Indigenization of battery manufacturing in India
Presentation for ACEF 2023 Deep Dive Workshop

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Not for circulation
## Snapshot of grid scale battery storage investment pipeline (i.e., under bidding, permitting and under construction projects) and policy ecosystem in India

### Total capacity in pipeline
- Standalone BESS projects account for ~75% share and remaining are hybrid collocated with RE sources.

### USD ~7.3 billion
- Total investment in pipeline
- Rajasthan and Gujarat are top two states accounting for more than 60% of investment where project locations are reported.

### USD cents ~11 - 12/kWh
- Levelized cost of service determined in recent auctions
- Determined @ 2 cycles per day for 3-4 hours of discharge; Govt. is targeting USD cents 5-6 / kWh for mass adoption.

### 208 GWh
- BESS capacity for optimum generation mix by 2030 planned by CEA
- The energy storage capacity required for 2029-30 is likely to be 60.63 GW (18.98 GW PSP and 41.65 GW BESS) with storage of 336.4 GWh (128.15 GWh from PSP and 208.25 GWh from BESS).

### ~4.1 GWh
- Energy Storage Purchase Obligations
- Total prescribed obligations will progressively increase from 1% in 2023-24 to 4% by 2029-30

### Policy description
<table>
<thead>
<tr>
<th>Key highlights (status quo)</th>
<th>Energy Storage Purchase Obligations</th>
<th>Viability gap funding for BESS projects</th>
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<td>Fixed cost recovery (INR / MW / month) for project developers helps de-risk uncertainties in capacity utilisation (no. of charge-discharge cycles)</td>
<td>Total prescribed obligations will progressively increase from 1% in 2023-24 to 4% by 2029-30</td>
<td>Announced in FY-24 budget for supporting ~4000 MWh capacity addition; Guidelines for VGF application under development</td>
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### Key highlights (status quo)
- **Guidelines for Procurement and Utilization of BESS as part of GT&D assets**
- **Energy Storage Purchase Obligations**
- **Viability gap funding for BESS projects**

### Goods and Services Tax (GST)
- Lithium-ion batteries currently attract 18% GST

### Basic customs duty (BCD)
- Li-ion batteries currently attract 10% BCD on imports

### Production linked incentives (PLI)
- PLI scheme dedicated for manufacturing of stationary grid storage batteries is under development

### Source:
- EY analysis
Snapshot of battery manufacturing investment pipeline and policy ecosystem in India

Total capacity in pipeline for manufacturing
Much of this capacity is likely catering to mobility applications (electric vehicles): ~65% for cell and pack assembly followed by 24% for pack assembly and 9% for cell component manufacturing.

Eligible for production linked incentives (PLI) of USD 2.2 billion from government
Most of these incentives is likely to benefit EV battery supply chain and linked to achieving domestic value addition (60% in five years). Another 20 GWh is likely to be allocated soon within this budget.

Total investment in pipeline
USD ~16 billion
Gujarat, Karnataka, Tamil Nadu and Telangana are top two states accounting for more than 90% of pipeline.

Manufacturing capacity of stationary grid storage batteries for allocating PLI
~30 GWh
Under planning

~97 GWh

Structuring PLI for grid storage battery manufacturing
<table>
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<tr>
<th>Battery chemistry / technology (Li-ion, Na-ion, Redox flow, Metal air etc.)</th>
<th>Agnostic to enable cost optimisation and long duration storage capabilities</th>
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<tr>
<td>Cycle life</td>
<td>&gt;10,000 @ 5 C - C/100</td>
</tr>
<tr>
<td>Energy density</td>
<td>Not important</td>
</tr>
<tr>
<td>Cost of cell production</td>
<td>&lt;50 USD per kWh for mass adoption</td>
</tr>
<tr>
<td>Active materials for electrode assembly</td>
<td>Earth abundant (beyond lithium, vanadium)</td>
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<td>Safety (thermal runaway)</td>
<td>Inorganic / solid state / non-oxidizable electrolytes will reduce cost of thermal management</td>
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EY Point of View

Battery chemistry / technology (Li-ion, Na-ion, Redox flow, Metal air etc.)
Agnostic to enable cost optimisation and long duration storage capabilities

Cycle life
>10,000 @ 5 C - C/100

Energy density
Not important

Cost of cell production
<50 USD per kWh for mass adoption

Active materials for electrode assembly
Earth abundant (beyond lithium, vanadium)

Safety (thermal runaway)
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Source: EY analysis
The value chain of lithium-ion battery manufacturing ecosystem

**Mining**
Extraction of raw materials, such as Li, Co, Ni, Mn and graphite

**Chemical processing**
Conversion of raw materials into intermediate compounds

**Active material production**
Manufacturing of electrode materials, such as NMC, LFP, etc.

**Cell production**
Integration of electrodes, electrolytes, and separators into a sealed unit

**Recycling**
Reclamation of valuable materials from used batteries

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**Indigenization of battery manufacturing in India**

Source: EY analysis
Key components and materials for manufacturing lithium-ion batteries (LIBs)

Components of a lithium-ion cell

- Cathode active material (NMC/LFP/NCA, etc.)
- Separator (polyethylene)
- Electrolyte (LiPF$_6$)
- Anode active material (graphite)
- Positive current collector (aluminum)
- Negative current collector (copper)

Components of a lithium–ion cell

- Lithium ions
- Electrons

Applications

- Grid storage, electronics, etc.
- Electric vehicle applications

LIB cell manufacturing

- Cathode
- Anode
- Current collector foil
- Electrolyte
- Separator

Raw Materials

- Lithium
- Nickel
- Cobalt
- Mn, Fe, P, etc.
- Needle coke
- Coal tar pitch
- Spherical Graphite
- Copper
- Aluminum
- Ethylene carbonate
- Polypropylene
- Lithium hexafluorophosphate

Source: EY analysis
India’s LIB cell manufacturing industry will need ~193 thousand tons/annum of cathode active material, ~98 thousand tons /annum of anode active material, 91 thousand tons /annum of aluminum and 41 thousand tons of copper and 8 thousand tons/annum of LiPF6 electrolyte material to produce ~100 GWh / annum of batteries by 2030.
Cost breakdown of manufacturing LIBs indicates active materials synthesized from critical mineral commodities and their chemical precursors can contribute up to ~55% of overall cost.
Indigenization of battery manufacturing in India

Synthesizing active cathode materials and their chemical precursors can add up to ~40% value addition in LIB pack manufacturing.

Cost breakdown of cathode active material as a % share of NMC-622 LIB pack cost

<table>
<thead>
<tr>
<th>CAM Processing</th>
<th>Li2CO3</th>
<th>CoSO4</th>
<th>NiSO4</th>
<th>MnSO4</th>
<th>Li-NMC 622 (US$/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost % as share of battery pack cost</td>
<td>3%</td>
<td>4%</td>
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<td>Cost % as share of battery pack cost</td>
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Source: EY Analysis based on market (spot) prices for active materials and their critical mineral constituents (battery grade chemical precursors) from the period of Jan 2021 - April 2022.

Note: The prices considered for Li-NMC 622 powder is taken from "https://source.benchmarkminerals.com/article/cathode-prices-fall-for-first-time-since-may-on-weaker-demand", prices for Li2CO3, Cobalt and Nickel is taken from internal EY data. For FePO4 a constant price of US$ 2/kg and for MnSO4 a constant price of US$ 1.5/kg is considered for the period of Jan 2021 - April 2022.
## 2030 Action plan for building resilience in critical battery mineral supply chains

<table>
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<th>Strategic intervention</th>
<th>Action Plan</th>
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</table>
| Domestic exploration, mining and refining of critical mineral resources | • National stockpiling of refined mineral precursors used in LIB electrodes  
• Incentives for critical battery mineral exploration, mining and extraction through appropriate royalty and tax regimes  
• PLI for setting up critical mineral processing / refining units, especially for Li2CO3 / LiOH, NiSO4, CoSO4 and Spherical graphite  
• Production linked incentives for extraction of critical minerals through recycling LIBs |
| Overseas exploration and mining of critical mineral resources | • Strengthen Indian missions in critical mineral bearing foreign countries to facilitate due diligence of greenfield / brownfield mining assets, acquisition and investment by Indian companies  
• Strengthen KABIL to plan and undertake joint exploration, mining activities in critical mineral bearing foreign countries |
| Establish supply chain linkages with friendly foreign countries | • “G20 Critical Minerals Security Partnership” (G20-CMSP) should focus on building resilient supply chain of critical battery minerals, including stockpiles in different member countries as per comparative advantages in extraction and processing  
• Critical Battery Minerals Supply Chain should be prioritized as a key pillar of Indo-Pacific economic framework and a key factor in diplomatic outreach with mineral bearing foreign countries |
| R&D to develop recycling, extraction technologies and find earth abundant alternatives to critical battery minerals | • Formulate national R&D grand challenge for:  
  ▪ developing high performance LIB electrodes made from earth abundant alternatives  
  ▪ direct lithium extraction technologies from seawater that can selectively separate lithium from sea water using physical or chemical processes |
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