEL	NPF/own forecast	NPF/own forecast		
RO-UA	TEL	NPF/own forecast	NPF/own forecast		
RO-MD	TEL	NPF/own forecast	NPF/own forecast		
RS-HR	HOPS	NPF	NPF		
HU-RS	MAVIR	NPF	NPF		
HU-UA	MAVIR	NPF	NPF		

Annex: Forecast on NEMO Link



N-SIDE

Nemo Link flow forecast

Product description

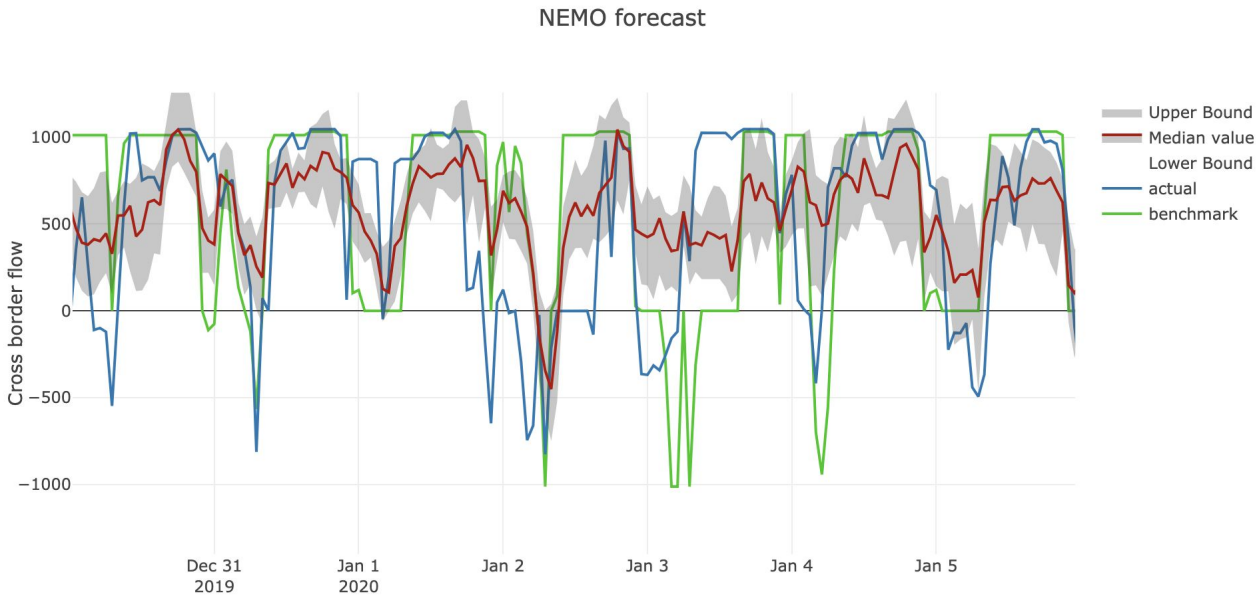
January 2026

Product specifications

N-SIDE provides a forecast of the **Nemo Link physical flow forecast** (in MW), with hourly resolution (red curve in figure).

N-SIDE provides the forecast (at least) **two different times within a day**:

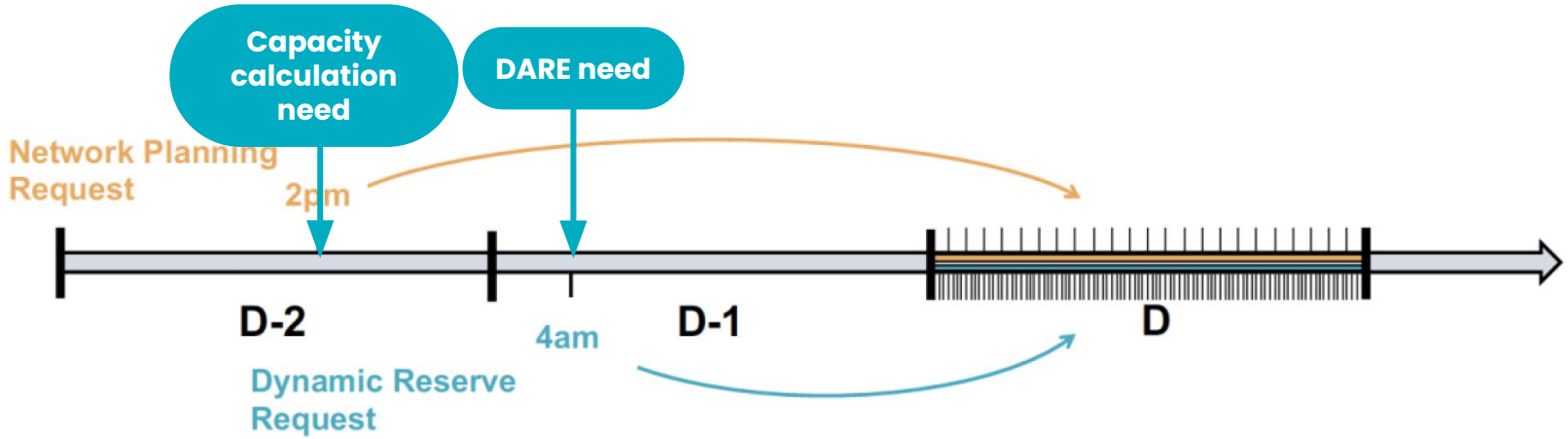
- **Two days in advance (D-2)**, a new forecast is made available at 14:00 (Belgian time) for Network Planning purposes. The forecast is given with an hourly resolution.
- **One day in advance (D-1)**, a new forecast is made available at 04:00 (Belgian time) for Dynamic Reserve Calculation purposes. The forecast is given with an hourly resolution.



Elia use cases

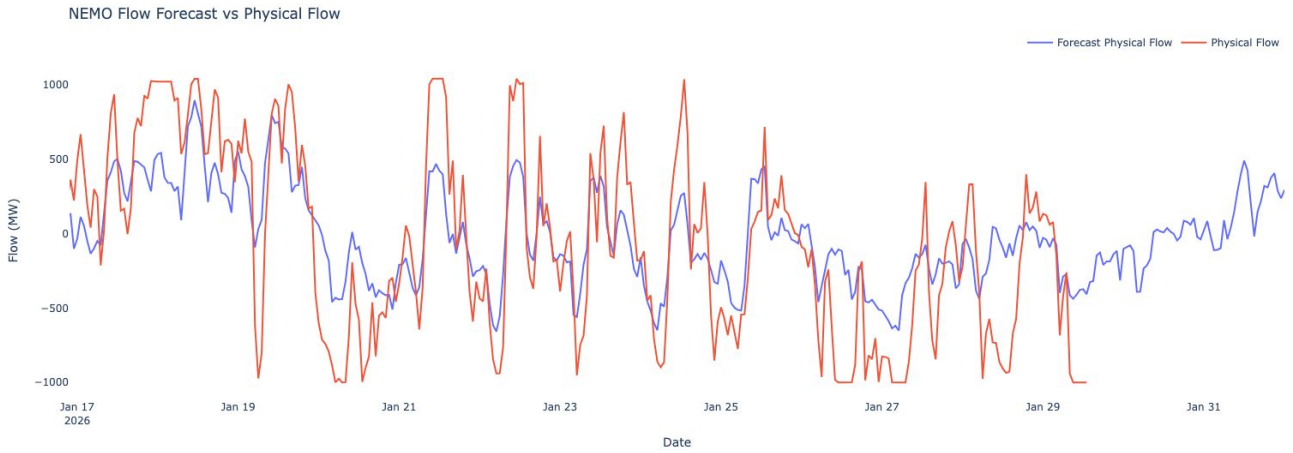
Elia uses a physical flow forecast for two use-cases:

- The DARE tool, which allows ELIA to dynamically size the FRR reserve needs every day on D-1 at 4AM
- A physical NEMOlink flow forecast for the D-2 capacity calculation process



Nemo Link flow forecast was developed by N-SIDE and is available to Elia since Sep 2020

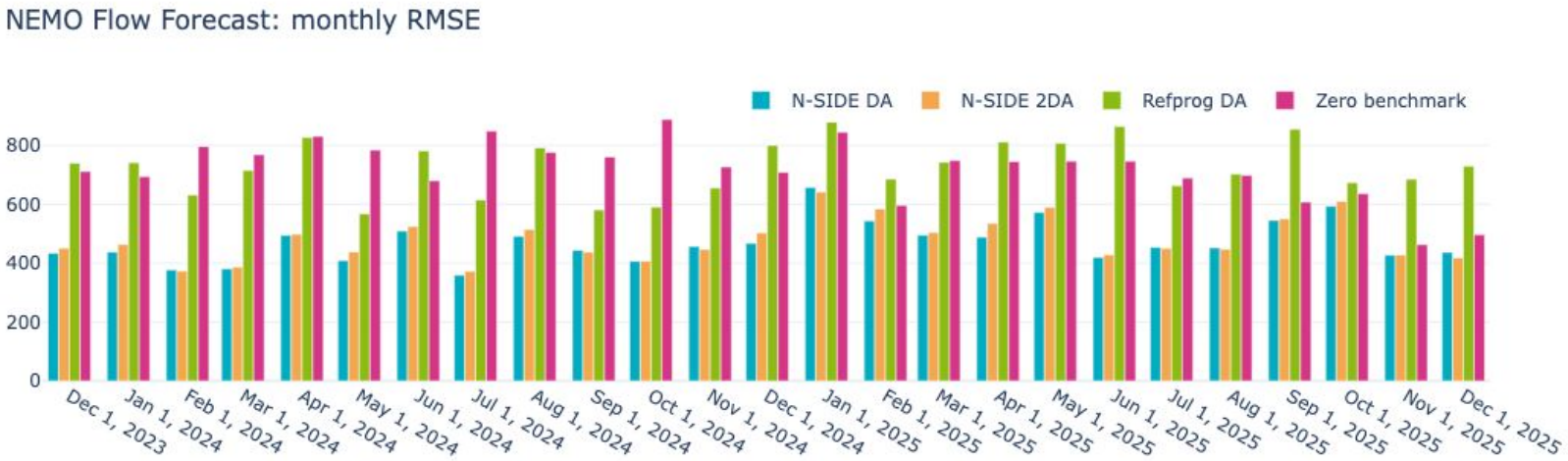
- A ML-based forecast was developed by N-SIDE, based on **historical data of the Nemo Link physical flow**
- The forecast is used in **production** since September 2020
- Forecast is available from D-4 to D-1, 4:00 AM



Input drivers: weather forecasts, solar and wind generation forecasts, load forecast, time features, historical prices, etc.

ML model : N-SIDE custom Boosted Regression Trees models for time-series forecasting in Energy

Consistent benefits of the models compared to the benchmarks



The model has a consistent performance throughout the year and out performances these benchmarks:

- Zero flow benchmark
- Refprog

N-SIDE

Thank you

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