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In Brazil, Colombia, Panama, Uruguay, Chile and elsewhere, LNG import terminals have been built or are planned. Solar and wind have exploded in countries such as Chile, Honduras, Peru, Brazil and most recently Argentina, where the RENOVAR program has awarded 2,400 megawatts of projects.

Although its current impact is minimal, energy storage -- and specifically battery storage -- will play key a role in this transformation. In part, the increased importance of battery storage will be inevitable as the costs of batteries decrease. However, the extent of the growth of battery storage -- and its effect on market penetration of renewable energy, rural electrification and disaster relief -- will depend on both the extent of the decrease in battery storage costs and the development of regulatory regimes that reward the services that storage is capable of providing.

These projects provide an indication of what energy storage in Latin America may look like in the future, as well as a tool for regulators and developers to understand how energy storage projects can provide valuable services to the grid. They also provide insight into how energy storage is being used across disparate markets in Latin America: in countries with large, inter-connected grids, for off-grid, rural electrification and on island grids.

Argentina has had pumped-storage hydropower since the 1980s. The Los Reyunos power plant in Argentina has an installed capacity of 224 megawatts and has been generating electricity since 1983. Using the same technology but at a larger scale, the Rio Grande hydroelectric complex was built in 1986. It has an installed capacity of 750 megawatts comprised of four turbines of 187.5-MW each.

Pumped-storage hydropower is a mature technology that relies on moving water from one reservoir to another in order to generate electricity. When energy is cheaper during off-peak hours, electricity is used to pump water from one reservoir located at a lower altitude to another reservoir located at a higher altitude. Later, when electricity is in high demand and more expensive during peak hours, the water from the higher reservoir is released to the lower reservoir, causing electricity to be generated when the water passes through a turbine or set of turbines.

Thus, this technology is dependent on the presence of specific conditions. The geography of the location must allow the construction of two interconnected reservoirs located at different altitudes so the water can fall from one to the other at a speed significant enough to generate electricity through the turbines.

The quality services technical regulations adopted in 2015 require all generating companies interconnected to the grid to meet certain standards of security and quality services to ensure the grid operates at a near-constant frequency of 50 Hz (slightly lower in contingency scenarios). If a generating facility displays poor

performance on frequency regulation, then the Superintendent of Fuels and Electricity can impose penalties ranging from US$75 to US$9,000,000.

Other regulations that complement the quality services technical regulations require frequency regulation to be remunerated as part of ancillary services that any generation company interconnected to the grid can provide.

AES Gener (a subsidiary of The AES Corporation) owns 52 MW of storage capacity in operation in Chile through three separate lithium battery arrays. Each of the battery arrays is tied to one of AES Gener"s thermal plants. The AES Gener storage projects help AES Gener"s thermal plants comply with spinning reserve requirements and increase power generation from the plants because the spinning reserve requirement is met by the batteries.

The 20-MW Angamos array reportedly allows AES Gener to increase the power generation of the Mejillones 544-MW thermal plant by up to 4%. Although the Chilean regulations are not specifically geared toward energy storage, the ability of energy storage to provide frequency regulation through spinning reserve is a natural fit.

The groundwork was laid in 2001 with the passage of a General Electricity Law (No. 125-01), followed a year later by an "application regulation" (adopted through Presidential Decree No. 555-02), that established a requirement for all generators to provide frequency regulation service to the grid and empowered the Superintendent of Electricity to adopt an incentive. The amount of the incentive is calculated from a formula set yearly by the Superintendent of Electricity, with the current base incentive for 2018 being US$9.65 a megawatt hour

In September 2017, the Dominican Republic took a near direct hit from hurricanes Irma and Maria, forcing 40% and 55% of the nation"s power plants off line, respectively. However, the Dominican grid itself remained operational, thanks in part to frequency regulation services provided by two AES-owned 10-MW lithium ion arrays. The role of the batteries in maintaining the Dominican grid is being studied by other Caribbean islands, including Jamaica and Puerto Rico.