

How to generate profit for energy storage systems beyond ancillary services



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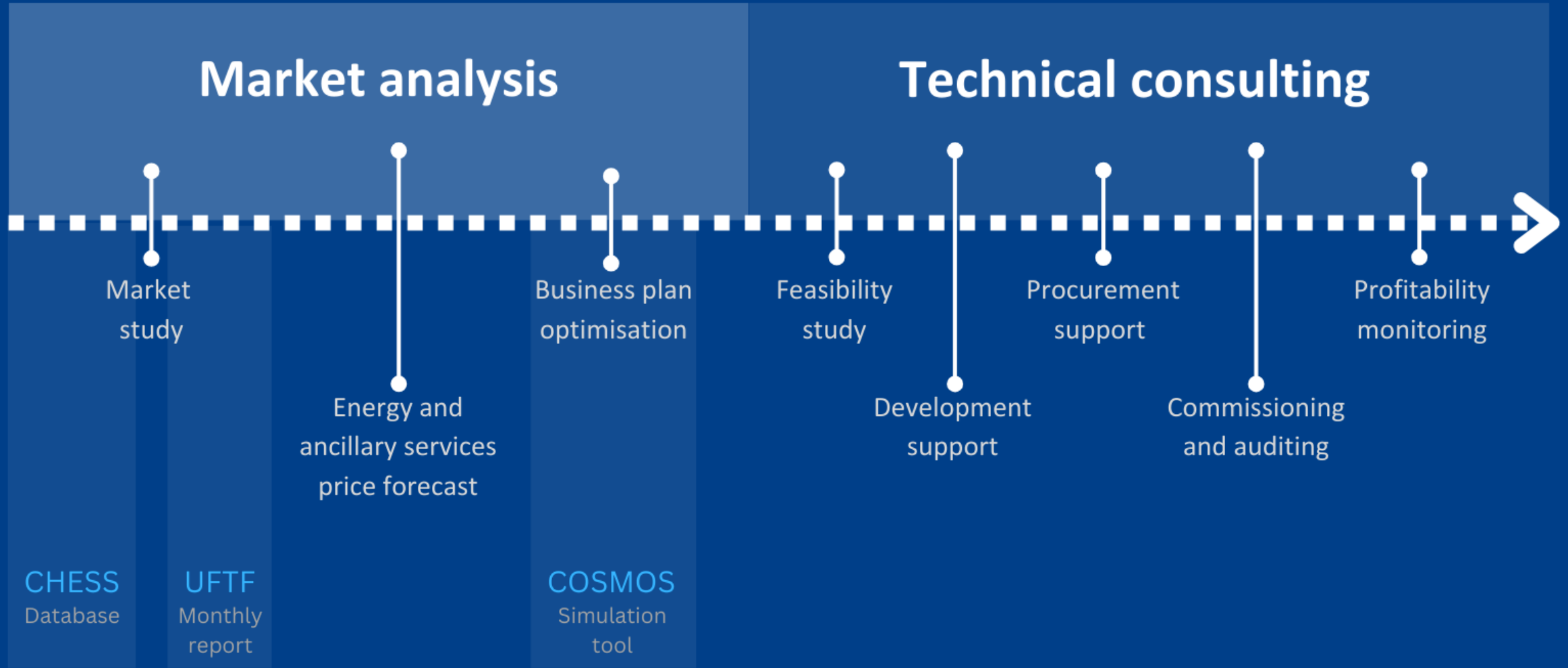


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CLEAN HORIZON IS ACTIVE ON ENERGY STORAGE WORLDWIDE





GEOGRAPHICAL COVERAGE FOR ANCILLARY SERVICES PRICE FORECAST



CLEANHORIZON



COUNTRIES COVERED AS OF Q1 2024:

France
Spain
Italy (Sardinia)
Germany
Belgium
Sweden
Finland
Baltic states (Lithuania, Latvia, Estonia)

COUNTRIES TO BE COVERED BY Q2 2024

Portugal
Poland

ROLLING OUT BETWEEN Q1 2024 AND 2025

Key storage geographies across ENTSO-E

Revenues available for energy storage

Revenue structure

Capacity mechanism	
Revenue structure	Capacity payment in €/MW/year (Belgium, Ireland, France, Poland, the UK and Italy)

FCR Frequency Containment Reserve	
Revenue structure	Capacity payment in €/MW/hour at a daily auction D-1, remunerated for a symmetric services provision, with pay-as-clear methodology

aFRR capacity automatic Frequency Restoration Reserve	
Revenue structure	Capacity payment in €/MW/h with 1h granularity at a daily auction D-1, at the national level

aFRR energy automatic Frequency Restoration Reserve	
Revenue structure	Energy payment in €/MWh with 15 min granularity, that can be changed up to 25 min, common across all PICASSO countries

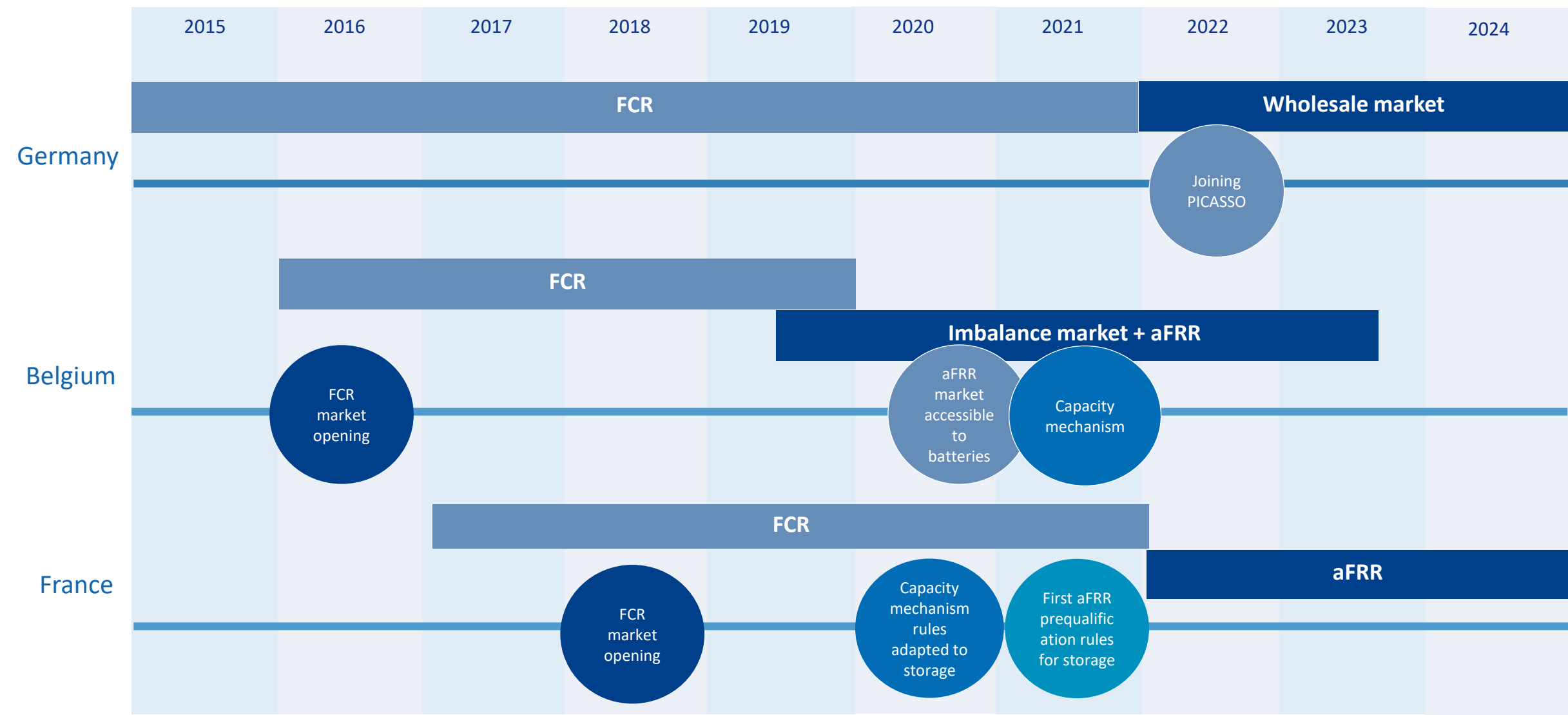
mFRR	
Revenue structure	Participation in the balancing mechanism pay-as-bid auction, high spreads

Wholesale market	
Revenue structure	Energy payment in €/MWh, benefiting from the volatility

Intraday	
Revenue structure	Revenues generated from price fluctuations

Evolution of market drivers for energy storage

Timeline indicating the main driver for storage deployment in 3 European countries

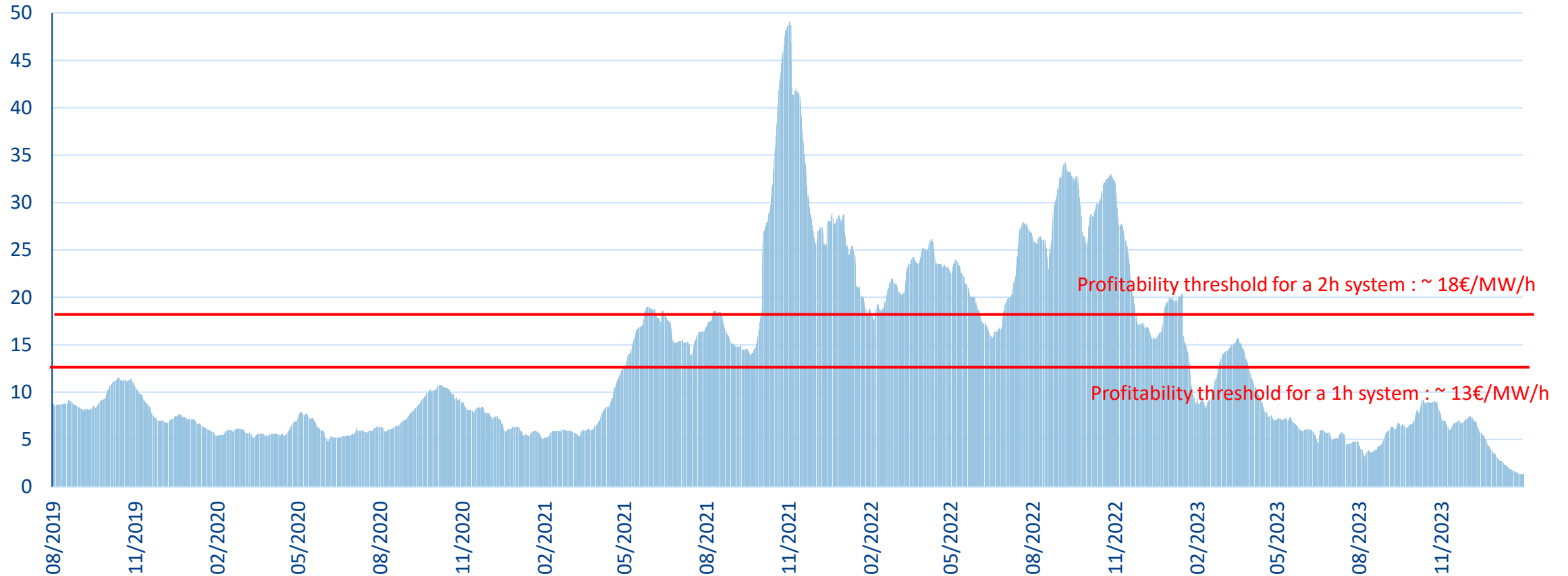


FCR is historically the main revenue stream for energy storage assets in Europe

With a higher penetration of storage, the FCR have dropped in the last years

FCR prices in France (monthly moving average)

In €/MW/h



COSMOS:

a simulation tool for project sizing, performance analysis and optimization

Clean Horizon optimizes the economic model, based on the quantitative elements, including



Economic parameters

Storage/ PV/ WIND CAPEX
Storage/ PV/ WIND OPEX



Technical parameters

MW of storage
MWh of storage
MWp of PV
MW of WIND
MW of grid connection



Market parameters

Forecast of ancillary service prices
Forecast of wholesale prices
Forecast of balancing mechanism prices

In particular, this tool allows :

1

To determine optimal sizing
for different configurations
for the storage system

2

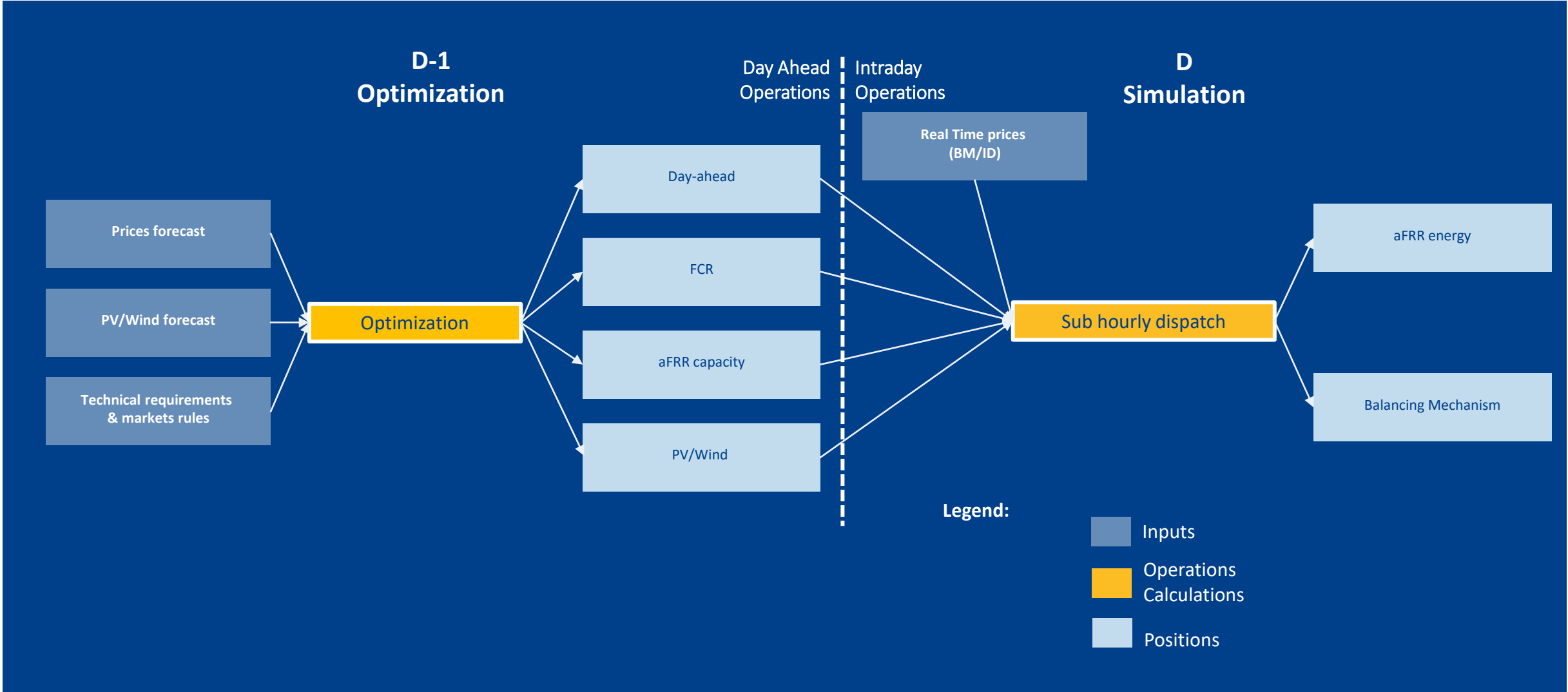
To calculate the cashflows,
NPV and IRR

3

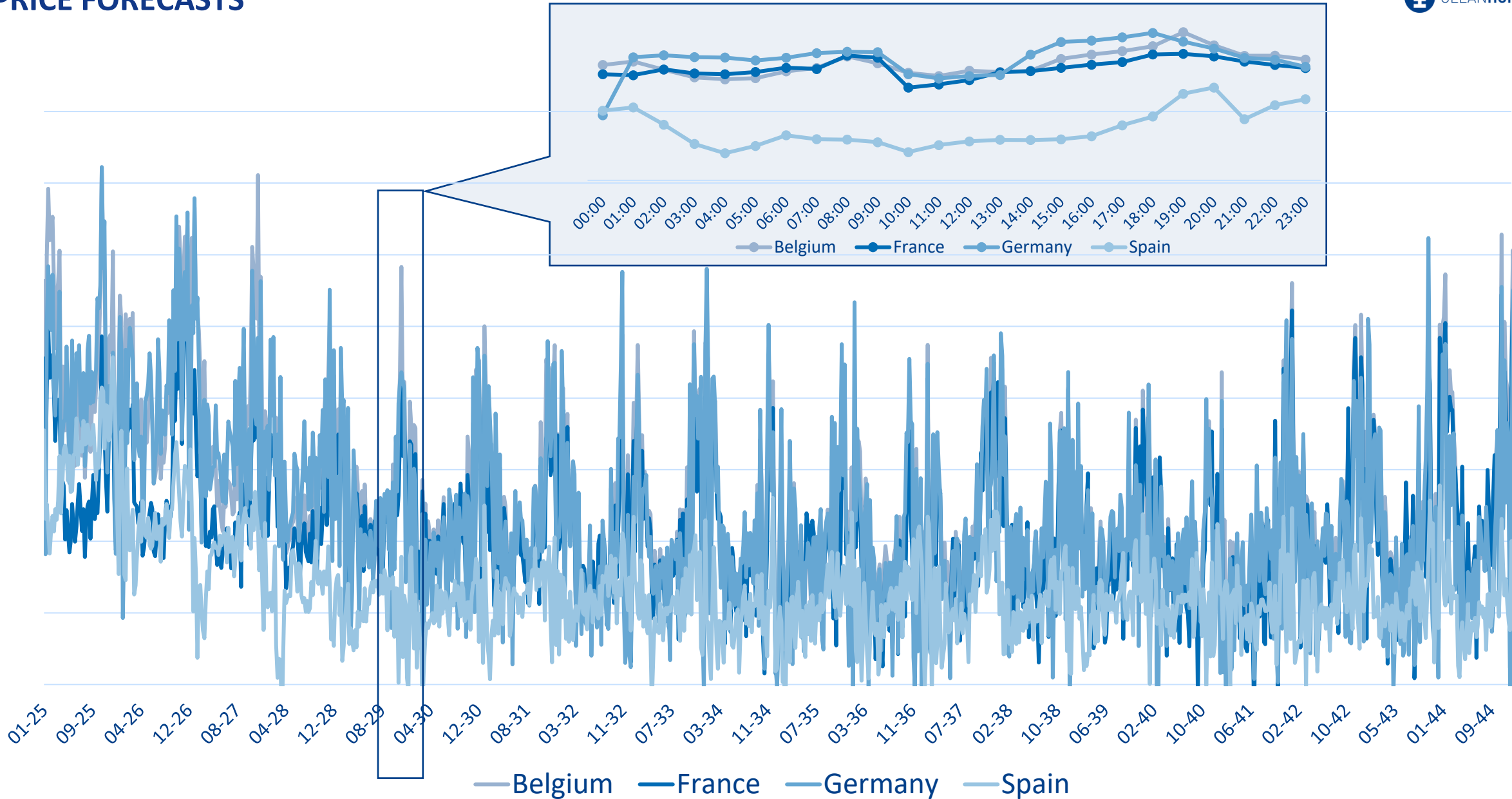
To easily generate
sensitivity analyses

4

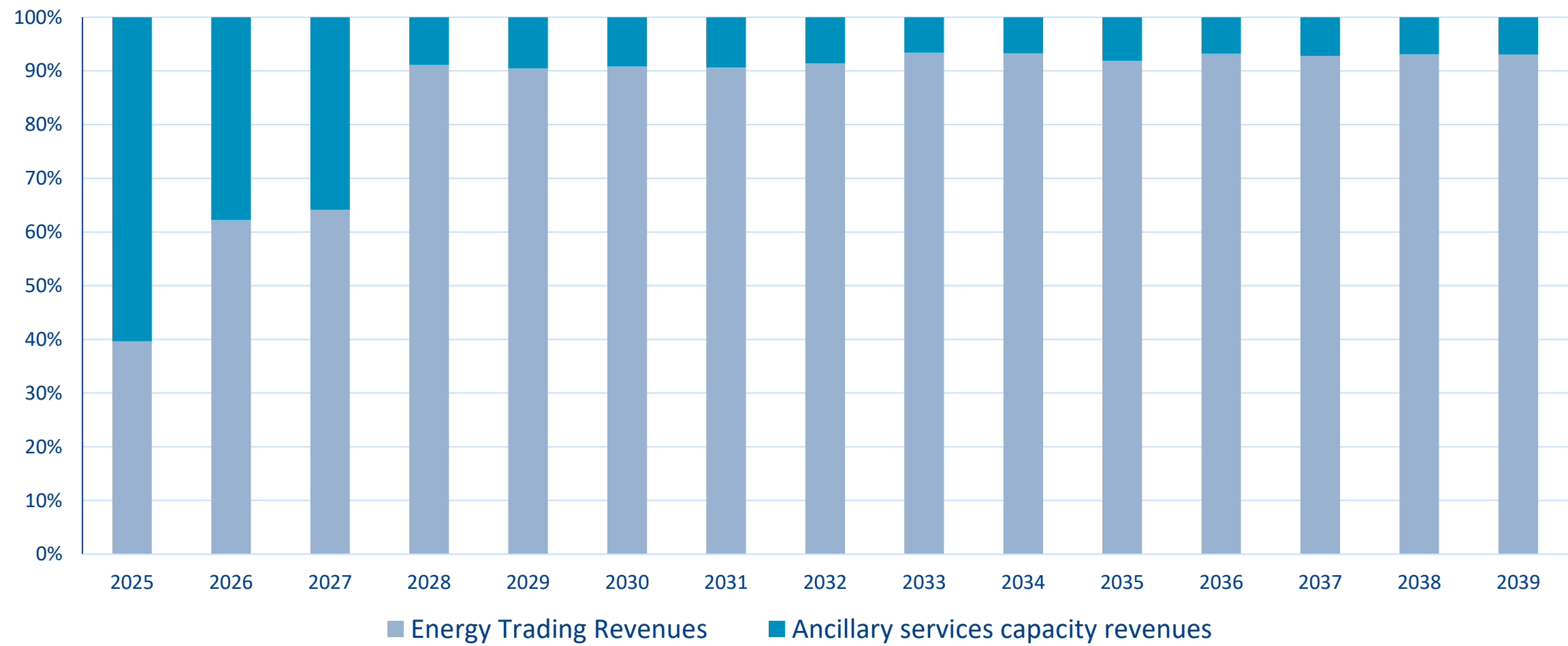
To optimize dispatch and
to find an optimum scenario



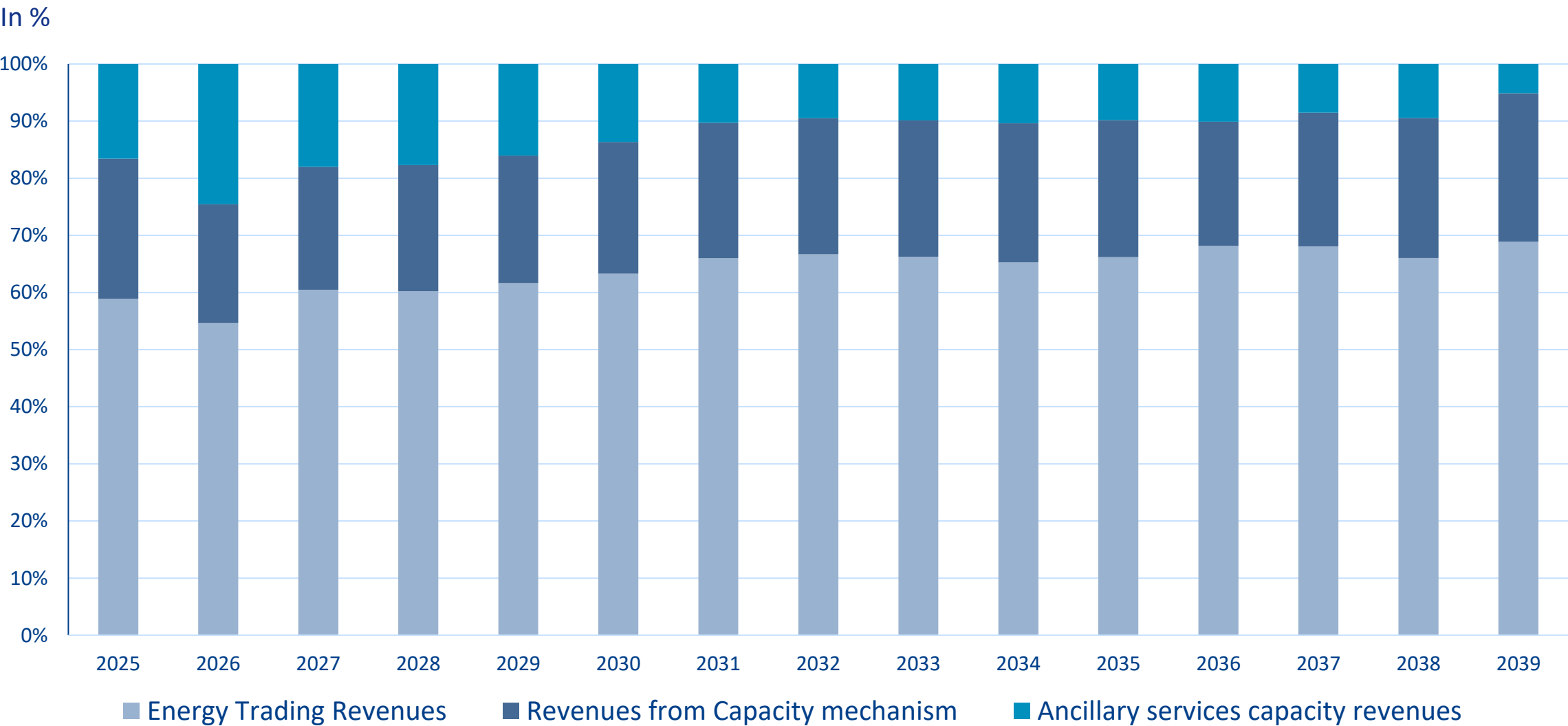
PRICE FORECASTS



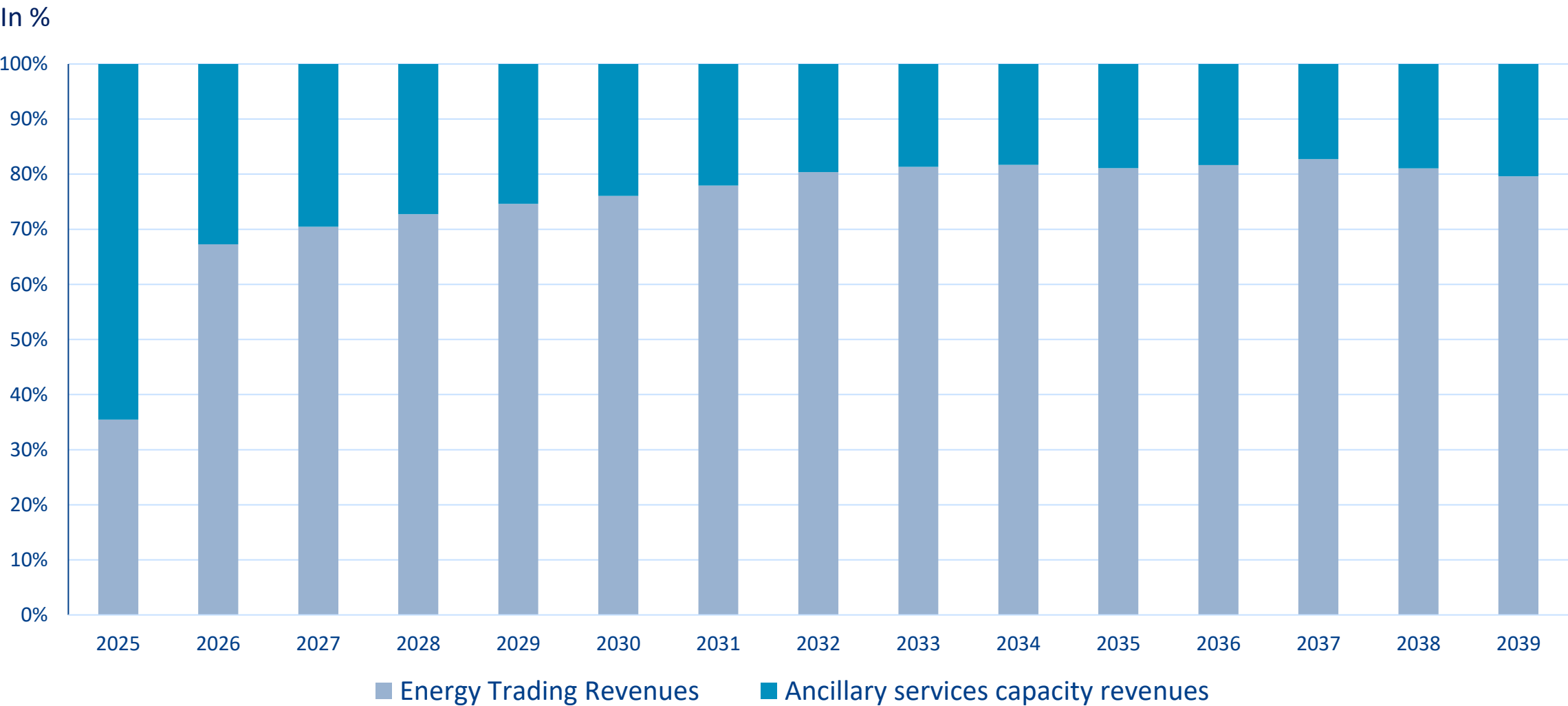
Distribution of revenues for a 1h BESS system
In %



Distribution of revenues for a 1h BESS system

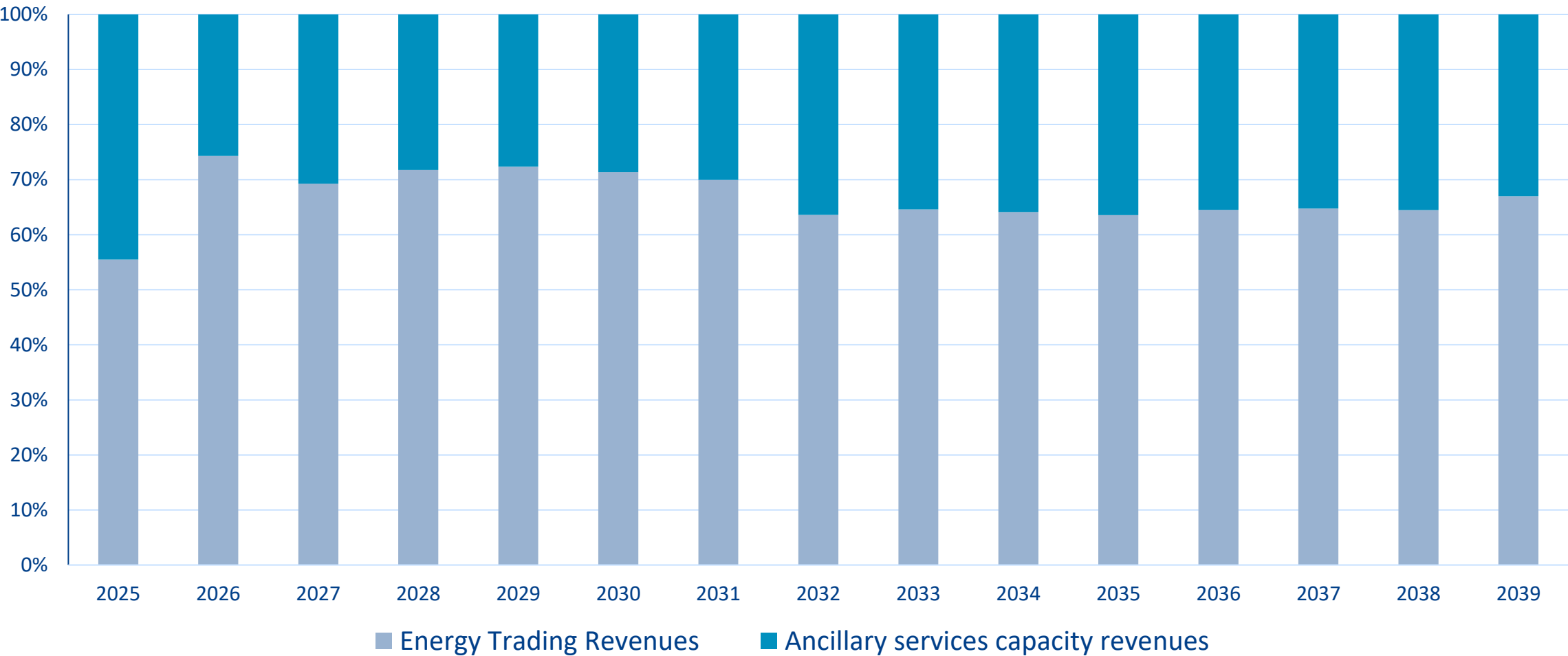


Distribution of revenues for a 1h BESS system



Distribution of revenues for a 1h BESS system

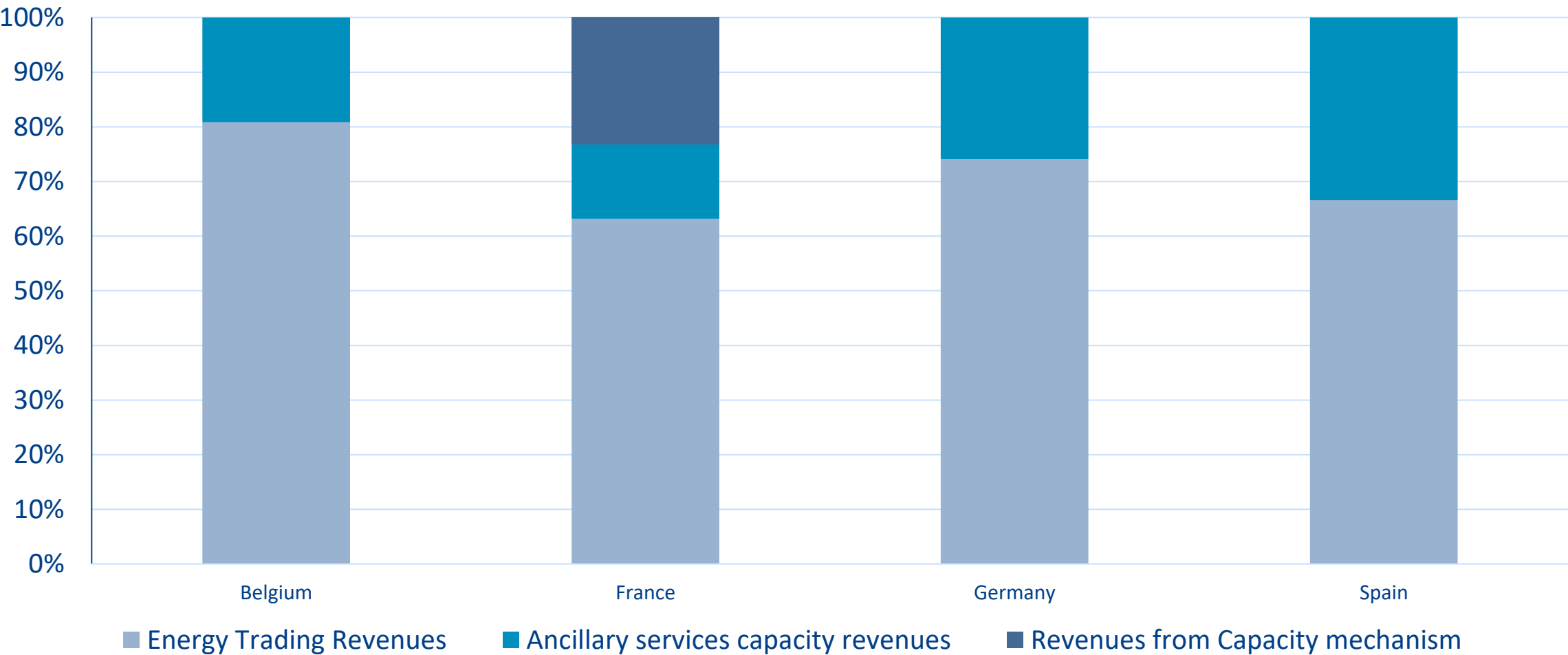
In %



REVENUE STACK SUMMARY

Distribution of revenues for a 1h BESS system

In %





Market insights

- Context: renewable penetration, subsidies for storage, targets
- Evolution of the energy storage market & key players
- Revenues streams available to energy storage and market volumes
- Regulatory maturity. Future opportunities and risks
- Storage penetration



Energy and ancillary services price forecast

Long-term price forecast of:

- ancillary service prices
- wholesale prices
- balancing mechanism prices



Business plan optimization COSMOS Simulation tool

- project sizing
- performance analysis
- optimization



We look forward
to working with you!

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Making new energy flow

Yuso BV


Generating profits with BESS beyond ancillary services

Bart Pycke

4th of April 2024

Clean Horizon Webinar



- 
- Who am I ?
 - Who is Yuso ?
 - The problem with renewables in a market system
 - BESS as the game changer
 - Energy Strategies for BESS: experience in the Belgian market
 - Main takeaways

Who is presenting ?





Who is presenting

About me - Bart Pycke



MERCURIA



Who are we ? Introduction of Yuso





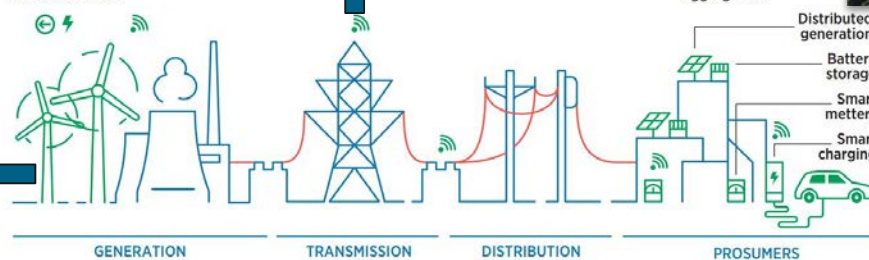
YUSO aims to enable the energy transition across the full spectrum

Power Purchase



Real-time energy sharing

Interconnections



Utility-scale flexibility



Power Supply



Yuso inside optimization





Yuso and large scale BESS projects

- Standalone BESS in operations now
 - BE: Deux-Acren Energy Storage - 50 MW - 100 MWh (since November 2022)
 - BE: Ruien Energy Storage - 25 MW - 100 MWh (since February 2023)
 - BE: Balen Energy Storage - 10 MW - 40 MWh and 15 MW - 60 MWh (undisclosed)
 - UK: Tollgate BESS - 49.5 MW - 49.5 MWh (since July 2023)
- Belgian and UK pipeline 2024-2026
 - Nippon Koei Energy Europe: 2 more projects
 - Independent > 10 more projects



Utility-scale standalone BESS in Yuso portfolio



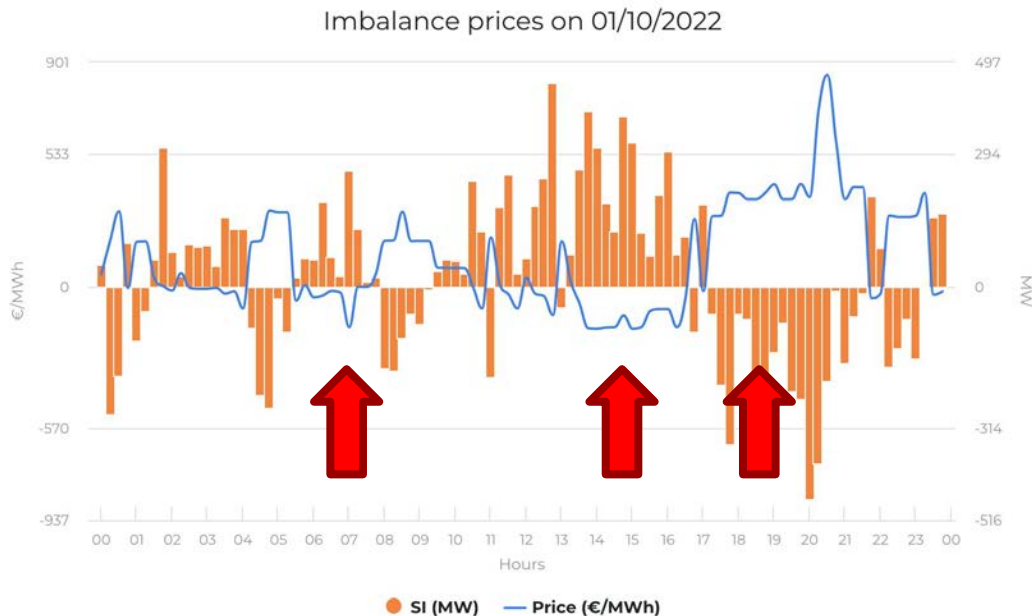


The problem with renewable infeed in a market system



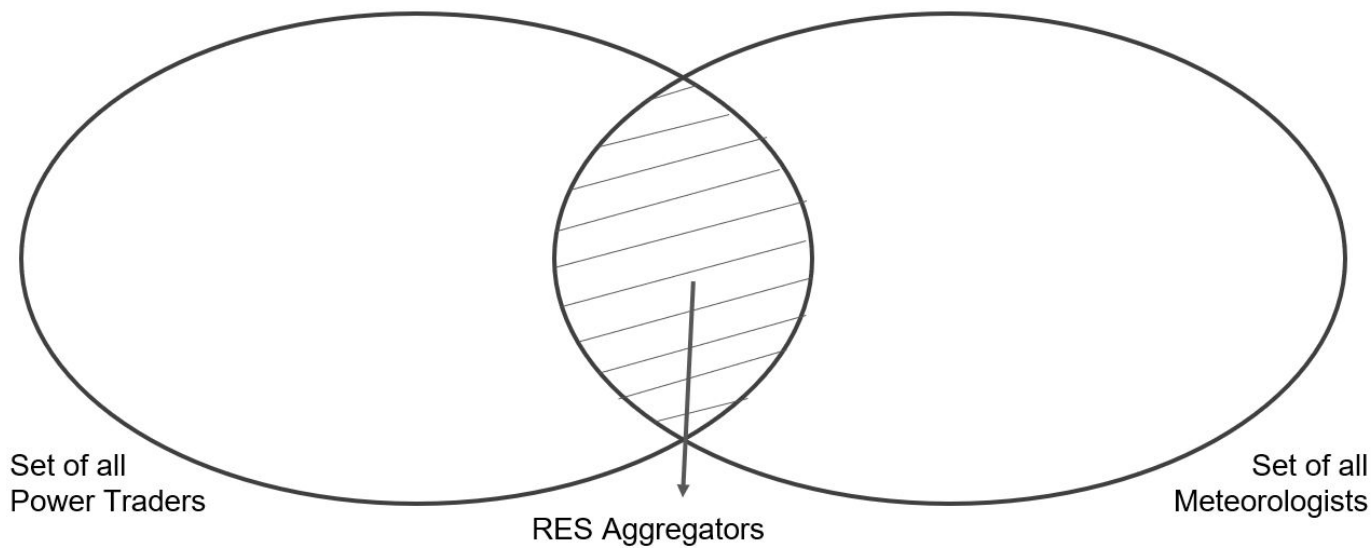


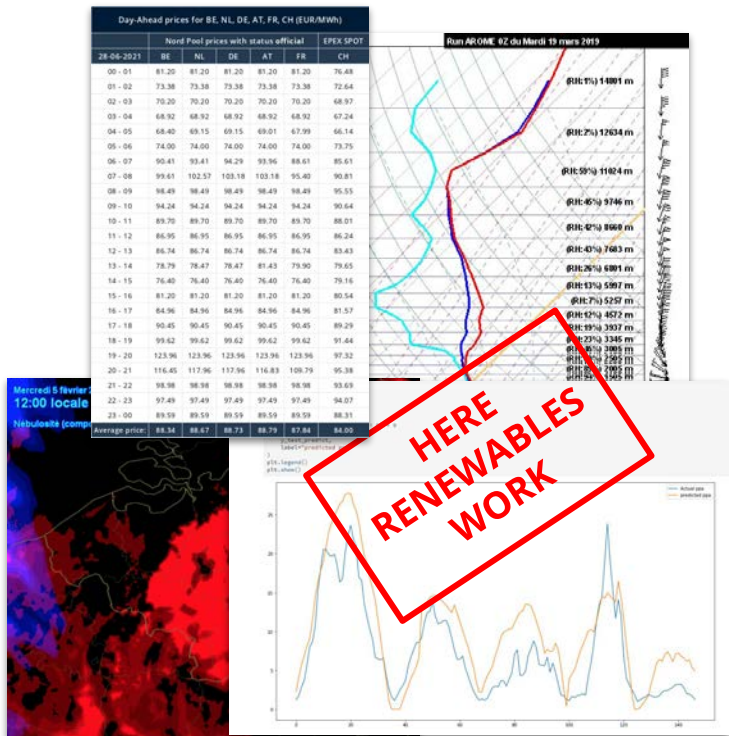
Power price volatility driven by intermittent renewable infeed into the Belgian system



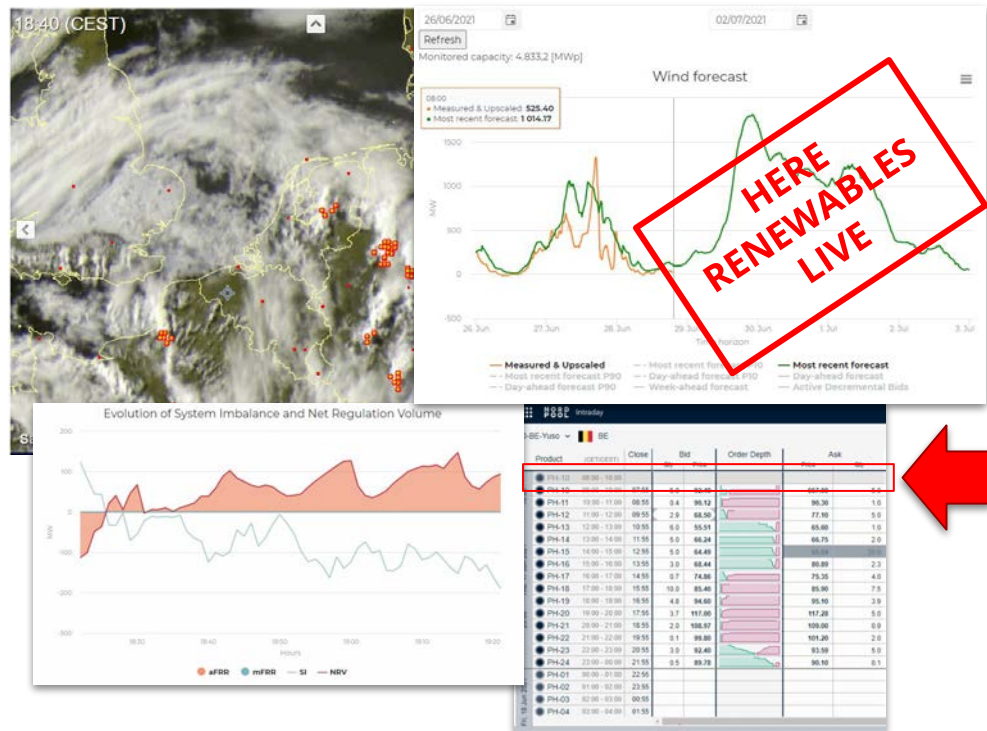


Renewables and aggregation: a practical guide





D-1 to D transition 00:00h CE(SJT)



Day-Ahead: weather models + machine learning models

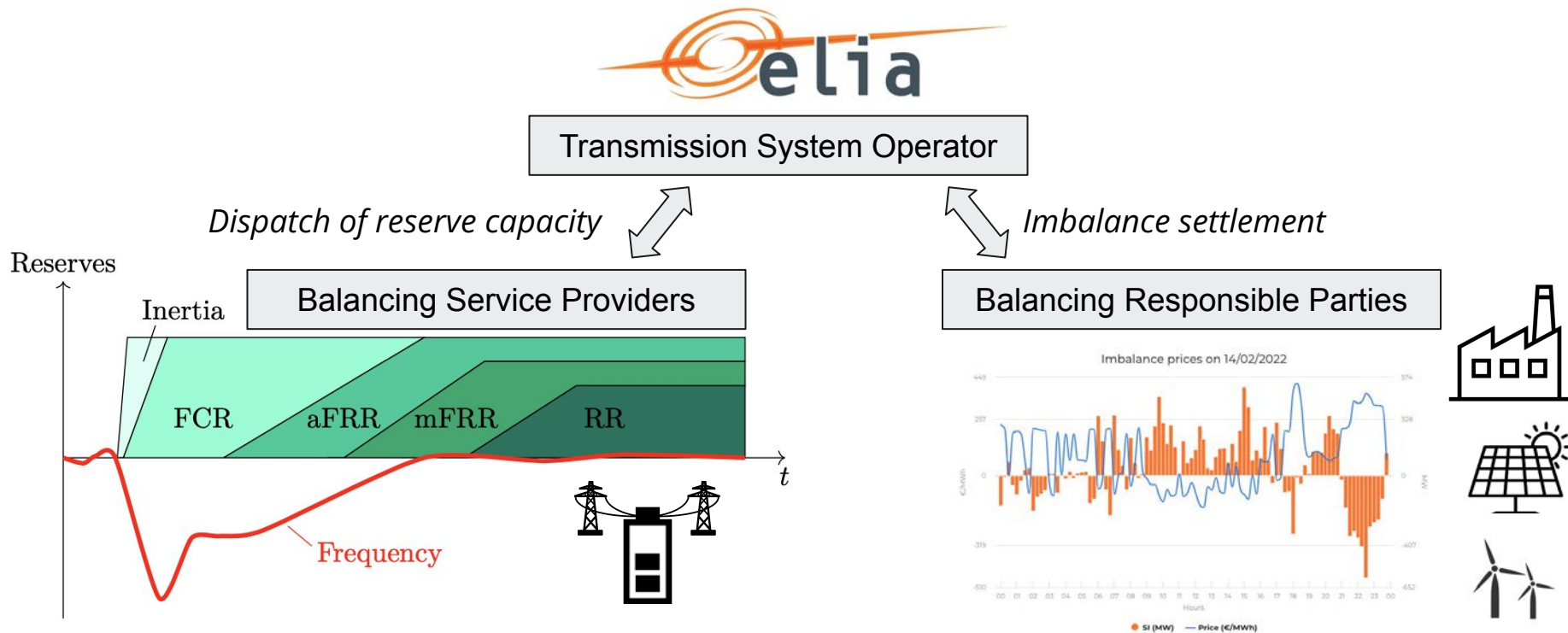
Intraday: real time data and short term forecasts

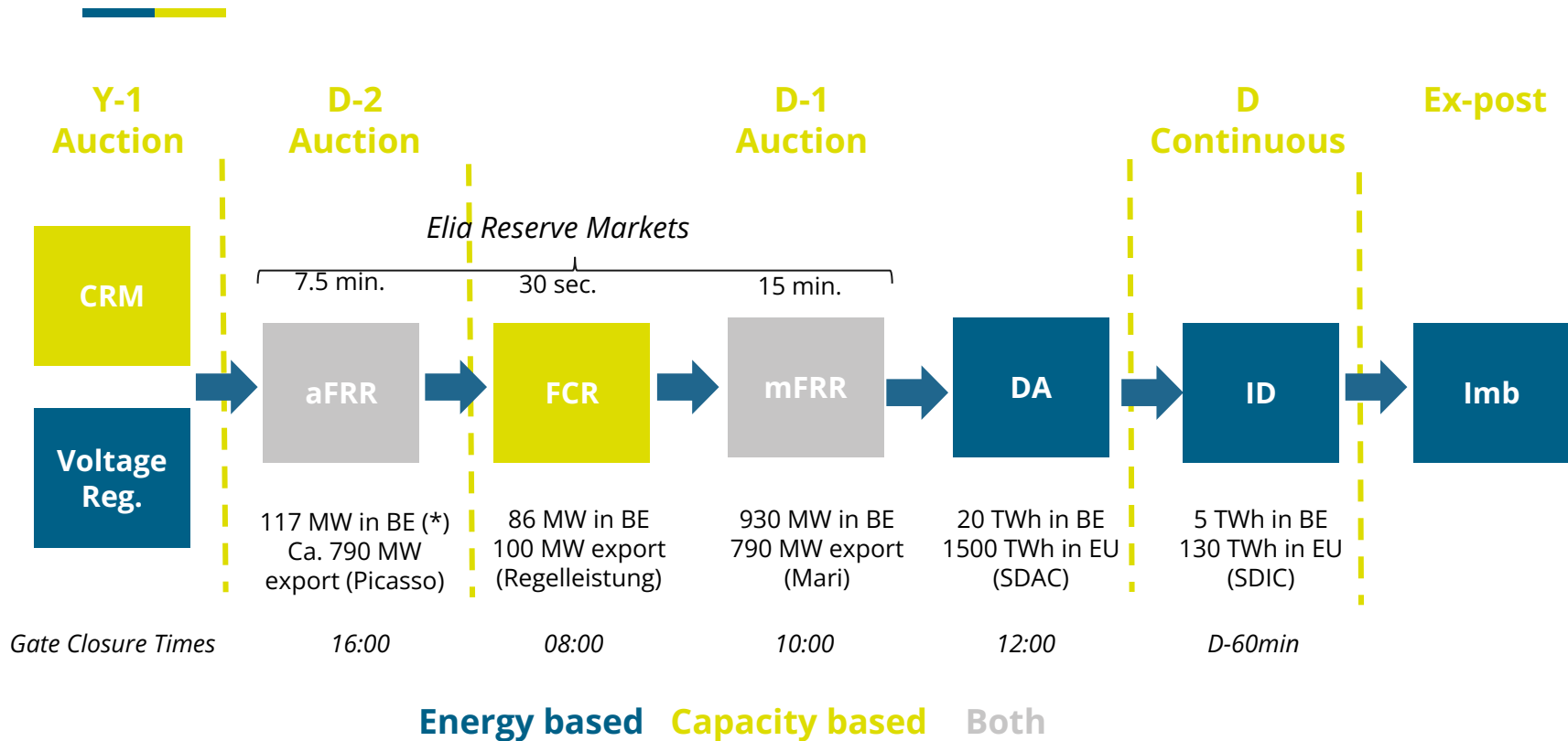
BESS Market Strategies





The Electricity Markets are highly regulated, so are ancillaries...





(*) procured for Upward and Downward Direction

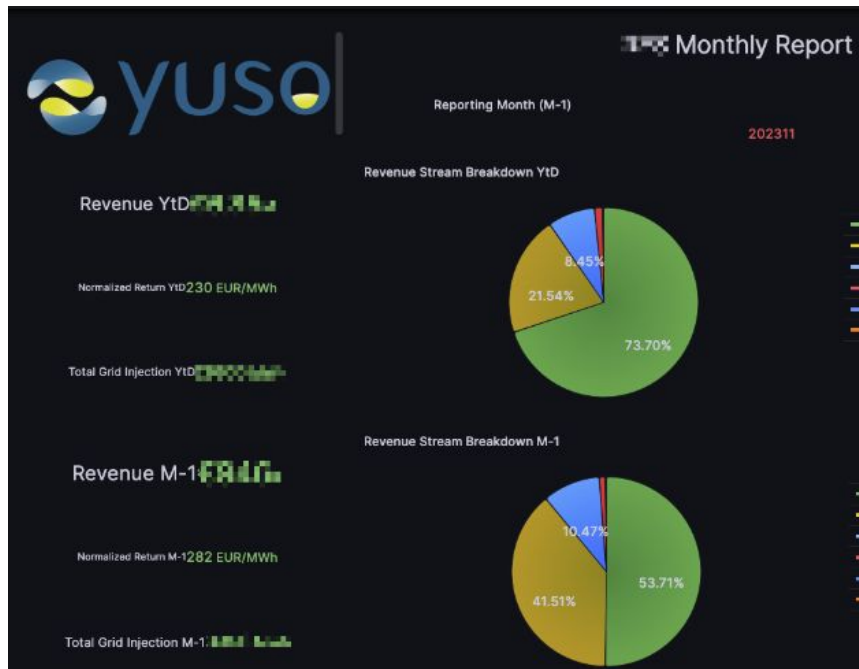


YUSO as fully integrated Route-to-Market





Already today energy strategies makes up for the majority of all BESS revenues in Belgium



Energy strategy 1

Ancillary strategy 1

Energy strategy 2

Ancillary strategy 2

Energy strategy 3



Trading capabilities of your BESS RTM provider matter

Top Storage Assets ▾ by £ / MW / h ▾ for Mar 2024 ▾

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Plant								Profit (Power & Hour Normalised) (£/MW/h)											
ID	Name	BMU	Owner	Optimiser	Power (MW)	Energy (MWh)	Duration (hrs) ▾	Net ▾	Balancing	Wholesale ▴	DC-L	DC-H	DR-L	DR-H	DM-L	DM-H	FFR	N-BR	P-BR
E_TOLLB-1	Tollgate BESS	✓	Nippon Koei	Yuso	49.5	56.48	114	3.88	0.52	0.46	0.76	1.69	-	-	-	-	-	-	0.45
2_GSTAT005	Oldham	✓	Field Energy	Statkraft Markets	20	20	1	3.87	0.99	0.85	0.63	0.74	-	-0.52	0.75	0.29	-	0	0.13
2_BFLEX002	Breach Farm	✓	Core Street Capital	Flexitricity	10	10	1	3.82	0.14	0.58	1.2	1.9	-	-	-	-	-	-	-
2_MSTAT001	Creyke Beck	✓	Statera	Statkraft Markets	50	50	1	3.75	0.49	2.38	0.86	0.54	-	-114	0.35	0.17	-	0	0.09
2_NFLEX001	South Redhouse	✓	Greenspan Energy	Flexitricity	16	16	1	3.69	0.07	0.52	1.19	1.91	-	-	-	-	-	-	-
2_GLOND001	Hulley Road	✓	Core Street Capital	EDF Energy Customers	20	20	1	3.68	1.03	1.42	0.63	0.94	-	-0.53	0.16	0.02	-	-	0.01
E_CUPAB-1	Coupar Angus BESS	✓	Gresham House	Statkraft Markets	40	40	1	3.65	-0.2	2.43	0.83	1.31	-	-0.88	-	-	-	0	0.15
2_EFLEX001	Larport Farm	✓	Core Street Capital	Flexitricity	19.5	19.5	1	3.59	0.25	0.39	1.13	1.82	-	-	-	-	-	-	0.01
2_NFSEN007	Byers Brae	✓	Gresham House	Arenko	29	29.87	1.03	3.54	0.36	0.08	1.26	1.89	-	-0.05	-	-	-	-	-
2_HSTAT002	Minety South Storage 2	✓	Statera	Statkraft Markets	50	50	1	3.53	0.76	1.68	0.66	1.08	-	-0.79	-	-	-	0	0.13
2_HANGE002	Fareham	✓	SSDC Opium Power	Shell	40	40	1	3.5	0.22	-0.02	1.3	2.01	-	-	-	-	-	-	-
2_BFLEX001	Mill Farm	✓	ESB Ireland	Flexitricity	72	7	0.97	3.49	0.15	0.48	1.11	1.76	-	-	-	-	-	-	-
T_NURSB-1	Nursling Two	✓	Downing	EDF Energy Customers	50	48.08	0.96	3.46	1.17	1.21	0.43	1.02	-	-0.77	0.39	-	-	-	-
T_RICHB-2	Richborough Energy Park 2	✓	Sosteneo Fund 1	Shell	49.9	49.9	1	3.41	0.15	0.19	1.19	1.88	-	-	-	-	-	-	-
2_PFLEX001	West Gourdie	✓	JLEN	Flexitricity	49.9	49.9	1	3.4	0.2	0.59	0.99	1.68	-	-0.1	0.02	0.01	-	-	-

(source: Enact)



Energy markets dwarf ancillary markets

Total capacity costs in 2022 & 2023

Costs in M€	FCR	aFRR*	mFRR
2022	20,1	174,7	78,0
2023	16,4	74,2	70,9

(source: Elia WG Balancing)

2022: 25 TWh * 244 EUR/MWh = 6.1 billion EUR

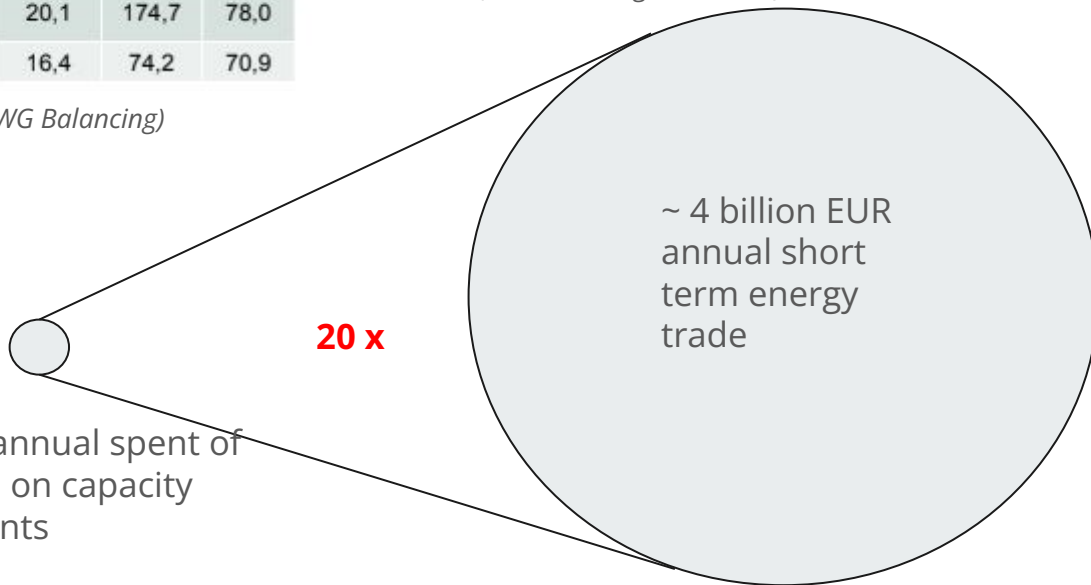
2023: 25 TWh * 91 EUR/MWh = 2.4 billion EUR

(source: own guesstimate)

~ 200 mio EUR annual spent of
the Belgian TSO on capacity
ancillary payments

20 x

~ 4 billion EUR
annual short
term energy
trade



Main takeaways





- Main challenge with renewables are intermittency and associated balancing costs
- Provision of ancillary service is a niche compared to the wider need for flexibility in the energy system
- Your BESS business plan needs to energy strategy
- Your Route-to-Market Provider needs to be able to optimize across ancillary services and energy markets, in standalone configurations as well as embedded / colocated configurations
- Big Data and data algorithms and automation are at the heart of a RTM activity
- Belgian market system is ideally designed to optimize across ancillaries and energy and for BESS to harvest revenues
- Yuso is uniquely placed and welcomes your BESS



What uniquely identifies Yuso...

- **OUR KNOW-HOW OF THE MARKET**

→ Transparency guaranteed...

- **ADVANCED INFORMATION SYSTEMS AND AUTOMATION**

→ Lowest transaction costs for its customers...

- **HANDS-ON EXPERIENCE IN STORAGE**

→ Use your Energy in the best way possible...

We are ready
for the future...

How about you?

