Sustainable Supply Chains with LCA

Case Study for Winter Project 2025

Sustainibilty Cell,
IIT Bombay

Presented by:
Arth Shivhare
24B2404

Selected Company:
Tesla

Industry: Electric Vehicle Automation

Raw Material: Lithium, Cobalt.

Industry Context	Selected Raw Materials	Product Value Chain Overview
• **Electric vehicles as a sustainability solution:** EVs eliminate tailpipe emissions, but their sustainability depends heavily on upstream supply chains. • **Material-intensive battery technology:** Lithium-ion batteries require energy intensive and globally dispersed raw materials. • **Need for life-cycle perspective:** True sustainability can only be assessed by analysing the entire value chain, not just vehicle use.	• **Lithium (battery cathode material):** Drives energy storage capacity and has a high water and energy footprint. • **Cobalt (battery stabiliser):** Improves safety and longevity but is associated with severe social and governance risks. • **Reason for selection:** These materials dominate the environmental and social impacts of EV batteries.	• **Raw material extraction:** Mining of lithium and cobalt from geographically concentrated regions. • **Processing and manufacturing:** Energy-intensive refining and battery cell production. • **Use and its life end:** Emissions depend on electricity mix and recycling determines long-term sustainability.

LCA Methodology & System Boundary

Method used: Life Cycle Assessment (LCA)
Identifies environmental and social impacts across product life stages.

System boundary: Cradle-to-grave
Includes extraction, processing, transport, use, and end-of-life.

Approach adopted
Qualitative hotspot analysis focusing on major impact drivers.

Raw Materials: Lithium

Extraction Impacts

- Major sourcing regions: Brine extraction in South America and hard-rock mining in Australia.
- Water consumption: Brine extraction requires large volumes of water in arid regions.
- Local impacts: Groundwater depletion and conflicts with local communities.

Processing, Transport & End-of-life

- Energy-intensive refining: Processing largely occurs in China using carbon-heavy electricity.
- Long transport routes: Global shipping significantly adds to emissions.
- End-of-life challenges: Recycling is technically possible but currently inefficient and costly.

Raw Materials: Cobalt

Extraction & Social Risks

- **Geographic concentration:** Around 70% of cobalt is mined in the Democratic Republic of Congo.
- **Labour concerns:** Artisanal mining is linked to child labour and unsafe conditions.
- **ESG significance:** Cobalt represents the highest reputational risk material in EV batteries.

Processing, Use & End-of-life

- Processing dominance: Refining is concentrated in China with limited transparency.
- Role in battery use: Enhances thermal stability and reduces fire risk.
- Recycling potential: High economic value encourages recovery, but informal recycling poses risks.

LCA Hotspot Summary

Extraction stage
Dominates water use, land degradation, and labour risks.

Processing stage
Major contributor to carbon emissions.

End-of-life stage
Critical opportunity for circularity but currently underdeveloped.

Concluding LCA

- Upstream impacts dominate: Most environmental and social impacts occur before vehicle use.
- Common misconception challenged: EVs are not automatically sustainable without responsible sourcing.

Supplier Sustainibility Columns

EVALUATION (COBALT)	EVALUATION CRITERIA	SCORECARD
Material evaluated Cobalt, due to high ESG and LCA risk.	Environmental performance Carbon and energy footprint of operations.	Artisanal DRC suppliers is 38/100 High social risk and low transparency.
Key supplier regions DRC (extraction), China (refining), Australia (industrial mining).	Social and governance factors Labour practices, certifications, and regulatory compliance.	Certified industrial DRC suppliers is 65/100 Improved controls but regional risks remain.
Purpose of evaluation To translate LCA insights into sourcing decisions.	Traceability and transparency Ability to track material origin and practices.	Australian industrial suppliers is 82/100. Strong labour standards and traceability.

Selected Supplier & Justification

- Preferred supplier: Australian industrial cobalt producer.
- Key justification: Lower ESG risk and better alignment with sustainability goals.
- Trade-off acknowledged: Higher cost accepted to reduce long-term reputational and supply risks.

Solutions

Proposed Procurement Strategy	Circular Economy Strategy	Vision 2030 Sustainability Outlook
Supplier diversification Reduce dependency on high-risk regions.	Design for recovery Modular batteries and easy disassembly.	Material circularity At least 50% recycled battery materials.
Ethical sourcing Prioritise certified and audited suppliers.	Product life extension Second-life applications for used batteries.	Responsible sourcing Zero cobalt from artisanal mining.
Material innovation Support battery chemistries with lower cobalt content.	Closed-loop recycling Recover critical materials to reduce virgin extraction.	Supply-chain transparency Full traceability across battery materials.

Conclusion

- LCA reveals hidden impacts because pstream stages dominate sustainability outcomes.
- Supplier decisions matter as responsible sourcing directly reduces ESG risks.
- Circular strategies are essential: Long term sustainability depends on closing material loops.

THANK YOU :)