

India's Renewable Push Needs Energy Storage Solutions for Grid Stability

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Energy Storage



Energy Storage Latest News

- India's rapid expansion of renewable energy is creating a major power management challenge because solar and wind energy are intermittent, while electricity demand remains continuous and often does not match generation patterns.
- Solar power stops after sunset, and wind output varies with weather, creating supply-demand mismatches that can strain grid stability.
- This challenge is especially significant as **renewables account for 53%** (283 GW) of India's total installed power capacity of 532 GW, with solar contributing over 150 GW.
- As a result, energy storage systems have become essential for balancing supply and demand, though India's storage capacity remains inadequate.

What is Energy Storage

- Energy storage refers to systems that store excess electricity generated from renewable sources such as solar and wind during periods of high generation and release it later when demand rises but power generation is low.
- These systems convert electricity into a storable form and then reconvert it into electricity when needed.

Major Types of Energy Storage Systems

- **Pumped Hydro Storage (PHS)** – Pumped Hydro Storage uses surplus electricity to pump water from a lower reservoir to a higher reservoir. When electricity demand rises, the stored water is released downhill through turbines to generate power.
- **Battery Energy Storage Systems (BESS)** – BESS store electricity chemically and release it when needed. Lithium-ion batteries, especially Lithium Iron Phosphate (LFP) batteries, dominate grid-scale storage due to their declining costs, high efficiency, and long lifespan. In 2025, LFP batteries accounted for over 90% of annual global storage additions.
- **Concentrated Solar Thermal Storage** – This technology uses mirrors to focus sunlight onto a receiver, heating materials such as molten salt to store thermal energy. The stored heat is later used to generate steam and produce electricity.
- **Compressed-Air Energy Storage** – Excess electricity is used to compress air and store it in underground caverns or tanks. When demand increases, the compressed air is released to drive turbines and generate electricity.
- **Flywheel Energy Storage** – Flywheels store electricity as rotational energy by spinning a rotor at very high speeds. They are especially useful for instant power injection, grid stability, and managing short-term fluctuations.
- **Gravity Energy Storage** – This system uses electricity to lift heavy weights to higher elevations. When power is needed, the weights are lowered, converting gravitational potential energy back into electricity through generators.

India's Energy Storage Capacity and Expansion Plans

- India's energy storage deployment has not kept pace with the rapid expansion of renewable energy, raising concerns about the grid's ability to efficiently manage a growing share of intermittent power.
- Currently:
 - Battery Energy Storage Systems (BESS): ~0.27 GW
 - Pumped Hydro Storage (PHS): ~7.2 GW
- India is primarily focusing on expanding the two major storage technologies:
 - Battery Energy Storage Systems (BESS) for short-duration storage
 - Pumped Hydro Storage Projects (PSP/PHS) for long-duration storage
- According to the Central Electricity Authority (CEA), India's total energy storage capacity is projected to reach 174 GW / 888 GWh by 2035-36, comprising: 80 GW / 321 GWh of BESS; 94 GW / 567 GWh of PHS.
- The CEA expects 4-6 hour duration storage systems to become increasingly critical after 2030 as renewable energy integration deepens.

Role of Different Storage Technologies

- **BESS:** Best suited for short-duration storage and quick balancing needs
- **PHS/PSP:** Better suited for long-duration storage and round-the-clock renewable energy supply, especially for commercial and industrial consumers

India's Energy Storage Expansion Plans and Key Challenge

- India is significantly scaling up its energy storage infrastructure across both pumped hydro and battery storage technologies.
- A key concern is India's heavy reliance on imported battery storage components.
 - India imports 75–80% of its lithium-ion cells.
 - Lithium-ion cells account for around 80% of the total cost of battery storage systems.
- The CEA has warned that global battery manufacturing is heavily concentrated in **one Asian country**, creating risks related to: Geopolitical tensions; Trade disruptions; Price volatility.
- This dependence could become a major obstacle to India's long-term energy storage and renewable energy ambitions.

Global Trends in Energy Storage

- Globally, Pumped Hydro Storage (PHS) remains one of the most widely used electricity storage technologies, with an installed capacity of around 160 GW, according to the International Renewable Energy Agency.
- Leading Countries in PHS – China (~66 GW); Japan (21.8 GW); United States (18.9 GW); Europe (collectively ~28 GW)

Rapid Growth of Battery Energy Storage

- BESS are expanding rapidly worldwide, with total installed global capacity estimated at around 270 GW.
- In 2025 alone, 108 GW of new battery storage capacity was added globally—representing a 40% increase over 2024, according to the International Energy Agency (IEA).
- China remained the global leader in battery storage deployment in 2025, accounting for nearly 60% of new global additions, followed by the United States and Europe.
- Battery storage deployment is also accelerating in emerging regions such as Australia and parts of the Middle East, where storage is increasingly viewed as essential for electricity security and renewable energy integration.

Source: IE

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