UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

# Storing Power: Market Structure Matters

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The transition to a low carbon economy will require grid-scale electricity storage to facilitate the integration of intermittent renewable energy generation. Moreover, investments in electricity storage have the potential to boost productive and investment efficiency, leading to lower consumer prices. However, as David Andrés-Cerezo and Natalia Fabra warn in this paper, without proper regulation, market power and the ownership structure of storage can distort the incentives to invest and to use storage facilities, which runs the risks of jeopardizing their potential benefits.

Renewables provide substantial economic and environmental benefits, but their massive deployment is not free of obstacles. In particular, the intermittency of renewables poses a challenge for power systems: increasing the share of renewables in the power sector requires investing in flexible resources able to counteract the volatility of renewable output. Energy storage facilities are called to play that role. By storing electricity when renewables' availability is high and releasing it when it is low, storage will be key to balancing renewable-dominated electricity systems. In addition to tackling intermittency, electricity storage has further potential benefits. First, by smoothing production over time, it reduces generation costs and flattens the price curve, which translates into improved production efficiency and lower prices for consumers. Second, storage often prevents energy curtailment in periods of high renewables availability, thus allowing for a better use of available resources. Third, because storage improves security of supply, it reduces the need to invest in oil-fired or natural gas generators.

Do markets provide the right signals for investments in energy storage? Under the current market rules in place in most countries, storage owners make profits by arbitrating price differences over time. Thus, they store electricity in periods of low prices (and high renewable availability) to release it in periods of high prices (and low renewable availability). By increasing demand when prices are low and increasing supply when prices are high, this will lead to a flattening of the price curve, which will be greater the deeper the penetration of storage.

But this raises a key question: if increasing storage capacity reduces the benefits of arbitrating price differences over time, will the incentives to invest in storage also decrease? How will this depend on the type of storage technologies - batteries, hydro pumping, electric vehicles - and on the type of

owner who carries out the investments – stand-alone or vertically integrated companies that are also present in the generation segment?

In this paper, David and Natalia explore these questions as a necessary first step to understand whether additional regulatory measures are needed to support the deployment and efficient use of energy storage facilities. Their first approach is theoretical: they build a model of wholesale market competition that captures the key drivers of investment decisions in energy storage capacity. In their model, generation firms with varying degrees of market power undertake production decisions across periods. In turn, storage firms decide whether to invest in storage capacity, and if so, how to use it. Market structure – both in generation as well as in storage – are likely to be crucial to determine firms' incentives. On the one hand, market power in generation tends to make the price curve steeper, thus giving rise to wider arbitrage profits. On the other hand, market power in storage tends to smooth the usage of storage facilities over time in order to avoid strong price effects that would make storing more expensive and releasing less profitable. Under the three market structures considered (storage operated by a benevolent system operator, by a fringe of competitive storage owners, by an independent storage monopolist, or by a vertically integrated storage monopolist) they find that the most distorted outcome is obtained under the latter. The reason is that the vertically integrated firm internalizes the price effects caused by storage on its own energy sale and purchase decisions. This causes them to distort the use of storage away from the cost-minimizing pattern, reducing its profitability, and thus weakening the firms' incentives to invest.

This conclusion is in contrast with the debate in the policy arena on the rules on who should own and operate the storage facilities. In many jurisdictions, storage is considered a generation asset, which essentially bars system operators from owning and operating storage devices due to unbundling restrictions. Yet, our analysis suggests that regulators should not put the spotlight on the integration between transmission and storage (which could potentially be positive), but rather on the integration between generation and storage, as well as on the concentration in storage ownership.

David and Natalia complement their theoretical with simulations of the impact of storage on the Spanish electricity market. The results clearly show that, given the current costs of investing in storage, market revenues create a missing money problem, such that investment sin storage cannot be expected unless there is additional support. If that support is provided through auctions, the regulator should take into account that a given amount of storage capacity is more valuable in the hands of a benevolent or competitive storage operator, rather than in the hands of storage operators with market power, or vertically integrated with dominant generators.

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