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CHALLENGE TITLE
L1: Development and Pilot-Scale Scaling of Cathodic and Anodic Materials for Lithium-Ion Batteries, including Prototyping, Electrochemical Validation, and Pre-certification under Real Operating Conditions.
MACRO-AREA
Lithium - Materials
PROBLEM/GAP
In Chile, there is a significant gap in the development of value-added materials for lithium-ion batteries, despite its strategic position as one of the world's leading lithium producers. This gap is manifested in the limited capacity for applied research, industrial scaling, and technology transfer aimed at manufacturing advanced cathodic and anodic materials, which reduces the country's participation in higher-value stages of the global chain. Insufficient infrastructure for prototyping, electrochemical validation under real conditions, and pre-certification processes hinders the articulation between academia, industry, and technology centers, delaying the consolidation of local capabilities to develop competitive solutions at pilot and industrial scale.
CHALLENGE DESCRIPTION
The challenge consists of developing and scaling at pilot level cathodic and/or anodic materials for lithium-ion batteries, advancing from research to functional prototyping and electrochemical validation under real operating conditions. This implies strengthening technological capabilities to produce high-performance materials, optimizing manufacturing processes, and ensuring quality through pre-certification stages. It also seeks to reduce the existing gap between scientific knowledge and its industrial application, promoting value generation in the lithium chain and positioning Chile as a relevant player in the development of energy storage technologies.
GENERAL OBJECTIVE
To develop and scale at pilot level advanced cathodic and/or anodic materials for lithium-ion batteries, integrating prototyping, electrochemical validation, and pre-certification processes under real operating conditions, to generate local technological capabilities and increase the added value of the lithium industry in Chile.

SPECIFIC OBJECTIVES	
1.	Design and optimize scalable synthesis processes (coprecipitation, sol-gel, hydrothermal, calcination, coatings) for cathodic and anodic materials capable of producing homogeneous batches between 100 g and 1 kg.
2.	Manufacture electrodes and cell prototypes (coin, pouch, preliminary commercial) using reproducible mixing, coating, drying, and assembly methodologies.
3.	Establish protocols for structural, chemical, morphological, and electrochemical characterization (cycling, coulombic efficiency, degradation, EIS, post-mortem).
4.	Implement quality assurance and pre-certification routes, aligned with international standards (ASTM, IEC, UL), and define batch-to-batch reproducibility criteria.

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5.	Develop and execute validation pilots under real operating conditions (altitude, temperature, accelerated cycles), in conjunction with industrial partners.
6.	Develop specialized training programs, engineering guides, cost models, and transferable technology packages.

EXPECTED RESULTS

1. Validated scalable synthesis processes for cathodic and anodic materials (≥100 g per batch).
2. Electrodes manufactured with homogeneous quality and functional prototypes in coin-cell and commercial designs (pouch-cell or cylindrical).
3. Standardized testing protocols (cycling, aging, EIS, DSC/TGA, SEM/XRD).
4. Curated dataset of comparative electrochemical performance vs. commercial standards.
5. Pre-certification routes aligned with ASTM/IEC for materials and cells.
6. Demonstrative pilots at TRL 6–7 with validated performance under local conditions.
7. Scaling guides, operation manuals, and recommendations for pre-commercial production.
8. Identification of national infrastructure gaps for a future manufacturing line.

SCOPE

Includes:

- Scalable synthesis of cathodes/anodes (100 g – 1 kg).
- Thermal treatment, mixing, coating, and controlled drying.
- Manufacturing of electrodes and prototype cells.
- Complete electrochemical validation and post-mortem analysis.
- Pilots in relevant and semi-industrial environments.
- Quality, traceability (Battery Passport), and pre-certification routes.
- Technical training and technology transfer.

Excludes:

- Proofs of concept and/or laboratory-scale tests.
- Technologies with TRL equal to 9.
- Industrial manufacturing of cells or packs (>TRL 7).
- Mass production of materials for commercialization.
- Activities that pose risks to operations or workers.
- Installation of permanent industrial plants.

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KEY PERFORMANCE INDICATORS (KPIs)	
1.	Reproducible production of pilot material batches.
2.	Technological progress (Number of technologies advancing ≥1–2 TRL).
3.	Electrochemical performance vs. commercial baseline (% capacity, cycles, efficiency, degradation).
4.	Batch-to-batch reproducibility rate and thermal stability (% variation).
5.	Number of formalized synthesis, testing, and quality assurance protocols.
6.	Number of cell prototypes manufactured and validated (coin/pouch).

DESIRABLE CONTRIBUTION TO ITL CAPACITY BUILDING

- Scalable synthesis protocols for cathodes/anodes available to industry.
- Reusable quality and pre-certification routes.
- Pilot infrastructure enabled for scaling and prototyping.
- Specialized human capital in synthesis, electrochemistry, and battery quality.
- Performance data repositories for materials developed in Chile.
- Alliances with international organizations, R&D centers, and CELs.

INDUSTRY AFFECTED BY THE CHALLENGE

Battery industry seeking technical independence in the development of battery materials. Different countries seek to develop In-House batteries to maintain process control