

EXPLAINER

First Grid-Connected Battery Storage System to Improve Clean Energy Access in Pakistan



A battery energy storage system can improve the coverage, reliability, transparency, and quality of power transmission service in Pakistan. Photo credit: ADB.

A large-scale, grid-connected battery energy storage system will help Pakistan regulate its power supply and integrate renewable energy into the grid.

Introduction

Pakistan is deploying high-level technologies and climate-resilient power transmission systems to generate a more stable and secure electricity supply.

With funding support from the Asian Development Bank's (ADB) High-Level Technology Fund, the country will build its first large-scale, grid-connected Lithium-Ion Battery Energy Storage System (BESS) to dispatch intermittent renewable energy and improve transmission network stability.

Chronic electricity crisis

Pakistan is facing a serious power shortage. Aging, overloaded, and unreliable transmission and distribution systems have led to massive blackouts or frequent load shedding. In 2017, power system frequency was found to be operating outside the standard range almost 50% of the time because of lack of sufficient primary and secondary power reserves. This hindered economic progress as businesses, especially the manufacturing and service sectors, were gravely affected. A World Bank survey revealed that businesses in Pakistan considered electricity shortages as a major obstacle to business growth.

What is a battery energy storage system?

A lithium-ion battery energy storage system is a modular system that can be deployed in standard shipping containers. This system is designed for frequency regulation or the constant second-by-second adjustment of power to maintain system frequency at the nominal value to ensure grid stability.

Brownouts and blackouts occur when the demand for electricity exceeds supply and the system frequency falls. On the other hand, if more power is generated than consumers can use, the system frequency increases, possibly damaging connected electrical devices. Battery energy storage can provide regulating power at sub-second response times. This makes it an extremely useful asset for grid-balancing purposes.

This kind of energy storage also provides a power system with flexibility especially when it comes to renewable energy integration. It increases the volume of renewable power that can be safely and securely connected to the grid. More grid connections can be made under existing network capacity as surplus power can be stored. Smoothing of renewable in-feed also reduces forecast errors. Higher network capacity utilization likewise eases the burden on consumers as curtailments are reduced and network reinforcement is minimized.

How will energy storage be applied in this project?

With these batteries, Pakistan's National Transmission and Dispatch Corporation Limited—the executing agency, will have a primary and secondary response to power variation and will be able to quickly stabilize frequency. This will avert the need for automatic under-frequency load-shedding.

The pilot project also involves integrating wind power generation to the grid.

The main challenges presented by wind power integration are power intermittence, ramp rate, and limited wind-farm output. Large variations can occur within minutes. Wind turbines are usually disabled when wind speed exceeds 25 meters per second, potentially resulting in a large drop in power generation.

The battery system can improve wind energy dispatch by reducing forecast errors and improving the utilization of transmission capacity. The batteries can also be used by the system operator for providing

ancillary services to mitigate the variability and uncertainty of wind power on the grid side. This will make power plants operate at maximum efficiency.

Promoting sustainable advanced technologies

To scale up the effects of battery energy storage, the project will help the National Transmission and Dispatch Corporation Limited in developing:

- an energy storage system roadmap for promoting indigenous renewable energy and enhancing energy security,
- a framework of commercial ancillary services market, which is key to the envisaged competitive power market, and
- reports showcasing the impact of the pilot project as part of capacity building

Aside from the lithium battery packs, the High-Level Technology Fund will also cover a balance of system package, including inverters and transformers.

What is the High-Level Technology Fund?

Under its Strategy 2030, ADB is mainstreaming the use of advanced technologies by carrying out pilot testing, strengthening project design, emphasizing quality in procurement, and mobilizing subject experts.

The High-Level Technology Fund was established in May 2017 as a multi-donor trust fund in ADB that provides grant financing to encourage more widespread adoption of high-level technologies to address development challenges in member countries. It is currently funded by the Government of Japan.

Following the premise that development impact can be profoundly improved with the right advanced solutions, the fund seeks to promote the integration of high-level technologies and innovative solutions into ADB-financed and administered projects. It also aims to connect technology providers with ADB's project officers and member countries to explore business opportunities for high-level technology integration.

Resources

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Mr. Lei Zhang has 23 years' experience developing and administering infrastructure projects. Prior to joining ADB, he was site engineer, commercial manager, and project manager for SINOHYDRO (now POWERCHINA) and worked on investment and engineer-procurement-construction of infrastructure projects in Southeast Asia.



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Lin Lu is responsible for the overall coordination of her department's activities in catalyzing innovation across sector and thematic areas as well as across operational and nonoperational departments through the One ADB approach. She is also fund manager of the High-Level Technology Fund. Previously, Lin led energy projects and technical assistance in Central, West and East Asia. Before ADB, she was business development manager at Hollysys Asia Pacific Ltd. She also worked as an electrical engineer and systems engineer in the United States. Lin holds a PhD in Mechanical Engineering from Drexel University.



Asian Development Bank (ADB)

The Asian Development Bank is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 68 members—49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.



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