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Caps-and-Floors for Long Duration Storage and Firming: Contract Design Under Risk and Price Asymmetry – Non-Technical Summary

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Electricity systems around the world are rapidly transitioning toward energy sources such as wind and solar. While these technologies are low-emissions, they also create new challenges for electricity markets because their output varies depending on weather conditions. As a result, modern power systems are argued to increasingly require "firming" resources — such as batteries, long-duration storage, and flexible gas generation.

In many jurisdictions, governments have introduced long-term support schemes designed to attract private investment in long-duration storage and firming. One of the newer forms of contract emerging in such support schemes (especially for storage) are so called "cap-and-floor" or "collar" contracts. These contracts support investors with top-up payments in periods where market revenues are low, but in return capture a share of windfall profits during highly profitable periods. In practice they work as revenue sharing schemes above and below specific thresholds of market profits.

This paper examines how these collar-style contracts interact with investment incentives, financing structures, and electricity derivative markets. The analysis focuses on several emerging schemes, including Australia's Capacity Investment Scheme (CIS), the Long-Term Energy Service Agreement (LTESA) framework in New South Wales, South Australia's Firm Energy Reliability Mechanism (FERM), and the United Kingdom's Long Duration Electricity Storage (LDES) Cap-and-Floor regime. To do this, the paper models long-duration batteries and gas peaking plants operating in Australia's National Electricity Market (NEM). The modelling incorporates uncertainty, including volatile electricity prices, forecast errors, forced outages, and heavy-tailed price distributions.

The paper's central finding is that the economic pricing of a collar contract is driven less by its average or "fair" market value and more by its ability to reduce downside financial risk. This distinction is important because infrastructure investors and lenders do not evaluate projects purely based on average expected profits. Instead, financing decisions are heavily influenced by the possibility of very poor outcomes that threaten debt repayment.

The results show that for long-duration storage assets, the level of downside protection required to make projects financeable can be materially greater than what would be

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considered "fair value" from the perspective of a government or central agency providing the hedge under current patterns and distributions of wholesale electricity prices. In practice, the central agency would be relying upon a material change to the pattern and magnitude of price spreads during the day for the contract to be financially break-even. For example, the paper finds that an 8-hour battery may require a relatively high floor level to satisfy financing requirements, while a 12-hour battery may require such extensive downside support that a commercially realistic cap level cannot fully offset the effective subsidy provided by the floor.

A second major contribution of the paper concerns the impact of collar contracts on electricity derivative markets. Policymakers have argued that collar contracts preserve incentives for storage and generation projects to continue participating in forward hedge markets because projects still retain some exposure to spot prices. The paper tests this assumption directly. The results suggest that once downside risk is reduced through a government-backed collar contract, project owners could well retain exposure to high-price events rather than further hedge their revenues through private derivative contracts. As a consequence, the incentive to "re-contract" or continue trading in hedge markets can decline substantially.

This finding has important implications for electricity market design. Forward derivative markets are critical for retailers and large consumers because they provide protection against wholesale price volatility. If centralized support schemes unintentionally reduce liquidity in private hedge markets, they may weaken one of the core mechanisms that supports efficient investment and risk management in liberalized electricity systems.

More broadly, the paper argues that policymakers should carefully consider how government-backed contracts interact with existing market incentives. The paper concludes that transparent valuation methods and careful contract calibration are essential if governments continue to intervene to support investment. Future changes to market design could also be well directed towards enabling 'full strength' price formation to improve market signals for resilience.

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