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Contract design for storage in hybrid electricity markets

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To meet ambitious net-zero targets, many countries will need to drastically ramp up the deployment of renewable energy generation sources – like solar and wind. However to balance the variability of such sources and maintain the reliability of power systems, storage (particularly long-duration storage of 8 to 100 hours) will be needed as a firming resource. While long-duration storage technologies are coming down the cost curve, they are not at a stage where they can be deployed at large scale on a commercial basis. At the same time, legacy thermal units (such as coal), which have traditionally made up the bulk of firm capacity, are expected to retire increasingly quickly due to price pressures of rising zero marginal cost renewables.

In practice this has led to governments and central agencies actively providing financial incentives for more storage in the market. In some markets this has come in the form of grants or subsidies. In other such as Australia's National Electricity Market (NEM), governments are increasingly providing long-term revenue contracts with the aim of deploying large quantities of long-duration storage rapidly. However, unlike many forms of generation, there is no clear consensus on how such revenue contracts should be designed given the array of services provided by the facilities. There is also the added complexity given the role of the central government in providing the contract. Our focus is thus on the principles and practice of designing revenue contracts for storage where the contracting party is a central agency.

First, we establish six principles for government contracting based on a review of the literature, as follows:

1. Ensuring storage unit contracts have the correct incentives to participate in the market. This includes making sure they retain economic signals from short term markets to provide energy and grid services (viz. frequency control, voltage support).
2. Limiting distortions to already existing commercial markets for the short, medium and long-term contracting and hedging. The key issue here is to recognize that by providing a project hedge or incremental revenue source, central agencies inevitably affect the market. Consideration must be given as to how to limit adverse impacts.
3. Relatedly the risk of distorting long-term investment signals requires careful consideration as certain contracts may be biased towards particular resources.
4. Governments need to ensure that they don't create moral hazards in the market – where private parties are protected from downside outcomes while retaining upside outcomes.
5. Avoiding adverse impacts on system reliability and security. This has strong links to (1) but extends further to how storage participates during times of market scarcity.

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6. Finally. efficient procurement and value for money for consumers given the role of the government acting as an agent for energy consumers.

Second, we analyse a set of proposed storage contracts against these principles. The contract forms that have been analysed include (i) revenue swaps – where governments provide private storage operators with a fixed revenues in exchange for floating (market-based) revenue streams (ii) caps and floors – financial instruments that bound the revenues of storage units between an upside threshold and a downside threshold and (iii) availability contracts, where an incremental revenue stream is provided to storage units for being 'available'. We also propose a new form of contract – called 'yardstick' contracts which creates a revenue performance measure for the storage to meet, to ensure that it continues to participate efficiently in the short term market.

The results have important policy implications for how central agencies procure storage. While governments may retain a preference for simple contract structures, electricity storage assets are more complex. As such, governments and central agencies need to be acutely aware that their decisions on how the contract is designed can impact the incentives of the participants in short term markets.

Revenue caps and floors provide a viable way of supporting the financing of a storage project while ensuring projects do not extract windfall gains. However, our analysis suggests that two design features are important, viz. (1) caps on revenue must be partial to ensure projects access some upside revenues vis-à-vis incentives in times of scarcity; and (2) we prefer the floor structure with a 'yardstick' style arrangement – this prevents the storage unit being protected from poor operational performance.

The threshold question of whether governments should get involved in executing more complex derivative arrangements, rather than providing more simple capital grants, remains present. However, if governments are minded to enter into derivative contracts then a comprehensive risk management program which aligns their procurement decisions with the financial exposures they are taking on is critical.

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