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Internship Outcomes

Probabilistic Forecasting in Practice: Use-Case Strategies

Agenda

- **Uses Cases Based on Sector**
- **Potential Business Cases for Probabilistic Forecasts - Client Based**
- **Understanding the penalty scheme - Case 1: Neoen (14MW - France)**
- **Results and Findings – Based on Revenue Improvements & Volume Deviations**
- **Comparisonal Analysis with Case 2: Sunnic (85 MW - Germany)**
- **Overview on Energy Regulators**

Uses Cases Based on Sector

Energy Market Participation

- Optimal Quantile Bidding
- Revenue Optimization
- Risk Management

Grid and Portfolio Management

- Balancing Reserve Sizing
- Congestion Management
- Portfolio Diversification

Asset Operation and Optimization

- Battery and Hybrid System Dispatch
- Storage Optimization
- Curtailment Management

Enhanced Strategies and Services

- Insurance Products
- Contract Structuring

Potential Business Cases for Probabilistic Forecasts - Client Based

Part 1/2

Clients	Category	Usability	Output	Complexity & Status Quo
Urbasolar(FR)	IPP	Revenue Maximization	% increase in revenue	High + Strong
Neoen (FR)	IPP			
Vena Energy (IDN)	IPP			
Enefit Green(EST)	IPP			
Adris Grupa(CRO)	IPP			
BlueLeaf Energy(AsiaPacific)	IPP			
Engie Chile	IPP			
Finerge (POR)	IPP / Trader			
Grid Beyond(UK)	Aggregator / Trader		% increase in revenue	IPP + portfolio level
Sunnic(GERMANY)	Aggregator / Trader			

Part 2/2

Clients	Category	Usability	Output	Complexity & Status Quo
PowerFlow Trade (LAT)	Aggregator / Trader			
Adani (IND)	Utility	Same as IPP	Same as IPP	Moderate
TATA Power (IND)	Utility			
Engie India	Utility			
Enel (SPAIN)	Utility			
Masdar (Multi)	Utility			
Corsica Sole (FR)	Hybrid Sys	Battery Health	% reduction in LCOS	Moderate to high, Avg
SiemensEnergy (FR)	Hybrid Sys			
Spie-Kibali (AFR)	Hybrid Sys			
Electricite de Tahiti (FR)	Standalone	Improved operational planning	% reduction in LCOE	Highly complex and not studied

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Understanding the penalty scheme

Case 1: Neoen (14MW - France)

IS THIS POSSIBLE ?

Actual Production: 0.847 MWh

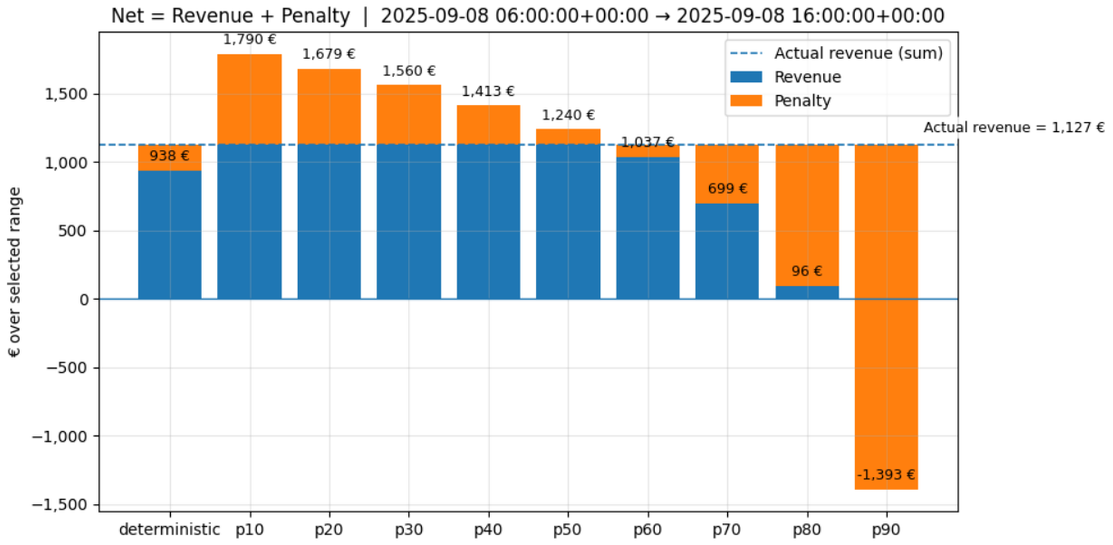
?	FORECAST 1	FORECAST 2
FORECAST VALUE(MWh)	0.686	0.098
NET REVENUE(€)	**50.30**	**87.09**

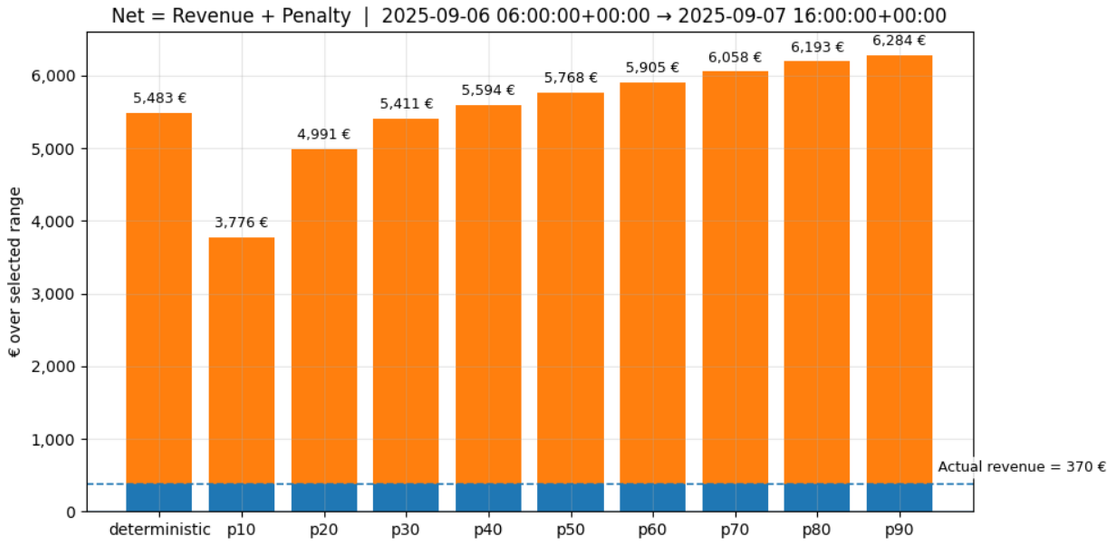
When does imbalance become revenue?

	System Long (Negative)	System Short (Positive)
Actual > Schedule	Penalty	Remuneration
Actual < Schedule	Remuneration	Penalty

“In imbalance settlement, you are rewarded when your deviation reduces the grid imbalance, and penalised when it amplifies it.”

Revenue Comparison across Forecast Types





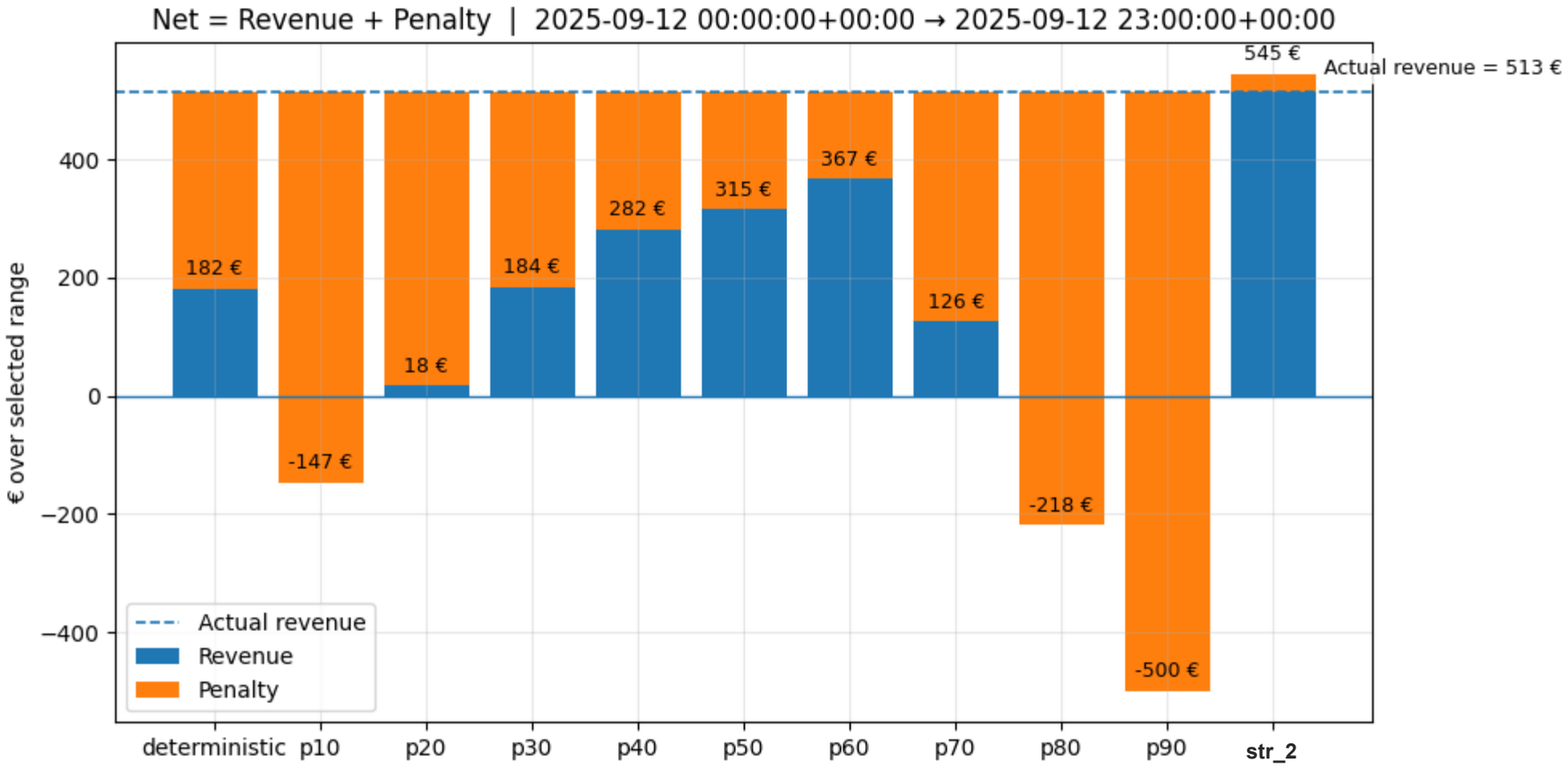
Model Considerations for Grid / System State Prediction

By anticipating grid conditions, we optimize bid quantiles to enhance revenue opportunities and reduce risk.

	Model 1	Model 2
Features Used	Cyclic features (TOD* & DOW**)	Lag + Cyclic features (1 step autoregression)
Prediction Accuracy	**57.23%**	**74.23%**

*TOD: Time of the Day
**DOW: Day of the Week

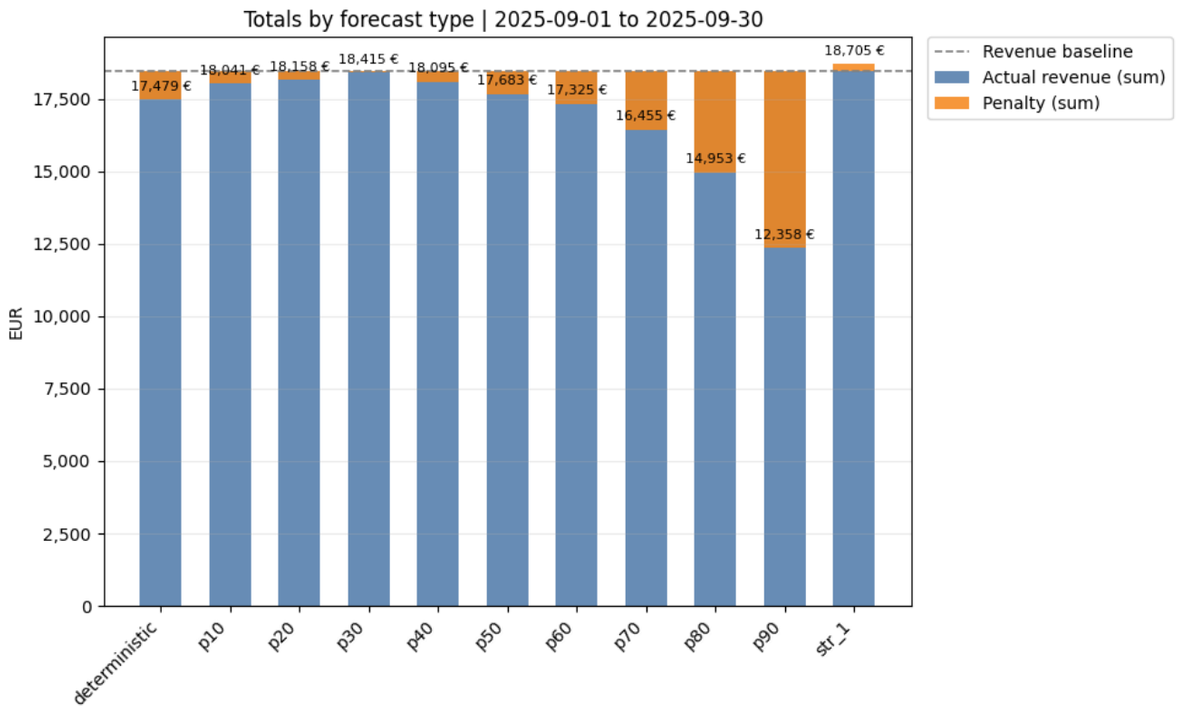
Revenue Comparison: Specific Day

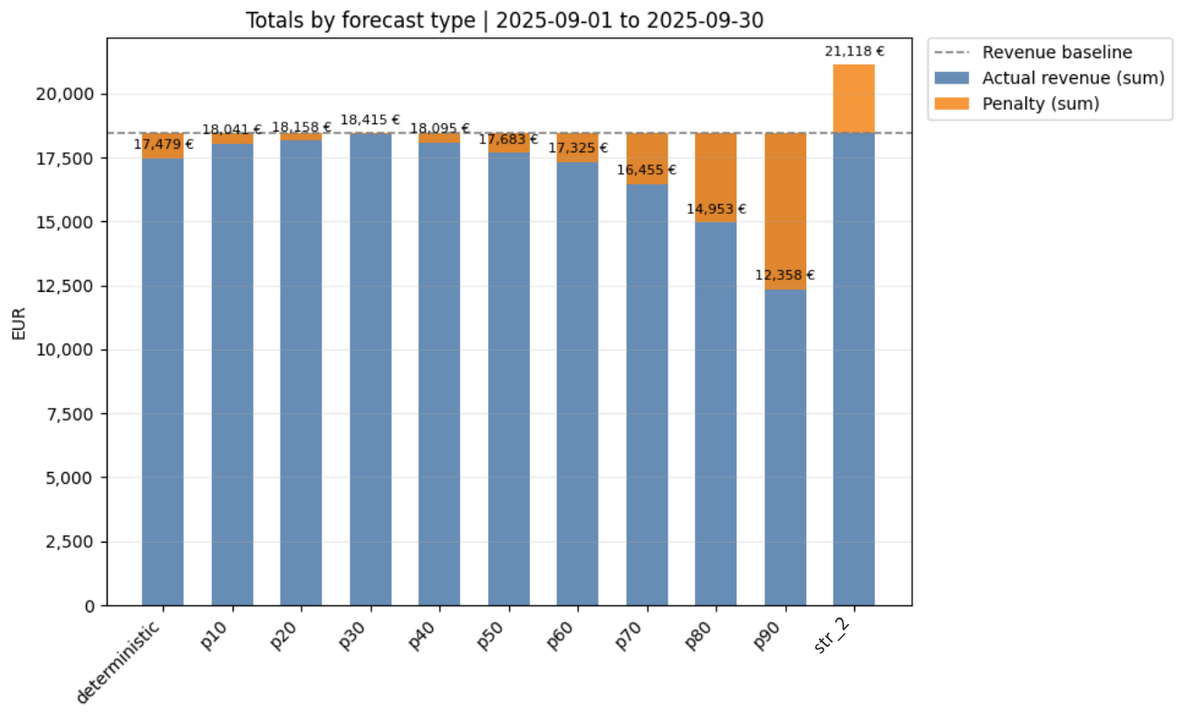


Δ% (Deterministic Vs Strategy) : **200.19%**

Performance Comparison: Analysis over a month (September 2025)

Revenue Baseline – €18,452

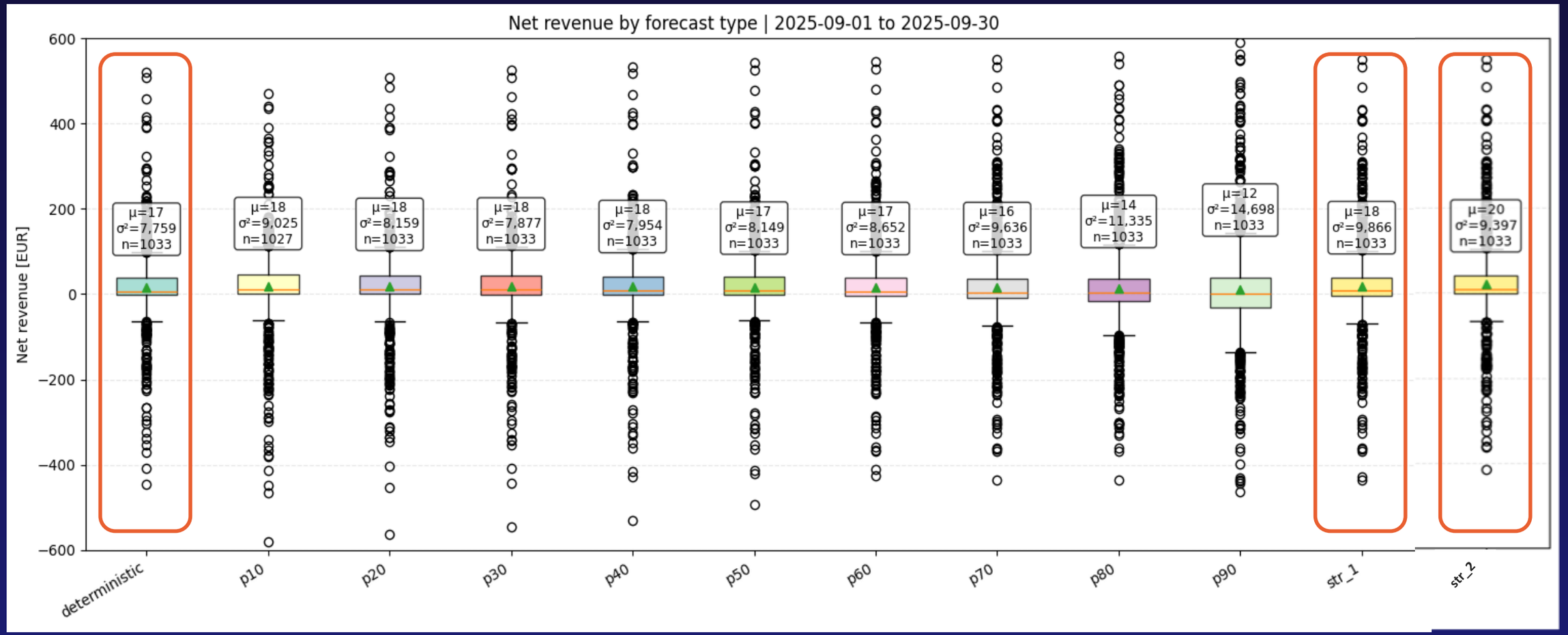




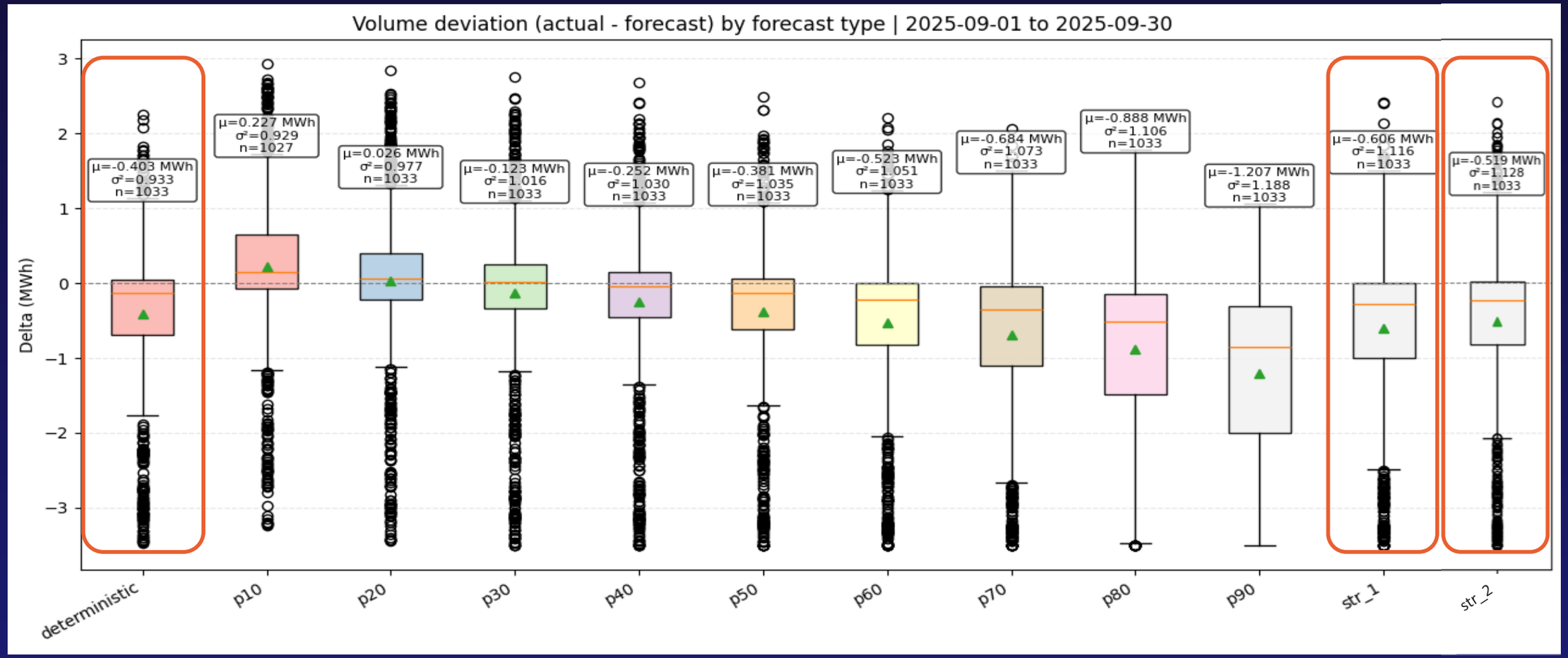
Δ% (Deterministic Vs Strategy_1) : **7.02%**

Δ% (Deterministic Vs Strategy_2) : **20.83%**

Performance Comparison 1: Revenue over a month (September 2025)



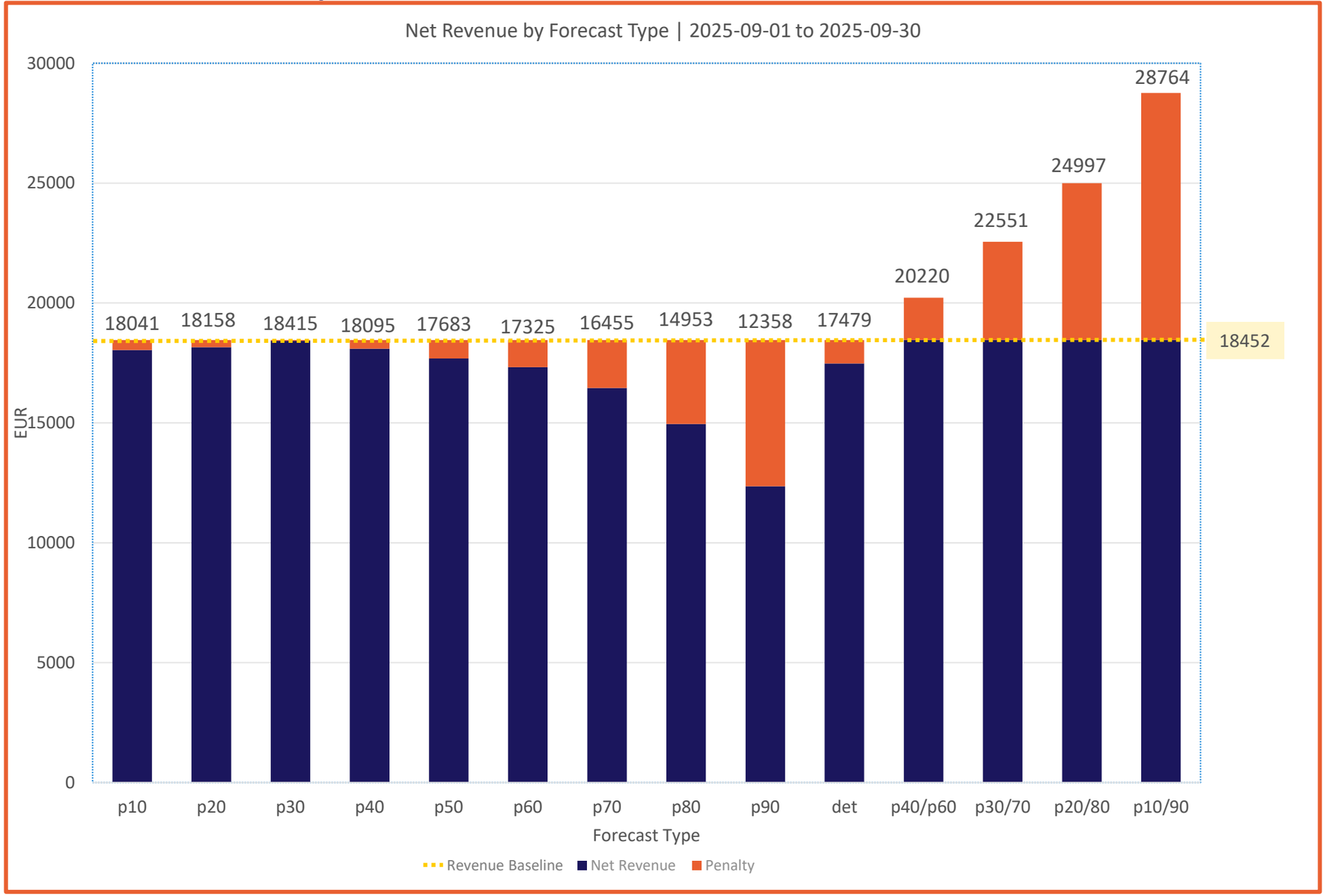
Performance Comparison 2: Volume Deviation over a month



Results comparison across strategies

Strategy	μ (Δvolume) [MWh]	σ^2 (Δvolume)	μ (net rev) [€]	σ^2 (net rev)
Str_1 (Acc: 57.23%)	**–0.606**	**1.116**	**18**	**9,866**
Str_2 (Acc: 74.23%)	**–0.519**	**1.128**	**20**	**9,397**

Revenue Comparison across Quantiles



Δ% (Deterministic Vs Probabilistic)

- P40/P60 - **15.68 %**
- P30/P70 - **29.03 %**
- P20/P80 - **43.02 %**
- P10/P90 - **64.58 %**

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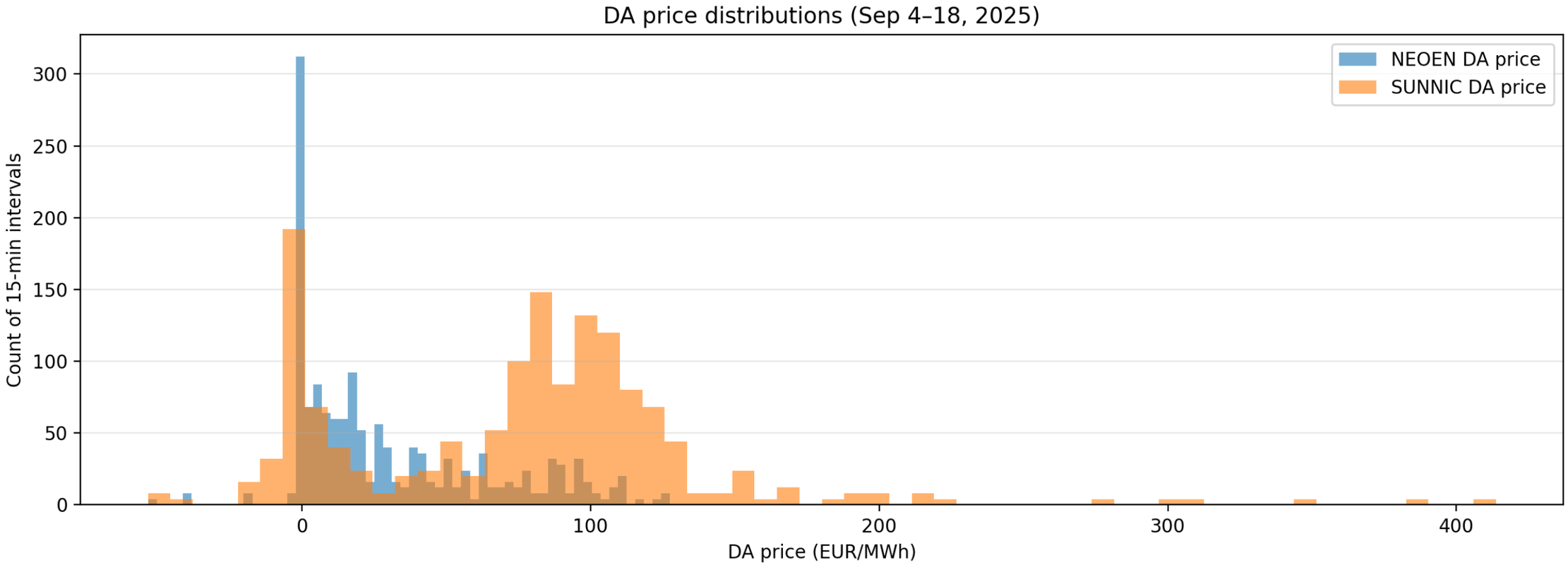
Comparisonal Analysis with Case 2: Sunnic (85MW - Germany)

Comparison on the DA prices for France & Germany



FRANCE: 20.10 EUR/MWh
GERMANY: 38.85 EUR/MWh

Calculating Expected incremental revenue from deviations

$$E[e \cdot spread] = (\sigma_{spread} * \sigma_e * \rho(e, spread)) + E[e] * E[spread]$$

Correlation Term

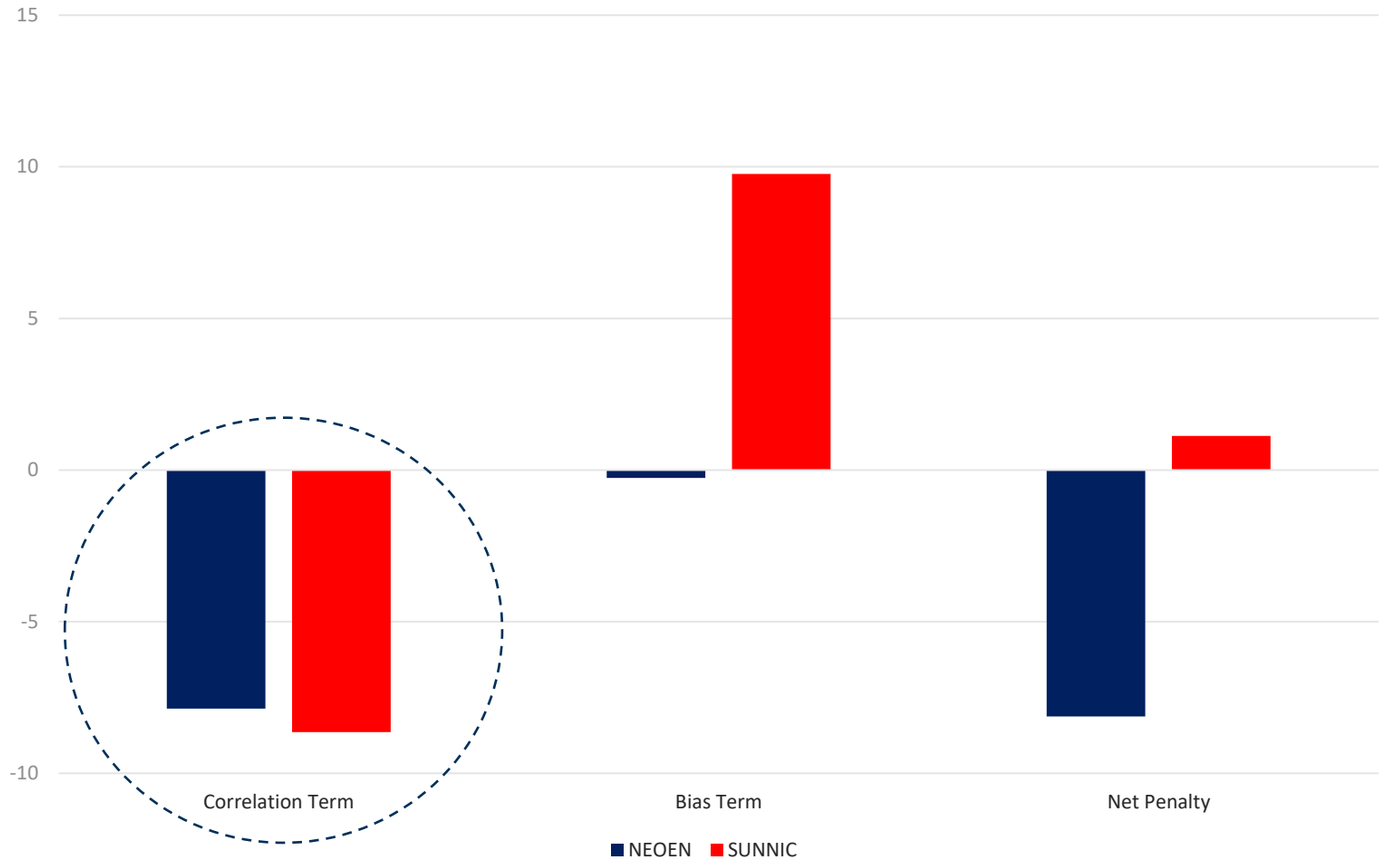
Bias Term

Where,

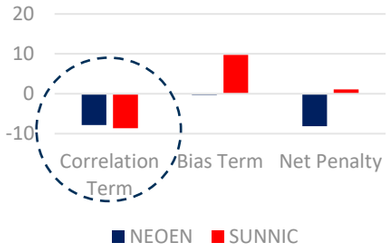
- $e_t = (actual_t - forecast_t)$
- spread_t =(Imbalance price$_t$ – DA$_t$)

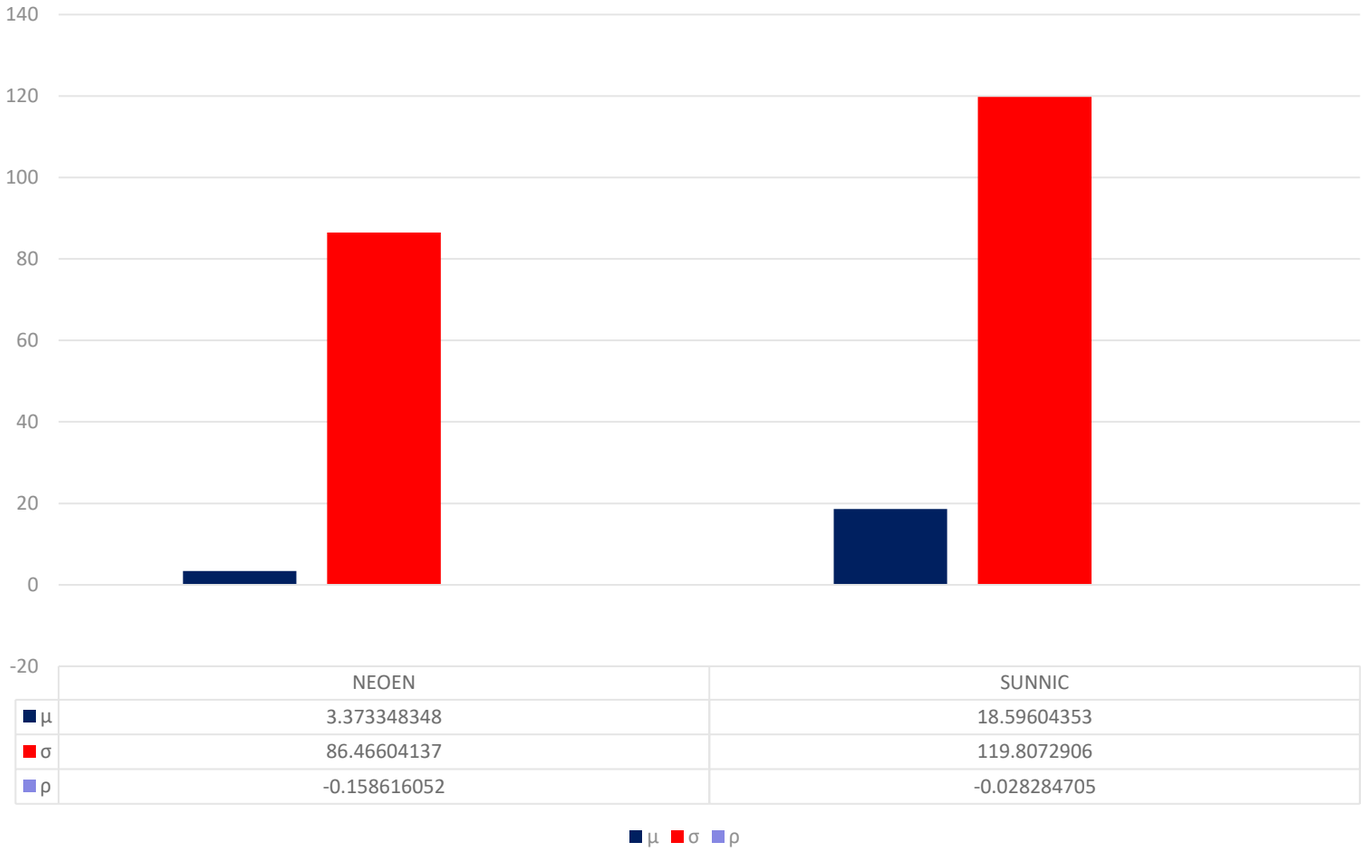
*TOD: Time of the Day
**DOW: Day of the Week

Comparison of Expected incremental revenue - Deterministic



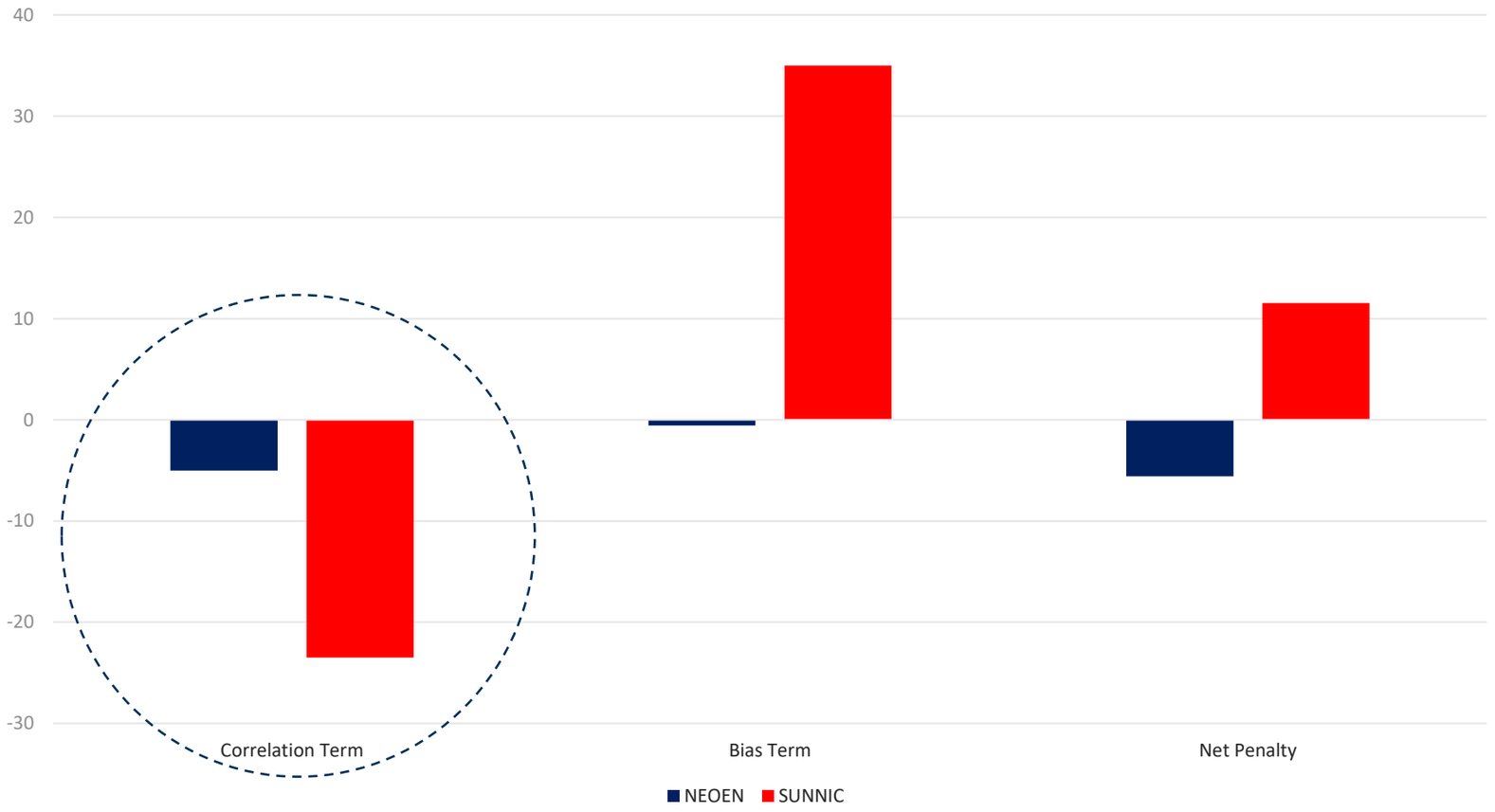
Comparison of Expected incremental revenue - Deterministic



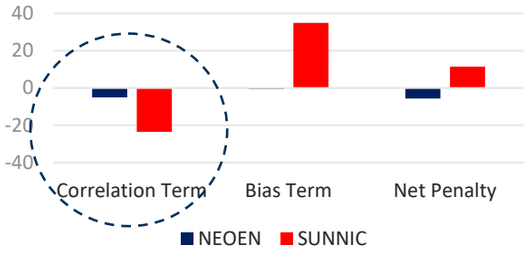


	NEOEN	SUNNIC
μ	3.373348348	18.59604353
σ	86.46604137	119.8072906
ρ	-0.158616052	-0.028284705

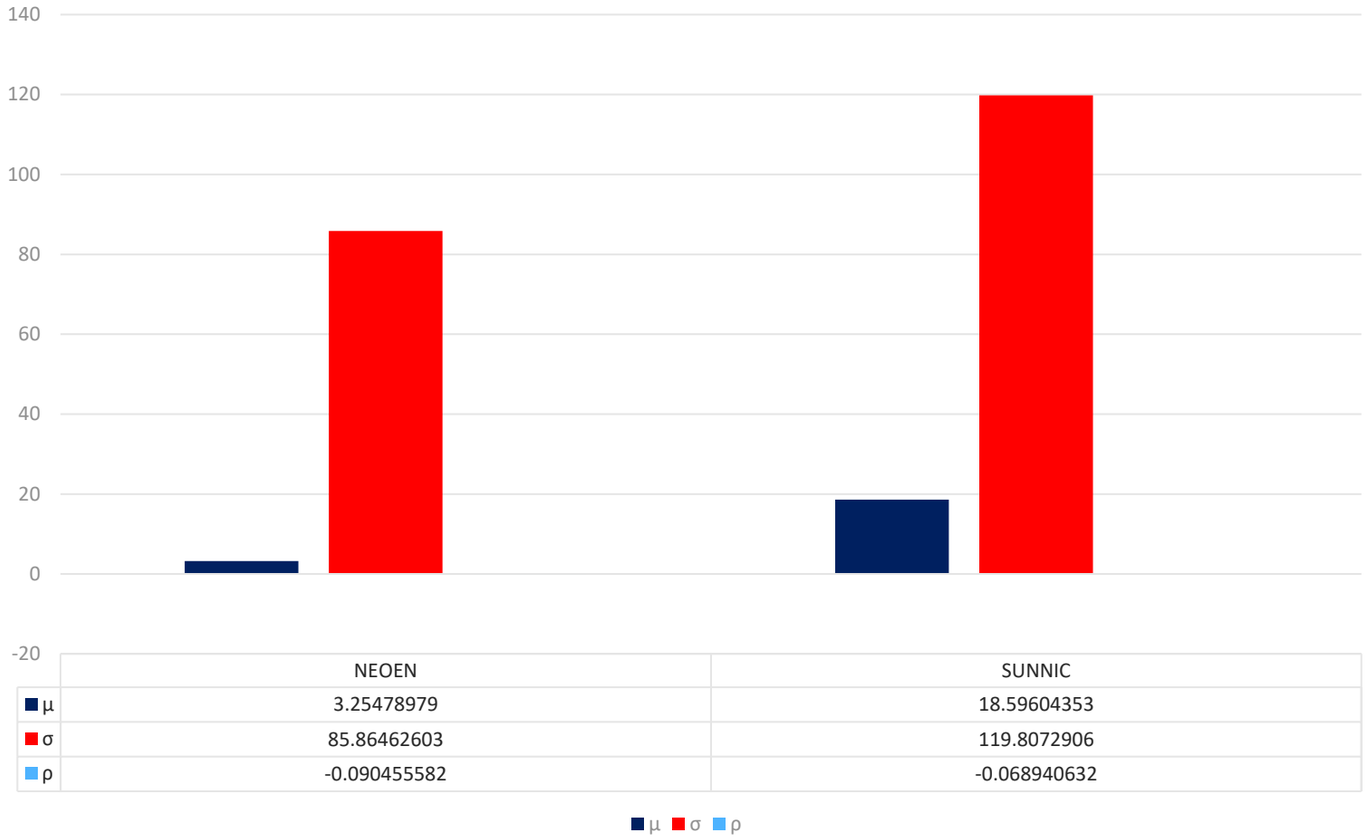
Comparison of Expected incremental revenue - Strategy



Comparison of Expected incremental revenue - Strategy



	NEOEN	SUNNIC
μ	3.373348348	18.59604353
σ	86.46604137	119.8072906
ρ	-0.1584	-0.02828



ACER & REMIT (EU cross-border)

Agency for the Cooperation of Energy Regulators – ACER

- EU rulebook and market surveillance
- Coordinates cross-border REMIT probes

EU REgulation on wholesale energy Market Integrity and Transparency – REMIT

- Article 5: Non tolerance for market manipulation or abuse

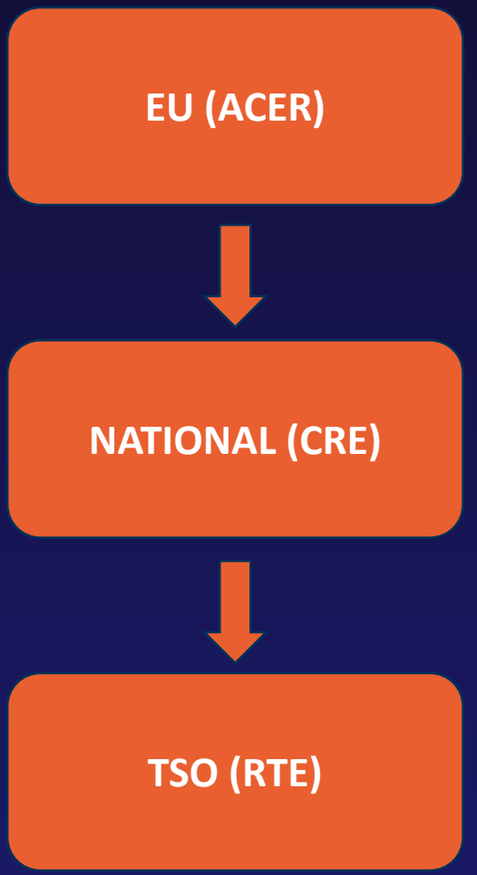
CRE & CoRDiS (France)

Commission de régulation de l'énergie – CRE

- National energy regulator for France

Comité de règlement des différends et des sanctions – CoRDiS

- Investigates REMIT in France



Further Study

- Penalty analysis focusing on the intra-day market – Penalty mechanisms varies across countries.
- More accurate prediction of grid state and prices of imbalances – Might be a pivot focussing more on market forecast
- Setting a base case scenario for other customer segments – Say Hybrid operators

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