

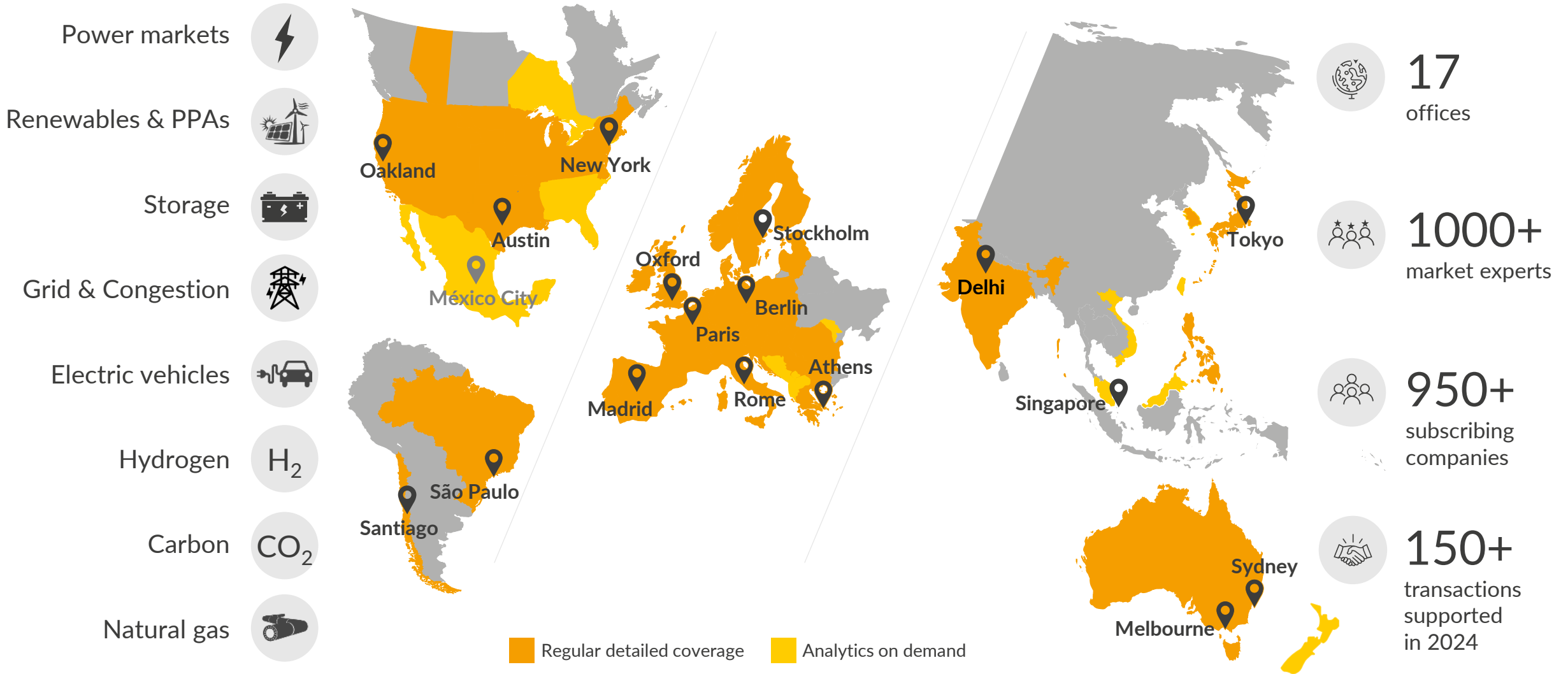
Contract designs for storage in low-carbon markets

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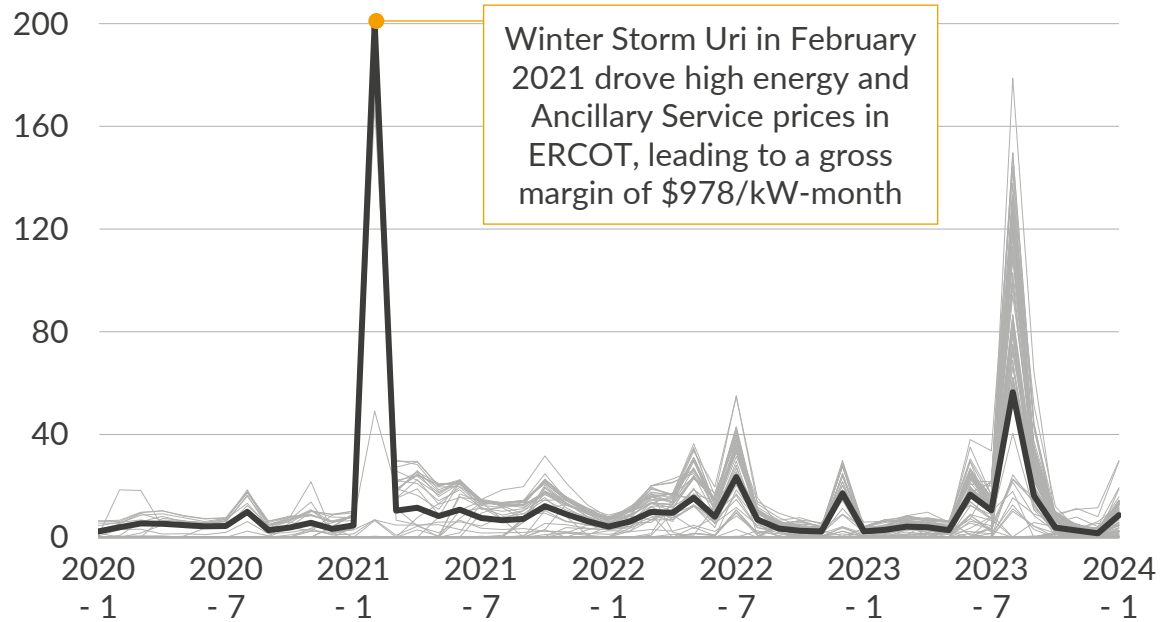
Battery value varies month by month; this is exacerbated in ERCOT, driving the need to secure revenue via tolling agreements



ERCOT

Battery value is concentrated in very few months; historically this has included both hot summers and extreme winter events

Monthly energy and Ancillary Service gross margins across battery units
\$/kW-month (nominal)



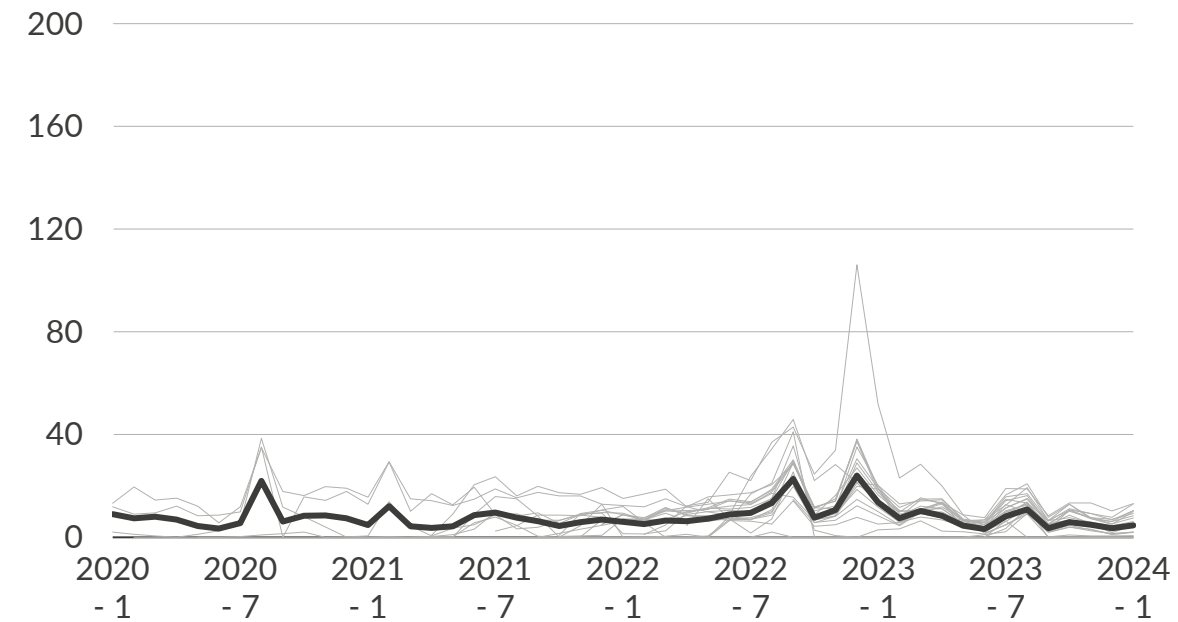
- Battery value in ERCOT varies widely month to month - \$978/kW-month average in February 2021 (capped in graph to \$200/kW-month).
- Generally, summers see increased value due to increased demand for cooling driving scarcity value, benefitting dispatchable assets like batteries.

— Battery units (ERCOT) / QSEs (CAISO) — Average

CAISO

Value in CAISO tends to be less concentrated; value is more distributed throughout the entire year, exacerbated by RA

Monthly energy and Ancillary Service revenues across battery QSEs¹
\$/kW-month (nominal)



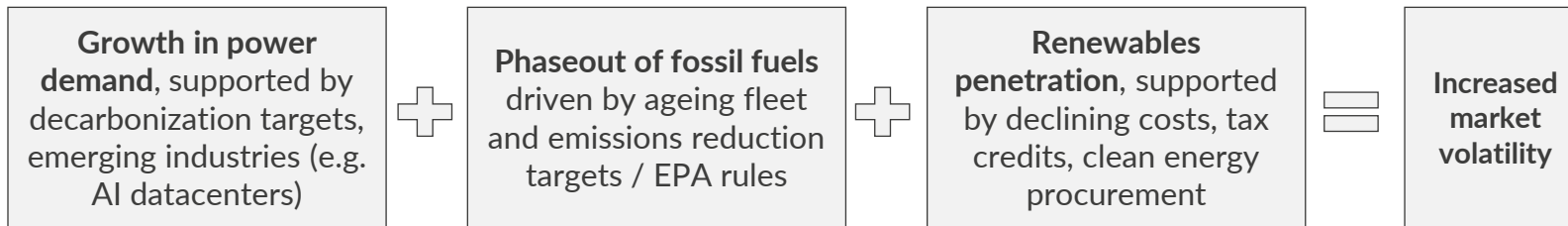
- Battery value is also variable month to month in CAISO, though absence of scarcity pricing adder and addition of Resource Adequacy payments reduces volatility.
- RA contracts (not shown in revenue here) provide an additional means of securing consistent revenue across all months in the year.

1) Data from FERC EQR, generally data is more limited; not showing results for all battery capacity in CAISO. Shows company-level granularity.

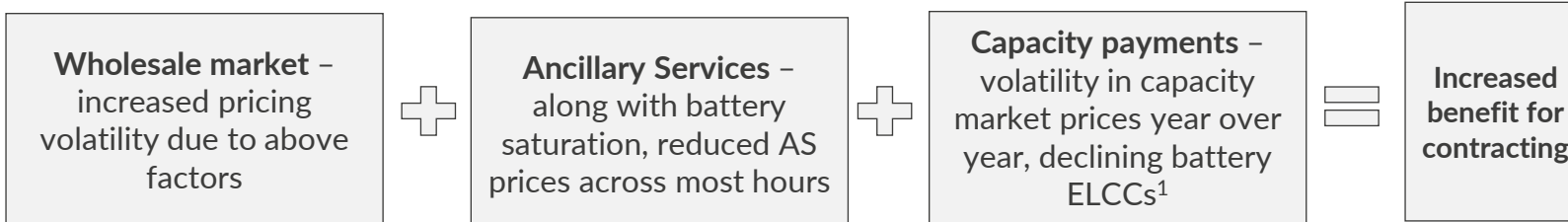
Battery offtake agreements have emerged as a mechanism to firm battery revenues and unlock debt financing

Landscape for battery contracting

1 Market volatility is growing across power markets



2 Various risks across battery revenue streams may increase attractiveness for battery contracting



3 Developers and offtakers may see different incentives for contracting



Battery developers

Reasons to contract

- Ensure constant and predictable revenue stream.
- Unlock debt financing for new-build assets, lowering the cost of capital.



Offtakers

Reasons to contract

- Short and long-term price hedge.
- Potential for upside from market exposure.
- Self-balancing.
- OEM an Optimizers - Strategic BD

Publicly announced full toll contracts

In ERCOT

100MWh Crosset Storage



In CAISO

1,000MWh Cormorant Energy Storage Project



In NEM (Australia)

BESS and LDS projects

Capacity Investment Scheme
















Battery developers

Offtakers

1) Effective Load Carrying Capability.

Various structures for battery offtake have been seen to date, with availability and prevalence varying across markets

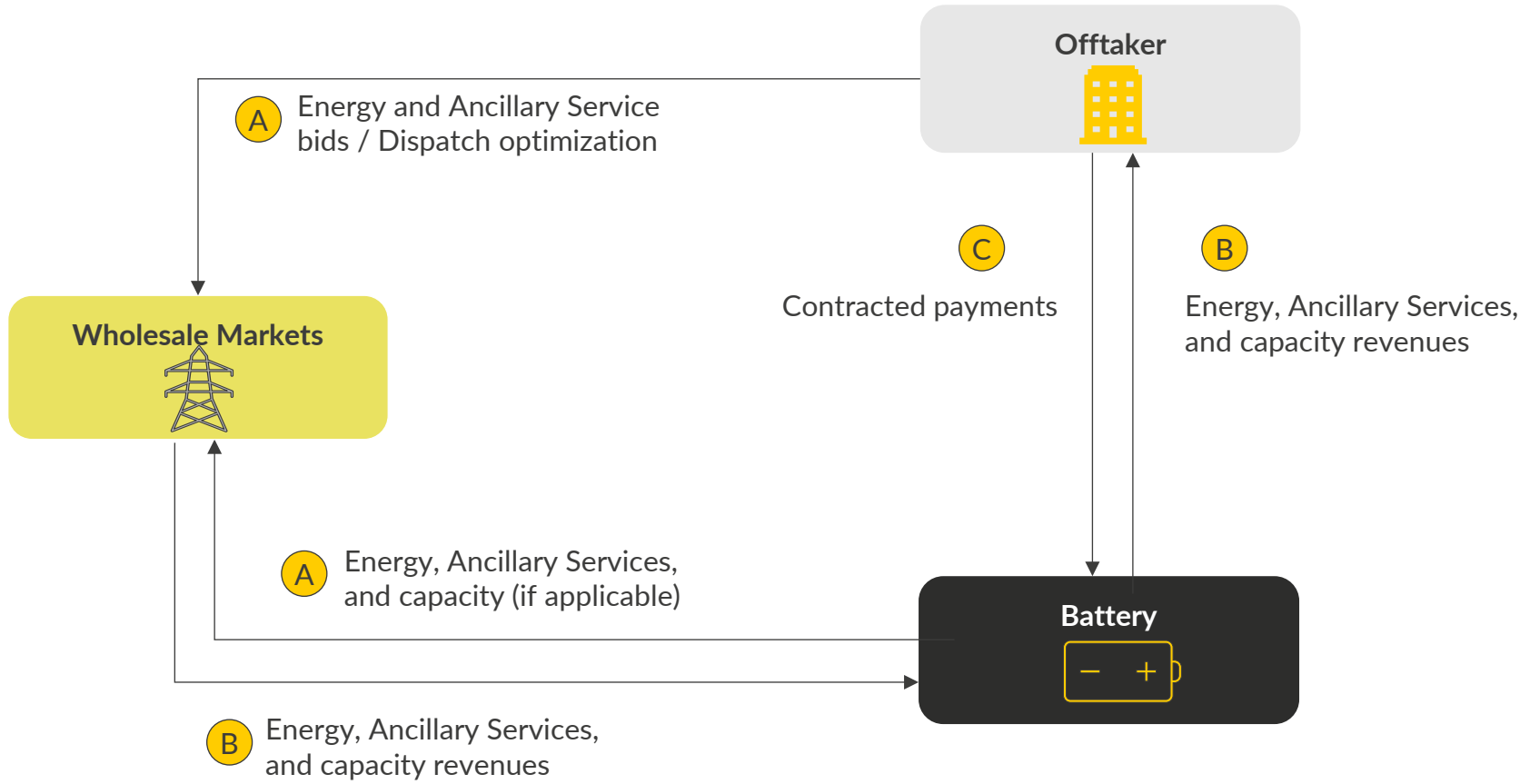
 Deep dive on following slides

Contract type	Contract structure	Battery receives	Offtaker receives	Main markets present	Typical tenor (years)	Potential size of market
Tolling agreements	Fixed price 	Pre-determined contract price	Asset dispatch rights; market energy and Ancillary Service revenues	ERCOT, MISO, CAISO	5 - 7	
	Floor price with profit sharing	Pre-determined contract price + share of market revenues	Asset dispatch rights; remainder of market revenues	ERCOT	5 - 7	
Financial hedges	Top / bottom spread swaps 	Fixed rate	Floating rate based on realized top / bottom spreads	ERCOT, CAISO	1 - 5	
	Ancillary Services swaps	Fixed rate	Floating rate based on realized Ancillary Services prices	ERCOT	1 - 5	
	Revenue puts and collars	Caps and floors on market revenues	Receives market revenues above cap and pays market revenues below floor	ERCOT, AEMO	1 - 15	
Capacity sales	RA ¹ contracts 	Pre-determined contract price	Credit towards resource adequacy obligation	CAISO	10 - 15	
	Long-term capacity sales	Pre-determined contract price	Credit towards capacity market obligation	MISO, PJM	10 - 15	
State subsidies	Indexed storage payments 	“Strike Price” (as bid by battery developer), market energy, Ancillary Services, and capacity revenues	“Reference Price,” intended to reflect the market revenues over a given period (netted off from payment to battery)	NYISO	15	

1) Resource Adequacy.

1 Under a toll, the offtaker assumes market price risk, in exchange for a fixed payment. Incentive alignment management is critical.

Tolling agreements – Fixed price



Contract design and incentive compatibility implications

- Under a “full” tolling agreement, market revenues are passed through to the offtaker, in exchange for a fixed payment.

A Under a 100% toll the battery does not retain any economic link to market outcomes.

B Thus, the battery owner has no ongoing incentives to maximize revenues.

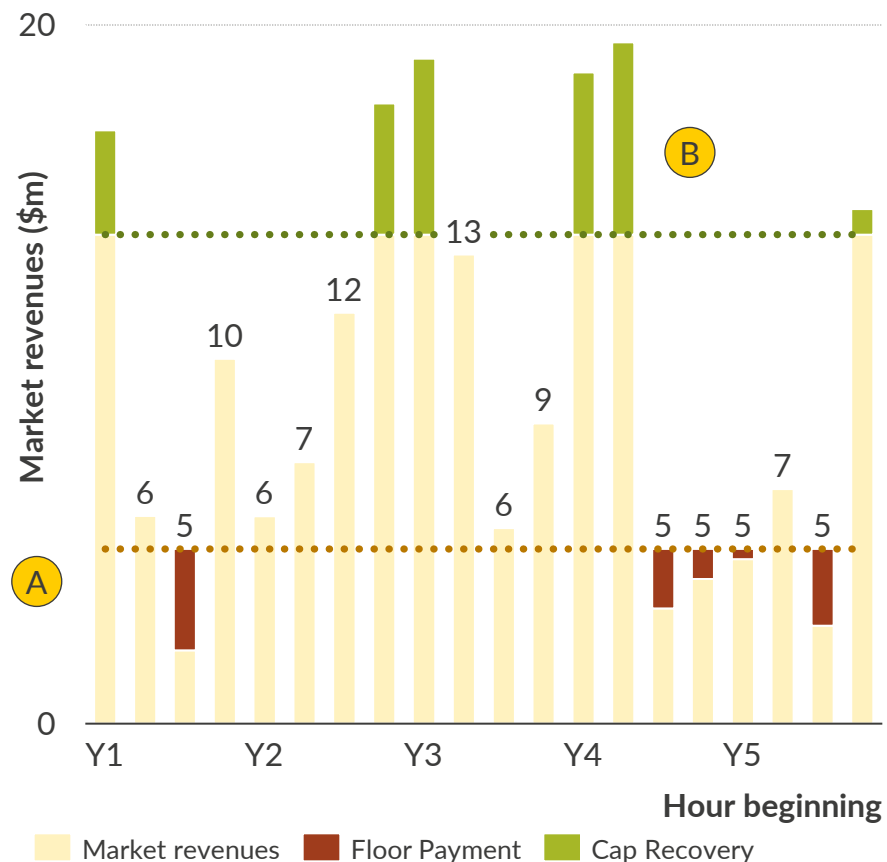
C Contract design options to retain incentive compatibility:

- Trading rights alignment:** “right to operate and trade” follows revenues.
- Partial toll:** where battery owner retains a share in market revenues.
- Virtual toll:** benchmarked performance (percentage-of-perfect).

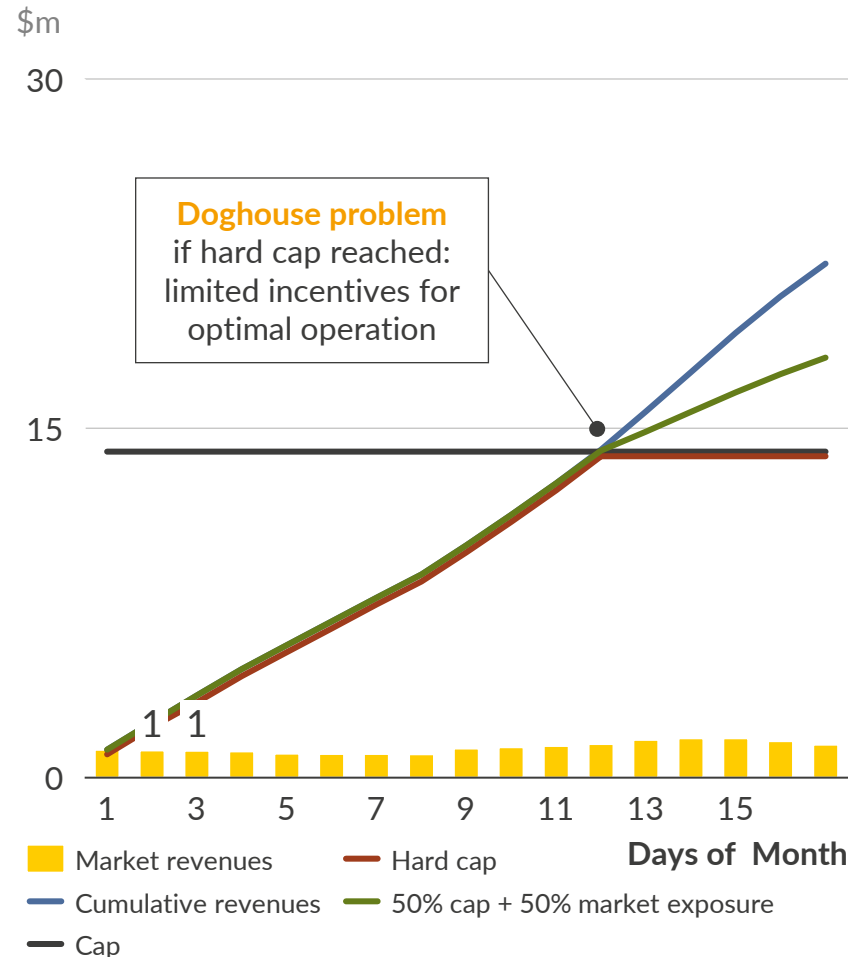
2 'Caps & floors' contract designs seek to bound market revenues under a no-cost collar.

Financial hedges – Revenue 'cap & floor' or collar

Example AEMO Capacity Investment Scheme, \$m



Example of the "Doghouse problem" in collar structure



- Revenue 'Caps & Floors' seek to bound revenues within a range under a zero-cost collar structure.

- A** When market revenues are higher than the cap, battery pays offtaker.
- B** When market revenues are lower than the floor, offtaker pays battery.

Incentive compatibility:

"The Doghouse Problem":

- Under a **hard revenue cap** when the cap threshold is reached the battery has no incentives to participate optimally in the market.

Potential mitigations

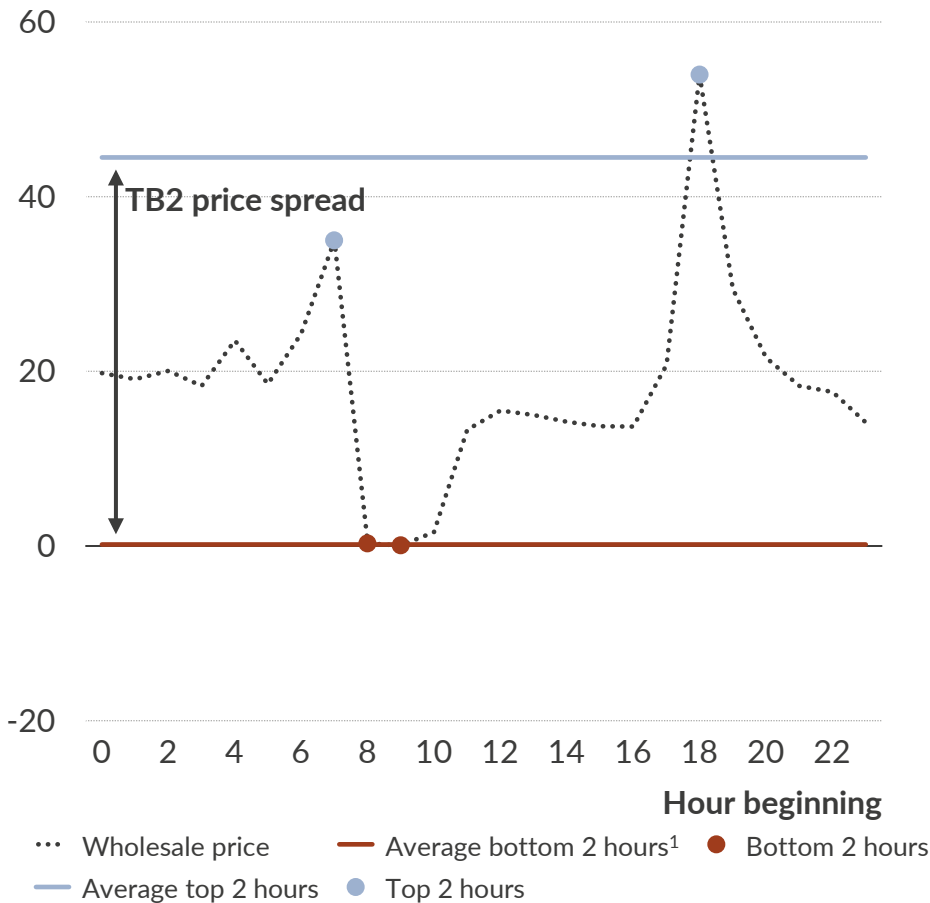
- Soft cap**: a revenue share rather than a hard cap mitigates.
- "Yardstick contracts"**: create a 'perfect-foresight' benchmark rather than payouts based on actual performance.

3 Top / Bottom spread swaps allow a battery to lock in energy revenues without any physical exchange of power with the offtaker

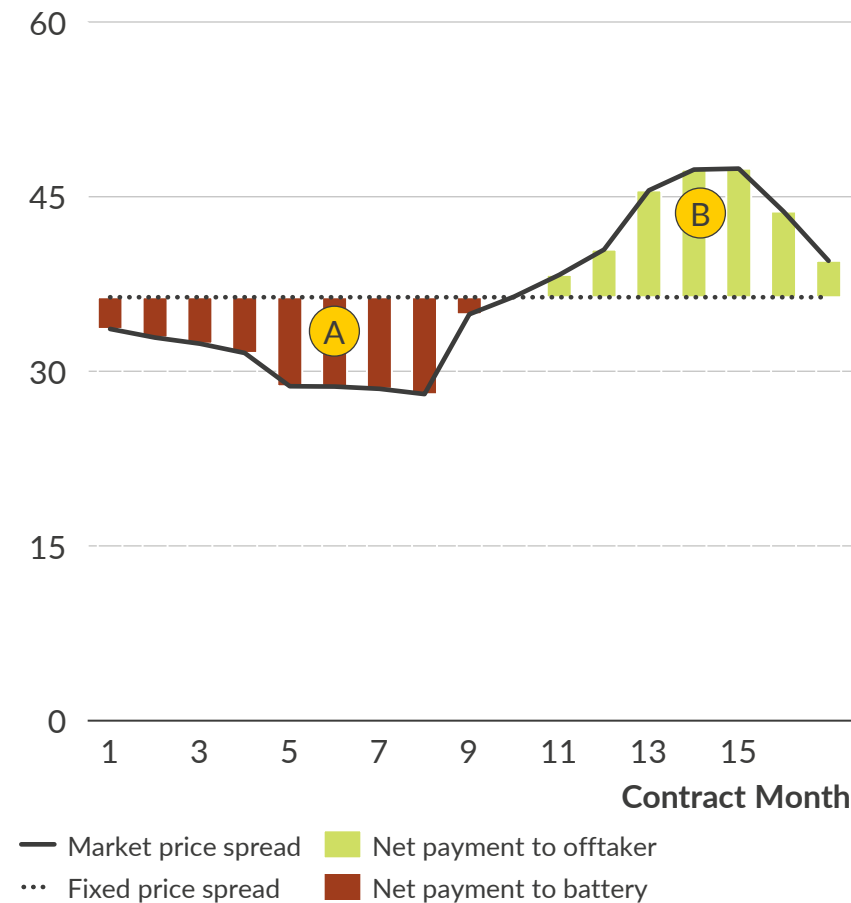


Financial hedges – Top / Bottom spread swaps

Example “Top / Bottom 2” price spread (March 3, 2023 ERCOT West hub), \$/MWh



Example settlement of “Top / Bottom 2” financial swap \$/MWh



- A Top / Bottom spread swap is a financial transaction where the battery receives a fixed price, based on anticipated price spreads. In exchange, the offtaker receives a “floating” payment, based on realized price spreads over the tenor of the contract.

- The fixed price allows the battery to “lock in” a price spread.

A When fixed price spread is higher than market price spread, offtaker pays battery.

B When fixed price spread is lower than market price spread, battery pays offtaker. From the battery’s perspective, this loss is offset by increased energy arbitrage revenues due to higher than anticipated price spreads.

- Unlike a tolling agreement, the battery generally retains control over asset dispatch.

3 More than 80% of batteries expected to interconnect in CAISO in the near term have signed a long-term Resource Adequacy contract

Capacity sales – RA contracts

Resource Adequacy contracts offered by California utilities

Resource Adequacy only

Product: Resource Adequacy
Structure: The utility compensates the battery only for the Resource Adequacy value. The battery maintains control over dispatch and exposure to market energy and ancillary services prices.

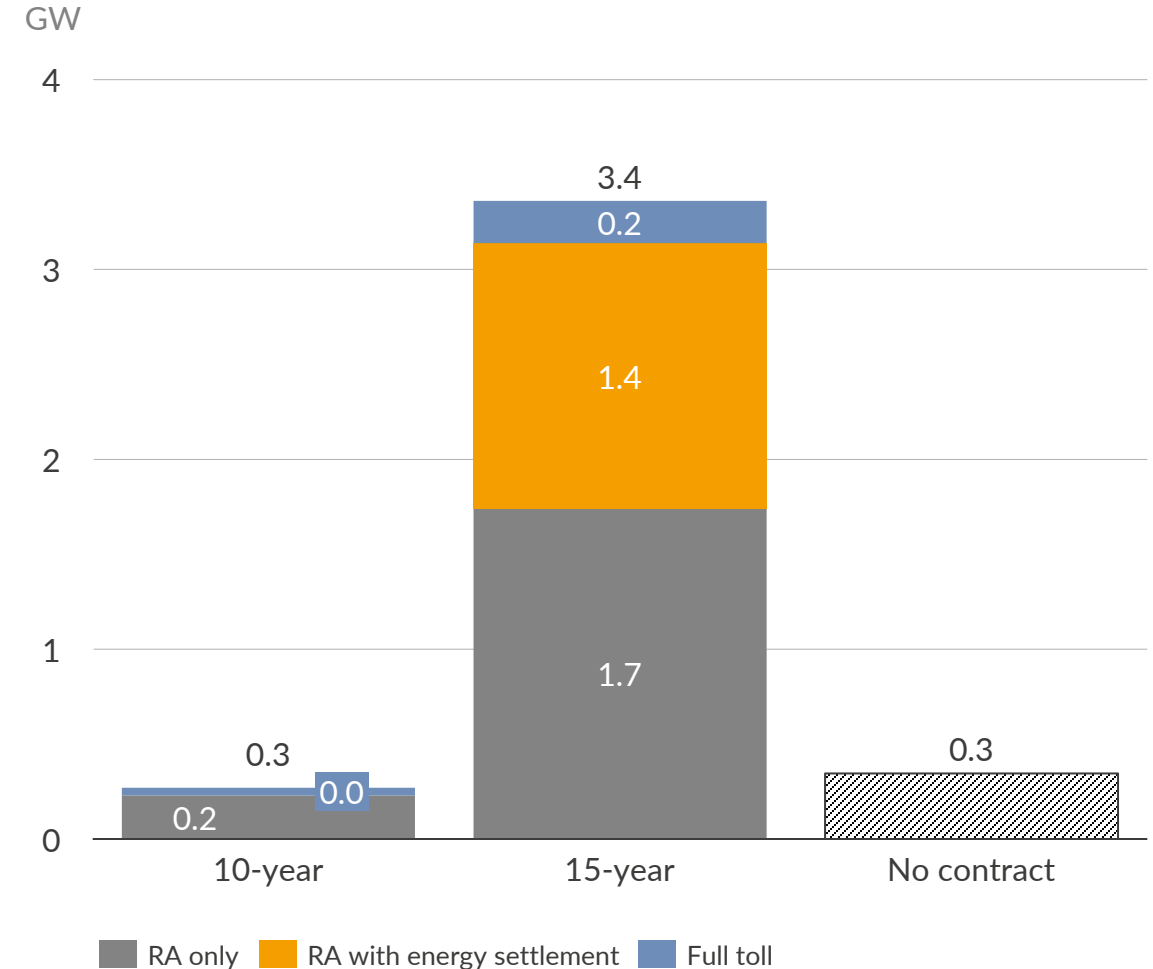
Resource Adequacy with energy settlement

Products: Resource Adequacy, energy
Structure: Energy settlement resembles a top / bottom spread swap, and thus allows the battery to lock in energy arbitrage revenues. The battery retains control over ancillary service revenues.

Full tolling agreement

Products: Resource Adequacy, energy, Ancillary Services
Structure: The utility compensates the battery for energy and ancillary services at a fixed price, controls asset dispatch, and is exposed to market energy and Ancillary Services prices.

New battery capacity anticipated to connect by 2026¹

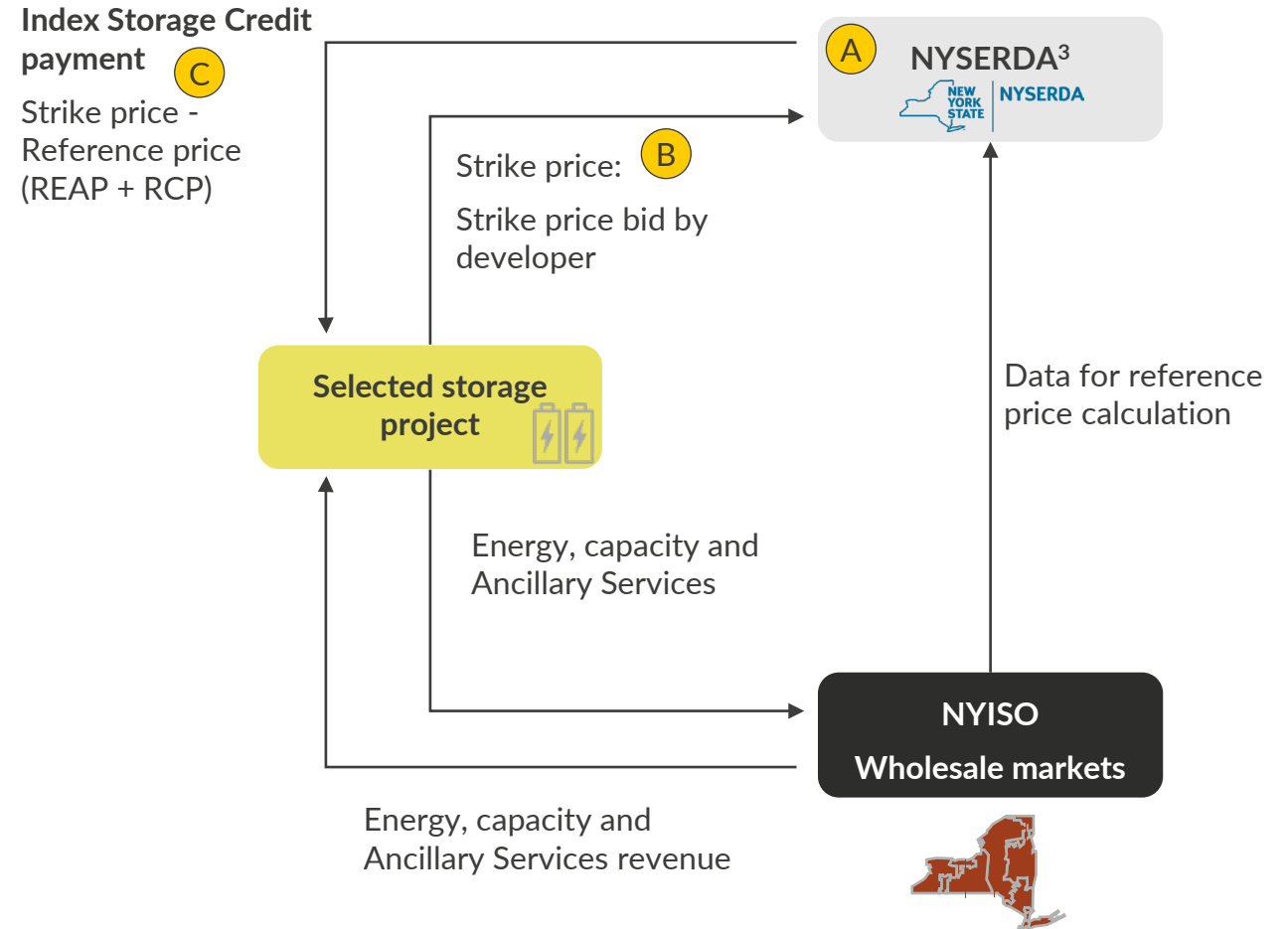


1) Aurora assumes battery projects with announced RA contracts, as well as projects CAISO lists as ready to connect on current transmission in their near-term connection report (which may not have RA yet) will connect by or within 2 years of their planned online date.

4 New York Index Storage Credit System aims to provide storage projects with revenue certainty and any necessary subsidization

State subsidies – Indexed storage payments

- A** NY's 2024 6GW Energy Storage Roadmap proposes the implementation of NYSERDA-led programs towards procuring an additional 4.7GW of new storage projects.
 - After reviewing various options, NYSERDA³ suggested (and NYDPS⁴ approved) **implementing the Index Storage Credit (ISC) to procure 3GW bulk storage.**
- B** Under the proposal ESR¹ projects in yearly bids would offer a Strike Price, a crucial factor for NYSERDA's project selection; aiming to reflect the project's revenue needs.
- C** Chosen projects would earn revenue calculated as the gap between the Strike Price and the Reference Price, which approximates an ESR's anticipated service market value by combining the **Reference Energy Arbitrage Price (REAP)** and the **Reference Capacity Price (RCP)**.
 - **REAP** = Difference between the top four and bottom four priced hours of the day-ahead zonal LBMPs².
 - **RCP** = The adjusted ICAP spot auction price considering the Capacity Accreditation Factor.
 - The NYSERDA/DPS filing suggests that if the Strike Price surpasses the total of REAP and RCP, NYSERDA pays the difference to selected projects. **If the combined REAP and RCP exceed the Strike Price, the project pays NYSERDA.**



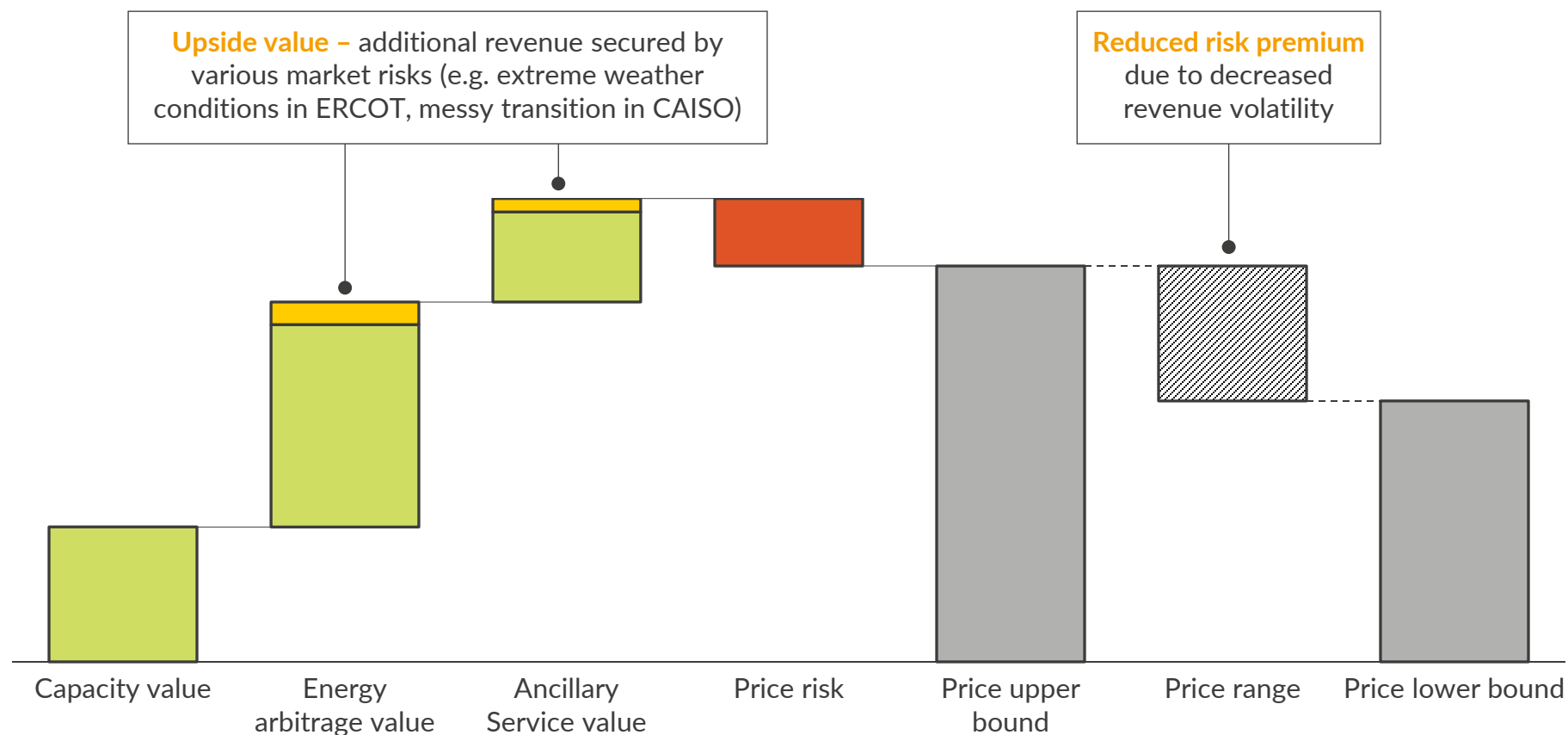
1) Energy Storage Resource. 2) Locational based marginal prices. 3) New York State Energy Research and Development Authority. 4) New York Department of Public Service.

Methodology: The tolling agreement price is bounded by the value to the offtaker and battery, respectively

Tolling agreement price calculation
\$/kW-month

1. Offtaker perspective

2. Developer perspective



Waterfall components

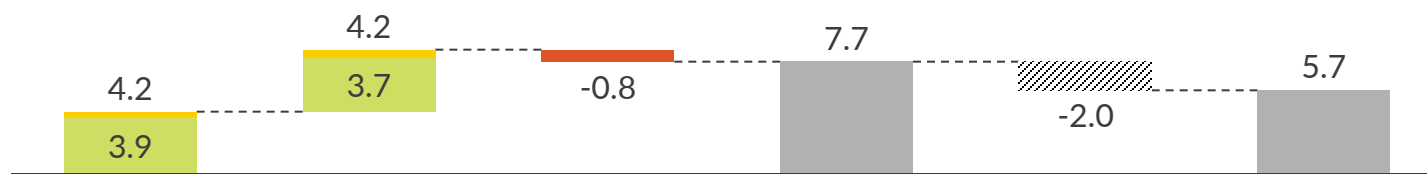
- For the **offtaker**, the maximum willingness to pay depends on the value of the revenue streams.
 - Levelized value of expected **capacity** (if applicable), **energy**, and **Ancillary Services revenues**
 - Any incremental value associated with the project's node¹
 - **Upside value**
 - **Price risk** discount, reflecting the uncertainty in the realization of revenue streams
- For the **developer**, the minimum acceptable price is calculated with hurdle rate that reflects a decrease in risk premium.
- The ultimate price is a function of supply-demand dynamics, impacted by the number of offtakers relative to batteries.

1) The ensuing calculations assume zero nodal premium.

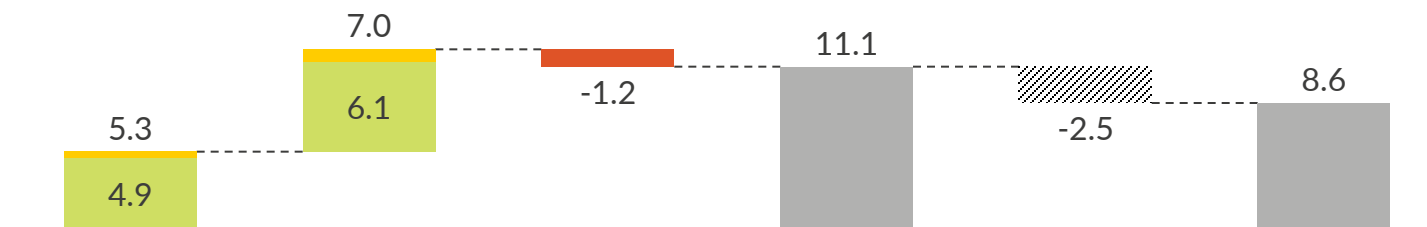
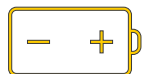
ERCOT: The fair price for a 7-year tolling agreement in the West hub ranges from \$5.7/kW/month (1-hour) to 13.7/kW/month (4-hour)

ERCOT: 7-year tolling agreement in West Hub starting in 2025 – by various durations, \$/kW-month, nominal

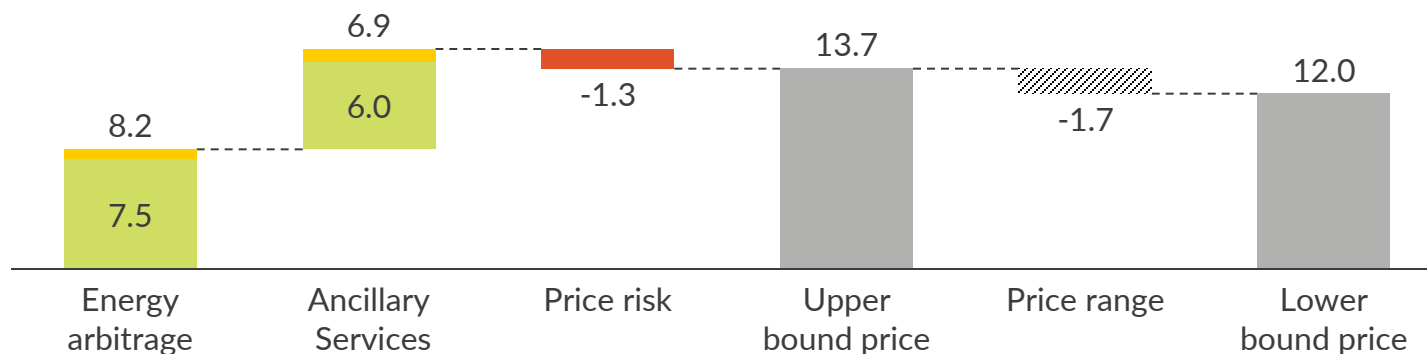
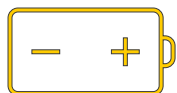
1hr duration



2hr duration



4hr duration



Upside value Central value

Drivers of valuation

- Tolling agreement fair prices are higher for longer-duration batteries, though not proportionally (i.e., the fair price for a 4-hour battery is less than 2x the fair price for a 2-hour battery).
- Although revenues from Ancillary Services are expected to decline over time as markets saturate, Ancillary Services still comprise a significant portion of tolling agreement value across all durations.
- 2-hour and 4-hour batteries see higher Ancillary Service value than 1-hour batteries, primarily due to the 2-hour duration constraint for the ECRS product.

- 1** Market or centrally based hedging schemes essential to risk management of volatile revenue streams for storage market participation. Hedge frameworks assist with revenue support and enable financing and investment.
- 2** Multiple contract forms exist with respect to storage including tolls, revenue *caps & floors*, and spread (top-bottom difference) contracts. Incentive compatibility issues need to be actively managed through innovative contract design, alignment of operational rights, and ensuring 'skin-in-the-game' through shared exposure.
- 3** Valuation of complex hedging contracts require consideration of 'two sides of the coin': The developer's perspective based on a 'capital recovery' approach and an offtaker's perspective based on a 'fair value' approach.

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