CEEW THE COUNCIL

NEIS CENTER

Issue Brief | November 2026

Localising Battery Electrolyte Manufacturing in India

Capabilities, Constraints, and Policy Support

Authors Varnika Prakash
Akanksha Tyagi



Copyright © 2026 Council on Energy, Environment and Water (CEEW).

Open access. Some rights reserved. This work is licenced under the Creative Commons Attribution- Non-commercial 4.0. International (CC BY-NC 4.0) licence. To view the full licence, visit: www.creativecommons.org/licences/by-nc/4.0/legalcode.

Suggested citation: Prakash, Varnika and Akanksha Tyagi. 2026. *Localising Battery Electrolyte Manufacturing in India: Capabilities, Constraints and Policy Support*. New Delhi. Council on Energy, Environment and Water.

Disclaimer: The views expressed in this report are those of the authors and do not reflect the views and policies of the Council on Energy, Environment and Water.

Cover image: iStock. For illustrative purposes only.

Peer reviewers: Dr Ujval Vaishnav, President-Business Development-Speciality Business, Anupam Rasayan; Dr Parveen Kaushik, Director, Bharat Navurja Recycling Pvt Ltd. and Anant Material Pvt. Ltd; Dr Parveen Kumar, Programme Head-Sustainable Batteries, WRI India; Dr Vandana, WRI India; Dr Rishabh Jaiswal, Deputy Lead, Swaniti Global; Aravind Srinivasachari, Programme Associate, CEEW; and Rishabh Jain, Fellow, CEEW.

Acknowledgement: This work is generously supported by the New Energy Industrial Strategy (NEIS) Center.

Publication team: Rhea Khanna (CEEW); Alina Sen (CEEW); Surit Das; Twig Designs, and FRIENDS Digital Colour Solutions.

Organisation: The Council on Energy, Environment and Water (CEEW)—**a home-grown institution** with headquarters in New Delhi—is among the **world's leading climate think tanks**. The Council uses **data, integrated analysis, and strategic outreach** to support public policy, transform markets, shape technology, and nudge behaviour. It addresses pressing regional and global challenges through an **integrated and internationally focused** approach. The Council prides itself on the **independence** of its high-quality research and strives to **impact sustainable development at scale**.

CEEW
THE COUNCIL

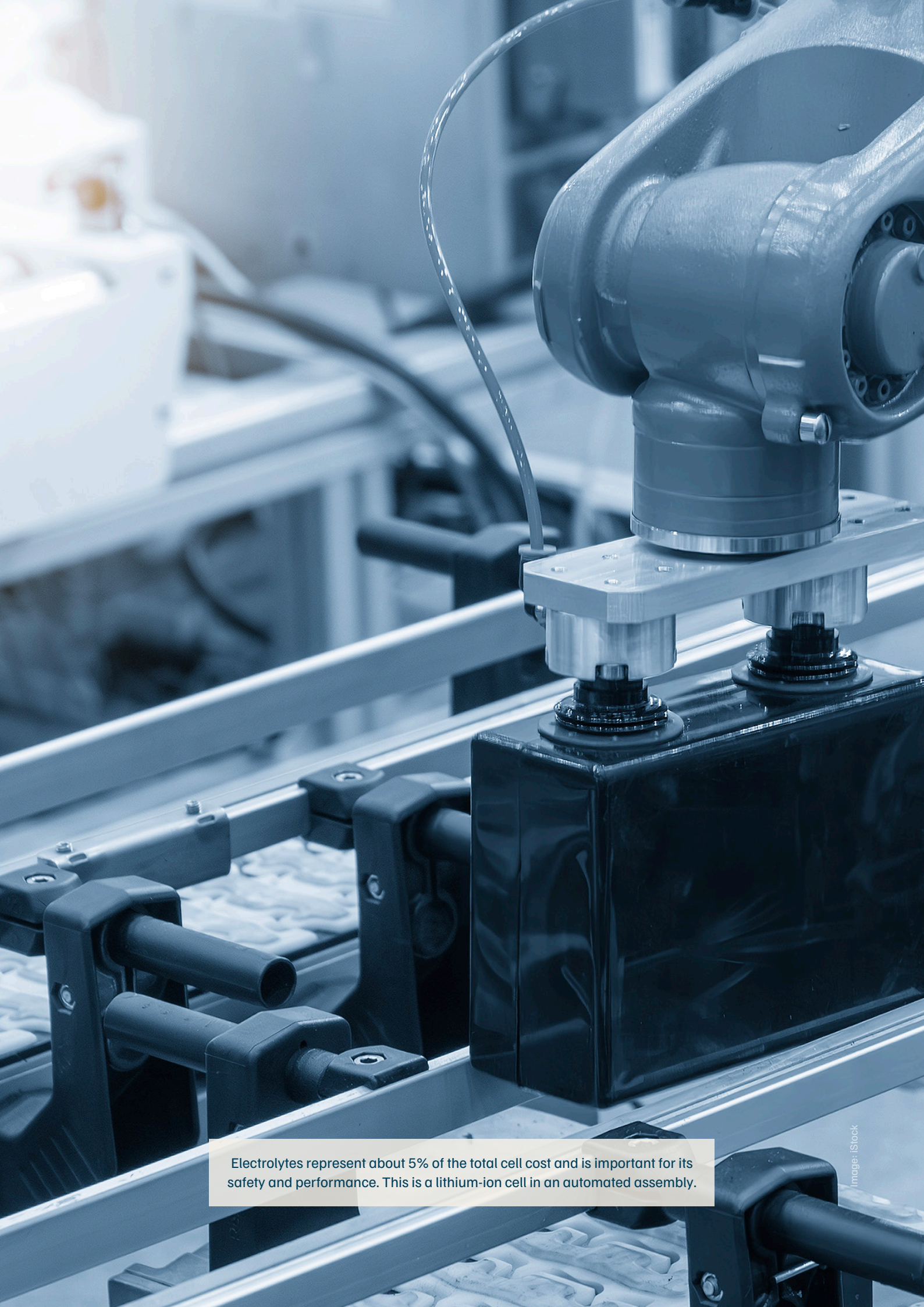
NEIS
CENTER

Localising Battery Electrolyte Manufacturing in India

Capabilities, Constraints, and Policy Support

Issue Brief | November 2026

Varnika Prakash and Akanksha Tyagi



Electrolytes represent about 5% of the total cell cost and is important for its safety and performance. This is a lithium-ion cell in an automated assembly.

Image: iStock

Council on Energy, Environment and Water

INTEGRATED | INTERNATIONAL | INDEPENDENT

The Council on Energy, Environment and Water (CEEW)—**a homegrown institution** with headquarters in New Delhi—is among the **world's leading climate think tanks**. The Council uses **data, integrated analysis, and strategic outreach** to support public policy, transform markets, shape technology, and nudge behaviour. It addresses pressing regional and global challenges through an integrated and internationally focused approach. The Council prides itself on the **independence** of its high-quality research and strives to **impact sustainable development at scale**.

CEEW IN NUMBERS

16 years
16 research teams
400+ team members
680+ peer-reviewed studies

240+ policies & plans informed
80,000+ livelihoods enabled

770+ convenings
800+ opinion articles
52 mn reached via films & documentaries

CEEW'S LEADERSHIP

Board: Mr Jamshyd Godrej (Chairperson); Dr Suresh Prabhu; Mr Amitabh Kant; Dr Janmejaya Sinha; Mr Montek Singh Ahluwalia; Dr Naushad Forbes; Mr S. Ramadorai, and Ms Vinita Bali

CEO: James Abraham

CEEW'S STRATEGIC PILLARS

Clean electricity penetration
Low-carbon industrialisation & circularity
Security of fuels of the future
Quality of life
Green economy & livelihoods
Sharing lessons from India

SELECT POLICY ENGAGEMENTS

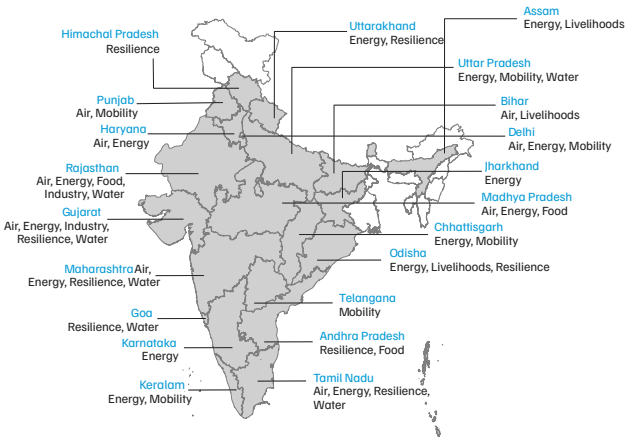
NATIONAL/INTERNATIONAL

2011 | National Water Resources Framework
2014 | 175 GW renewables target
2015 | International Solar Alliance
2016 | PM *Ujjwala Yojana*
2017 | *Saubhagya Scheme*
2019 | *India Cooling Action Plan*
2021 | Net Zero by 2070
2022 | *Mission LiFE*
2022 | *National Bioenergy Programme*
2022 | E-waste (Management) Rules
2023 | G20 Green Development Pact
2023 | *National Green Hydrogen Mission*
2024 | Green Steel Taxonomy
2024 | *PM Surya Ghar Yojana*
2025 | *National Critical Mineral Mission*
2025 | Rajya Sabha Guidelines on Crop Residue Burning
2025 | India's Carbon Credit Trading Scheme (CCTS)
2025 | IFSCA's Framework for Transition Bonds
2026 | Disaster Risk Index for 16th Finance Commission
2026 | India's NDC 3.0
2026 | India's Scenarios towards Viksit Bharat and Net Zero

STATE

2022 | *Rajasthan Organic Farming Mission*
2022 | *Jharkhand State Solar Policy*
2022 | *Uttar Pradesh Vidyut Sakhi programme*
2023 | *Rajasthan Renewable Energy Policy and Green Hydrogen Policy, 2023*
2023 | *Uttarakhand Solar Policy*
2025 | Green Odisha Initiative
2025 | *Maharashtra Climate Action Plan 2.0*
2025 | *Delhi Clean Air Action Plan*
2026 | *Delhi EV Policy 2.0*
2026 | Bihar Promotion of New and Renewable Energy Sources
2026 | Gujarat Integrated Renewable Energy Policy and Green Hydrogen Policy
2026 | *Uttarakhand Mukhyamantri Saur Swarojgar Yojana*
2024-26 |
Directives of Commission on Air Quality Management
Net Zero Roadmaps (BH, GJ, TN, UK)
Agroforestry Roadmaps (AS, MH, OD)
140+ Heat Action Plans (GJ, MH, OD, TN)
Treated Used Water Reuse Plans (MH, UP)
Flood Risk Mitigation Plans (GJ, MH)

21 STATES SUPPORTED





Electrolyte manufacturing requires fluoropolymer-lined steel reactors similar to those used in the fine-chemicals industry.

Image: iStock

Contents

Section	Pg
Executive summary	1
1. Introduction	4
1.1 Objectives	4
1.2 What is an electrolyte? What is its importance in the battery value chain?	5
1.3 What are the constraints to manufacturing electrolyte in India?	6
2. The electrolyte value chain: components, processes and business models	7
2.1 Technologies used for manufacturing electrolyte components	8
2.2 Electrolyte manufacturing business models	11
3. India's current capabilities in electrolyte and its component manufacturing	12
3.1 Leveraging latent capabilities in the existing industrial base	14
3.2 Accessing technology partnerships through MoUs, LOIs and acquisitions	14
4. Role of domestic testing infrastructure in scaling electrolyte manufacturing	16
5. Policy recommendations to create a local battery electrolyte manufacturing ecosystem	18
5.1 Target grants and upskilling programmes to encourage indigenous manufacturing of electrolyte manufacturing machines	18
5.2 Invest in domestic testing infrastructure and introduce standardised testing norms	19
5.3 Orientate JVs and international technology transfers for long-term benefits	19
5.4 Encourage R&D in next-generation electrolyte salts and manufacturing processes	20
5.5 Introduce direct fiscal support for manufacturing components in upstream segments	20
5.6 Create assured demand for domestic electrolyte	21
6. Conclusion	22
Acronyms	23
References	26

Executive summary

India's battery industry is built on imports it does not control. The entire cell manufacturing industry is almost 100 per cent dependent on imports for all cell components like electrolytes, cathode active materials (CAM), anode active materials (AAM), and separators primarily from China, which creates a deep vulnerability for the industry. This exposure is set to deepen as the global demand for batteries is expected to increase more than 2.6 times by 2030 to reach 4.2 terawatt hour (TWh) (Hughes 2026; McKinsey & Company 2026).

India will represent a small share, with some estimates putting its battery demand to rise 216 gigawatt hour (GWh) by 2030 (Jain and Jhunjhunwala 2025). However, despite the various initiatives to boost local production such as the Advanced Cell Chemistry Production Linked Incentive (ACC PLI) Scheme (MHI ACC PLI 2021) and the exemption of basic customs duty on capital goods used in manufacturing lithium-ion batteries (LiBs) (MoF, GoI 2026), as of October 2025, India commissioned only 1.4 GWh of ACC capacity under the PLI scheme (IEEFA and JMK Research Analytics 2026). The announced projects could take the domestic cell manufacturing capacity to around 150 GWh in the coming years.

This issue brief, first in the series of localising cell components manufacturing, examines how domestic production of **battery-grade electrolyte** can be a strategic lever in enhancing India's current battery manufacturing ecosystem. The brief focuses on the lithium ion batteries given the largest share of contribution in the electric vehicles and energy storage (IEA Global EV Outlook 2026).

Key findings

- **Electrolytes account for around five per cent of the cost of a cell**[1], with indispensable functionalities around cell safety and performance (McKinsey & Company 2026).

- **Electrolyte can be built by drawing on the strengths of** fluorochemicals, petrochemicals, pharmaceuticals, and fine chemicals industries[2] (Figure ES1) **and is a cell component that India can manufacture locally**.

- India would require around 60,000- 90,000 tonnes of electrolyte to cater to a domestic cell manufacturing capacity of 150 GWh[3]. However, the growth of electrolyte manufacturing in India is constrained by the **limited domestic demand for locally manufactured electrolyte**, dedicated incentives through policies, lack of advanced chemical processing machines, advanced purification systems, and battery-grade configured testing equipment.

The business models of electrolyte manufacturing companies globally can be categorised into **five types** (Figure ES2).

1. CEEW analysis from (Volta Foundation 2025; Argonne National Lab 2023).
2. CEEW analysis- mapped the overlaps in the input materials, skills and technical processes involved in the electrolyte industries to the existing industries in India.
3. Authors' analysis. The electrolyte demand is estimated drawing on the cell bill of materials in Manjong et al. (2024), Supplementary Table S2. and Bat Pac v 5.1 analysis. Electrolyte intensity is taken as 0.42 kg/kWh for NMC811 and 0.58 kg/kWh for LFP cells. Actual requirements will vary with the chemistry mix, cell format and electrode design. 150 GWh is the estimated domestic battery cell manufacturing capacity based on public information available on current and announced capacities.

Figure ES1. India has the process and equipment capabilities to manufacture battery-grade electrolytes

Potential transfers from existing capabilities in pharmaceutical, fine chemical, and petrochemical industries

- Established organic-solvent manufacturing base such as of ethylene carbonate and ethylene glycol
- Experience of handling fluorochemicals like HF
- Local availability of manufacturing equipment such as
  - Aluminium-lined & HDPE drums
  - Corrosion-resistant Hastelloy and PTFE-lined reactors
  - Cryogenic refrigeration
  - Acid and gas management systems
  - Distillation units
  - Drying systems

Gaps to close for battery industry

- Improve raw material purity to battery-grade specification
- Cryogenic process engineering skills
- Convert existing manufacturing equipment, such as corrosion resistant reactors, for battery industry
- Specialised equipment such as
  - Zero-leakage magnetic-drive agitators
  - Precision dosing and filling systems
  - Sub-micron filtration for blending

Source: Authors' analysis.

Figure ES2. Five business models are prevalent globally for electrolyte manufacturing

Custom or contract formulation

Makers formulate and produce to the cell-maker's specs. Offers flexibility, faster customisation, lower R&D burden for battery producers, next-gen chemistries.

Examples: LANXESS (subsidiary Saltigo, Germany to Tinci)

Vertical integration and self-supply

Cell makers produce electrolyte in-house and secure their IP formulations, cutting dependence on external suppliers.

Example: CATL (China)

Joint ventures

Electrolyte firms partner with OEMs/ battery makers to co-develop chemistry-specific electrolytes. Offers long-term demand visibility, shared investment risk.

Example: Neogen Chemicals (India)

Localised gigafactory supply

Plants sited next to gigafactories for just-in-time supply, lower logistics cost and safer transport of hazardous liquid electrolyte.

Example: UBE Corporation (Louisiana), Tinci (Texas), CapChem (Louisiana & Ohio)

High performance

Advanced electrolyte for fast charging, high energy density, extreme temperature and next generation chemistries, R&D led

Example: Mitsubishi Chemical, UBE, Soul Brain (South Korea)

Source: Authors' analysis.

Key recommendations

Government ministries should develop a coordinated policy approach to build a self-reliant, globally competitive, future-oriented electrolyte market in India (Table ES1).

Table ES1. Policy recommendations for localising battery electrolytes

Aim	Recommendations	Implementing ministries
1. Build domestic capability of machines and equipment to support battery-grade electrolyte manufacturing	Target grants and upskilling programmes to encourage indigenous manufacturing of electrolyte manufacturing machines	MHI (Capital Goods Scheme Phase II), CSIR-CECRI, CSIR-NML, CMTI, IITs, CSIR-NCL
2. Reduce dependence on foreign testing and OEM qualification	Invest in domestic testing infrastructure and introduce standardised testing norms	MHI, DST (FIST), CSIR-CECRI, CMET, NPL, IITs, NCL, ARCI, BIS, NABL
3. Build a domestic R&D and innovation base rather than relying on technology transfers	Orientate joint ventures (JVs) and international technology transfers for long-term benefits	Industry stakeholders, DPIIT MoC&F (DCPC), (IMPRINT with DST & MoE)
4. Develop next generation electrolyte materials, use indigenised processes and local resources	Encourage R&D for the next -generation electrolyte salts and manufacturing processes	MoC&F (DCPC), (IMPRINT with DST & MoE)
5. Create domestic demand via policy	Introduce direct fiscal support for manufacturing components in upstream segments	MHI, MoC&F (DCPC), BIS
6. Create guaranteed offtake for the domestic electrolyte	Introduce a phased local electrolyte sourcing norms for the upcoming gigafactories Approved List of Battery Component Manufacturers (ALBCM)	MHI, MoP, Ministry of Power, ACC PLI PMA, BIS

Source: Authors' analysis.

1. Introduction

As India's energy transition journey accelerates rapidly, batteries are emerging as the critical enablers of renewable energy integration and transport electrification. By 2030, the demand for batteries is projected to be 4.2 TWh globally (McKinsey & Company 2026) and 216 GWh domestically (Jain and Jhunjhunwala 2025).

Battery and the cell components manufacturing is concentrated in China, that accounts about **75–85 per cent** of the global battery cell manufacturing capacity; contributes **85 per cent** of the global cathode active materials (CAM) production; and holds **90 per cent** of the anode active materials (AAM) manufacturing capacity and **60 per cent of electrolyte manufacturing** (Global EV Outlook 2025; Mordor Intelligence 2026).

Considering the risks associated with geographical supply chain concentration– ike Chinese export controls, price volatilities, technological sovereignty–countries across the globe are taking initiatives to localise batteries and its components.

Major economies like the US (Xing et al. 2022; US Department of Energy 2025); Europe (European Critical Mineral Mission 2023); and Japan have introduced targeted policies and incentives to mitigate exposure to China's export restrictions while future-proofing resilient battery supply chains.

The Ministry of Heavy Industries (MHI) of the Government of India (GoI) rolled out the Advanced Cell Chemistry Production Linked Incentive (ACC PLI) Scheme by targeting 50 gigawatt-hour (GWh) of domestic cell generation capacity by the end of 2029 (MHI 2021).

The ACC PLI scheme provides cell manufacturers foundational policy support but capacity commissioning and incentive disbursements are limited, highlighting implementation, execution problems, and the policy falls short of achieving its core objective of domestic value addition and supply chain resilience.

As of early 2026, only 2.8 per cent of the targeted 50 GWh capacity has been commissioned, and no incentive disbursed against the targeted amount around USD 1.9 billion (INR 18,100 crore) tied to early production timelines (JMK and IEEFA 2026).

The major challenges faced were meeting stringent DVA targets without a local supply chain, technology constraints, foreign visa delays for external experts, and delayed procurement of cell components.

The current DVA targets are aggregated and Indian manufacturers are inclined to attain it more through pack assembly and less through technology complex activities. This means that a fully compliant ACC PLI winner can attain the DVA target without manufacturing cell components locally and operate largely as battery pack assemblers.

1.1 Objectives

Many reports focus on India's battery manufacturing ecosystem, the focus on manufacturing of individual cell components is limited.

To address this gap, we are publishing a series of issue briefs on the theme of *localising battery component manufacturing in India*. The issue briefs unpack the strategic opportunity offered by localising the manufacturing of different battery components, their market potential, supply chains, manufacturing processes, challenges to localising manufacturing, and strategies to overcome the challenges.

This issue brief, first in the series, examines how domestic production of *battery-grade electrolyte* can be a strategic lever in enhancing India's current battery manufacturing ecosystem. This brief focuses on lithium-ion batteries and liquid electrolytes because of their market dominance and speculated large share in future markets as well.

> India imports almost all of the electrolyte that goes into its batteries, overwhelmingly from a single supplier.

1.2 What is an electrolyte? What is its importance in the battery value chain?

An electrolyte is an ion-conducting, electrically insulating medium in the form of liquid, gel, or solid–sandwiched between anode and cathode–that facilitates lithium-ion movement in the cell and contributes around five per cent of the cell cost.[4] An electrolyte is a critical factor in cell safety (Senthil et al. 2025).

The global battery electrolyte market size is expected to grow at a compound annual growth rate (CAGR) of 12.94 per cent and reach USD 34.46 billion by 2034 (Fortune Business Insights 2026). India's electrolyte market is projected to be a small but fast-growing market: at around USD 0.52 billion, its 2025 revenues represent approximately 4.48 per cent of the global market (Fortune Business Insights 2026).

Based on BatPaC analysis, India would need around **60,000- 90,000 tonnes of electrolyte blends** to serve 150 GWh of India's annouced cell manufacturing capacity.[5] At the stage of development like India's, raw materials imports and technology transfers become business mandates but continued dependence brings economic and security risks.

Localising electrolyte manufacturing insulates India from supply chain and geopolitical vulnerabilities; offers growth opportunity and cell price stability; and requires the country to strengthen its research and development (R&D), technology, and innovation capability.

Insulation from supply chain and geopolitical vulnerabilities

The electrolyte value chain is **structurally dependent on China** for most of the production. **Japan** and **Korea** represent the primary alternatives to China. This concentration leaves India exposed on price and availability. China's scale and overcapacity shape global electrolyte pricing that is difficult for the rest of the world to match.

In 2022, $LiPF_6$ prices experienced a sudden rise of approximately USD 50,000/MT around the post COVID era prices fell to USD 16,740/MT in March 2026 (ChemAnalyst 2026). China imposed **export control on critical battery components** like graphite anode materials, cathode materials, and relevant process equipment in October 2025; later, the controls were temporarily suspended till November 2026 (MOFCOM and GAC 2025). This creates uncertainty and disruption risks for the battery supply chain and a likelihood for other cell components as well. Similarly, **overdependence on a single nation weakens India's price-negotiating leverage**, leaving the country more vulnerable to supplier-driven cost hikes.

Growth opportunity

If India continues to import electrolyte materials (salts, additives, and solvents) and blended electrolytes, the country can lose the opportunity to **establish a high-value specialty chemicals–dense market**. Our consultations with stakeholders indicate that, given that there are very few Indian players, the price difference between industrial and battery-grade chemical products is significant and the profit margins are high. Establishing local electrolyte production will create highly skilled jobs in R&D, quality assurance, chemical engineering, specialised manufacturing techniques, and process control.

Cell prices stability

Localising electrolyte manufacturing in India will not impact cell prices initially. However, scaling the facility at commercial scale, **backward-integrating the ecosystem** with domestic electrolyte materials along with stable policy support **will help cell manufacturers optimise the cell prices in the long term**. Also,

> Localising electrolyte production will create highly skilled jobs in R&D, quality assurance, chemical engineering, specialised manufacturing techniques, and process control.

4. The estimates, from a CEEW analysis, are for lithium iron phosphate (LFP) cell chemistry (Argonne National Lab 2023; Volta Foundation 2025).
5. Authors' analysis, drawing on the cell bill of materials in Manjong et al. (2024), Supplementary Table S2. and Bat Pac v 5.1 analysis, Electrolyte intensity is taken as 0.42 kg/kWh for NMC811 and 0.58 kg/kWh for LFP cells. Actual requirements will vary with the chemistry mix, cell format and electrode design.

electrolyte manufacturers, if co-located near the upcoming cell manufacturing gigafactories, electrolyte manufacturers can help further reduce the costs related to insurance and temperature-controlled storage and, by iterating formulations in real time, also the degradation-related quality rejection rate.

Stronger R&D, technology, and innovation capability

Developing cell chemistry requires different sets of formulated experiments with variations in electrolyte specifications with specific molarity, additive combinations, and solvent ratios. Requesting such formulations via imports risks exposing proprietary information across the commercial transactions. Hence, India's dependency on imported electrolytes restricts it in developing or working towards advanced and latest cell chemistries like high voltage cells and solid state batteries.

High-voltage and fast-charging cell formulations require special combinations of electrolyte salts, solvents, and additives that offer a wider electrochemical stability window (ESW) so that the electrolyte does not decompose itself at high voltages.

Technological advancements occur every two or three years. If dependency on foreign innovations—mostly by China, Japan, and Korea—continues, India will not innovate upgraded, novel products or manufacturing processes, and technological dependency will persist.

1.3 What are the constraints to manufacturing electrolyte in India?

Electrolyte manufacturing holds strategic value in upgrading the battery ecosystem in India. However, capital investment is constrained by nascent domestic market demand, price competitiveness, import dependence on electrolyte resources, and rapid technological developments.

A chicken-and-egg problem underlies these constraints: electrolyte manufacturers withhold investment because cell manufacturers do not provide an assured demand signal and cell manufacturers remain import-dependent because the domestic electrolyte value chain is inconsistent and lacking in scale and quality.

Leading cell-manufacturing countries, like China, have large rebates on value added tax (VAT), low production cost (due to economies of scale), industrial clusters, and low-cost financing that helps lower prices that, in turn, ensure market consolidation. India is unlikely to match China in cost structure in the near term.

Another structural risk is that electrolyte manufacturing is highly dependent on effective operational capacity and the yield output of gigafactories. Also, electrolytes degrade fast: they are difficult to stockpile and require special conditions for storage.

Domestic demand is nascent; if cell manufacturing gigafactories and electrolyte manufacturing grow asynchronously, heavy investments and long-term contracts would be at risk. If advancements in technology become so rapid that electrolyte uptake and consumption becomes nonlinear, demand-side uncertainty would be created.

Apart from all these risks, growth in the electrolyte manufacturing ecosystem in India is constrained by the lack of advanced chemical **processing machines** and advanced **purification and drying systems, testing and validation** institutes for locally manufactured products, and awareness of the **machine and equipment certifications** needed for electrolyte manufacturing; and by the limited **access to proprietary information** on electrolyte components manufacturing.

All these structural bottlenecks and associated risks discourage large-scale investments, delay technological developments, and prolong approval cycles with original equipment manufacturers (OEMs). Lastly, existing global partnerships can help India bypass certain R&D timelines and reduce entry barriers but also constrain the country from becoming technology-independent.

2. The electrolyte value chain: Components, processes and business models

The electrolyte is the ionic conductor sandwiched between anode and cathode, enabling lithium ion (Li^+) shuttling during charges and discharges while remaining electronically insulated to prevent short circuits. The electrolyte directly governs ionic conductivity, electrochemical stability window (ESW), and solid electrolyte interphase (SEI) layer quality, and it modulates key processes such as SEI formation and interfacial and thermal stability making it central to both performance and safety (Seo et al. 2025).

Modern-day cells mostly use **three types of electrolyte–liquid, solid state**, and **gel/polymer** (W. Knehr et al. 2022). Liquid electrolytes dominate the current market (Fortune Business Insights 2026; IEA Global EV Outlook 2025). Liquid electrolytes have three building elements: **salts, solvents, and additives** (Figure 1; for a detailed description, see Annexure 1).

Figure 1. Lithium-ion battery electrolyte has three key components

Salts	Solvents	Additives
• $LiPF_6$ is the market leader, production is concentrated in China, Japan and South Korea. • LiFSI, LiTFSI, LiBOB and $LiBF_4$ are emerging alternatives.	• EC and PC are the mostly commonly used solvents for electrolytes. • DMC, DEC and EMC are added in EC to reduce the viscosity and improve the Li ion movement.	• Additives contributes 1–5% of composition but 10–15% of the total raw materials cost of the electrolyte • FEC, VC and lithium salts with special functions like LiFSI are some commonly used additives.

Source: Authors' analysis.

Note: $LiPF_6$: lithium hexafluorophosphate; LiFSI: lithium bis(fluorosulfonyl)imide; LiTFSI: lithium bis(trifluoromethanesulfonyl)imide; LiBOB: lithium bis(oxalato)borate; LiBF4: lithium tetrafluoroborate; EC: ethylene carbonate; PC: propylene carbonate; DMC: dimethyl carbonate; DEC: diethyl carbonate; EMC: ethyl methyl carbonate.

2.1 Technologies used for manufacturing electrolyte components

Electrolyte manufacturing is a complex process wherein each component (salt, additive, and solvent) has its own production steps (Figure 2).

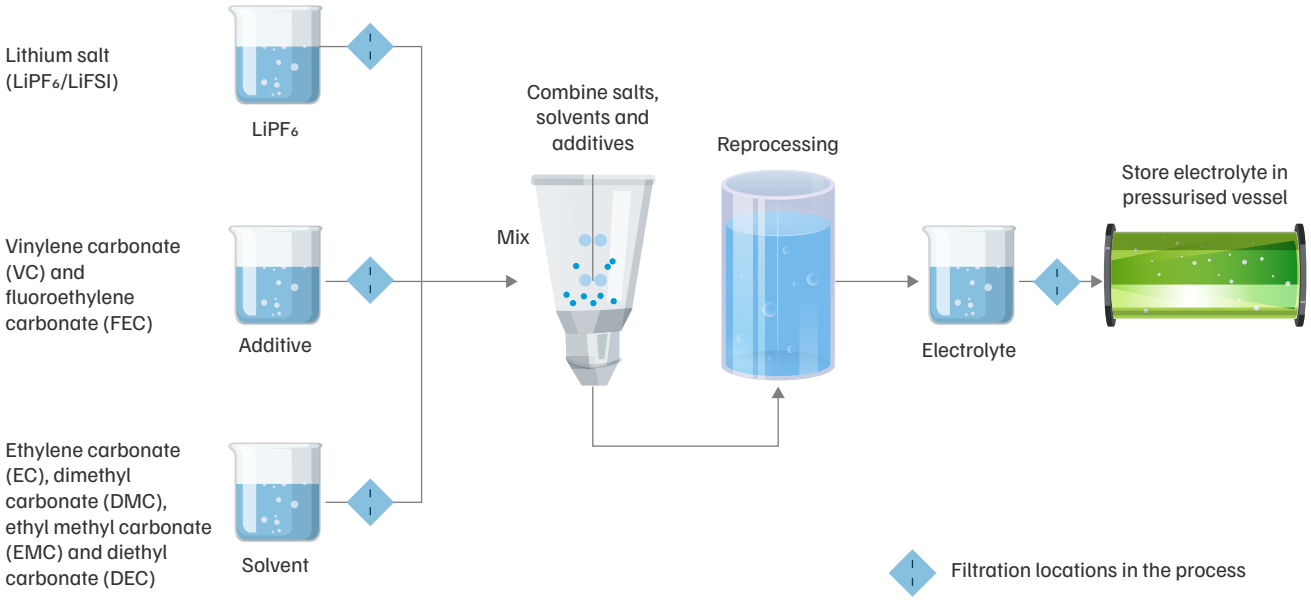
However, the complexity involved in the synthesis and purification of the individual components–electrolyte salt (lithium phosphorus fluoride, $LiPF_6$); solvents (EC, EMC, and DMC); and additives (VC, FEC, and LiFSI)—is far greater than in the subsequent steps.

Manufacturing of electrolyte salt, lithium hexafluorophosphate ($LiPF_6$)

The HF method is the most commonly used industrial method commercially. However, many players in this segment choose their production method based on the availability of raw materials and strategies to reduce production costs (Box 1 describes an alternative method).

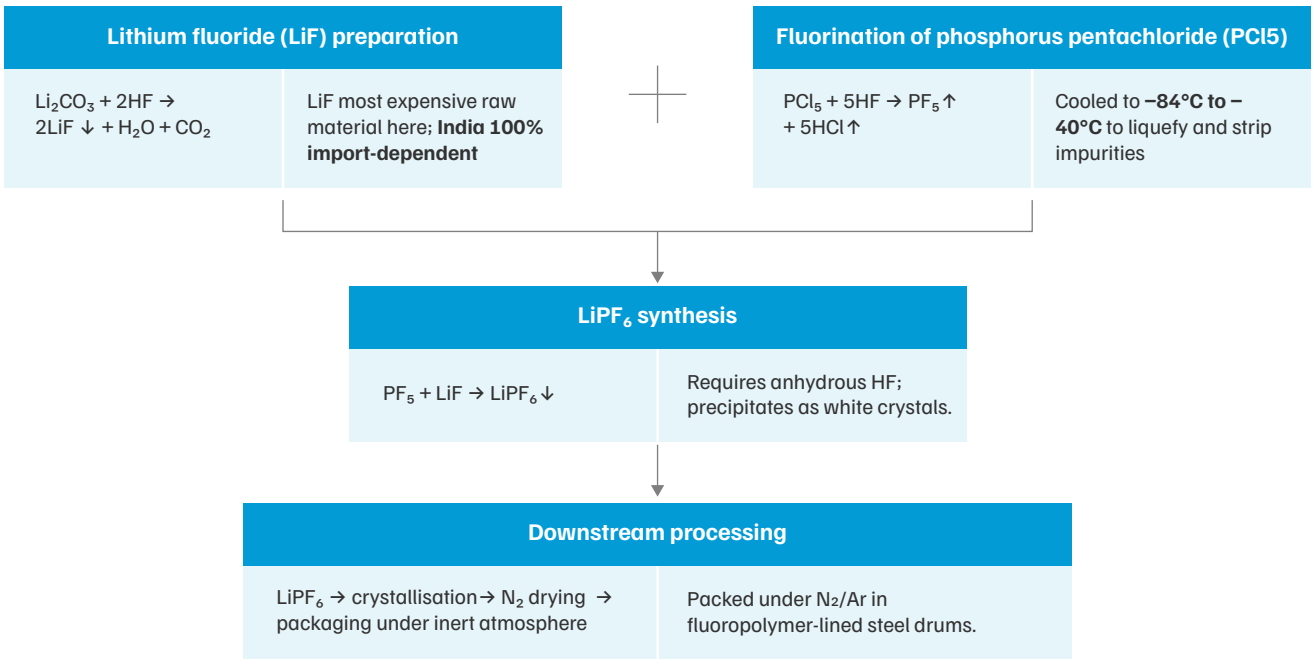
Most of the battery-grade $LiPF_6$ production is **concentrated in China, Japan, and South Korea**. China has outgrown its capabilities and compete in the market on the basis of enormous scale and cost efficiency, while Japan and South Korea dominate the market in advanced quality control and specialised electrolyte materials. The most common method used for the industrial production of $LiPF_6$ is the **hydrogen fluoride solvent method** (Figure 3; for a detailed description, see Annexure 2).

Figure 2. Electrolyte manufacturing is a three-step process involving electrolyte salts, carbonate additives, and solvents



Source: Authors' adaptation from Pall Corporation, 2024.

Figure 3. $LiPF_6$ is commercially manufactured using the hydrogen fluoride solvent method



Source: Authors' analysis.

Box 1. Alternative process for manufacturing $LiPF_6$

Fluorspar (CaF_2) based fluorination is another method to manufacture $LiPF_6$. This method requires CaF_2 as the direct fluorinating agent instead of HF, reducing production costs and improving handling safety. The reaction is halogen exchange fluorination in the same category as the conventional HF route but using CaF_2 as the fluorine donor instead of anhydrous HF.

Source: Authors' analysis.

Manufacturing of solvents EC, EMC, and DMC

China's Shida Shinghwa Advanced Material Group reports a 40 per cent market share in the global high-end carbonate solvent market. Its downstream customers are the leading manufacturers of electrolyte worldwide that dominate the market with their enormous scale and proprietary catalytic technology for the transesterification route and vertical integration into electrolyte blending (Shinghwa Advanced Material Group).

Japanese technology players (UBE Corporation and Asahi Kasei) compete on process differentiation to make cleaner and higher-purity products. UBE Corporation has developed a **proprietary gas-phase nitrite process**[6] that can solve the challenges associated with DMC production, like azeotrope DMC separation from methanol, water produced during the process, and that EC is required as a mandatory starting material in the transesterification method (UBE Corporation 2025). In 2021, Asahi Kasei entered the market with their well-proven CO_2-based technology of producing EC and DMC as an alternative to the conventional transesterification

6. UBE corporation plans to manufacture DMC (100,000 tonnes per year) and EMC (40,000 tonnes per year) in Louisiana beginning late in 2026.

method (Asahi Kasei Corporation 2021). Recent research focuses on a metal organic framework (MOF) with tetrahedral potassium ion clusters as pore gates that enables this separation generating high-purity DMC (99.9999 per cent) (Zhou et al. 2026).

Battery-grade carbonate solvents production is chemically sequential (Figure 4). The most common solvent, EC, is synthesised using one of two common techniques: cycloaddition of ethylene oxide (EO) and CO_2; and CO_2 carboxylation with ethylene glycol (Yan et al. 2023; Li et al. 2024). The cycloaddition method requires a special halogen free catalyst to obtain a battery-grade EC solvent. Further, DMC is produced either from transesterification of EC with methanol by two routes that require no EC: oxidative carbonylation **or** oxidative carbonylation of methanol **or** vapour-phase methyl nitrite carbonylation method. EMC is made by transesterification of DMC with ethanol (Chen et al. 2026).

India can position itself as a feedstock anchor by investing in **producing battery-grade EC**. With the **existing availability of feedstock ethylene oxide (EtO) production** at Reliance Industries Ltd (RIL), Indian Oil Corporation Ltd (IOCL), and India Glycols, India has a **good opportunity** to focus on the **production of battery-grade ethylene carbonate (EC)**. The Indian EtO market size reached USD 1.8 billion in 2025 and is projected to reach USD 2.5 billion by 2034 at a CAGR of 3.6 per cent (IMARC Group 2026).

Similarly, ethanol is also required for the transesterification process of DMC into EMC. In India, the ethanol market is undergoing a structural shift, propelled mainly by the *Ethanol Blending Programme,* E20 fuel mandate, the *National Biofuel Policy* and the rising sugar surplus (IMARC Group 2026). The ethanol market size was USD 4.14 billion in 2026 and is projected to be USD 11.78 billion by 2034 (IMARC October 2026). However, India will need to focus on **solving the gaps: access to a commercially proven halogen-free catalyst process**; the ecosystem needs an **advanced distillation train**; and **battery-grade EC testing standards and infrastructure** are required for localising battery-grade EC.

Producing DMC through the conventional transesterification route is a challenge because India **lacks commercial battery-grade EC**; catalysts that do not contribute to metal contamination in end products; and **advanced molecular sieve-drying infrastructure** for sub-20-ppm moisture. Also, the country **depends on imports for over 90 per cent of its methanol** (typically obtained from natural gas), another reactant in the process (NITI Aayog 2021).[7] Similarly, EMC solvent has even more complex problems of azeotropic separation as multiple products like DMC, EMC, DEC, methanol, and ethanol form azeotropes with each other.

Figure 4. Ethylene carbonate is one of the foundation material and India has the opportunity to become a global feedstock anchor

Carbonate solvents with sequential manufacturing	3 proprietary technologies commercial	India's opportunity to become a feedstock anchor
Produce EC using ethylene glycol or ethylene oxide	Catalytic transesterification (Shida Shinghwa Advanced Material Group, China)	Existing ethylene glycol manufacturing units like IOCL, RIL and India Glycols can expand to make battery grade EC
Transesterification of EC with methanol to make dimethyl carbonate (DMC)	Gas-phase nitrite process (UBC Corporation, Japan)	Ethanol production can be leveraged to make EMC using DMC
Transesterification of DMC with ethanol to make ethyl methyl carbonate (EMC)	CO_2-based technology (Asahi Kasei, Japan)	

Source: Authors' analysis.

7. As US sanctions disrupted Middle east supply, India diversified its import sources to Japan, China, and Russia (Kapoor 2026).

Manufacturing of additives VC, FEC, and LiFSI

The commonly used additives VC and FEC are derived out of **EC as the starting material**. VC through chlorination and subsequent dechlorination and FEC through fluorination of EC or halogen exchange on the chlorinated intermediate. Manufacturing LiFSI (Lithium bis(fluorosulfonyl)imide), an emerging significant salt involves a complex synthesis method through the reaction of bis(fluorosulfonyl)imide acid with lithium salts. The global LiFSI market size for lithium battery electrolyte is projected to grow from USD 1,053.25 million in 2026 to USD 2,419.43 million by 2034 (Fortune Business Insights 2026). LiFSI can be used as a co-salt with $LiPF_6$ and also as an additive providing thermal stability (Kerner et al. 2016). The synthesis route of LiFSI involves dichlorosulfonimide synthesis; and fluorination (the most critical and hazardous step). Worldwide, **industries are competing to handle and process the fluorination step better**.

Once the three materials (salts, solvents, and additives) are ready, they are mixed together in a process called electrolyte solution blending—one of the prominent steps in electrolyte manufacturing—under relative humidity (RH) less than one per cent to avoid salt degradation. These solutions are made according to the targeted molarity where the additives are dissolved in small quantities (1–5 per cent). The blended solution undergoes a fine filtration process using sub-micron filters that allow only the permissible particulate matter. The solution is packaged under an inert gas environment in fluoropolymer bottles or moisture-tight aluminium containers.

2.2 Electrolyte manufacturing business models

A close examination of the current battery electrolyte manufacturers globally leads to five models shown in Figure ES2 and discussed below.

Contract formulation custom electrolyte production

Electrolytes are formulated and produced **according to customers' specifications** in this model, which offers battery producers flexibility, faster product customisation, and a lower R&D burden. The formulation IP typically remains with the customer, who outsources only the manufacturing. A global example is LANXESS, whose subsidiary Saltigo manufactures electrolytes on contract in Germany for the Chinese electrolyte producer Tinci, giving Tinci European production capacity without building its own plant (LANXESS 2021).

Vertical integration and self-supply

Electrolytes are **produced in-house** in this model, which **secures their IP formulations** and eliminates dependence on external suppliers; for example, CATL operates a dedicated battery materials and recycling business through its subsidiaries and affiliates (CATL 2025).

Joint ventures (JVs)

Electrolyte companies partner with OEMs or battery manufacturers to **jointly develop and manufacture electrolytes** tailored to specific battery chemistries and performance requirements. Such partnerships provide long-term demand visibility and share investment risks.

Localised gigafactory supply

Electrolyte production facilities are **established close to battery gigafactories** to ensure just-in-time supply, reduce logistics costs, and address the **challenges associated with transporting hazardous liquid electrolytes**. This model is increasingly preferred as battery manufacturing scales globally, UBE Corporation is building a plant in Louisiana and Capchem is establishing facilities in Louisiana and Ohio.

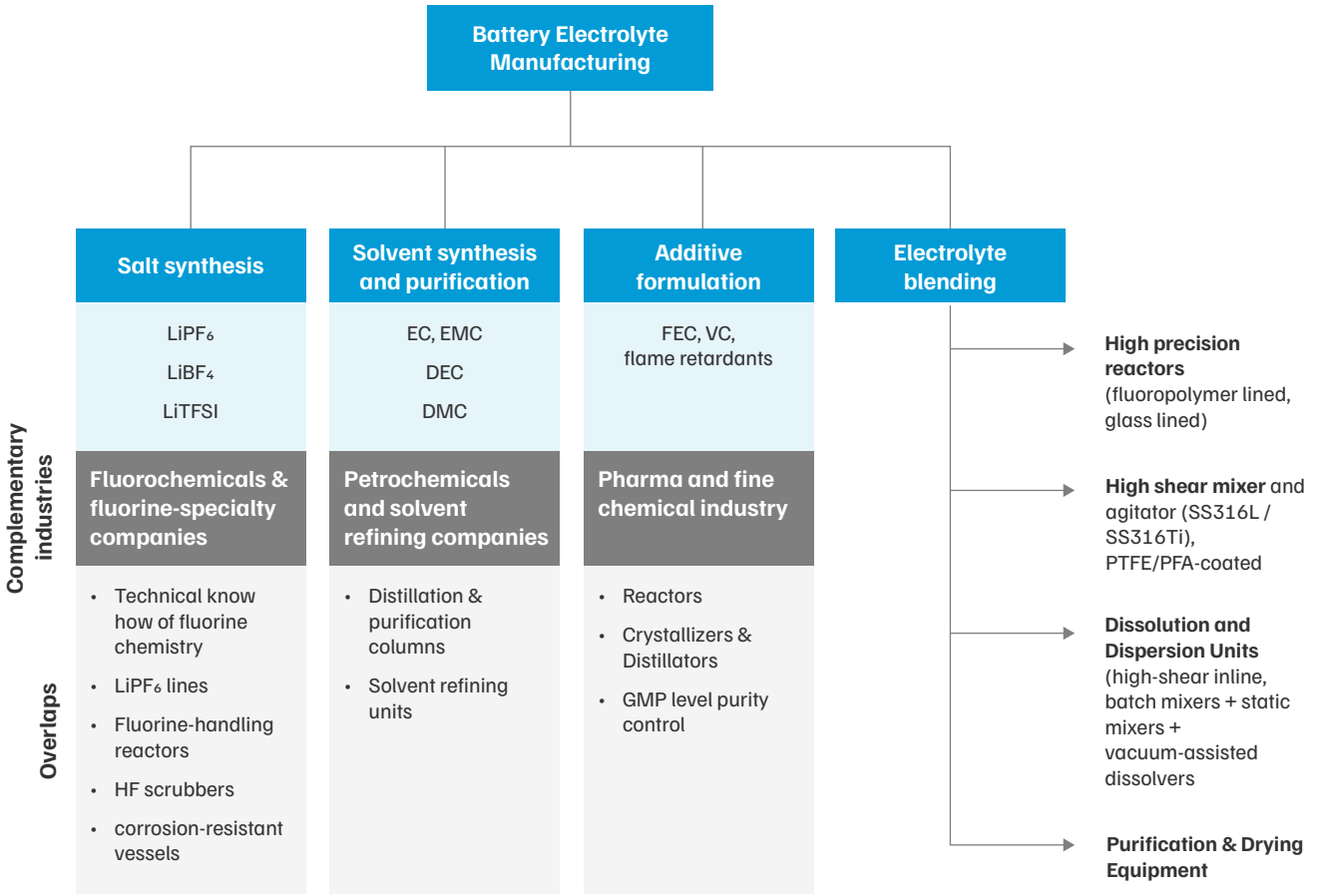
High-performance or speciality-focused

This model is focussed on advanced electrolytes designed for high-performance applications—such as fast-charging, high-energy-density batteries; extreme-temperature operations; and next-generation chemistries—that are typically costlier, command higher margins, and are based on strong R&D capabilities. Mostly, Japanese and Korean players like Mitsubishi Chemical, UBE, Central Glass, and Soulbrain (2020) are focused on high-performance materials and advanced cell chemistries. In this model, the companies exclusively own the electrolyte IP and supply the products on demand.

3. India's current capabilities in electrolyte and its component manufacturing

Battery electrolyte manufacturing, a precise process of formulating chemicals, requires specialised **machinery and infrastructure** such as **high-purity reactors, dry rooms**, and **moisture-controlled systems**. Industries like pharmaceuticals, fine chemicals, and petrochemicals are equipped with these machines, and these industries are well positioned to manufacture battery-grade electrolytes and components (Figure ES1 and Figure 5).

Figure 5. Process capabilities and equipment in India's fine chemicals, petrochemicals, and pharmaceuticals industries overlap with those in the battery electrolyte industry



Source: Authors' analysis.

The current demand–fulfil the short-term goals of reducing imports, creating markets, and laying a foundation–needs quality upgrades, advanced purification, and reliable testing and certifications; it does not need new products to be invented. **The low-hanging fruit are the organic solvents used in electrolytes; the solvents already have a manufacturing base foundation laid for different applications** (Aricò 2025). The existing **aluminium and high-density polyethylene (HDPE) drums**–and machinery like **fluoropolymer lined reactors, distillation units**, and **drying systems**–used in these industries **overlap strongly** with the infrastructure required for electrolyte components manufacturing, but the existing machinery or equipment models **lack the technological advancements** required to produce battery-grade electrolyte, **mostly in terms of purity levels**.

Some Indian chemicals companies have recognised this opportunity and have pivoted a part of their operations towards the battery sector. They have done so by drawing on latent capabilities in their existing industrial base, and by accessing technology through memoranda of understanding (MoUs), licensing, letters of intent (LoIs) and acquisitions (Table 1).

Table 1. Companies leveraging their skills to pivot from conventional to cleantech industries lead the current Indian battery electrolyte market

Company	Existing business	Electrolyte products	Existing partnerships	Distinctive edge
GFCL EV	Fluoropolymers, speciality chemicals, refrigerants	Electrolyte salts, binders, cathode materials $LiPF_6$, PVDF/PTFE, LFP	No partnerships, only investments from IFC	Claims own in-house $LiPF_6$ technology, no foreign licensing, entering $NaPF_6$ salt
Acutaas Chemicals	Pharma, agrochemicals, chemicals & petrochemicals	Electrolyte additives VC and FEC	Exclusive global CDMO partnerships	First Indian commercial VC/FEC manufacturer outside China
Neogen Ionics	Pharma chemicals	Electrolytes salts and additives $LiPF_6$, LiFSI, LiTFSI	JV with Morita Investment Limited (Japan) - Neogen Morita New Materials	PPAP clearance from gigascale customers
Anupam Rasayan	Speciality & fluorine chemistry	Electrolyte salts, additives and solvents $LiPF_6$	LOIs with Elementum Materials (US); E-Lyte Innovations and Fuchs Lubricants (Europe) and Tanfac Industries acquisition and the BASQUEVOLT LoI	Backward integrated in fluorine chemistry via Tanfac.

Source: Authors' adaptation from (GFCL EV Products Limited 2026). (GFCL EV Report 2026), (Acutaas Chemical 2024-2025 report), (Neogen Chemical Limited 2026) (Anupam Rasayan Report 2024- 2025).

Note: CDMO: contract development and manufacturing organisation; FEC: fluoroethylene carbonate; JV: joint venture; LFP: lithium iron phosphate; LiFSI: lithium bis(fluorosulfonyl)imide; $LiPF_6$: lithium hexafluorophosphate; LiTFSI: lithium bis(trifluoromethanesulfonyl)imide; LoI: letter of intent; $NaPF_6$: sodium hexafluorophosphate; PPAP: production part approval process; PTFE: polytetrafluoroethylene; PVDF: polyvinylidene fluoride; VC: vinylene carbonate; IFC: International finance corporation.

3.1 Leveraging latent capabilities in the existing industrial base

Gujarat Fluorochemicals Limited Electric Vehicle, officially known as GFCL EV Products Ltd., has years of experience in producing fluoropolymers, speciality chemicals, refrigerants, and chemicals. The company has leveraged this expertise to rapidly expand the **business into battery-grade materials** used in the electrolytes salts; reagents like hydrogen fluoride (HF), $LiPF_6$,fluoride based polymers (PVDF/ PTFE); and cathode-active materials like lithium iron phosphate (LFP) (GFCL EV 2024). The competitive advantage of GFCL EV lies in its **fully backward-integrated operations using the fluorspar $LiPF_6$ preparation method, corrosion-resistant reactors, specialised gas-handling systems**, and **high-purity crystallisation/ drying steps** for producing $LiPF_6$.

Acutaas Chemicals (formerly known as **Ami Organics**) is another company that has followed a similar strategy. Previously serving the pharmaceuticals, agrochemicals, fine chemicals, and petrochemicals sectors, the company has **entered the new market of batteries and semiconductor materials** (Acutaas Chemical 2024–2025 report). Expecting commercial ramp-up by 2027, Acutaas has inaugurated a new battery chemicals block at Jhagadia, Gujarat, with an initial capacity of 2,000 MT each for VC and FEC (Shah 2026).

The strategy also extends to electrolyte manufacturing equipment. Indian companies like SEPREX, Trident Labortek, and Tinita Engineering manufacture Hastelloy and PTFE-lined reactors. Kirloskar Pneumatic Chillers **manufactures industrial refrigeration systems for pharmaceutical and chemical applications** (Kirloskar Pneumatic), and the chlor alkali industry works for **acid management systems**.

> Leveraging an existing industrial base shortens the learning curve for electrolyte manufacturing but the battery-specific gaps still have to be closed.

3.2 Accessing technology partnerships through MoUs, LOIs and acquisitions

Neogen Chemicals was originally a pharmaceuticals chemicals company. Its subsidiary Neogen Ionics Limited (NIL) secured technology licensing for **$LiPF_6$ salt production** from Morita Investment Limited (MIL), a Japanese firm, and formed an Indo-Japan JV Neogen Morita New Materials Limited (Neogen Chemical Limited 2026). Neogen Ionics Limited holds a majority stake in this JV and it has received production part approval process (PPAP) clearance for commercial production at the Dahej plant (Neogen Chemicals Limited 2026). This JV and partnership has provided a structured pathway and helped the company to **bypass R&D timelines, access proprietary electrolyte formulations, gain the trust of domestic gigafactory owners**, and gain expedited entry to established technologies, market response, and technology licensing.

Anupam Rasayan is another example of this strategy. An established speciality chemicals company, it has entered the battery electrolyte value chain business through four Letters of Intent (LoIs) signed in 2025 and 2026[8]. Anupam Rasayan acquired Tanfac Industries to integrate backward into fluorine chemistry. Leveraging the acquisition, Anupam Rasayan has developed various fluorinated materials like $LiPF_6$ and new-age additives, barrier materials, advanced electrolyte solvents as well as materials enabling quick charging and high voltage batteries. While the learning curve for these industries can be shorter than for companies starting afresh in manufacturing electrolytes, there will still be challenges. Gaps in converting the existing manufacturing base towards battery electrolytes need to be overcome (Box 2).

Further, now partnership follows, mostly, a technology transfer model. Agreements are transactional in the exchange of royalties, foreign licensors retain the core intellectual property rights (IPR) and most partnerships are **focused on increasing production capabilities, not technology innovation**.

8. In February 2025, Anupam Rasayan signed an LoI with Elementum Materials, Inc., a US-based company, to develop advanced fluorine-based electrolyte materials (Anupam Rasayan Report 2024–2025). Later, in June 2025, the company signed three-party Letters of Intent (LoI) involving European companies called E-Lyte Innovations GmbH and Fuchs Lubricants GmbH with an intent to enter upstream electrolyte salts ($LiPF_6$) and additives and envisaging around 1,500 tonnes per annum (TPA) and a five-year supply contract (Anupam Rasayan press release, June 2025). Both agreements support Anupam Rasayan's $LiPF_6$ salt and advanced solvents cater the western battery supply chains. Another LoI was signed with a Spanish battery manufacturer BASQUEVOLT for supply to explore potential supply of specialty chemical product in July 2026.

Box 2. Battery-specific challenges faced by companies with complementary skills

Complementarities exist between the battery and fine chemicals, pharmaceuticals, and petrochemicals industries. Our analysis maps the overlaps in the input materials, skills, and technical processes involved in the electrolyte industries to the existing industries in India, and it finds that these industries lack stringent output specifications for battery-grade materials. For example, battery-grade electrolyte manufacturing requires HF-resistant Hastelloy and PTFE-lined reactors for $LiPF_6$ synthesis, **especially configured to stay unreactive** to anhydrous hydrogen fluoride (AHF) and have **specialised sealing standards** equipped with **zero-leakage magnetic drive agitators** with high precision moisture (<10 ppm), thermal, and inert gas control. Apart from this electrolyte infrastructure, electrolyte manfacturing require **precision dosing and filling systems** for electrolyte packaging along with sub-micron filtration systems for electrolyte blending.

Similarly, while Indian companies have manufacturing equipment similar to those in the electrolyte industry, offtake is constrained by the absence of equipment standards, lack of skills, and the lack of domestic demand.

Machine manufacturers have no specification or certification they trust or can benchmark their products for battery-grade electrolyte manufacturing. The industry needs specialised skills under one system, such as integrating the cryogenic thermal cycling jacket system, HF removal to below 1 ppm at the exhaust, and acid gas management. Also, in the Indian ecosystem, other skills like HF handling and cryogenic process engineering are not well established. Missing domestic demand for such specialised machines and equipment so far has prevented growth and never triggered the capital goods industry to focus on this niche but valuable market.

Source: Authors' analysis.

Battery chemistry evolves rapidly. Every two or three years, electrolyte formulations, solid-state architectures, and novel additive packages advance. If India keeps using the current model, it risks locking itself in a loop of repeated licensing costs and continued dependence where no innovation base accumulates domestically. What these partnerships lack is co-development or co-ownership of the process or manufacturing technologies used in battery electrolyte manufacturing. This highlights problems that India needs to focus on. International companies are hesitant in co-developing a technology with India because the country lacks technical know-how and its appetite for investing in R&D is low. India's R&D landscape is heavily dependent on public funding and private companies contribute only 40 per cent against 70 per cent in the innovation-led countries like China (Sharma and Shah 2025). Further, India's gross expenditure on R&D (GERD) remains only 0.65 per cent of its gross domestic product (GDP) (Sharma and Shah WRI 2025). Bridging the gap will require Indian companies to invest heavily in R&D, without which technology partnerships will continue to deliver production capacities rather than genuine innovation capabilities.

4. Role of domestic testing infrastructure in scaling electrolyte manufacturing

Any material manufactured by a company must go through a detailed testing and accreditation cycle to be accepted by buyers. Currently, India lacks accredited domestic testing facilities and standards for battery-grade electrolyte materials. Our conversations with electrolyte components manufacturers reveal that, for testing infrastructure and approval processes, entrants into the electrolyte components manufacturing market rely on foreign countries like South Korea, Japan, and Germany. This dependence results in **extended commercialisation timelines spanning to several months** creating structural **market entry barriers** for OEMs along with **high laboratory fees and courier and special packaging costs**.

Testing infrastructure for electrolyte materials like salts, solvents, and additives requires facilities like dry rooms (relative humidity less than 1 per cent, dew point -60°C to -40°C) argon glove boxes (< 1 ppm moisture) solvent storage systems (moisture free and nitrogen blanketing) and HVAC with desiccant systems. Some other critical and specialised instruments are coulometric Karl Fischer titrator (KFT) gas chromatography and ion chromatography and Inductively Coupled Plasma Mass Spectrometry ICP-MS) specially configured for battery-grade electrolytes materials (that detect moisture levels less than 10 ppm, less than five ppm metal ion detection).

The most critical of these is KFT as it detects moisture at parts per million levels even a trace of moisture can reduce battery capacity and introduce a genuine safety hazard (Chemistry World 2026). The alcohol-based reagents used in the conventional KFT instrument causes side reactions with electrolyte additives (FEC and VC) and borate-based electrolyte salts, resulting in inaccurate measurements. Hydranal Coulomat A-FA and C-FA from Solstice Advanced Materials Research Chemicals, USA—are the only commercially available Karl Fischer reagents that are free of both alcohol and imidazole, removing the side reactions that compromise accuracy in reactive matrices (Chemistry World 2026). **Most of these instruments are made by American, Swiss and Austrian equipment manufacturers** like Agilent, Metrohm, Anton Paar, Brookfield etc.

Next is the critical environment infrastructure that includes argon nitrogen glove boxes and inert gas supply infrastructure. The facility would also need battery cyclers, coin cell assembly unit, and potentiostat/electrochemical impedance spectroscopy (EIS) equipment for electrochemical studies. Stakeholder consultations[9] reveal that establishing an electrolyte testing facility would require an investment of about USD 1.6 million (INR 15 crore). This capability is resilient to the electrolytes used in newer, upcoming cell technologies like sodium ion and solid state, reducing the risk that the investment will be stranded if the technology mix evolves in the future.

Introducing strict quality norms early may seem premature, but it would build trust between electrolyte manufacturers, gigafactory operators and OEMs, and the investment should repay itself over time. Without certified domestic testing facilities, Indian producers cannot establish themselves as credible global suppliers. Standardised testing and validation protocols, together with early quality benchmarks, would set a floor that deters low-quality products from entering the market and undermining the value chain as it forms. China offers a useful precedent: it built testing standards alongside its electrolyte industry rather than after it (Box 3).

9. This estimate is based on prices of critical equipment (like KFT, ICP-MS, and chromatography instruments) and on the infrastructure required for testing (like low-moisture, low-oxygen, inert environment, and packing conditions).

Box 3. Evolution of China from depending on electrolyte imports-to becoming the world's leading producer

In the early 2000s, China did not produce battery grade electrolyte locally and, just like India, depended entirely on imports from Japan and Korea. In the industry's early years, firms such as BYD and Tianjin Lishen relied entirely on imported electrolyte, bearing both high prices and long delivery times (ASIACHEM 2017).

Domestic production began displacing these imports from 2001. The Chinese firms like Tinci Materials and Capchem that led this were not new entrants but chemical companies building on existing fine-chemicals capability. Using imported salts and solvents, the Chinese reverse-engineered the electrolytes, followed basic testing procedures.

Quality specifications were codified alongside the build-out. China's chemical industry standard for electrolyte, HG/T 4067, has been in force since 2008 and was revised as HG/T 4067-2015, *Cell liquor of lithium hexafluorophosphate*, setting impurity limits and prescribing the test methods used across the industry (MIIT 2015).

In 2020, the electrolyte for the power batteries in China was approximately 88,000 tonnes accounting for almost 50 per cent of the world's output (Gaogong Industry Research Institute 2021, quoted in Lu et al. 2022) and the exported amount was more than 30,000 tonnes, mainly supplied to Japanese and South Korean enterprises (Guanyan Tianxia 2021). The two enterprises were Guangzhou Tinci Materials Technology Co., Ltd. and Shenzhen Capchem Technology Co., Ltd. accounting for 78 per cent of the domestic market (Lu et al.).

India has minimal manufacturing and negligible testing facilities; it depends solely on Korean or Japanese companies to validate products. The key learnings for India are to

- develop early robust quality protocols to build cell manufacturers' trust and avoid rejections;
- intervene early and build testing laboratories in collaboration with certification bodies; and
- pair capacity-building with sustained investment in purification systems and process capability.

Source: Authors' analysis.

5. Policy recommendations to create a local battery electrolyte manufacturing ecosystem

5.1 Target grants and upskilling programmes to encourage indigenous manufacturing of electrolyte manufacturing machines

The MHI should direct the identification of critical battery-grade electrolyte manufacturing machines and equipment, and focus on establishing standards that can align with global benchmarks, by identifying technical specifications and certifications required for current and future-generation electrolyte materials. In deciding and framing technical specifications, the MHI could leverage the expertise of institutions like CSIR-CECRI and CSIR-NML in corrosion science, electrochemical systems, and pilot-scale technology development. Critical machines and equipment may include $LiPF_6$ synthesis reactor system (operating conditions, materials of construction), advanced distillators, dryers, PF_5 gas introduction system design, cryogenic refrigerators, etc.

Under the scheme, key initiatives like *Smart Advanced Manufacturing and Rapid Transformation Hub* (SAMARTH) UDYOG 4.0 can be a good platform to make manufacturers aware of specialised machines, techniques, and the battery market these can cater. UDYOG 4.0 also facilitates the setting up of Common Engineering Facility Centres (CEFCs), technology acceleration centres, and testing and certification centres.

One of the CEFCs responsible for accelerating indigenous technology development, testing, and industry collaboration is the Central Manufacturing Technology Institute (CMTI). The MHI should direct the CMTI to designate battery-grade electrolyte manufacturing equipment as a critical focus area. The CMTI can play an important role in the prototype development of the integrated electrolyte manufacturing system. The development process should involve all the potential individual manufacturers of the critical components in the electrolyte manufacturing system. The process can play an important role in testing and certifying equipment like Hastelloy reactor vessels, PTFE-lined components, and cryogenic jacket systems that electrolyte manufacturing equipment requires. Lastly, the CMTI should develop and implement upskilling programmes or courses that educate the workforce in critical and quintessential processes for electrolyte manufacturing like HF process safety and cryogenic chemical process engineering.

The MHI may develop a consortium that includes regional electrochemical societies and institutes like CSIR-CECRI, AMPRI, IITs, NITs, and industrialists—to understand existing R&D capabilities that can help in developing the ecosystem around the machines. India stands at a technologically weaker position in prominent areas of electrolyte manufacturing reactants like PCl_5 and AHF, lack of advanced distillation, and drying and packaging facilities for a 99.9 per cent purity level product. Upgrading the machinery is costly but necessary to begin the manufacturing process and generate trust in local and global markets. The industries should explore **the possibility of lease agreements** for acquiring the machines required for the advanced processes.

Our analysis maps the overlaps in the input materials, skills, and technical processes involved in the electrolyte industries to the existing industries in India and shows overlaps like vacuum distillation columns, dry room construction, fluoropolymer reactors, nitrogen blanketing systems, blending and metering systems, and packaging lines. Therefore, in the initial phase, we should work on how Indian **equipment engineering can help us upgrade our purification systems** and evaluate the investments required.

5.2 Invest in domestic testing infrastructure and introduce standardised testing norms

Given India's dependence on foreign entities for testing infrastructure, the country needs to invest in building state-of-the-art domestic testing infrastructure and in establishing validated methods to test electrolyte materials. At industrial level, the electrolytes and its materials manufacturers should allocate significant funds of their investments in establishing these testing facilities inhouse. The Department of Science and Technology (DST) Fund for Improvement of S&T Infrastructure (FIST) Level C provides funding up to USD 1.04 million (INR 10 crore) over a five-year period for acquiring state-of-the-art equipment and for setting up laboratories for internationally competitive research in well-established science and technology (S&T) departments at universities and research institutions.

Similarly, with FIST-SHAKTI, the amount is around USD 2.1 million (INR 20 crore). Academic institutions can utilise these funds to become shared testing facilities for industry. A local testing infrastructure can help Indian cell OEMs expedite adaptation of electrolyte materials. India can adapt to international testing methods in the short term but eventually, the country should tailor its testing standards to its own battery working conditions and OEM requirements.

The initial phase could focus on designing voluntary test methods. After thoroughly understanding the industrial requirements that would help create a shared yardstick of trust in the electrolyte supply chain, a common testing protocol for battery-grade electrolyte should be developed voluntarily by institutions like International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Centre for Materials and Electronics Technology (CMET), Indian Institutes of Technology (IITs), and National Physical Laboratory (NPL). These organisations can help in building a foundational testing protocol for battery-grade electrolyte. This should be done after thoroughly understanding the industrial requirements that will then help create a shared yardstick of trust in the electrolyte supply chain.

Over time, the frameworks can be institutionalised under the Bureau of Indian Standards (BIS). To ensure nationwide compliance, accredited laboratories could be built under the National Accreditation Board for Testing and Calibration Laboratories (NABL). The NABL is a signatory to the International Laboratory Accreditation Cooperation (ILAC) and Asia Pacific Accreditation Cooperation (APAC); therefore, mutual recognition arrangements (MRA) for testing and accreditation would remove the need to re-test abroad and make Indian test certificates acceptable to customers overseas.

5.3 Orientate JVs and international technology transfers for long-term benefits

Battery electrolytes are based on an already established chemical industry and technology licensing market where India has the chance to collaborate or co-develop. Therefore, we recommend that stakeholders at the industry level focus on co-developing partnerships in which laboratory facilities and research teams are shared and on-site personnel training that transfers the technological process knowhow is encouraged. In return, this will also promote co-ownership of the intellectual property (IP) of the process and not merely the licensor's IP. The agreements should be built with strong knowledge-sharing clauses that give Indian companies the right to own or co-own the improvements made during the process. The DPIIT can support the process by approving JVs quickly based on co-development.

> Electrolytes sit on an established chemical industry, which gives India room to co-develop rather than only license technologies.

5.4 Encourage R&D in next-generation electrolyte salts and manufacturing processes

Upgrading equipment and machinery, or acquiring them, can solve the materials purity problem. However, India should also work towards developing alternate recipes to make materials for electrolytes and focus on developing some critical and strategic electrolyte materials that can leverage current minerals and industrial and academic facilities and technical knowledge. In particular, India must focus on:

- leveraging the domestic fluorspar reserves to build battery-grade fluorspar (CaF_2) capacity, which would allow fluorspar to replace the hazardous anhydrous HF currently used to synthesise $LiPF_6$;
- developing commercially viable halogen-free catalysts used during EC production;
- solving the energy-intensive step in separating solvent azeotropes with reactants (ethanol and methanol);
- recycling battery materials and conducting research to attain battery purity grade materials; and
- conducting R&D to develop next-generation electrolyte salts and additives to cater to upcoming high-density and voltage batteries.

India is capable of manufacturing $LiPF_6$ and LiFSI to an extent. However, next-generation salt molecules like LiTFSI and LiDFOB will give the Indian electrolyte market an edge, and conducting R&D to develop next-generation electrolyte salts and additives will cater to upcoming high-density and -voltage batteries.

We propose that the MoCF and the DST take an action-oriented approach wherein research funds are channelled to institutes and organisations focused on real industrial problems. The MoC&F should help in identifying the fluorochemicals, petrochemicals, and specialty chemicals companies whose technical knowledge and the infrastructure could be leveraged for battery-grade products. The DST should recognise the industrial manufacturing problems relating to battery materials and, accordingly, roll out funding opportunities.

The chemistry and materials science departments at IITs and CSIR-NCL have active MOF research programmes. If the DST were to fund a dedicated programme to develop this MOF separation for DMC purification, India would have a cutting-edge solution to one of the hardest technical barriers in battery-grade DMC production. The IMpacting Research Innovation and Technology (IMPRINT-2) initiative by the DST and the Ministry of Education can help industry-academia collaborations in translating a lab scale technology to pilot-scale demonstrations.

5.5 Introduce direct fiscal support for manufacturing components in upstream segments

We suggest direct fiscal support targeted on all cell components domestic manufacturing that directly supports the localisation of electrolytes and their components. We propose that the MHI lead the rollout of incentivised cell components manufacturing scheme.

For all cell components manufacturers, the MHI can introduce a milestone-based capital subsidy that will cover a pre-decided share of the project cost. The subsidy will be disbursed against progressing milestones of commissioning, equipment installation, first battery-grade product , and commercialisation to side step the capital barrier and build strategic manufacturing capacity. Continued fiscal support from the government will benefit cell manufacturers, as they can focus on research into new electrolyte materials, because the battery supply chain will not be interrupted and delays and chemical degradation due to imports will be avoided.

Battery electrolytes is a chemicals sector: solvents, additives, and salts are regulated and produced under the remit of the MoCF. Therefore, we suggest that the MHI and MoCF collaborate closely so that the Department of Chemicals and Petrochemicals (DCPC) under the MoCF can play a critical, non-overlapping role: identify the list of industries whose current capabilities can be adapted to manufacture electrolyte and its components; and work towards setting up specialised quality standards for battery-grade electrolyte with the BIS.

5.6 Create assured demand for domestic electrolyte

India's electrolyte manufacturing capabilities are still developing—battery manufacturing gigafactories (ACC PLI and non–ACC PLI winners) depend on imported battery electrolytes. To ensure that the products are of certified quality and create demand in the market, we suggest that the **government introduce public off-take agreements and an Approved List of Battery Component Manufacturers** (ALBCM).

Two separate instruments currently apply to the sector, and they work differently. Under the ACC PLI scheme, administered by the MHI, beneficiaries must meet a phased domestic value addition (DVA) target, measured in aggregate across the cell and pack. Separately, viability gap funding for battery energy storage systems, administered by the Ministry of Power, carries a domestic content requirement (DCR) of 20 per cent for supported projects (MoP). Therefore, we recommend extending the scheme deeper into local cell components—specific usage in government BESS and grid storage tenders where the use of localised cell components in the project is preferred over others.

Along with demand creation, another instrument is needed to ensure the quality of electrolytes. When the sector matures and there are enough domestic suppliers, the MHI could consider introducing an Approved List of Battery Component Manufacturers (ALBCM) that includes components including electrolytes.

To reduce imports slowly, local sourcing of electrolyte should be mandated as a subsequent action in a phased manner.

The first phase should be voluntary sourcing targets where electrolyte manufacturers can be financially incentivised through direct fiscal support for manufacturing cell components.

The second phase can commence with a partial localisation norm where only a certain percentage of electrolyte used in cells can be imported when domestic manufacturing reaches a significant point.

The third phase can be established as a full localisation norm for the use of locally manufactured electrolyte which then should be able to cover 100 per cent of the total projected demand of the cell gigafactories.

We also recommend that the MHI collaborate with the MoP to form and maintain a transparent open online platform that contains the forward-looking electrolyte procurement plans of the gigafactories managed by ACC PLI's Project Management Agency (PMA). Parallel platforms like the power market's MERIT and the solar capacity tracking portals of the MNRE can set a precedent in creating a platform for the battery ecosystem. This can be a 'battery ecosystem dashboard' that tracks the upcoming battery demand forecast.

The MoP ensures BESS and grid storage procurement under government schemes aligns with localisation norms. This will help manufacturers of cell and other components to plan scale-up operations. A stable offtake system can also attract foreign technology licensors to partner with Indian firms, help cell and electrolyte manufacturers to have a real-time market signal, and enable them to function in a synchronised manner.

6. Conclusion

Achieving India's ambitious energy transition goals hinges on establishing a resilient, home-grown battery ecosystem. Domestic electrolyte manufacturing emerges as a strategic and crucial stepping stone that connects India's matured chemicals industry with the rising clean energy sector.

Indian companies like Neogen Ionics, Acutaas Chemical (formerly known as Ami Organics), and Anupam Rasayan have taken initiatives that utilise their existing capabilities and that have encouraged the concept of adaptation, repurpose, and reuse. Supported by a robust testing infrastructure, a synchronised growth-and-demand roadmap of electrolyte manufacturing facilities and upcoming gigafactories will not only avoid building overcapacities but also help to cater a customer-segmented market ensuring a high-quality, globally benchmarked product.

At this nascent stage, international collaboration is vital, however, India needs to make sure collaboration does not block innovation, and it needs to put concerted effort into R&D for upcoming tech. Building electrolyte manufacturing capability in India and encouraging electrolyte and cell manufacturers requires integrated investment for infrastructure, technology development, and policy support. Creating the whole backward integrated battery electrolyte system in India means building the upstream chemical infrastructure, synthesising home-grown electrolyte components, and becoming well-equipped with the advanced machinery and controlled environment required for electrolyte production lines. Therefore, India needs to plan a dual-track roadmap that balances the capability-building and technological development focussed on building for today and inventing for tomorrow.



Image: iStock

Precision dosing and filling under controlled conditions are among the specialized equipment and processes that battery-grade electrolyte manufacturing requires.

Acronyms

AAM	anode active material
ACC	advanced chemistry cell
AHF	anhydrous hydrogen fluoride
ALBCM	Approved List of Battery Component Manufacturers
AMPRI	Advanced Materials and Processes Research Institute
APAC	Asia Pacific Accreditation Cooperation
API	active pharmaceutical ingredient
ARCI	International Advanced Research Centre for Powder Metallurgy and New Materials
BESS	battery energy storage system
BIS	Bureau of Indian Standards
CAGR	compound annual growth rate
CAM	cathode active material
CATL	Contemporary Amperex Technology Co. Limited
CECRI	Central Electrochemical Research Institute
CEFC	Common Engineering Facility Centre
C-MET	Centre for Materials for Electronics Technology
CMTI	Central Manufacturing Technology Institute
CO_2	carbon dioxide
CSIR	Council of Scientific and Industrial Research
DCPC	Department of Chemicals and Petrochemicals
DCR	domestic content requirement
DEC	diethyl carbonate
DMC	dimethyl carbonate
DPIIT	Department for Promotion of Industry and Internal Trade
DST	Department of Science and Technology
DVA	domestic value addition
EC	ethylene carbonate
EIS	electrochemical impedance spectroscopy
EMC	ethyl methyl carbonate
ESS	energy storage system
EtO	ethylene oxide
ESW	electrochemical stability window
EV	electric vehicle
FEC	fluoroethylene carbonate
FIST	Fund for Improvement of S&T Infrastructure
GAC	General Administration of Customs
GDP	gross domestic product
GERD	gross expenditure on research and development
GFCL	Gujarat Fluorochemicals Limited
GWh	gigawatt-hour
HCl	hydrogen chloride
HDPE	high-density polyethylene
HF	hydrogen fluoride
HVAC	heating, ventilation and air conditioning
ICEA	India Cellular and Electronics Association

ICP-MS	inductively coupled plasma mass spectrometry
IEA	International Energy Agency
IEEFA	Institute for Energy Economics and Financial Analysis
IFC	International Finance Corporation
IIT	Indian Institute of Technology
ILAC	International Laboratory Accreditation Cooperation
IMARC	International Market Analysis Research and Consulting
IMPRINT	Impacting Research Innovation and Technology
INR	Indian rupee
IOCL	Indian Oil Corporation Limited
IPR	intellectual property rights
JV	joint venture
KFT	Karl Fischer titration
LFP	lithium iron phosphate
LiB	lithium-ion battery
$LiBF_4$	lithium tetrafluoroborate
LiBOB	lithium bis(oxalato)borate
LiCl	lithium chloride
LiDFOB	lithium difluoro(oxalato)borate
LiF	lithium fluoride
LiFSI	lithium bis(fluorosulfonyl)imide
$LiPF_6$	lithium hexafluorophosphate
LiTFSI	lithium bis(trifluoromethanesulfonyl)imide
Li_2CO_3	lithium carbonate
LoI	letter of intent
MERIT	Merit Order Despatch of Electricity for Rejuvenation of Income and Transparency
MHI	Ministry of Heavy Industries
MIL	Morita Investment Limited
MNRE	Ministry of New and Renewable Energy
MoC&F	Ministry of Chemicals and Fertilizers
MoE	Ministry of Education
MOF	metal organic framework
MOFCOM	Ministry of Commerce of the People's Republic of China
MoP	Ministry of Power
MoU	memorandum of understanding
MT	metric tonne
NABL	National Accreditation Board for Testing and Calibration Laboratories
$NaPF_6$	sodium hexafluorophosphate
NCL	National Chemical Laboratory
NIL	Neogen Ionics Limited
NIT	National Institute of Technology
NITI	National Institution for Transforming India
NMC	nickel manganese cobalt
NML	National Metallurgical Laboratory
NPL	National Physical Laboratory
OEM	original equipment manufacturer
PC	propylene carbonate
PCl_5	phosphorus pentachloride
PF_5	phosphorus pentafluoride

PLI	production linked incentive
PMA	Project Management Agency
POF_3	phosphoryl fluoride
PPA	power purchase agreement
PPAP	production part approval process
ppm	parts per million
PTFE	polytetrafluoroethylene
PVDF	polyvinylidene fluoride
R&D	research and development
RH	relative humidity
RIL	Reliance Industries Limited
SAMARTH	*Smart Advanced Manufacturing and Rapid Transformation Hub*
SEI	solid electrolyte interphase
S&T	science and technology
TPA	tonnes per annum
TWh	terawatt-hour
US	United States
USD	United States Dollar
VAT	value added tax
VC	vinylene carbonate
VGF	viability gap funding

References

Acutaas Chemicals Limited. 2025. *Annual Report 2024–25*. Surat, India: Acutaas Chemicals Limited. September 1, 2025.

Ami Organics. 2024. “Ami Organics to Set up Rs. 300 Crore Electrolytes Manufacturing Plant in Gujarat.” 26–29. https://www.indianchemicalnews.com/battery/ami-organics-to-set-up-rs-300-crore-electrolytes-manufacturing-plant-in-gujarat-20037.

Anupam Rasayan. 2025. “Anupam Rasayan Report 2024–2025.” Press release, June 12, 2025.

Aricò, Fabio. 2025. “Organic Carbonates as Green Media: From Laboratory Syntheses to Industrial Applications.” *Green Chemistry* 27 (June). https://doi.org/10.1039/d5gc00536a.

Arifiadi, Aninditya, Lennart Wichmann, Tobias Brake, Christian Lechtenfeld, Julius Buchmann, Feleke Demelash, Peng Yan, et al. 2025. “Evaluation of Alternative Lithium Salts for High-Voltage Lithium Ion Batteries: Higher Relevance of Plated Li Morphology Than the Amount of Electrode Crosstalk.” *Small* 21 (19): 2410762. https://doi.org/10.1002/smll.202410762.

Asahi Kasei Corporation. 2021. “Asahi Kasei Licenses Technology Package to Manufacture High-Purity Ethylene Carbonate and Dimethyl Carbonate Using CO_2 as Main Feedstock.” Press release, July 1, 2021. https://www.asahi-kasei.com/news/.

ASIACHEM Consulting. 2017. “Why Do Foreign Electrolyte Manufacturers Frequent Loss in China?” 27 July 2017. http://www.asiachem.org/en/libm_20170727.

Contemporary Amperex Technology Co., Limited (CATL). 2026. “Zero-Carbon Technology Powers ‘All-Domain Growth’: CATL Releases 2025 Annual Report.” https://www.catl.com/en/news/6773.html.

ChemAnalyst. 2026. “Lithium Hexafluorophosphate Prices, Trends, Chart, Index and News.” Accessed June 9, 2026. https://www.chemanalyst.com/Pricing-Data/Lithium-Hexafluorophosphate-1226.

Chemistry World. 2026. “Karl Fischer Titration for Moisture Analysis: Applications in Batteries, Fuels and Food.” *Chemistry World*, May 5, 2026. https://www.chemistryworld.com/.

Chen, Xiaoyan, Yaxin Cai, Yiwei Lan, Changshen Ye, Ting Qiu, and Jie Chen. 2026. “Transesterification of Dimethyl Carbonate and Ethanol to Ethyl Methyl Carbonate with Full Product Selectivity and High Rate Enabled by Functionalized Quaternary Ammonium Ionic Liquids.” Chemical Engineering Science. https://doi.org/[DOI].

Congressional Research Service. 2026. *The Strait of Hormuz: Security Developments and Impacts on Oil, Gas, and Other Commodities*. CRS Report R45281. Washington, DC: Congressional Research Service. https://crsreports.congress.gov/product/pdf/R/R45281.

Contemporary Amperex Technology Co., Limited (CATL). 2026. 2025 *Annual Report*. Ningde: CATL. https://www.catl.com/en/investor/annual-report/.

Dey, Monami, Sohan Nail, Nikhil Havele, Shreya Sikarawar, and Bindu Madhavi. 2026. “VISION 2047: India’s Roadmap for a Self-Reliant.”

Enchem Co., Ltd. 2026. Corporate Profile and Battery Electrolyte Updates. http://www.enchem.net/en/.

European Critical Mineral Mission. 2023. “European Critical Mineral Mission Report.” No. March.

Fan, Hao. 2025. “Understanding Lithium-Ion Battery Weight and Energy Density.” *Large Power*, September 17, 2025. https://www.large.net/news/.

Fortune Business Insights. 2026. “Battery Electrolyte Market Size, Share & Industry Analysis.” 1–9. https://www.fortunebusinessinsights.com/battery-electrolyte-market-103131.

GFCL EV Products Limited. 2026. “Battery Chemicals.” GFCL EV Corporate Overview. https://www.gfclev.com/products.html.

Global EV Outlook. 2025. “Global EV Outlook 2025: Expanding Sales in Diverse Markets.” International Energy Agency. https://www.iea.org/reports/global-ev-outlook-2025.

Global Trade Alert. 2025. “A Widening Net: A Short History of Chinese Export Controls on Critical Raw Materials and Their Usage.” Global Trade Alert. https://www.globaltradealert.org/blog.

Gujarat Fluorochemicals Limited. 2024. "GFCL EV Announces Commencement of $LiPF_6$ Project – Catering to Global EV/ESS Battery Supply Chain." Press release, February 7, 2024. https://www.gfl.co.in/press-releases.

Gujarat Fluorochemicals Limited. 2025. Integrated Annual Report 2024–25. Vadodara: Gujarat Fluorochemicals Limited. https://gfl.co.in/upload/pages/GFCL_2024-25%20AR_C2C_V6.pdf.

Gaogong Industry Research Institute, Lithium Battery Research Branch. 2021. "China's Electrolyte Market Resumed in 2020." 1 January 2021.

Guanyan Tianxia (Beijing) Information Consulting Co., Ltd. 2021. *Analysis Report of China's Consumer Lithium-Ion Battery Market in 2021: Research on Market Operation Situation and Development Orientation*. Beijing: Guanyan Tianxia (Beijing).

Huang, Zi-Xuan, Xin-Chun Zhang, Zhi-Yong Wang, Ruo-Yi Dong, Li-Xiang Rao, and Li-Qiang An. 2026. "How Does High Temperature and Humidity Exposure Affect Lithium-Ion Battery Failure under Impact Loadings: A Multi-Scale Study." *Composites Part B: Engineering* 325: 113999. https://doi.org/10.1016/j.compositesb.2026.113999.

Hughes, Iola. 2026. "Global Lithium Ion Battery Demand Rose 29% in 2025." 25–30.

IMARC Group. 2026. *India Ethylene Oxide Market Size, Share, Trends and Forecast by Derivatives, End Use, and Region, 2026–2034*. https://www.imarcgroup.com/india-ethylene-oxide-market.

IndexBox. 2025. *World - Lithium Electrolyte Salts ($LiPF_6$ Class) - Market Analysis, Forecast, Size, Trends and Insights*. https://www.indexbox.io/store/world-lithium-electrolyte-salts-lipf6-class-market-analysis-forecast-size-trends-and-insights/.

Institute for Energy Economics and Financial Analysis (IEEFA). 2026. Battery Supply Chain Security Analysis, May 29, 2026. Accessed June 9, 2026. https://ieefa.org/resources.

International Energy Agency. 2026. *Global EV Outlook 2026*. Paris: IEA. https://www.iea.org/reports/global-ev-outlook-2026.

International Finance Corporation (IFC). 2025. "50622 – GFCL EV: Environmental and Social Review Summary." Washington, DC: IFC. https://disclosures.ifc.org/project-detail/ESRS/50622/gfcl-ev.

International Institute for Sustainable Development (IISD). 2024. "Unlocking Supply Chains for Localizing Electric Vehicle Battery Production in India." IISD Report (November). https://www.iisd.org/publications/report/electric-vehicle-battery-production-india.

Jain, Abhishek, and Gunjan Jhunjhunwala. 2025. "Building a Green Economy for Viksit Bharat." November.

Kapoor, Kamna. 2026. "INDIA DATA: India Diversifies Methanol Supply as Sanctions Hit Iranian Imports." S&P *Global Commodity Insights*, February 23, 2026. https://www.spglobal.com/commodityinsights/en/market-insights.

Kerner, Manfred, et al. 2016. "Thermal Stability and Decomposition of Lithium Bis(fluorosulfonyl)imide (LiFSI) Salts." *RSC Advances* 6 (115): 114349–54. https://doi.org/10.1039/C6RA22253H.

Kirloskar Pneumatic Company Limited. 2026. "KCX Reciprocating Refrigeration Systems.". https://www.kirloskarpneumatic.com/solutions/air-conditioning-refrigeration/refrigeration-systems/industrial-refrigeration-packages/kcx-reciprocating-refrigeration-systems.

Knehr, Kevin W., Joseph J. Kubal, Paul A. Nelson, and Shabbir Ahmed. 2022. "Battery Performance and Cost Modeling for Electric-Drive Vehicles." Chemical Sciences and Engineering Division, Argonne National Laboratory. https://doi.org/10.2172/1897042.

Konda, Charith, and Dhruv Garg. 2026. "Securing India's Battery Supply Chain Is More Critical Than Ever." Institute for Energy Economics and Financial Analysis (IEEFA), May 29, 2026. Accessed June 9, 2026. https://ieefa.org/resources/securing-indias-battery-supply-chain-more-critical-ever.

LANXESS. 2021. "LANXESS Enters Battery Chemistry Business: Electrolyte Production for Lithium-Ion Batteries in Leverkusen, Germany." Press release. https://lanxess.com/en/Media/Press-Releases/2021/03/LANXESS-enters-battery-chemistry-business.

Lee, Jinhee, Ji-Yoon Jeong, Jaeyun Ha, Yong-Tae Kim, and Jinsub Choi. 2024. "Understanding Solid Electrolyte Interface Formation on Graphite and Silicon Anodes in Lithium-Ion Batteries: Exploring the Role of Fluoroethylene Carbonate." *Journal of Power Sources* 614: 235290. https://doi.org/10.1016/j.jpowsour.2024.235290.

Li, Ming-Ran, Ge-Ge Gu, Xiaokang Yan, Tian-Jun Yue, Wei-Min Ren, and Xiao-Bing Lu. 2024. "Jet Loop Reactor-Intensified CO_2 Utilization: An Efficient Strategy for the Synthesis of Ethylene Carbonate."

Lu, et al. 2022. *"Development of Lithium and Its Downstream Power Battery Industry Chain in China." Strategic Study of Chinese Academy of Engineering*. https://www.engineering.org.cn/sscae/EN/10.15302/J-SSCAE-2022.03.002.

Industrial & Engineering Chemistry Research 63 (10): 4257–64. https://doi.org/10.1021/acs.iecr.3c04229.

Manjong, Nelson Bunyui, Lorenzo Usai, Sina Orangi, Daniel Perez Clos, and Anders Hammer Strømman. 2024. "Exploring Raw Material Contributions to the Greenhouse Gas Emissions of Lithium-Ion Battery Production." Journal of Energy Storage. https://doi.org/10.1016/j.est.2024.114234.

Market Analysis Report. 2024. "Battery Electrolyte Market (2024–2030)." 1–9.

McKinsey & Company. 2026. "Battery 2035: Building the Future Battery Ecosystem." January. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights.

Ministry of Commerce of the People's Republic of China, and General Administration of Customs. 2025. "Announcement No. 58 of 2025: Decision to Implement Export Controls on Lithium-Ion Batteries (Including Cells and Packs), Artificial Graphite Anode Materials, and Related Production Equipment and Technology" [in Chinese]. October 9, 2025. https://www.mofcom.gov.cn/zwgk/zcfb/art/2025/art_79646f0161564975a938fe00fee158d5.html.

Ministry of Finance, Government of India. 2026. *Explanatory Notes to Budget 2026–27: Changes in Customs Duty (Department of Revenue, Tax Research Unit)*. New Delhi: Government of India. https://www.indiabudget.gov.in/.

Ministry of Heavy Industries. 2025. "PLI Scheme for National Programme on Advanced Chemistry Cell (ACC) Battery Storage: The Production Linked Incentive Scheme." *National Programme on Advanced Chemistry Cell (ACC) Battery Storage* 2: 2025–26. https://heavyindustries.gov.in/.

Ministry of New and Renewable Energy (MNRE). 2025. "India's Renewable Energy Capacity Achieves Historic Growth in FY 2024-25: Total Installed RE Capacity Reaches 220.10 GW." New Delhi: MNRE, 25–26. https://mnre.gov.in/.

Ministry of Industry and Information Technology of the People's Republic of China. 2015. *HG/T 4067-2015: Cell Liquor of Lithium Hexafluorophosphate*. Chemical industry standard, issued 14 July 2015, implemented 1 January 2016. https://www.codeofchina.com/standard/HGT4067-2015.html.

Mordor Intelligence. 2026. *Battery Electrolyte Market Size & Share Analysis - Growth Trends and Forecast (2026–2031)*. 1–17. https://www.mordorintelligence.com/industry-reports/battery-electrolyte-market.

MU Ionic Solutions. 2023. "Provision of Production Technology License in India for Electrolytes Used in Lithium-Ion Batteries." 30–32. https://www.muis.co.jp/english/.

Neogen Chemicals Limited. 2025. "Neogen Chemicals Limited Q2 FY26 Earnings Conference Call." Transcript, 2025. https://neogenchem.com/investor-relations/.

Neogen Chemicals Limited. 2026. *Investor Presentation*. Neogen Chemicals. https://neogenchem.com/investor-relations/.

NITI Aayog. 2021. Methanol: A Competitive Alternate Fuel. New Delhi: NITI Aayog. https://www.niti.gov.in/sites/default/files/2021-09/EconomicAnalysis-of-Methanol_020929021.pdf.

NITI Aayog. 2025. "Powering India's Participation in Global Value Chains." July. https://www.niti.gov.in/reports-and-publications.

Pall Corporation 2024. "Electrolyte Formulation Process." Technical paper, Pall Corporation, 1–3. https://www.pall.com/en/microelectronics/chemical-manufacturing.html.

Patsnap Eureka. 2026. "Report: Comparing Cost Impacts of Various Electrolyte Additives in Manufacturing." Accessed March 3, 2026. https://eureka.patsnap.com/.

Polycarpou, Andreas A. 2025. "Advances and Future Prospects of Low-Temperature Electrolytes for Lithium-Ion Batteries." *Energy & Environmental Science* 18: 385–426. https://doi.org/10.1039/d5eb00013k.

Press Trust of India. 2025. "India's Battery Manufacturing Capacity Projected to Reach 100 GWh by 2026: Experts." November 4, 2025. Accessed June 9, 2026. https://www.ptinews.com/.

Seok, Jin-hong, and Kyeounghak Kim. 2025. "Forming Additives for Lithium-Ion Batteries." *Journal of Materials Chemistry* A 13: 13976–87. https://doi.org/10.1039/d5ta00347d.

Senthil, Chenrayan, et al. 2025. "Functional Electrolyte Additives: A Pinch of Salt/Solvent to an Electrolyte for High Energy Density Lithium-Ion and Lithium-Metal Batteries." *Small* 21 (34): 2504276. https://doi.org/10.1002/smll.202504276.

Seo, Harim, et al. 2025. "A Comprehensive Review of Liquid Electrolytes for Silicon Anodes in Lithium-Ion Batteries." *Advances in Industrial and Engineering Chemistry*. https://doi.org/10.1016/j.aiec.2025.100123.

Shah, Aarav. 2026. "Acutaas Chemicals Bets Big on India's Chip and Battery Future." *Whalesbook News*, January 17, 2026.

Sharma, Nitya, and Sarthak Shah. 2025. "Decoding India's Battery R&D Ecosystem: The Commercialization Challenge." WRI India, September 24, 2025. https://wri-india.org/publications.

Sharma, Prabhakar, and Saif Jahangir. n.d. "Assessing India's Incentive Scheme to Enhance the Battery Manufacturing Ecosystem." JMK Research & Analytics and Institute for Energy Economics and Financial Analysis. https://jmkresearch.com/reports/.

Shinghwa Advanced Material Group Co., Ltd. 2025. Corporate Report and Product Catalog. http://www.shinghwa.com/.

Soulbrain Co., Ltd. n.d. "Secondary Battery Materials." Accessed August 12, 2026. https://www.soulbrain.co.kr/en/m23.php.

Susarla, Naresh, and Shabbir Ahmed. 2019. "Estimating Cost and Energy Demand in Producing Lithium Hexafluorophosphate ($LiPF_6$) for Li-Ion Battery Electrolyte." *Industrial & Engineering Chemistry Research* 58 (11): 4483–94. https://doi.org/10.1021/acs.iecr.8b03752.

Tinci Materials. 2022. *Tinci Materials Quarterly Report*. 14–15. http://www.tinci.com/en/.

UBE Corporation. 2025. "UBE Corporation Holds a Groundbreaking Ceremony for a DMC and EMC Plant in Louisiana, the United States." Press release. https://www.ube.com/ube/en/news/.

US Department of Energy (DST). 2024. "Tropical EV Battery." *Department of Science and Technology* 570 (1). https://dst.gov.in/.

US Department of Energy. n.d. *Office of Science (SC), Office of Critical Minerals and Energy Innovation (CMEI), Office of Environmental Management (EM), Office of Electricity (OE), Hydrocarbons and Geothermal Energy Office (HGEO), and Office of Nuclear Energy (NE) Overview*. https://www.energy.gov/offices.

Xing, Jiale, Stoyan Bliznakov, Leonard Bonville, Miodrag Oljaca, and Radenka Maric. 2022. "A Review of Nonaqueous Electrolytes, Binders, and Separators for Lithium-Ion Batteries." *Electrochemical Energy Reviews* 5: 23. https://doi.org/10.10007/s41918-022-00131-z.

Zhang, Wei, Jun Li, and Xia Chen. 2022. "Electrolyte Innovations for High-Energy Lithium-Ion Batteries." *Sustainable Materials and Technologies* 33: e00456. https://doi.org/10.1016/j.susmat.2022.e00456.

Zhou, Mu-Yang, Fang-Di Dong, Yue Yu, Xing-Yu Li, Wen-Yu Su, Zhi-Shuo Wang, Rui-Biao Lin, Dong-Dong Zhou, Jie-Peng Zhang, and Xiao-Ming Chen. 2026. "Breaking the Methanol/Dimethyl Carbonate Azeotrope Using a Metal–Organic Framework with Tetrahedral Potassium-Ion Cluster Gates." *Journal of the American Chemical Society* 148: 1024–32. https://doi.org/10.1021/jacs.2026.1024.

Authors



Varnika Prakash

varnika.prakash@ceew.in

Varnika Prakash

Dr Varnika Prakash is a Programme Associate at CEEW's Technology Futures team, working on battery cell component manufacturing and linking complementary Indian industries to it. She holds a PhD in graphene-based electrochemical sensing and carries around 4.5 years of industrial research including leading battery research at Log 9 Materials.



Akanksha Tyagi

akanksha.tyagi@ceew.in

Akanksha Tyagi

Dr Akanksha Tyagi is a Senior Programme Lead at CEEW, co-leading the Technology Futures team. With over nine years' experience, including seven at CEEW, she guides research on clean energy manufacturing, resilient supply chains, critical minerals and circular economy integration.



Council on Energy, Environment and Water (CEEW)

ISID Campus, 4 Vasant Kunj Institutional Area
New Delhi - 110070, India
T: +91 (0) 11 4073 3300

info@ceew.in | ceew.in | @CEEWIndia | ceewindia

Scan to download the study