

BESS Quarterly Financial Analysis

Breaking Down Revenue Potential in the
Czech Republic, Hungary, Poland and Romania

What's Inside?



Breakdown of income sources,
including DAM and aFRR



Operational strategies to
maximise profitability



Comparison of results from
the previous quarter



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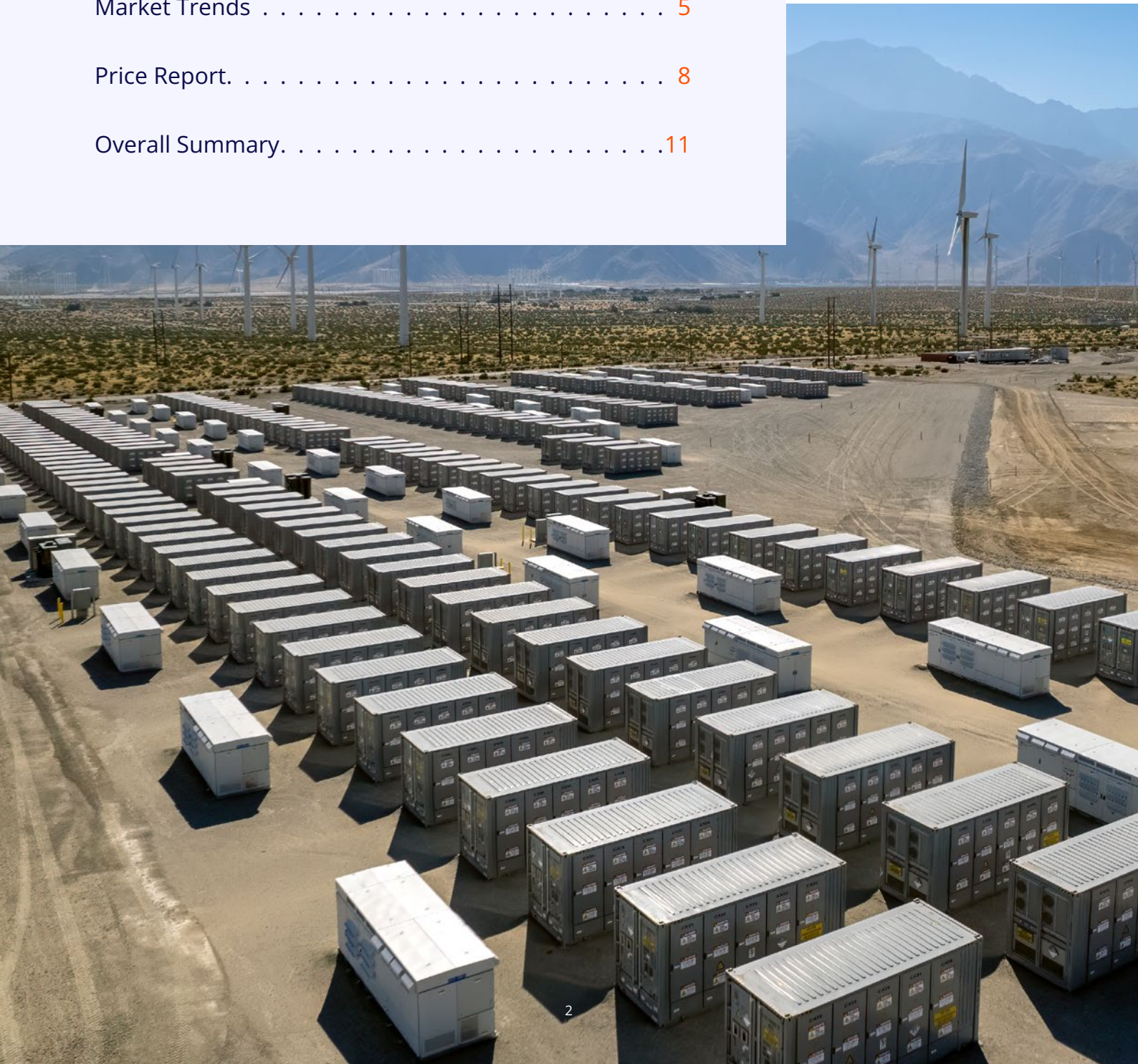
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Introduction

The Photon Energy BESS Quarterly Financial Analysis evaluates the financial performance of 1MW/1MWh and 1MW/2MWh battery energy storage systems (BESS) across the Czech Republic, Poland, Romania, and Hungary.

We've considered two main sources of income for this report: aFRR ancillary services (reservation, activation, recharging and discharging after activation) and day-ahead market (DAM) arbitrage. The reported data are calculated using an optimisation tool that assumes optimal battery performance each hour.

Assumptions

- ▶ We take into account 5% noise in the forecasted data
- ▶ The availability of the battery is 96% of total time
- ▶ The battery system has a roundtrip efficiency of 94% (97% for charging and discharging)
- ▶ We assume a maximum of two operational cycles per day
- ▶ To avoid fast degradation the battery is cycles just from 0% to 80% state of charge

This report covers the period from January to March 2025.

Monthly Average Revenues per 1 MWh

This table compares the monthly revenues per 1 MW standalone battery (in EUR/MW) for the months of January, February, and March 2025, highlighting the difference between revenues when the battery participates exclusively in the day-ahead market (DAM) and when it is optimised for both the day-ahead and automatic frequency restoration reserves (aFRR) markets.

Monthly Average Revenue per 1MW/1MWh Standalone Battery (EUR/MW)

	DAM	DAM + aFRR					
	Total	aFRR				DAM	Total
		aFRR Up		aFRR Down			
		Reservation	Activation*	Reservation	Activation*		
CZ	2,989	10,235	1,033	312	1,471	2,405	15,455
PL	3,056	17,801	187	11,537	397	2,185	32,106
RO	4,297	2,847	1,789	3,000	2,526	3,306	13,468
HU	4,355	2,545	881	1,257	1,810	3,188	9,680

Monthly Average Revenue per 1MW/2MWh Standalone Battery (EUR/MW)

	DAM	DAM + aFRR					
	Total	aFRR				DAM	Total
		aFRR Up		aFRR Down			
		Reservation	Activation*	Reservation	Activation*		
CZ	5,468	12,595	929	347	1,631	4,067	19,569
PL	5,588	22,736	218	13,156	473	4,382	40,965
RO	8,022	3,557	2,446	3,741	4,753	5,957	20,454
HU	8,138	3,357	1,177	1,603	2,150	5,610	13,899

* The activation portion of income includes expenses related to charging after activation Up and income related to discharging after activation Down.

In Poland, there is additional income from the capacity market, which can be added to the total revenue. The monthly amount is EUR 997 for a 1MW/1MWh battery and EUR 1,995 for a 1MW/2MWh battery.

Market Trends

Revenue from DAM Only

Across all countries, the monthly revenue from optimising a battery solely for the DAM remains lower compared to the combined strategy of optimising for both DAM and aFRR services.

- ▶ **Hungary** shows the highest revenue from DAM alone per 1MW: **EUR 4,355** for a 1MWh battery, **EUR 8,138** for a 2MWh battery.
- ▶ **Romania** follows with **EUR 4,297** (1MWh), **EUR 8,022** (2MWh).
- ▶ **Poland** earns **EUR 3,056** (1MWh), **EUR 5,588** (2MWh).
- ▶ **Czech Republic** has the lowest DAM-only revenue: **EUR 2,989** (1MWh), **EUR 5,468** (2MWh).

This indicates that DAM alone provides moderate returns but is not as lucrative as aFRR optimisation.

Impact of aFRR Optimisation

Optimising for both DAM and aFRR services significantly boosts revenue, particularly in **Poland and Czech Republic**, where **aFRR Up reservation** remains the dominant source of income.

- ▶ In Poland, aFRR Up reservation contributes EUR 17,801 per MW for a 1MWh battery and EUR 22,736 for a 2MWh battery — the highest single revenue stream across all countries.
- ▶ Czech Republic also earns most of its additional income from aFRR Up reservation, with EUR 10,235 (1MWh) and EUR 12,595 (2MWh).
- ▶ Romania and Hungary shows moderate but more balanced returns, with contributions from all aFRR categories

1MW/1MWh vs. 1MW/2MWh Batteries

While total revenue is higher for 2MWh batteries, **1MWh systems deliver greater value per MWh of capacity** in most markets due to faster cycling.

- ▶ **Romania** sees the **largest percentage increase** in total revenue: From **EUR 13,468** (1MWh battery) to **EUR 20,454** (2MWh battery) → a **+52% gain**, highlighting excellent monetisation of longer-duration flexibility, especially in **aFRR Down activation**.
- ▶ **Hungary** also benefits strongly, with revenue rising from **EUR 9,680** (1MWh) to **EUR 13,899** (2MWh) → a **+44% increase**, driven by balanced gains across all aFRR components.
- ▶ **Poland** shows a solid increase from **EUR 32,106** (1MWh) to **EUR 40,965** (2MWh) → a **+28% rise**, indicating that even with strong aFRR Up reservation already captured by 1MWh systems, 2MWh batteries still extract additional value.
- ▶ **Czech Republic** experiences the **smallest relative increase**, from **EUR 15,455** (1MWh) to **EUR 19,569** (2MWh) → a **+27% improvement**, consistent with its more concentrated reliance on aFRR Up reservation.

Despite higher absolute returns for 2MWh batteries, 1MWh systems maintain a better revenue-to-storage ratio.

Market Trends

Country Variations (1MW/1MWh battery)

Poland

- ▶ Q4 2024: Poland was the most lucrative market, with EUR 38,436, primarily driven by aFRR Up reservation (EUR 21,004).
- ▶ Q1 2025: Poland remains the top-performing market, earning EUR 32,106, despite a slight drop in total revenue. Notably, aFRR Up reservation increased to EUR 17,801, but DAM revenue **declined slightly**, offsetting the gains.

Trend: Stable leadership, slight revenue drop, but **aFRR Up remains dominant**.

Romania

- ▶ Q4 2024: Romania earned EUR 14,169, with aFRR Down activation (EUR 4,554) as the key revenue stream.
- ▶ Q1 2025: Total revenue declined to EUR 13,468. DAM revenue slightly increased and aFRR Down activation and aFRR Up reservation weakened.

Trend: Not so strong in **Down activation**, but overall revenue slightly down and **more reliant on a DAM service**.

Czech Republic

- ▶ Q4 2024: Total revenue was EUR 16,745, largely from aFRR Up reservation (EUR 12,608).
- ▶ Q1 2025: Revenue fell to EUR 15,455, with aFRR Up reservation dropping to EUR 10,235, though still the main source. DAM revenue rose slightly.

Trend: **Stable structure**, but slightly lower revenue due to **reduced aFRR earnings**.

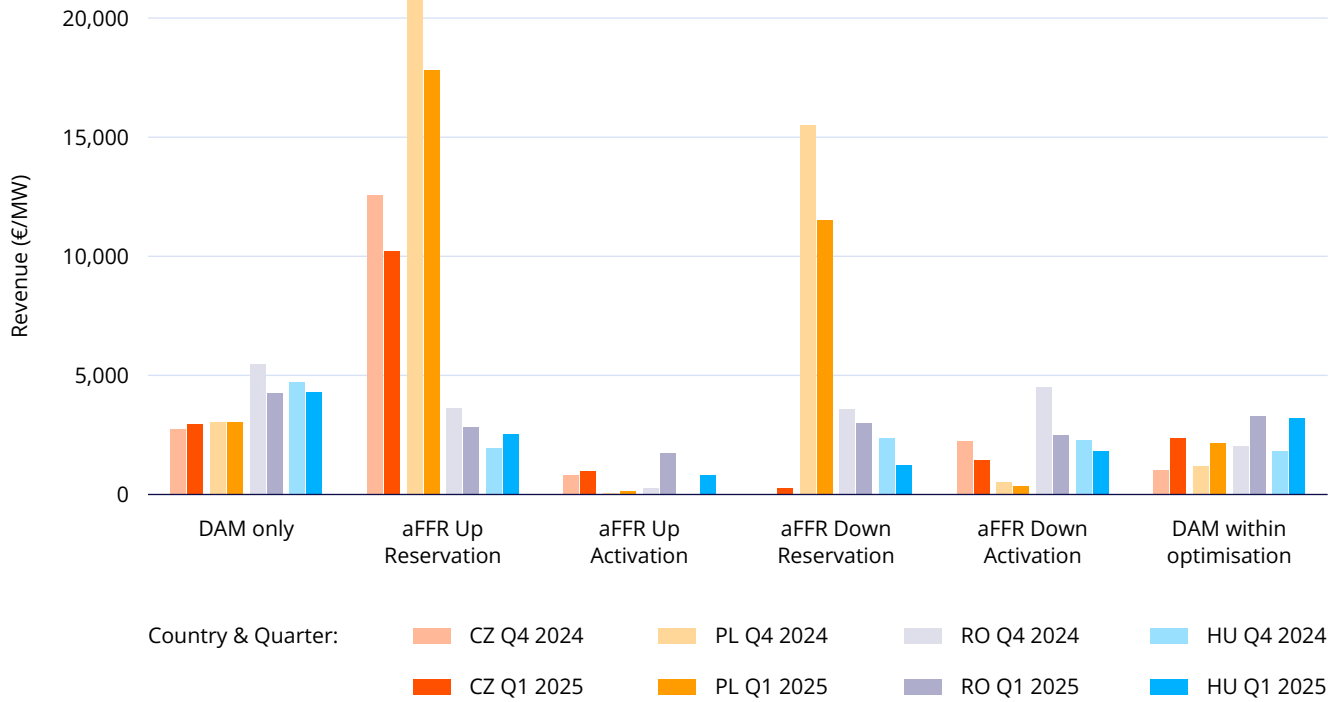
Hungary

- ▶ Q4 2024: Hungary had the lowest total revenue at EUR 8,599, with modest contributions from all services.
- ▶ Q1 2025: Revenue rose to EUR 9,680, with increases across all services. Notably: aFRR Up rose from EUR 1,988 → 2,545, and DAM from EUR 1,819 → 3,188.

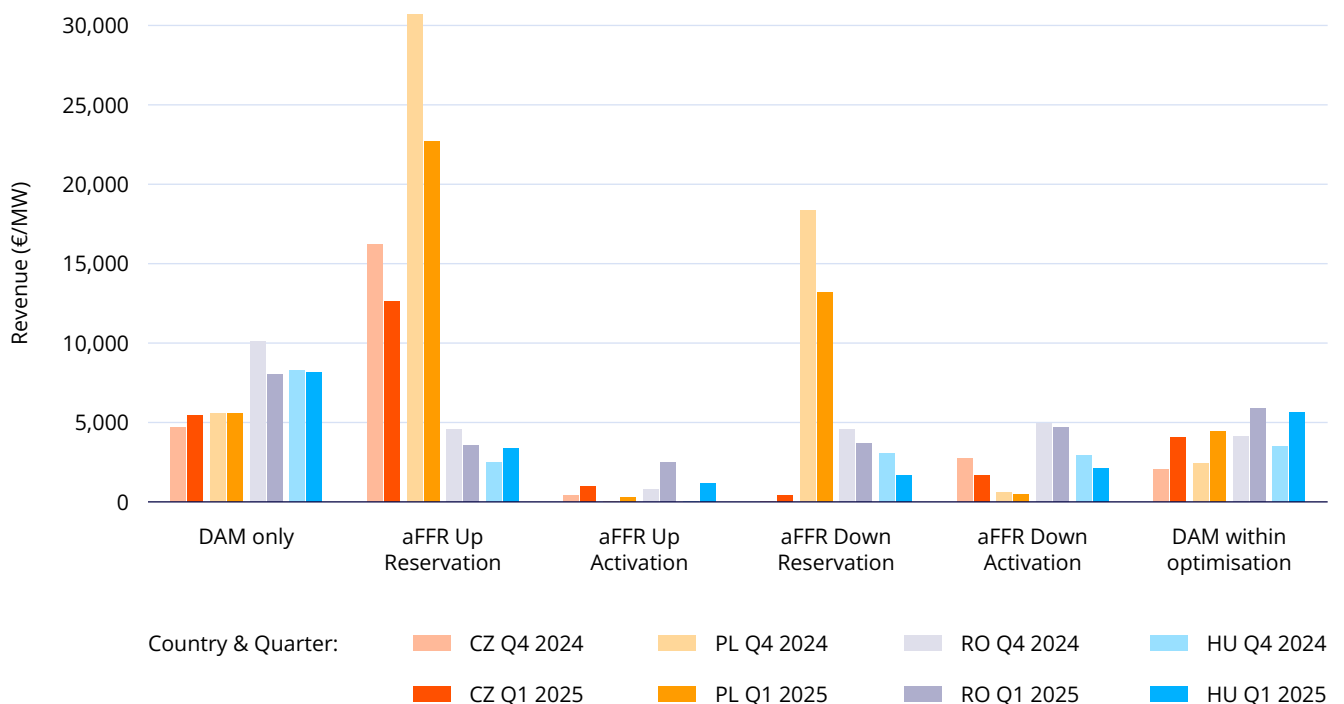
Trend: **Improved balance and stronger performance**, though still behind other markets in absolute revenue.

Market Trends

Monthly Average Revenue for Jan–Mar 2025 1MW/1MWh Standalone Battery Compared to Previous Quarter



Monthly Average Revenue for Jan–Mar 2025 1MW/2MWh Standalone Battery Compared to Previous Quarter



Price Report: Assumptions

Pricing for aFRR Ancillary Services ¹

	Reservation	Activation
CZ	Pay as bid	Marginal price
PL	Marginal price	Marginal price
RO ²	Marginal price	Marginal price
HU	Pay as bid	Pay as bid

Pricing for the Capacity Market in Poland

Parameter	Value ³
Correction factor for batteries	95%
Capacity market service	Max 4 hours in row
Capacity market testing	4x per year
Capacity market hours	7-22
Latest available price	210.00 PLN/MW/year

Network Tariffs ⁴

	EUR/MWh
CZ	38
PL	47
RO	21
HU	28

¹ 80% successful auctions for reservation and 50% for activations.

² In Romania, ancillary service offers must be symmetrical. Participants must participate in both directions, Up and Down.

³ These values are valid for 2025. The price reflects the average price from additional auction. System stress events (SSE) not counted, in 2025: 0 hours of SSE in Poland.

⁴ This fee is applied whenever a battery is charged from the grid, for the purpose of DAM arbitrage and when recovering from activation Up.

Price Report

This table provides detailed pricing information (in EUR) for different countries and different energy market mechanisms. The table captures a range of statistics for each country, including the **mean**, **minimum**, **maximum**, and **standard deviation**.

		DAM	aFRR Reservation		aFRR Activation	
			Down	Up	Down ⁵	Up
CZ	mean	120	0.7	23	43	144
	min	-25	0.1	12	-3,306	-26
	max	563	2.3	27	280	5,916
	std	46	0.6	2.3	139	215
PL	mean	117	24	40	111	115
	min	-103	5.0	3.8	-246	-233
	max	329	171	170	315	316
	std	47	30	28	63	60
RO	mean	133	13	13	-24	183
	min	-24	12	11	-1,372	0.0
	max	603	15	14	80	1,571
	std	59	0.7	0.7	148	185
HU	mean	137	2.9	6.3	19	103
	min	-0.8	0.0	0.0	-271	0.0
	max	615	50	49	225	3,381
	std	57	7.8	9.4	27	207

⁵ The positive Down activation prices represent a situation when the client is paying for charging the battery during activation, the negative Down activation prices represent a situation when client gets paid for charging the battery during activation.

Price Report

Insights

Day-Ahead Market (DAM) Prices

- ▶ **Mean Prices:**
 - DAM prices saw a slight **increase** in most countries.
- ▶ **Volatility (Standard Deviation):**
 - Slight decreases in standard deviation were observed in CZ and PL.
 - RO and HU showed minor changes, with HU remaining the most volatile DAM market.

aFRR Reservation Prices

- ▶ **Downward Reservation:**
 - Prices generally **decreased** across all countries, except CZ.
- ▶ **Upward Reservation:**
 - **A mixed trend observed:**
 - **CZ, PL, RO:** all experienced a decrease.
 - **HU:** increased slightly from 4.7 to 6.3 EUR/MWh.

aFRR Activation Prices

- ▶ **Downward Activation:**
 - A modest decline or improvement depending on the country.
 - **PL:** remained stable at 111 EUR/MWh.
- ▶ **Upward Activation:**
 - Diverging patterns across countries.

Key Takeaways

- ▶ DAM prices **slightly increased in Q1 2025, suggesting tighter market conditions or higher demand.**
- ▶ aFRR Reservation prices **declined in most countries, indicating possible reductions in system operator procurement or more competitive bids.**
- ▶ CZ saw the most notable increases **in both DAM and Upward Activation prices, signaling higher flexibility value or scarcity conditions.**
- ▶ HU experienced declining aFRR Up Activation prices, **suggesting a softer balancing market.**
- ▶ RO continued showing negative average prices in Downward Activation, **although less extreme than in Q4 2024.**

Overall Summary

Revenue Comparison (DAM vs. DAM + aFRR)

- ▶ Optimising battery operation for both DAM and aFRR significantly increases revenue, with Poland and Czech Republic benefiting the most.
- ▶ DAM-only revenues are highest in Hungary (EUR 4,355/MW) and lowest in the Czech Republic (EUR 2,989/MW).
- ▶ In Poland, aFRR Up reservation contributes significantly to total earnings.

Battery Size Impact (1MW/1MWh vs. 1MW/2MWh)

- ▶ The data shows that increasing the energy capacity from **1MWh to 2MWh per 1MW of power** leads to **significant revenue growth** across all countries, though the **scale of improvement varies**:
- ▶ While 1MWh batteries remain more efficient per MWh in fast-response markets, **2MWh batteries capture more total value**, especially in systems where **discharge duration and multi-hour services** like aFRR Down activation are better monetised (as seen in Romania and Hungary).

Country-specific Observations

- ▶ **Poland:** the most lucrative market, with strong gains from aFRR Up reservation.
- ▶ **Romania:** benefits the most from DAM arbitrage.
- ▶ **Czech Republic:** moderate benefits from aFRR Up reservation, but lower activation revenue.
- ▶ **Hungary:** shows limited benefits from aFRR, with relatively high DAM revenue.

Price Insights

- ▶ DAM prices slightly increased in most countries, with HU and CZ showing the highest rises. RO remained stable, and overall market volatility was moderate across all regions.
- ▶ Prices for both Downward and Upward Reservation generally declined, especially in PL, RO, and HU, indicating lower procurement costs or increased competition. Only CZ saw a slight rise in downward reservation.
- ▶ Upward Activation prices increased notably in CZ, while HU and RO experienced significant drops. Downward Activation remained volatile, with RO still showing negative average prices, though less extreme than in the previous quarter.

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