KU LEUVEN

Transparency++: Bringing more transparency to the ENTSO-E TP data and forecasts

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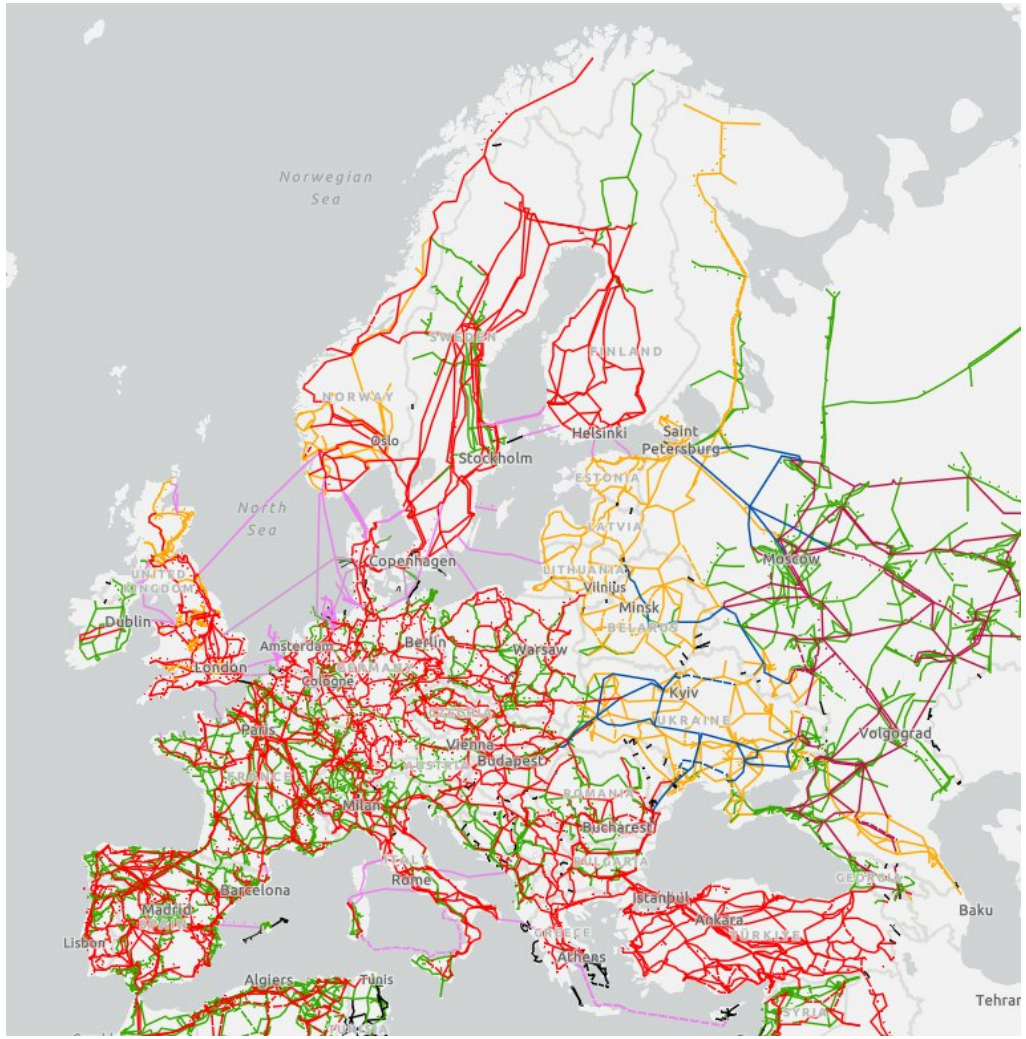
Content

- Introduction
- ENTSO-E Transparency Platform (TP)
- ENTSO-E TP Problems
- What can be done?
- Dashboard
- Conclusions

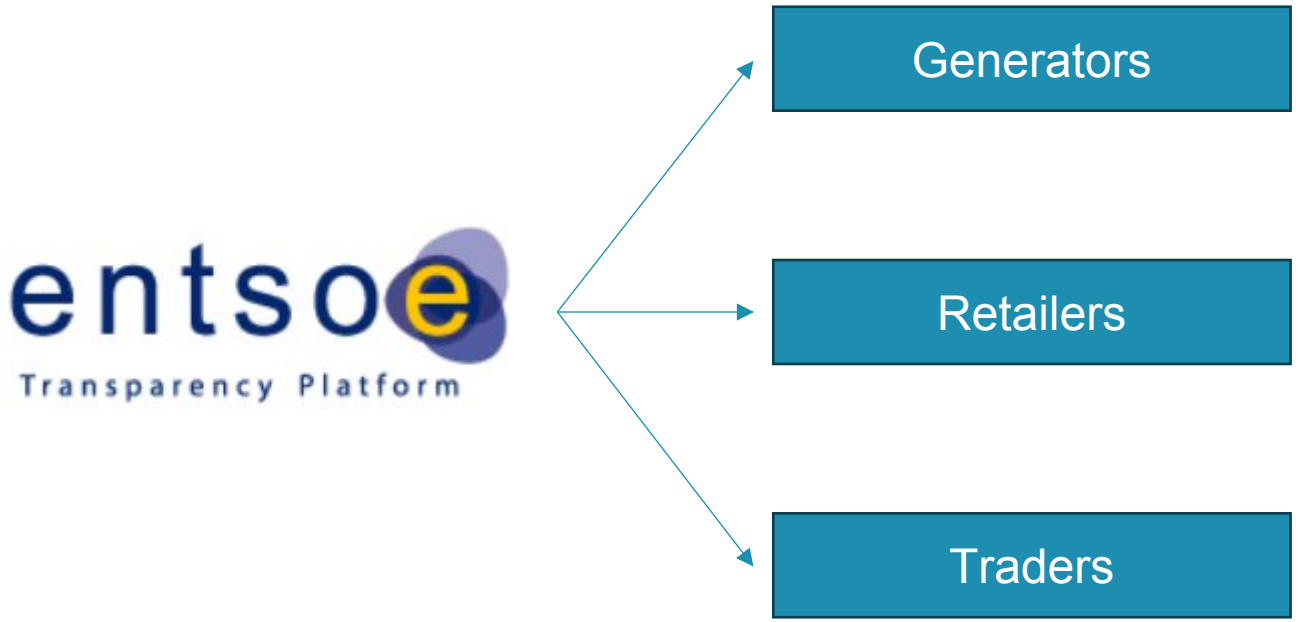
Introduction

- TSOs: forecast load, renewable generation
- Contract: generation, reserve capacity
- Third parties use forecasts
- Inaccurate forecasts: higher balancing, costs
- Cross-border flows



Transmission system network. ENTSO-E image.

ENTSO-E Transparency Platform (TP)



Central point for the collection, aggregation, and publication of electricity market data across Europe

ENTSO-E TP | Problems

Data Quality

- Missing Values
- Nonsense Values
- Incompatible Data Sources

ENTSO-E TP | Problems

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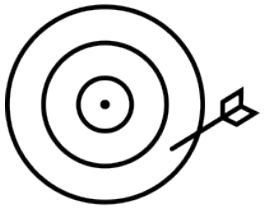
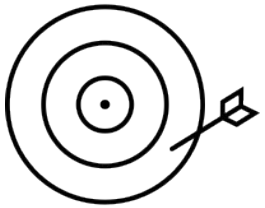


Missed Opportunities

- TSO Detailed Forecasts

ENTSO-E TP | Problems

- Data Quality
  - Missing Values
  - Nonsense Values
  - Incompatible Data Sources



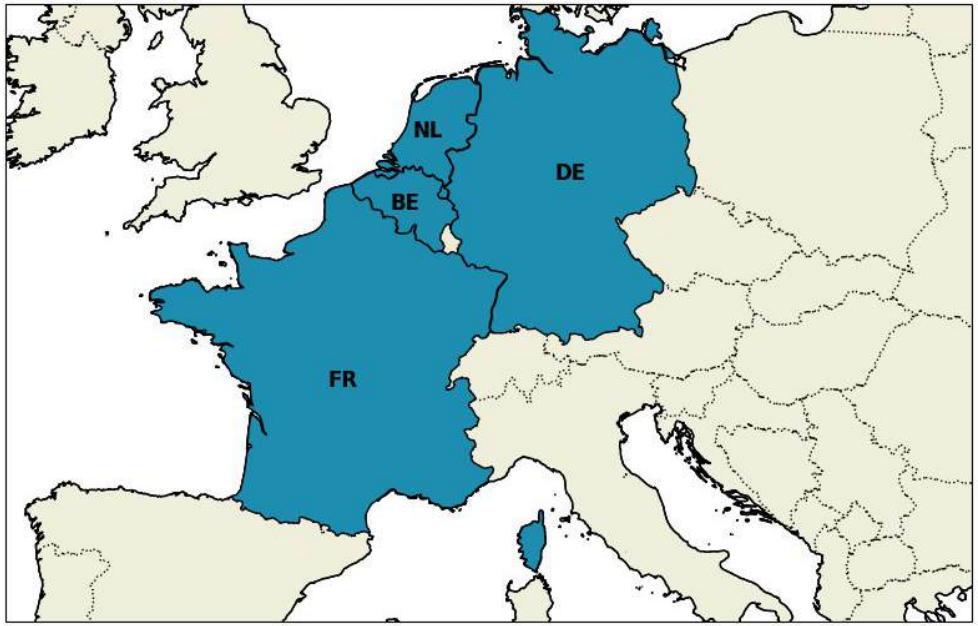
- Missed Opportunities
  - TSO Detailed Forecasts

- Missing Documentation
  - Frequency of Updates
  - Info on Data Quality

Data

Data from BE, FR, NL and DE-LU | 2024

- Load
- Load Forecast
- Solar
- Solar Forecast
- Wind Onshore
- Wind Onshore forecast
- Wind Offshore
- Wind Offshore forecast



Evaluation Metrics

Data Quality

Zonal Statistics

Forecast Accuracy

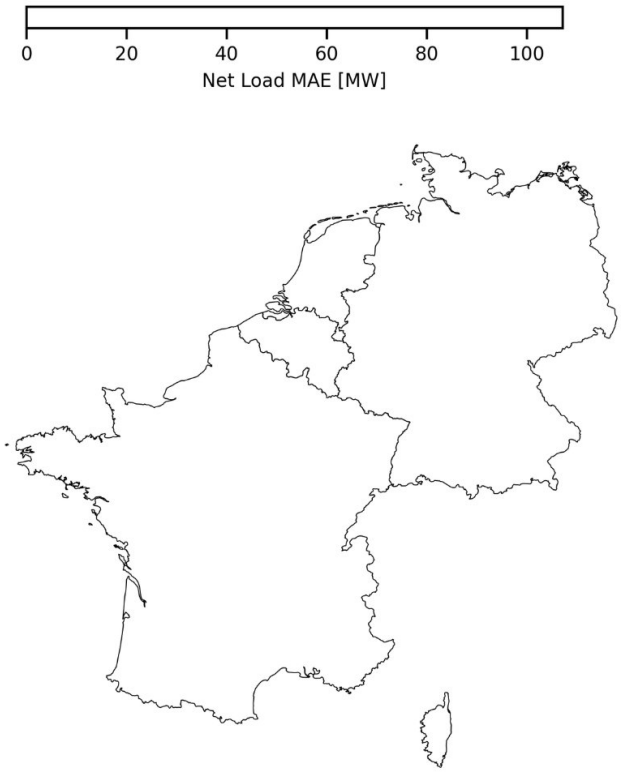
Evaluation Metrics

Data Quality

- **Completeness** - Percentage of missing values per field
- **Plausibility -** Values were flagged if negative or exceeding installed capacity (for solar and wind); for load, only negative values
- **Consistency** - Repeated measurements (>24 times) were flagged

Evaluation Metrics

Zonal Statistics



Net Load (NL):

$$NL_t = L_t - \left(W_t^{\text{on}} + W_t^{\text{off}} + S_t\right)$$

MAE of the NL:

$$MAE_{NL} = \frac{1}{N}\sum_{t=1}^{N}\left|NL_t - NL_t^f\right|$$

L_t: Actual load at time t

W_t^{on}: Actual wind onshore generation at time t

W_t^{off}: Actual wind offshore generation at time t

S_t: Actual solar generation at time t

NL_t: Actual net load at time t

NL_t^f: Forecast net load at time t

N: Total number of observations

Evaluation Metrics

Forecast Accuracy

$$MAE = \frac{1}{N}\sum_{t=1}^{N}|y_t - \hat{y}_t|$$

$$RMSE = \sqrt{\frac{1}{N}\sum_{t=1}^{N}(y_t - \hat{y}_t)^2}$$

$$rMAE = \frac{MAE}{MAE_{pers}} = \frac{\frac{1}{N}\sum_{t=1}^{N}|y_t - \hat{y}_t|}{\frac{1}{N}\sum_{t=1}^{N}|y_t - y_{t-\delta}|}$$

$$NMAE = \frac{MAE}{C_{installed}} \times 100 = \frac{\frac{1}{N}\sum_{t=1}^{N}|y_t - \hat{y}_t|}{C_{\text{installed}}} \times 100$$

y_t: Actual value at time t

$\hat{y}_t$: Forecast value at time t

$y_{t-\delta}$:Actual value δ hours before time t (persistence model)

N: Total number of observations

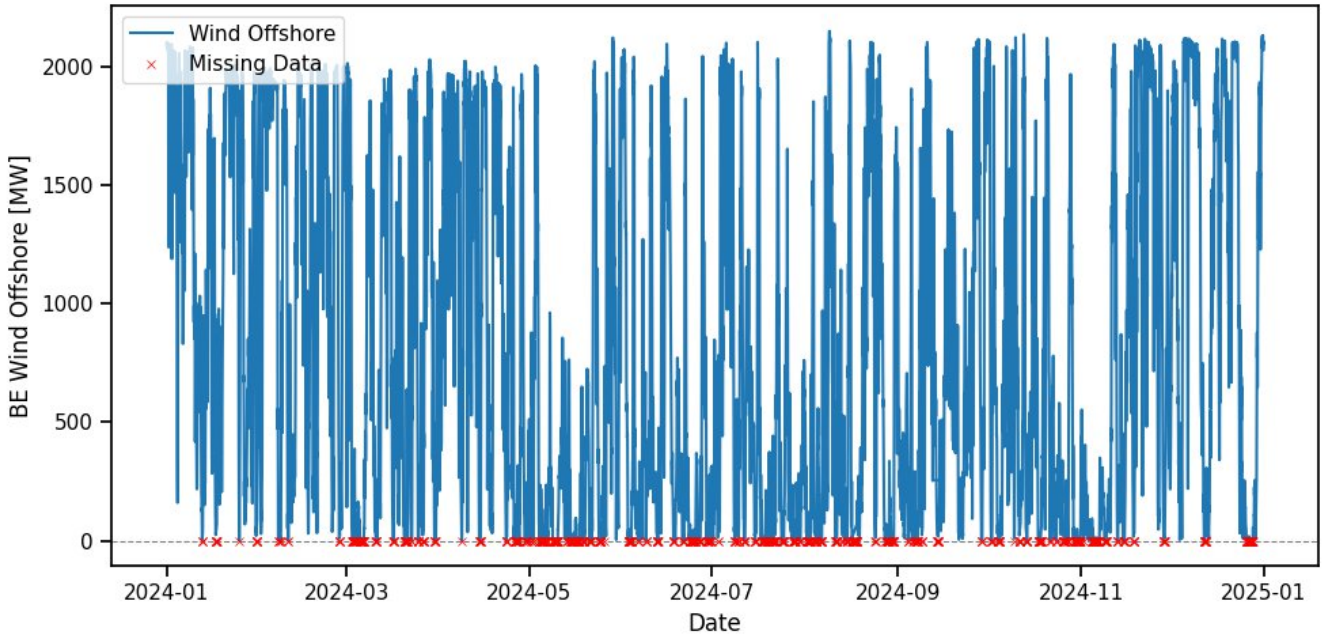
MAE_{pers}: MAE of the persistence model

δ: 24 hours (solar, wind) or 168 hours (load)

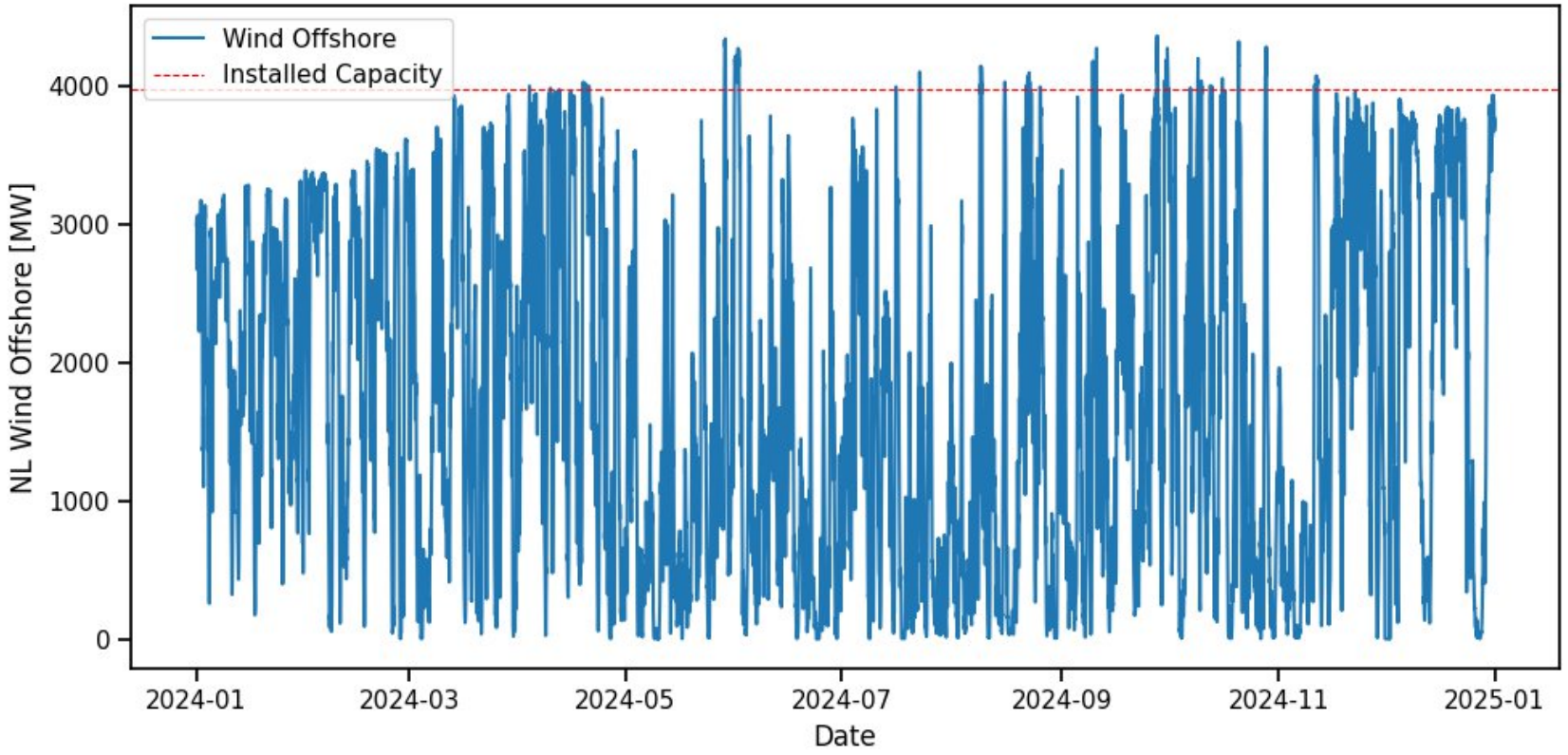
$C_{installed}$: Installed capacity (or average load for the load)

Results: Data Quality - Completeness

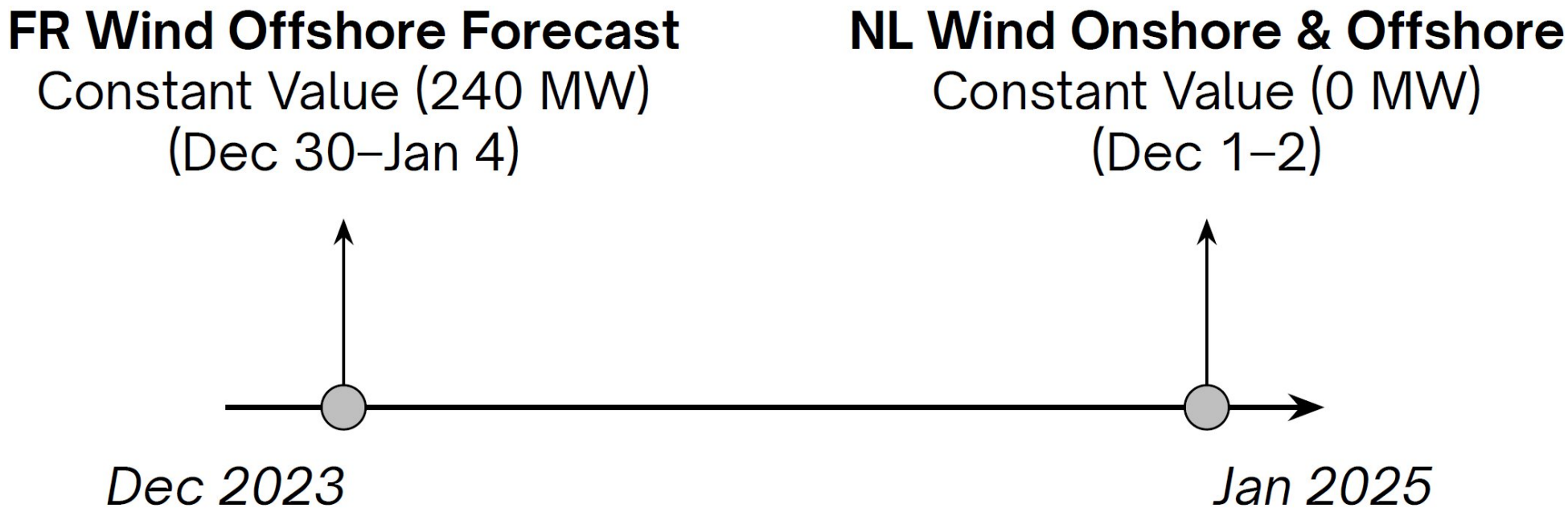
BDZ	Variable	Missing Values [%]
BE	Wind offshore	10.79
NL	Load	0.24
FR	Load	0.11
FR	Solar forecast	0.01
FR	Wind offshore	0.23
FR	Wind onshore forecast	0.01
DE-LU	Load	0.25
DE-LU	Solar forecast	0.55
DE-LU	Wind onshore forecast	0.27



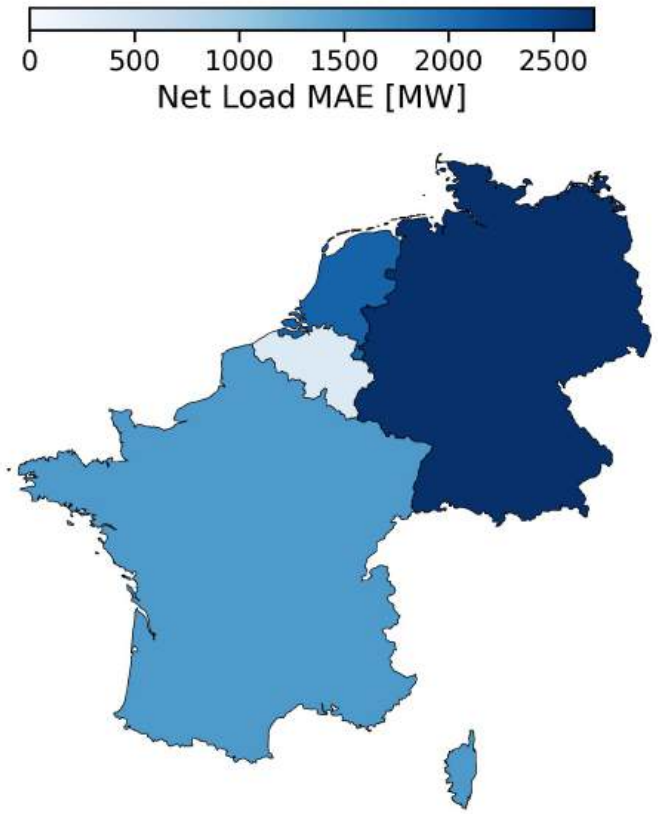
Results: Data Quality - Plausibility



Results: Data Quality - Consistency

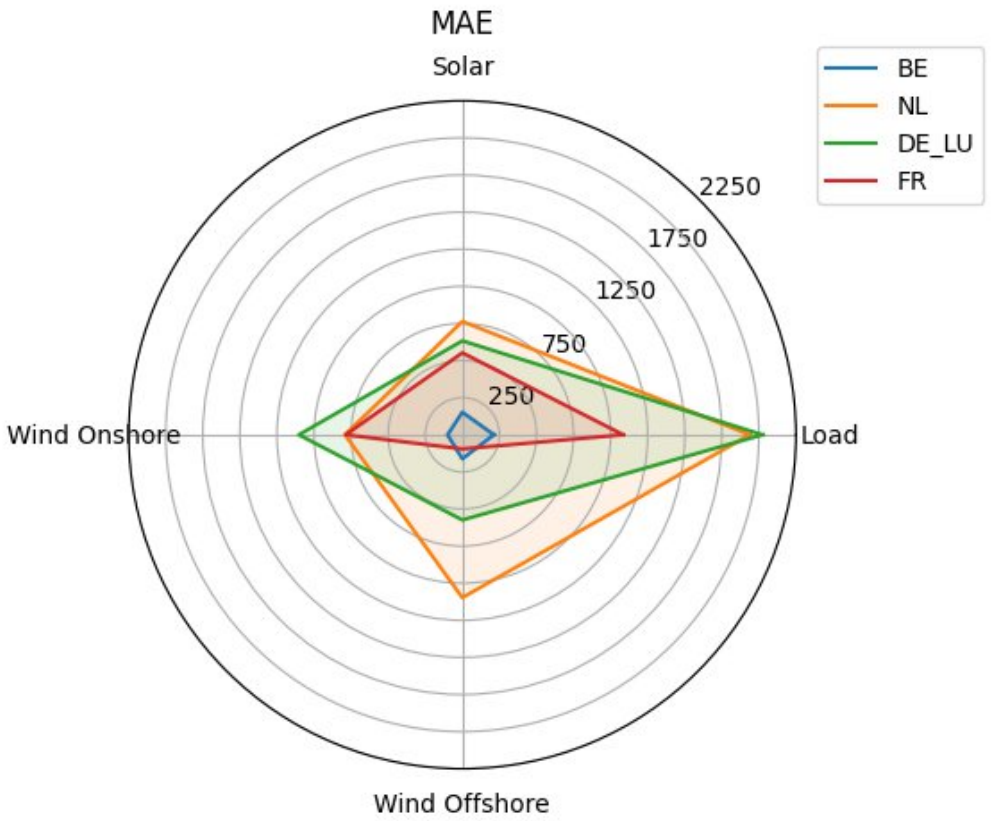


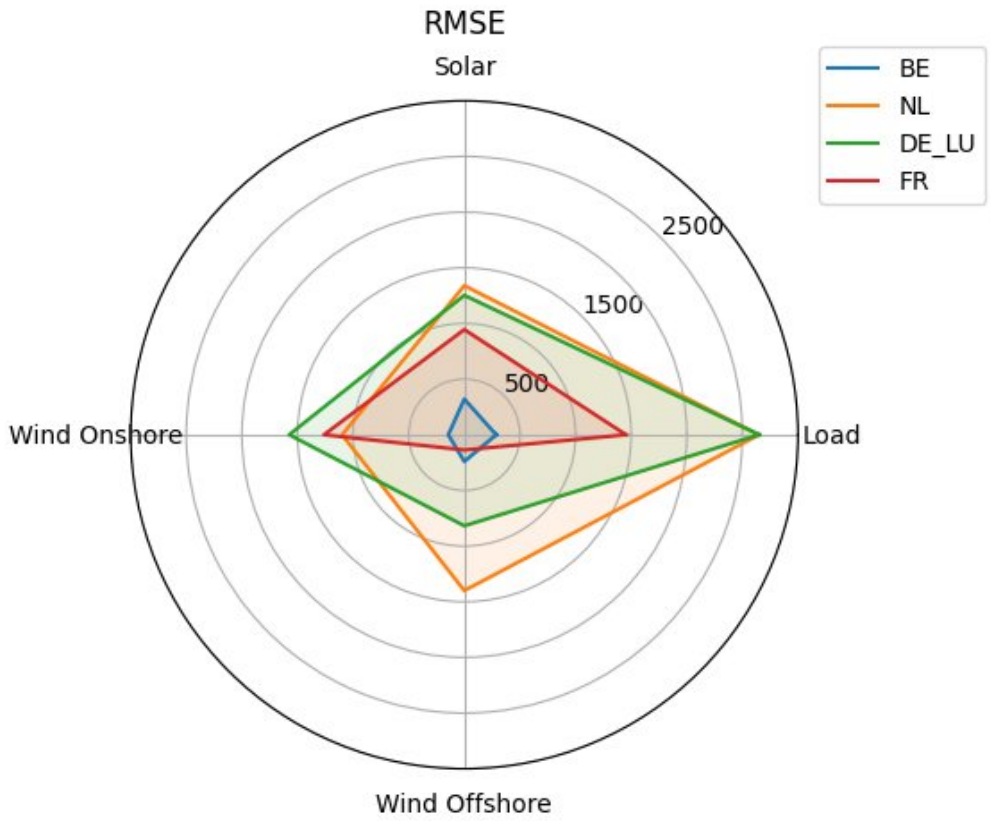
Results: Zonal Statistics



BDZ	NL MAE [MW]
BE	358.95
NL	2166.38
FR	1583.81
DE-LU	2692.47

Results: Forecast Accuracy





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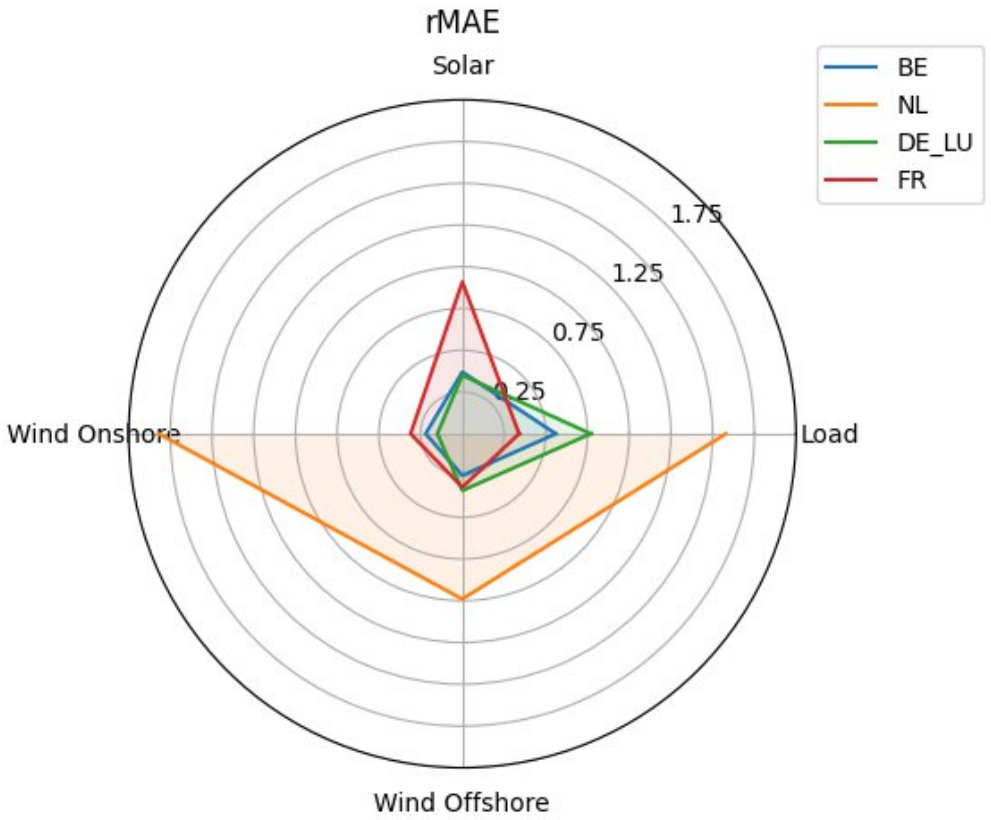

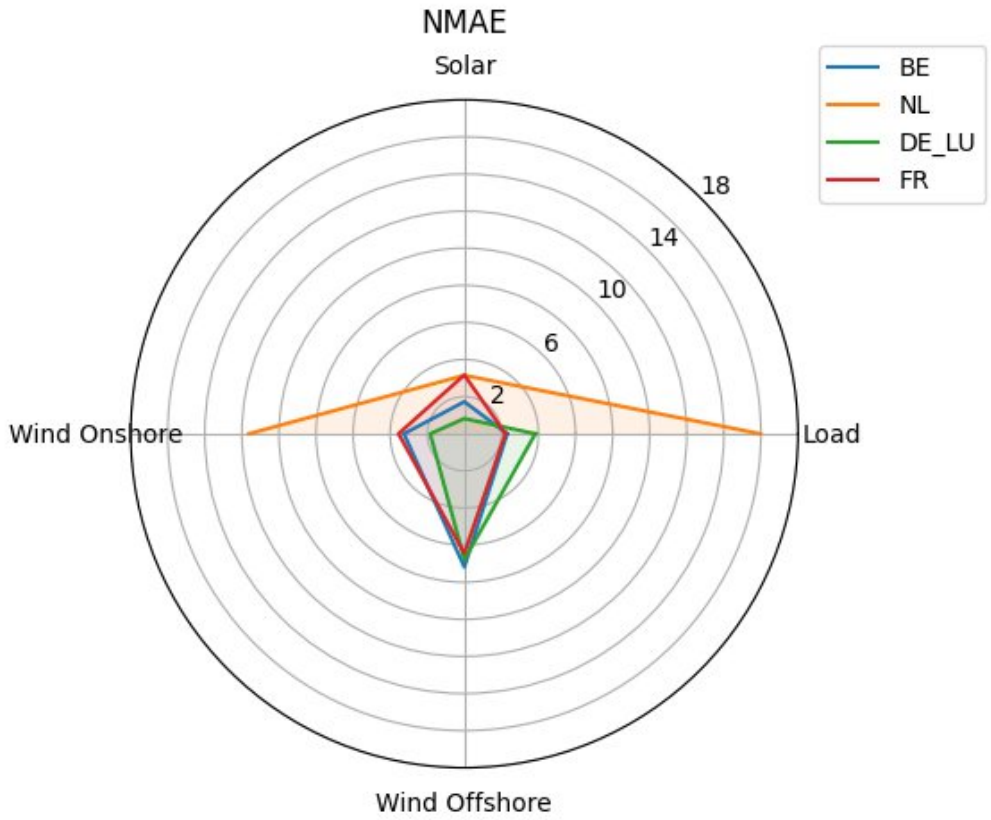

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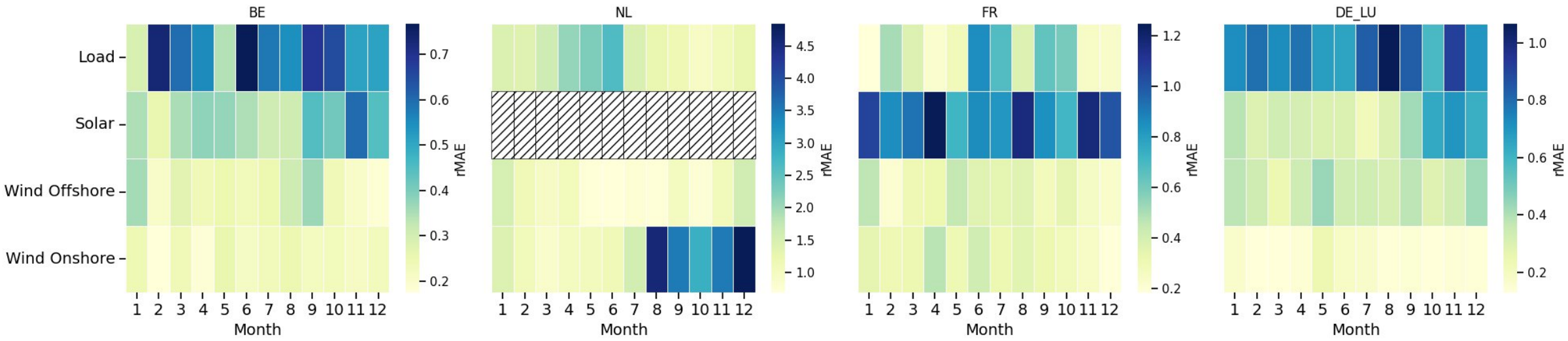

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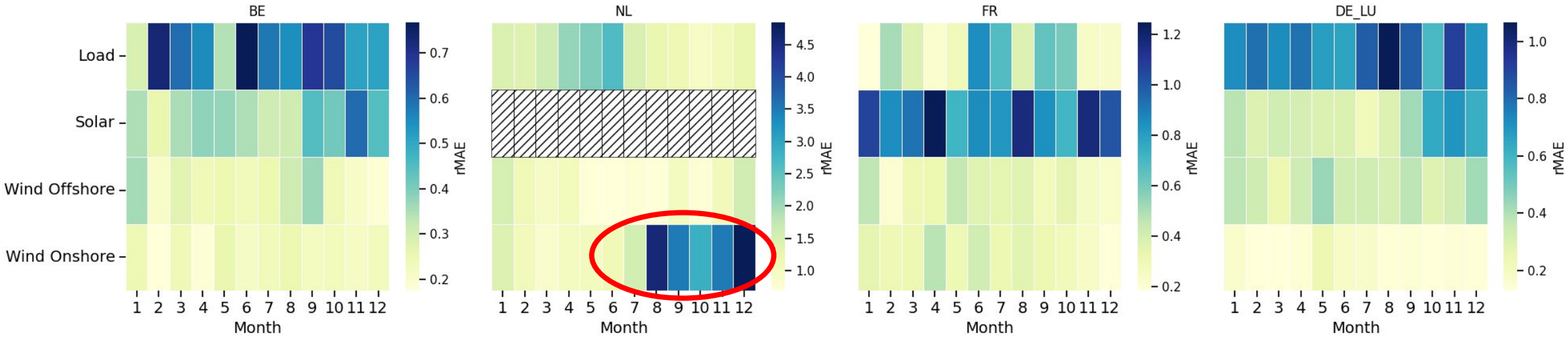


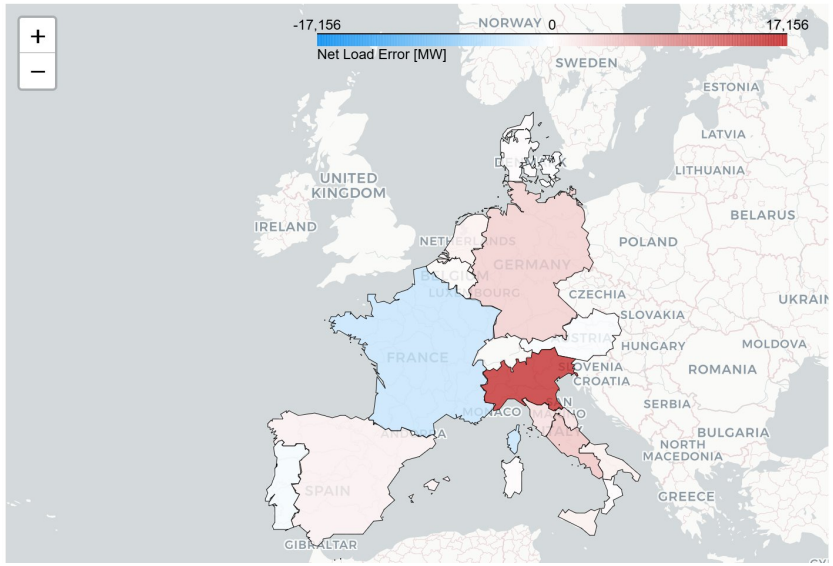
Dashboard | Transparency++

Transparency++

Evaluate and analyze ENTSO-E Transparency Platform data quality, forecast accuracy, and energy trends for ENTSO-E member countries.

Net Load Error Map

The net load error map highlights the error in the forecasted versus actual net load for each country. Hover over each country to see details on the latest net load error and the timestamp (with the time zone of the corresponding country) of the last recorded data.



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Dashboard | Transparency++

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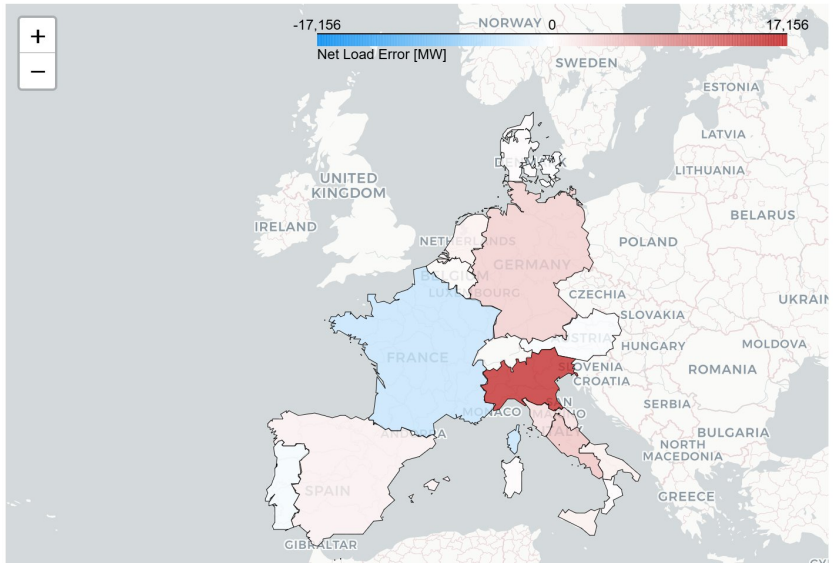

Transparency++

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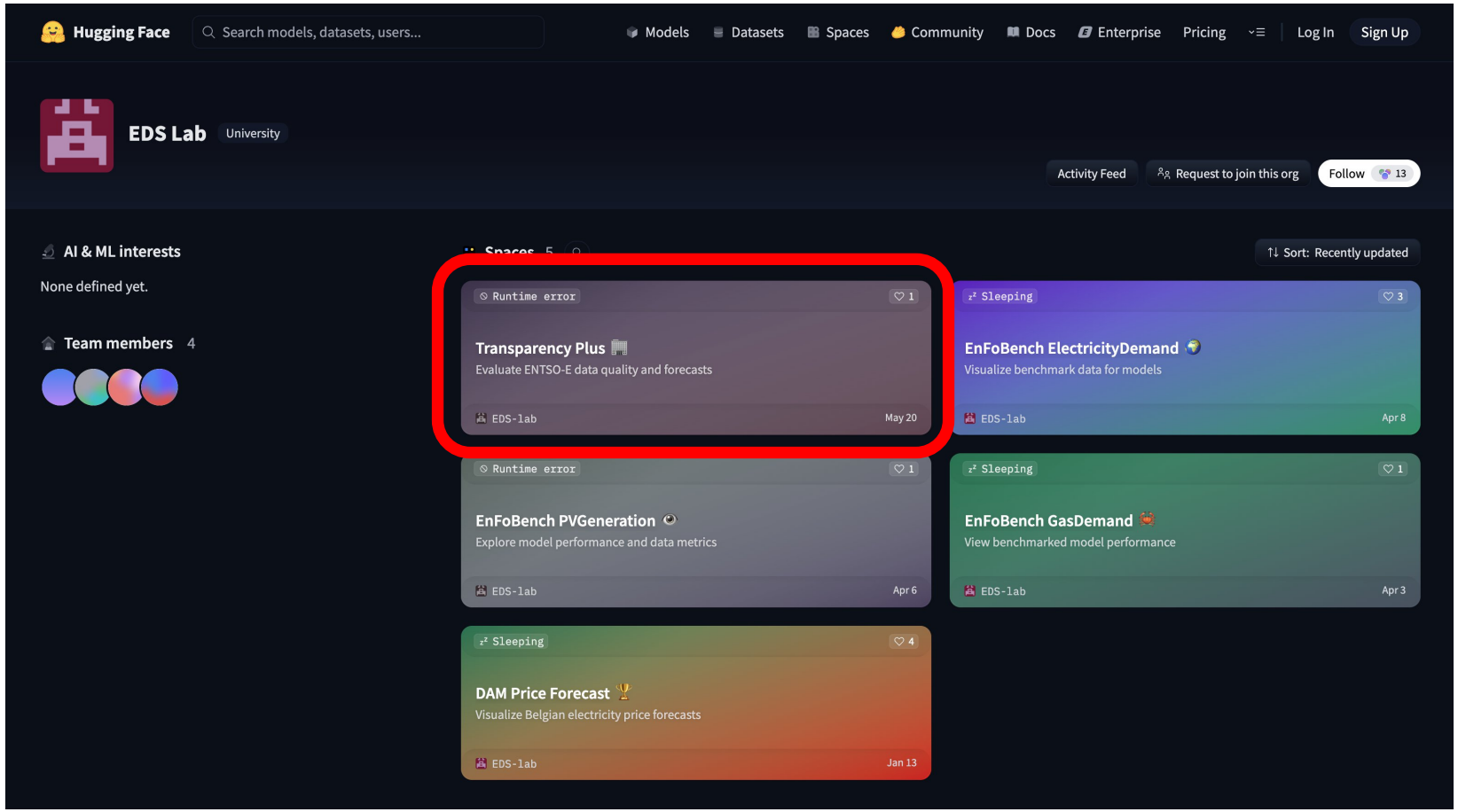
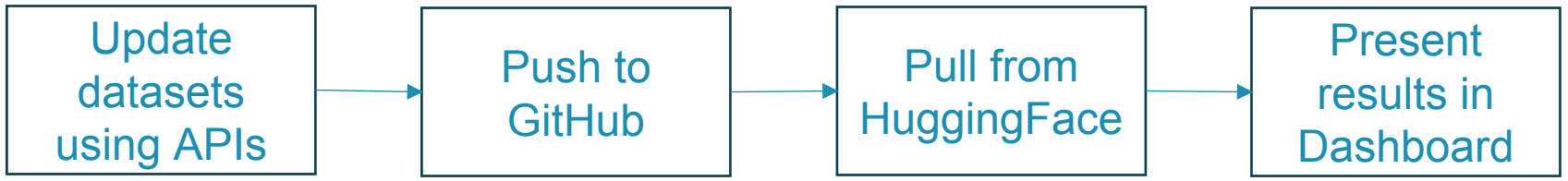


Pipeline | Transparency++

Transparency++



entsoe Transparency Platform

GitHub

Hugging Face

Streamlit

Conclusion

Data Quality
Zonal Statistics
Forecast Accuracy
Bringing Visibility
Better Data
Better Forecasts

What's Next

- Transparency ++ (v0.2)
  - ✓ Extended monitoring to all binding zones of ENTSO-E
  -

Move from monitoring to forecasting; operational, daily forecasts
  -

Benchmark against TSO / ENTSO-E forecasts

What features or insights would help your applications (e.g., conformal predictions of the forecasts, other metrics, consistency checks, cross-model comparisons)?