

COMMERCIAL VIABILITY

The commercial viability of this research was assessed through a systematic integration of market studies, stakeholder engagement, and potential industry partnerships. This ensured that the proposed lithium ore processing technologies were not only technically feasible but also economically attractive and strategically aligned with industry needs.

Market Studies

A comprehensive market study was conducted to determine the demand for battery-grade lithium Ion and lithium Iron Phosphate battery, with a specific focus on their application in **storage batteries** for renewable energy systems. The study included:

- i. **Global and Regional Market Analysis** – Global demand trends, price forecasts, and regional supply chains were reviewed to identify opportunities for Nigeria in the lithium value chain.
- ii. **Competitiveness Assessment** – Nigeria’s lithium reserves, beneficiation potential, and production costs were benchmarked against established lithium-producing nations such as Australia, Chile, and China.
- iii. **Policy and Investment Climate** – Government incentives, export policies, and infrastructure readiness for industrial-scale production were evaluated.

Stakeholder Engagement and Partnerships

To strengthen the business case, stakeholder consultations were carried out with battery manufacturers, renewable energy companies, local battery assembly plants, and policymakers. Where possible, **letters of intent (LOIs)** or **memoranda of understanding (MOUs)** were obtained, expressing potential interest in purchasing battery-grade lithium products. Furthermore, efforts were made to secure **off-taker agreements**, which served as concrete evidence of potential revenue streams and reduced the financial risks associated with market entry.

Economic and Industrial Alignment

This approach ensured that the proposed processing technology supported Nigeria’s broader industrialization goals by promoting local beneficiation, creating employment opportunities, and reducing reliance on imported lithium materials. Aligning the technical outcomes with real market needs increased the likelihood of attracting investors and policy support for pilot plant development and eventual commercial deployment.

SCALABILITY

Scalability of the proposed lithium ore processing technology was addressed by outlining a clear pathway from laboratory and pilot-scale operations to commercial production. Following the successful pilot experiments, the process parameters—such as optimal grind size, roasting temperature, leaching time, and reagent consumption—were standardized and validated for reproducibility. These data provide the foundation for process simulation and scale-up modeling using software such as Aspen Plus or HSC Chemistry.

The next step involves construction and operation of a **demonstration-scale facility** capable of processing **1-10 tonnes of ore per day**, serving as an intermediate step between pilot tests and full commercial production. This stage will be used to confirm process economics, energy requirements, product purity, and environmental performance under near-industrial conditions. Energy consumption, emissions, and effluent data collected during this stage will be used to refine life cycle assessment (LCA) and techno-economic models.

Upon successful demonstration, scale-up will proceed to **modular plant design**, enabling phased expansion to meet growing demand for battery-grade lithium carbonate and hydroxide. This modular approach minimizes upfront capital expenditure (CAPEX) and allows for incremental capacity addition as market demand evolves.

In parallel, partnerships with equipment suppliers and battery industry stakeholders will be pursued to secure offtake agreements, investment commitments, and supply chain integration. Compliance with ISO 9001 (quality management), ISO 14001 (environmental management), and ISO 50001 (energy management) will be ensured at each stage to align with global best practices.

This structured approach to scale-up ensures that the project transitions efficiently from research to commercial deployment while minimizing technical, financial, and operational risks.