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Waaree Battery Gigafactory — India's Push into Energy Storage Manufacturing

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SUBJECTS COVERED

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WHY IN NEWS

Waaree Energies, India's largest solar photovoltaic module manufacturer, announced a Rs 8,175 crore battery energy storage gigafactory in Anakapalli, Andhra Pradesh, with a capacity of 16 GWh. The facility will manufacture lithium iron phosphate (LFP) battery cells, targeting grid-scale energy storage and electric vehicle applications.

WHY INDIA URGENTLY NEEDS BATTERY MANUFACTURING

India's **energy transition** — moving from fossil fuels to renewable energy — faces a fundamental challenge: **solar and wind energy are intermittent**. The sun doesn't always shine; the wind doesn't always blow. The solution is **energy storage**: store surplus renewable electricity when generation exceeds demand, and release it when demand peaks.

Battery Energy Storage Systems (BESS) are currently the most scalable technology for this purpose. But India faces a paradox: despite being the world's third-largest solar market, it **imports almost all its batteries** — primarily from **China** and to a lesser extent South Korea and Japan.

In 2023-24, India imported batteries worth over **$5 billion** — a strategic and economic vulnerability.

The ACC Battery Storage PLI scheme (Production Linked Incentive for Advanced Chemistry Cell) was launched specifically to change this.

THE PLI FOR ACC BATTERY STORAGE — FRAMEWORK

ACC (Advanced Chemistry Cell) is the government's term for next-generation battery chemistries beyond traditional lead-acid. The PLI scheme was approved in **May 2021** with a total outlay of **₹18,100 crore**.

KEY PARAMETERS OF THE ACC PLI:

Parameter	Details
Total outlay	**₹18,100 crore**
Total capacity target	**50 GWh** (domestic manufacturing)
Minimum investment per bidder	₹225 crore/GWh
Domestic value addition requirement	25% in Year 2, 35% in Year 3, 50% by Year 5
Incentive rate	₹20 lakh/MWh (₹2 crore/GWh) on net sales
Contract period	5 years of incentive receipt
Operators selected	**Ola Electric** (20 GWh), **Reliance Industries** (5 GWh), **Rajesh Exports** (5 GWh) — initial round

Waaree's 16 GWh facility is part of **ACC PLI Round 2** expansion.

WHAT IS AN LFP BATTERY? — THE TECHNOLOGY

Lithium Iron Phosphate (LFP) batteries are one of several **lithium-ion battery chemistries**. The choice of cathode material is what differentiates them:

LFP VS. OTHER LITHIUM-ION CHEMISTRIES

Chemistry	Cathode	Energy Density	Safety	Cost	Application
LFP	$LiFePO_4$	Moderate (150-200 Wh/kg)	**Excellent** (no thermal runaway)	**Lowest**	Grid storage, buses, commercial EVs
NMC	Li-Nickel-Manganese-Cobalt	High (200-300 Wh/kg)	Good	Higher	Premium EVs, consumer electronics
NCA	Li-Nickel-Cobalt-Aluminum	High (200-260 Wh/kg)	Moderate	High	Tesla (some models)
Solid-State	Solid electrolyte	Very High	Excellent	Very High (not commercial yet)	Next-gen EVs

Why LFP for India's context:

- **Safety**: Extremely thermally stable — critical for large grid installations in India's hot climate
- **Cycle life**: 3,000-5,000 charge cycles vs. ~1,000-2,000 for NMC — ideal for daily cycling grid storage
- **Cost**: ~15-20% cheaper per kWh than NMC
- **No Cobalt**: Cobalt is ethically complex (DRC mining) and expensive; LFP avoids it
- **Lifespan**: 10-15 years for grid use

The trade-off: LFP has **lower energy density** than NMC, making it less suitable for small, lightweight applications where space is premium. For grid storage (which doesn't need to be light) and buses/commercial vehicles, LFP is optimal.

WAAREE ENERGIES — COMPANY PROFILE

Waaree Energies is headquartered in **Mumbai** and is India's **largest solar PV module manufacturer** by installed capacity.

- **Founded:** 1989 (as a diversified group; solar business scaled from ~2010)
- **Listed:** NSE, BSE (IPO in October 2024)
- **Solar module capacity:** ~12 GW/year (as of 2025)
- **Exports:** Significant exporter to the USA and Europe (beneficiary of US buyers seeking non-Chinese solar supply chains)
- **Expansion:** IPO proceeds used to expand manufacturing at Surat (Gujarat) and the new battery facility at Anakapalli (AP)

The move into **battery manufacturing** is a natural adjacency — solar power and battery storage are deployed together as **Solar + Storage** projects, and Waaree can offer integrated solutions to utilities.

GRID-SCALE ENERGY STORAGE — INDIA'S TARGET

India has set a target of **500 GW of non-fossil fuel capacity by 2030** (under its Nationally Determined Contributions/NDCs updated in 2022). Achieving this requires massive grid-scale storage to handle:

- **Duck curve**: Solar generation peaks mid-day when demand is moderate; demand peaks in the evening when solar output drops — storage bridges this gap
- **Seasonal imbalance**: Wind energy peaks in monsoon months; solar in summer — storage balances seasonal variation
- **Grid stability**: Rapid frequency fluctuations from high renewable penetration need battery response (faster than gas peakers)

India's **Central Electricity Authority (CEA)** estimates India will need **411 GWh of battery storage by 2030** — just to manage the 500 GW renewable integration target.

Currently installed BESS in India (2025): ~5-8 GWh — a massive gap.

CRITICAL MINERALS — THE UNDERLYING CHALLENGE

LFP batteries require **lithium** (primary), **iron**, and **phosphate**. India has:

Lithium: Minimal domestic reserves (largest known deposit: **Reasi, Jammu & Kashmir** — discovered 2023, estimated 5.9 million tonnes); major import dependence

Iron: Abundant (4th largest reserves globally)

Phosphate: Limited domestic reserves

The **Critical Mineral Mission** (announced in Budget 2024-25) aims to secure supply chains for lithium, cobalt, nickel, manganese, and other battery minerals through:

Domestic exploration intensification

Overseas mineral acquisitions (KABIL — Khanij Bidesh India Limited)

Recycling ecosystem development (battery recycling = urban mining)

KABIL is a JV of NALCO, HCL, and MECL set up specifically to acquire strategic mineral assets abroad (Australia, Argentina, Chile, Bolivia — the "Lithium Triangle").

UPSC RELEVANCE

ACC PLI scheme (₹18,100 crore, 50 GWh target), LFP battery chemistry, Waaree Energies, KABIL, Critical Mineral Mission, CEA's 411 GWh BESS target, BESS (Battery Energy Storage System). **Mains GS-3:** *Energy transition; energy storage technology; India's critical mineral strategy; PLI scheme design; EV ecosystem.* **Interview:** *"India is betting heavily on PLI to build a battery manufacturing base. What are the structural challenges in competing with China's battery supply chain, and how should India position itself?"*

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WAAREE BATTERY GIGAFACTORY:

Location: **Anakapalli, Andhra Pradesh**

Investment: **₹8,175 crore** | Capacity: **16 GWh**

Battery type: **LFP (Lithium Iron Phosphate)**

Parent: **Waaree Energies** (largest solar PV module maker in India; HQ Mumbai)

Scheme: **ACC Battery Storage PLI**

ACC PLI SCHEME:

Full form: **Advanced Chemistry Cell Battery Storage PLI**

Approved: **May 2021**

Total outlay: **₹18,100 crore**

Total capacity target: **50 GWh**

Incentive: ₹20 lakh/MWh on net sales for 5 years

Major awardees: Ola Electric (20 GWh), Reliance Industries (5 GWh), Rajesh Exports (5 GWh)

LFP BATTERY CHEMISTRY:

Cathode: **$LiFePO_4$ (Lithium Iron Phosphate)**

Advantages: Excellent safety (no thermal runaway), long cycle life (3,000-5,000), no cobalt, low cost

Disadvantage: Lower energy density than NMC

Best for: Grid storage, commercial EVs, buses

INDIA'S BESS NEED:

CEA estimate by 2030: **411 GWh** of battery storage

Current installed BESS: ~5-8 GWh (massive gap)

500 GW renewable target by 2030 (NDC commitment)

CRITICAL MINERALS FOR BATTERIES:

KABIL: Khanij Bidesh India Limited; JV of NALCO + HCL + MECL; acquires mineral assets abroad

India's first lithium deposit: **Reasi, J&K** (5.9 million tonnes, discovered 2023)

"Lithium Triangle": **Argentina, Bolivia, Chile** (60%+ of world lithium reserves)

Critical Mineral Mission: Announced in **Budget 2024-25**

OTHER RELEVANT FACTS:

India's battery import dependence: ~$5 billion/year (mainly from China)

Solid-state batteries: Next generation; no liquid electrolyte; higher energy density; not yet commercial at scale

PLI for ACC includes mandatory domestic value addition: 25% (Yr 2) → 50% (Yr 5)

Anakapalli: Industrial city in Visakhapatnam district, AP — already hosts industrial estates

14 PLI schemes total in India: Pharmaceuticals, Mobile, Telecom, Food, Solar, Battery, Auto, White Goods, Textile, Specialty Steel, Advanced Chemistry Cell, Medical Devices, Drones, Semiconductors

Sources: The Hindu, PIB, Ministry of Heavy Industries

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