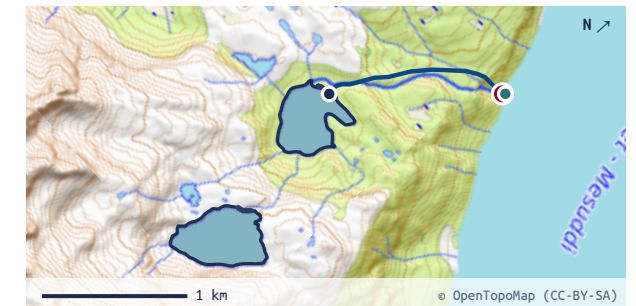


Storelva (Saltdal)

Run-of-river · price zone **N04** — full-year optimised dispatch, 1 Jan – 31 Dec 2025.

INSTALLED **6,7** MW MAX FLOW **3,6** m³/s RESERVOIR **0** h · 0,0 Mm³

WATERCOURSE & COMPONENTS · SALTDAL



THE HEADLINE · 2025

Co-optimising Storelva (Saltdal) across all balancing markets lifted modelled revenue **+190 %** over day-ahead-only dispatch — almost entirely from reserve capacity, not extra energy.

+190 %

REVENUE UPLIFT

€ 185 151

ADDITIONAL / YEAR

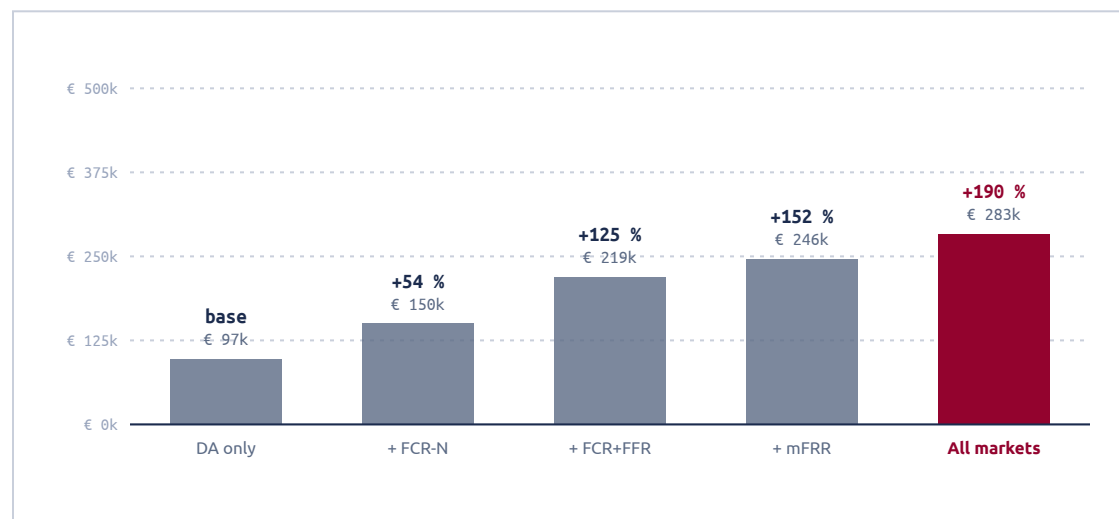
PERFORMANCE — ALL MARKETS (HYBRID)

SELECT MARKET STRATEGY ↓

Day-ahead only	DA + FCR-N (standalone)	DA + FCR + FFR (hybrid)	DA + FCR-N + mFRR (standalone)	All markets (hybrid)	
TOTAL REVENUE € 282 602 +190,0 % vs. DA only	ENERGY 11 631 MWh to grid	CAPACITY FACTOR 19,8 % of 6,7 MW	CAPTURE RATE 186 % 24,3 €/MWh realised (all markets ÷ energy)	RESERVOIR CYCLES n/a full equiv. / yr	SPILL 11,1 Mm ³ · 33,3 %

REVENUE BY STRATEGY

EUR · Δ vs day-ahead only



REVENUE BY MARKET

All markets (hybrid) · reserved MW · activated MWh/h

MARKET	AVG MW	ACT MWH	PEAK MW	REVENUE	SHARE
Day-ahead energy	—	1,33	6,7	€ 78 292	28%
FCR-N reserve	0,29	0,03	2,5	€ 73 110	26%
FCR-D up	0,04	0,00	2,7	€ 4 657	2%
mFRR up / down	1,08	0,00	6,7	€ 108 425	38%
FFR profile + flex	0,13	0,00	1,3	€ 18 117	6%
Total				€ 282 602	

THE MARKET STRATEGIES · what each scenario co-optimises

- 1 Day-ahead only**
Spot-price optimised dispatch only — no reserves. The revenue baseline.
- 2 DA + FCR-N (standalone)**
Adds FCR-N (symmetric frequency reserve). Autonomous droop setpoint, capped at 10 % of capacity.
- 3 DA + FCR + FFR (hybrid)**
FCR-N + FCR-D up + fast frequency response (FFR). Assumes a small ESS hybrid for the sub-second products.
- 4 DA + FCR-N + mFRR (standalone)**
FCR-N plus manual restoration reserve (mFRR up/down) — TSO-activated, needs an operations function.
- 5 All markets (hybrid)**
Co-optimised across every balancing market (DA, FCR-N/D, mFRR, FFR) as a hybrid.

Day-ahead only	DA + FCR-N (standalone)	DA + FCR + FFR (hybrid)	DA + FCR-N + mFRR (standalone)	All markets (hybrid)
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01 SCENARIO COMPARISON · uplift vs. day-ahead only

STRATEGY	REVENUE	REVENUE (BAR) · Δ VS DAY-AHEAD	ENERGY (MWH)	CAPTURE RATE	CAP. FACTOR	RESERVE UTIL.
Day-ahead only	€ 97 451	—	15 950	64 %	27,2 %	0 %
DA + FCR-N (standalone)	€ 150 077	+54,0 %	12 689	99 %	21,6 %	6 %
DA + FCR + FFR (hybrid)	€ 218 833	+124,6 %	9 398	144 %	16,0 %	13 %
DA + FCR-N + mFRR (standalone)	€ 245 642	+152,1 %	12 561	162 %	21,4 %	24 %
All markets (hybrid)	€ 282 602	+190,0 %	11 631	186 %	19,8 %	23 %

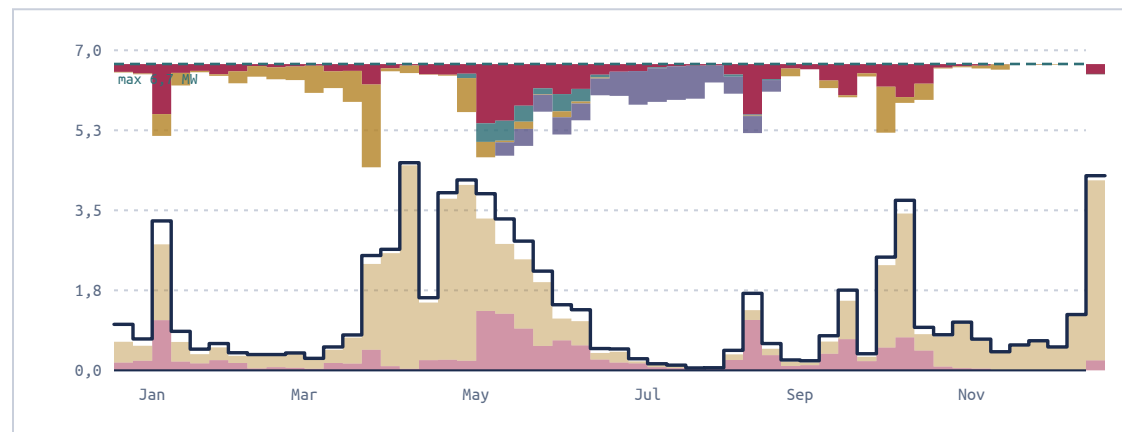
02 WATER BALANCE & CAPTURE · All markets (hybrid)

TOTAL INFLOW	TURBINED	SPILL (LOST)	AVG RESERVOIR	CAPTURE RATE
33,2	22,1	11,1	n/a	186 %
Mm³ · Sildre (Grytvikelva) × 6.59 — scaled so capped-turbine energy matches the NVE concession estimate (16.4 GWh; beta)	Mm³ through turbine	Mm³ · 33,3 % of inflow	% of usable volume	revenue ÷ (inflow energy × 8,7 €/MWh)

03 HOW THE PLANT WAS DISPATCHED · optimised dispatch for the selected strategy

RESERVE CAPACITY HELD

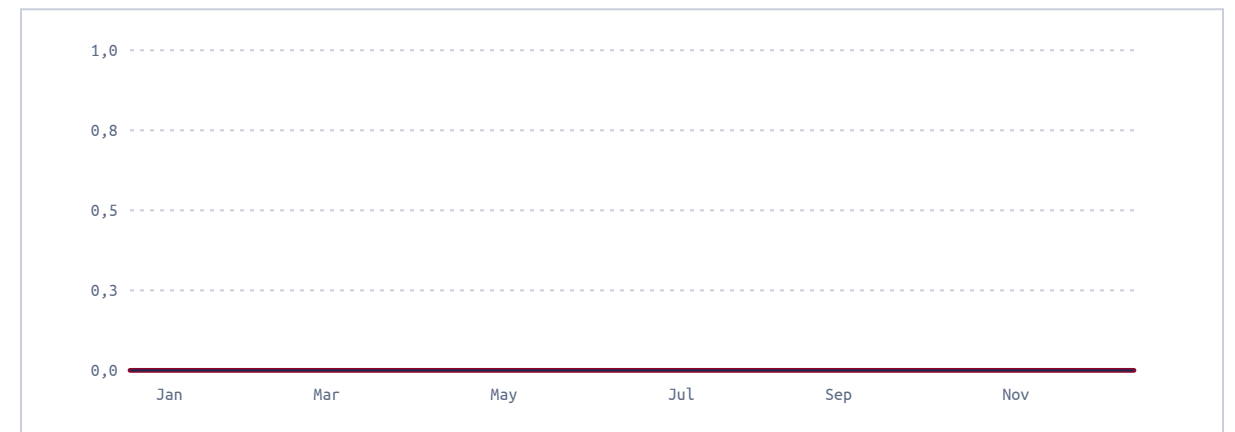
All markets (hybrid) · up from top, down from bottom



FCR-N FCR-D mFRR FFR Plant output Max capacity

RESERVOIR TRAJECTORY

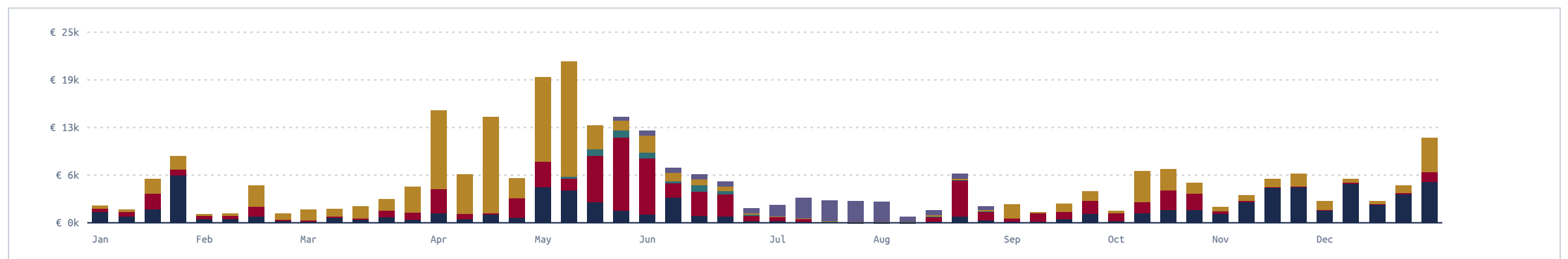
weekly · Mm³ · all strategies, selected highlighted



All markets (selected) Other strategies Min / max bounds

WEEKLY REVENUE BY MARKET

All markets (hybrid) · 52 equal periods



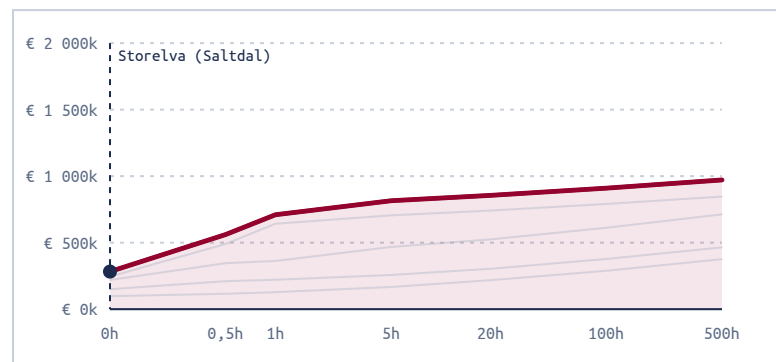
Day-ahead FCR-N FCR-D mFRR FFR

Day-ahead only	DA + FCR-N (standalone)	DA + FCR + FFR (hybrid)	DA + FCR-N + mFRR (standalone)	All markets (hybrid)
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01 WHERE THE MARGINAL VALUE IS

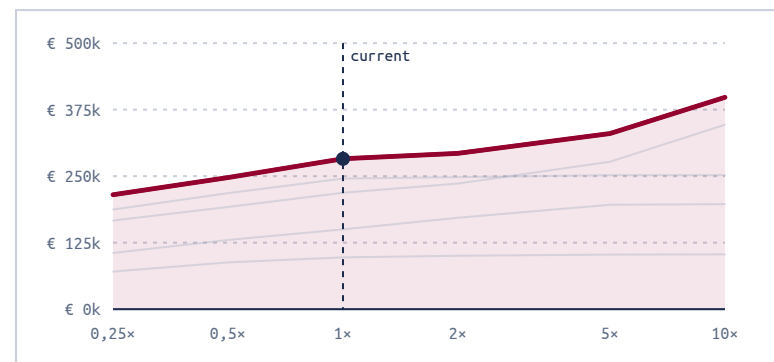
Sensitivity of optimised revenue to the plant's physical envelope, under each market strategy. The **highlighted line is the selected strategy**; the dashed marker is Storelva (Saltdal)'s current operating point.

STORAGE DISCHARGE DURATION



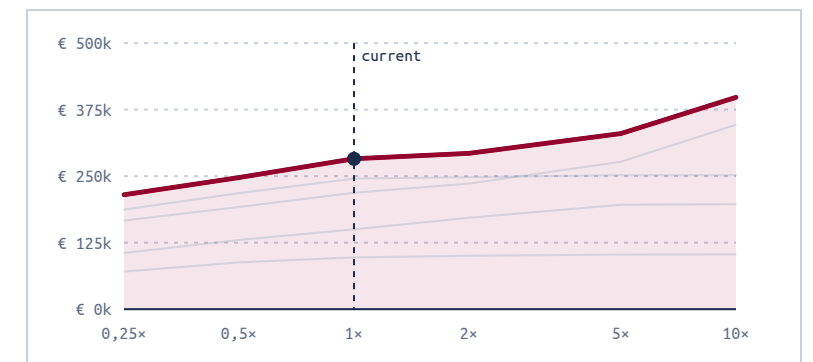
Annual revenue vs. usable storage hours (log). Marker = as-built.

TURBINE CAPACITY



Annual revenue vs. turbine flow capacity (x as-built, log). Marker = as-built.

PLANT SCALE



Revenue vs. scaling turbine + reservoir together (x as-built, fixed inflow). Saturates when the plant outgrows its water.

— All markets (selected) — Other strategies — Storelva (Saltdal) as-built

MARGINAL VALUES & BINDING CONSTRAINTS

as-built · All markets (hybrid)

Marginal water value	17,1 €/MWh	Extra revenue from one more MWh of stored water
Turbine capacity (+1 MW)	1 512 €/yr	Extra annual revenue from a turbine uprate at current scale
Storage (+1 MWh)	103 924 €/yr	Extra annual revenue from more usable storage (≈0 when over-provisioned)
Reserve-cap headroom (+1 MW)	3,2 €/MW·h	Extra €/MW·h from relaxing the binding reserve reservation cap
Day-ahead spot (reference)	8,7 €/MWh	Avg. zone NO4 day-ahead price
Reservoir upper bound	binds 100 %	Share of hours at the cap — spill risk in the melt

READING MARGINAL (SHADOW) PRICES

A marginal (shadow) price is the extra revenue the optimiser would earn from **one more unit** of a scarce resource — an MWh of stored water, +1 MW of turbine, +1 MWh of storage, or +1 MW of reserve-cap headroom — holding everything else fixed.

A value near **zero** means that limit isn't binding: loosening it wouldn't help, so don't invest there. A **large** value flags the binding bottleneck — where a relaxed limit or an upgrade would pay back, and roughly how much it is worth per year. They answer: *what is holding this plant back, and what is it worth to change it?* (Values are for the selected strategy at the as-built size.)

RECOMMENDATIONS

- 2025: +190 % — reserves carried the largest prospect too**
Day-ahead alone fell to €98 000 at NO4's 8,6 €/MWh average; full participation earned €283 000/yr. mFRR was the single biggest line (€108 000), followed by FCR-N (€73 000, standalone +€53 000/+54 %). The size that makes Storelva the portfolio's biggest energy asset also makes it the biggest reserve asset. Perfect-foresight upper bounds.
- mFRR route clearly ahead in 2025 — €246 000 vs €219 000 hybrid**
mFRR alone doubled year-over-year to €123 000/yr. If Småkraft Vekst runs any balancing operation across its fleet, adding Storelva at commissioning is the natural move; otherwise an outsourced agreement covers it. FCR-N first either way.
- The buffer lever scales with plant size**
0,5 h of pondage prices at €560 000/yr against the as-built €283 000 — the largest absolute buffer premium in the portfolio, and the same signal as 2024. With the plant under construction this may still be actionable at the intake; treat the figure as model-preliminary (LER assumptions) and reconcile the NVE production basis (16,4 GWh) as part of it. Spill at full reserves: 33 % of inflow.

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SIMULATION SETUP & ASSUMPTIONS

MODEL	HORIZON	HYDROLOGY	CAPS
Method: MILP co-opt.	Period: 2025 full-year	Inflow source: Sildre (Grytvikelva) × 6.59 – scaled so capped-turbinable energy matches the NVE concession estimate (16.4 GWh; beta)	FCR-N: 10% / 40% hyb.
Solver: CBC	Resolution: 60 min MTU	Station: Grytvikelva	FCR-D: 40%
Segments: 5	Hours: 8 760	Total inflow: 33,2 Mm ³	FFR: 10%
Boundary: cycling res.	Storage bounds: concession	Usable res.: 0,0 Mm ³ · 0 h	mFRR: 100%
MARKETS & PRICES			
Strategies: DA · FCR-N/D			
	mFRR · FFR		
Price zone: NO4			
Avg spot: 8,7 €/MWh			

