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DAILY EDITORIAL ANALYSIS

TOPIC

ROBUST BATTERY ECOSYSTEM FOR CLEAN ENERGY SHIFT

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Context

- As India expands renewable energy capacity and accelerates electric vehicle adoption, Battery Energy Storage Systems (BESS) are emerging as a critical component of a reliable and flexible clean energy ecosystem.

India's Energy Storage Requirements

- India's renewable energy capacity is estimated to reach **486 GW by 2030** with an annual growth of **15 percent.**
- **The Central Electricity Authority estimates** that India will need about **47.24 GW/236 GWh of BESSs by 2031-32**, alongside **26.69 GW/175 GWh** of pumped storage capacity.
- India needs to ramp up investments in battery storage and grid infrastructure to ensure a reliable power supply and achieve its target of 5**00 GW of non-fossil fuel capacity by 2030.**

Battery Energy Storage Systems (BESS)

- BESS are systems in which batteries, either **individually or more often in groups**, are used in order to store electricity produced by generation plants, and make it available when needed.
- In a battery energy storage system, the fundamental components are the battery blocks, along with other elements:
  - **An inverter,** which converts the direct current from the batteries into the alternating current of the electricity grid (and vice versa);
  - **A transformer**, which adapts the system's voltage to that of the grid;
  - **Auxiliary systems.**
- BESS technology is based on the use of **electrochemical batteries,** which can store the energy produced by renewable energy plants.

Types of batteries

- **Lithium-ion batteries:** These batteries typically use lithium in combination with other materials, such as iron and phosphate used in LFP (lithium ferrophosphate) batteries.
- **Solid-state batteries:** While conventional and flow batteries normally use liquid electrolytes, in this case they are in a solid state (e.g., ceramic or synthetic materials).

Significance of BESS

- **Renewable energy integration:** Stores surplus solar and wind power for use when generation falls.
- **Grid stability:** Helps balance fluctuations in electricity supply and demand.
- **Peak demand management:** Supplies stored electricity during periods of high demand, reducing pressure on the grid.
- **Reduced dependence on fossil fuels:** Can reduce the need to operate coal- and gas-based power plants solely to meet short-term demand fluctuations.
- **Energy security:** It supports a more reliable electricity system and improves the utilisation of domestically generated renewable energy.

Challenges in Developing a Robust BESS Ecosystem

- **High initial costs:** Battery storage remains capital-intensive, affecting its commercial viability.
- **Import dependence:** Dependence on imported battery cells, critical minerals and processing technologies creates supply-chain vulnerabilities.

- **Limited domestic manufacturing:** India needs to expand battery-cell production and develop capabilities across the battery value chain.
- **Recycling and environmental concerns:** Battery disposal, mineral extraction and recycling require effective regulation and infrastructure.
- **Financing and project viability:** Long-term revenue certainty and suitable market mechanisms are essential to attract investment.

Initiatives taken by India

- **Production-Linked Incentive (PLI) Scheme for Advanced Chemistry Cell (ACC) Batteries:** The scheme aims to establish **50 GWh** of domestic battery manufacturing capacity, including **10 GWh** earmarked for grid-scale storage.
- **Viability Gap Funding (VGF) Scheme:** Provides financial support to improve the commercial viability of large-scale BESS projects.
  - Two schemes support approximately **43.8 GWh of battery storage capacity,** including ₹**5,400 crore** from the Power System Development Fund for 30 GWh of storage.
- **Green Energy Corridor (GEC):** Facilitates the integration of renewable energy into the national grid through transmission infrastructure, helping evacuate renewable power from resource-rich regions.
- **Guidelines for Procurement and Utilisation of BESS:** The Ministry of Power has issued guidelines for procuring and utilising BESS across generation, transmission and distribution assets, as well as for ancillary grid services.

Way Ahead

- Develop solutions for **battery collecting, material recovery** and safe disposal.
- Coordinate the implementation of renewable energy, transmission infrastructure and energy storage.
- There is a huge opportunity for **India and Australia** to speed the global energy transition by combining A**ustralia's technical ingenuity and crucial mineral resources with India's industrial prowess** and integration into global supply chains.

Source: TH

Daily Mains Practice Question

[Q] Battery Energy Storage Systems (BESS) are critical for integrating renewable energy into India's power grid. Discuss the significance of BESS in India's clean energy transition and examine the challenges associated with its deployment.