STORING POWER: **Market Structure Matters**

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, David Andrés-Cerezo and Natalia Fabra warn that, 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. They have just received funding from Fundación Iberdrola to pursue their research on this topic.

David Andrés-Cerezo and Natalia Fabra

The energy transition is underway. Not even crises as serious as the current one will stop the ambitions to reduce carbon emissions. Most developed countries have committed to policies to decarbonize their economies, and the economic stimulus packages to fight the pandemic will likely accelerate their implementation. An example of this is the European Green Deal, which puts Europe on track to achieve climate neutrality no later than 2050. Beyond the environmental benefits, the Green Deal is seen as a lever for the recovery of the European economy.

The potential of electricity storage

It is beyond dispute that this process will require heavy investments in renewable energy. 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 renewables-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 renewable energy spills in periods of high renewables availability, thus allowing for a better use of the available resources.

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Third, because storage improves security of supply, it reduces the need to invest in oil-fired or natural gas generators. In sum, storage facilitates the integration of renewables, has the potential to improve market efficiency, and provides an environment-friendly alternative to traditional back-up capacity.

The potential benefits of electricity storage, coupled with the fact that their costs have declined over the past few years (and are expected to decline further), have created high expectations about their future prospects. However, **do the current market arrangements provide adequate incentives to promote investments in energy storage by the necessary amount? And even if such investments take place, will firms use the storage facilities efficiently?**

Under the market rules currently in place in most countries, storage owners make profits by arbitrating price differences over time (through the day, the week, or the seasons of the year, depending on the type of storage technology). 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). Increased demand when prices are low and increased supply when prices are high lead to a flattening of the price curve. This effect which will be greater with higher penetration of storage.

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?

The first objective of David and Natalia's research project is to answer these questions, a necessary first step to understand whether additional regulatory measures are needed to support the deployment and efficient use of energy storage facilities. The second objective of their project is to identify the best regulatory solutions to push in this direction.

They will tackle these issues through two approaches. First, David and Natalia

are already working to build up 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. To analyze these incentives in detail, Natalia and David will consider four different cases that differ in the storage ownership structure: storage owned by a benevolent system operator; by a fringe of competitive storage owners; by an independent storage monopolist; and by a vertically integrated storage monopolist. Under each scenario, they will characterize equilibrium prices, costs and storage investment decisions, and will then compare the outcomes across scenarios in terms of productive efficiency and total welfare.

Second, to complement the theoretical analysis, David and Natalia plan to simulate the Spanish electricity market in order to provide some orders of magnitude about the value of storage for society (in the form of lower costs of generation) as well as for individual agents (in the form of arbitration profits). The ultimate goal is to understand whether it is profitable to invest in storage capacity in the Spanish wholesale electricity market, and whether the private and the social incentives to do so are aligned ·

In summary, to enable the deployment of energy storage and batteries, technological innovation will be necessary, but it will not be enough unless regulation supports it. Regulatory innovation guided by rigorous research will thus be equally important to provide answers to the key issues listed above. David and Natalia's research will contribute towards this goal. The stakes are high!