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26-05-2024

Team 4

The problem

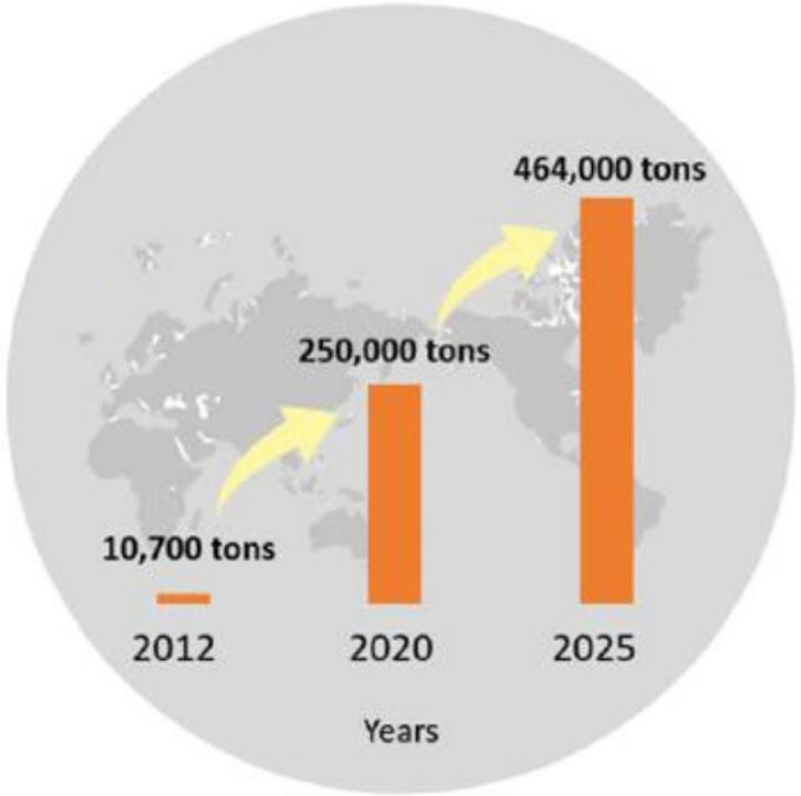
Small electronic devices (>80%)

Life time
2-3 years

Large electronic devices (>80%)

Life time
5-10 years

Global LIB waste



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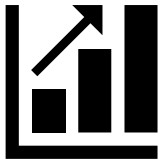
The problem



Growing **demand and production** of Li-ion batteries

Lithium mining is **water consuming**, generates **soil pollutions**, ecosystem **disruption** and **precarious** working condition

Metals that are used in batteries (Li, Co, Ni) are **finite** resources

Current recycling methods are **expensive, energy-consuming** and **not environmentally friendly**

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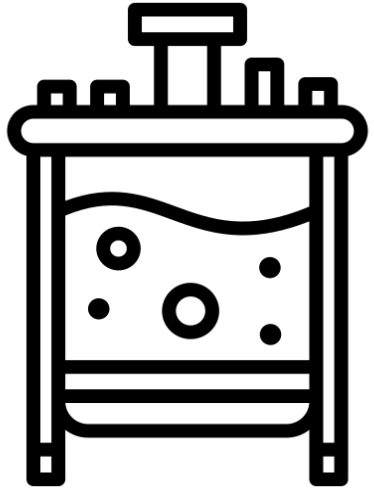
Our idea

Consortion of bacteria

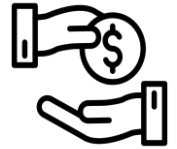
- *Acidithiobacillus thiooxidans*
- *Leptospirillum ferriphilum*
- *Acidithiobacillus ferrooxidans*

Lithium oxides

Lower environmental impact



Bioleaching



Recylced lithium

Final product:
Lithium carbonate

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Our process

76.5 kg

Lithium battery waste

SEPARATION

CATHODE

Milling

1.35 kg

Li, Co, Ni, Mn oxides

MICROORGANISM PREPARATION

Microorganism consortia, additional substrates

Bioleaching

ph 1

32°C

Metal ions

Precipitation

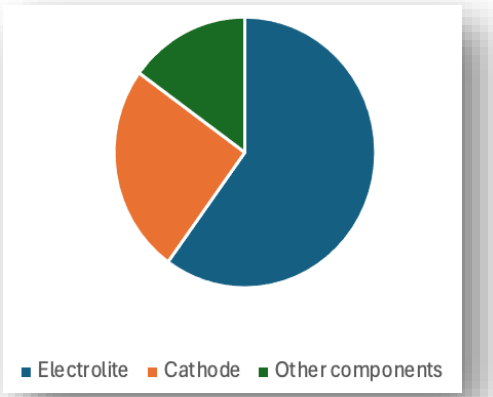
Lithium carbonate; Ni, Co, Mn sulphates

Electrolytes

3.24 kg

Lithium salts

Li_OUT = 4 kg



Li_cathode	2%
Li_salts	4%
Co_cathode	3.75%

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Scaling up risk assessment

Risk Type	Potential Issues	Likelihood	Impact	Mitigation Strategies
Equipment Failure	Bioreactor or pump failure	Medium	High	Regular maintenance, quality equipment, backup systems
Scale-Up Challenges	Inconsistent performance, inefficient mixing	High	High	Extensive pilot testing, scalable designs, optimized strains
Microbial Contamination	Contamination by unwanted microorganisms	Medium	High	Sterile conditions, monitoring, resistant strains
Nutrient Supply	Inadequate/imbalanced nutrient supply	Medium	Medium	Robust supply system, monitoring, adjust formulations
Chemical Imbalance	Imbalance in pH, redox potential	Medium	High	Real-time monitoring, automated control systems
Process Control	Inadequate control leading to suboptimal performance	Low	High	Advanced control systems, real-time monitoring, feedback loops
Operational Safety	Safety hazards in handling chemicals/equipment	Low	High	Strict safety protocols, training, PPE

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SWOT analysis

- Environmentally friendly
- Low energy costs
- Rapidly growing market

- Lack of commercial-scale implementations
- Significant scale-up risks

- Pioneering the technology
- Attractive to investors
- Compliant with SDGs
- Safe from regulation changes

- Established competition from existing recycling methods

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Economic feasibility

CAPEX

- Bioreactors
- Sensors and measurements
- Cooling and aeration
- S/L extraction and precipitation

OPEX

- Maintenance and monitoring
- Optimization of the process
  - Temperature regulation
  - pH regulation (acid + water)
- Labor work
- Logistics of battery waste
- Cost of battery waste

CAPEX	11981.7	€ /annual tons
OPEX	10% CAPEX	€/y
Li_cost	43.24	€/kg
TOT CAPEX	47.9	€
TOT OPEX	4,8	€/y
Revenue	172.8	€/batch

For a single reactor: **Economically feasible!**

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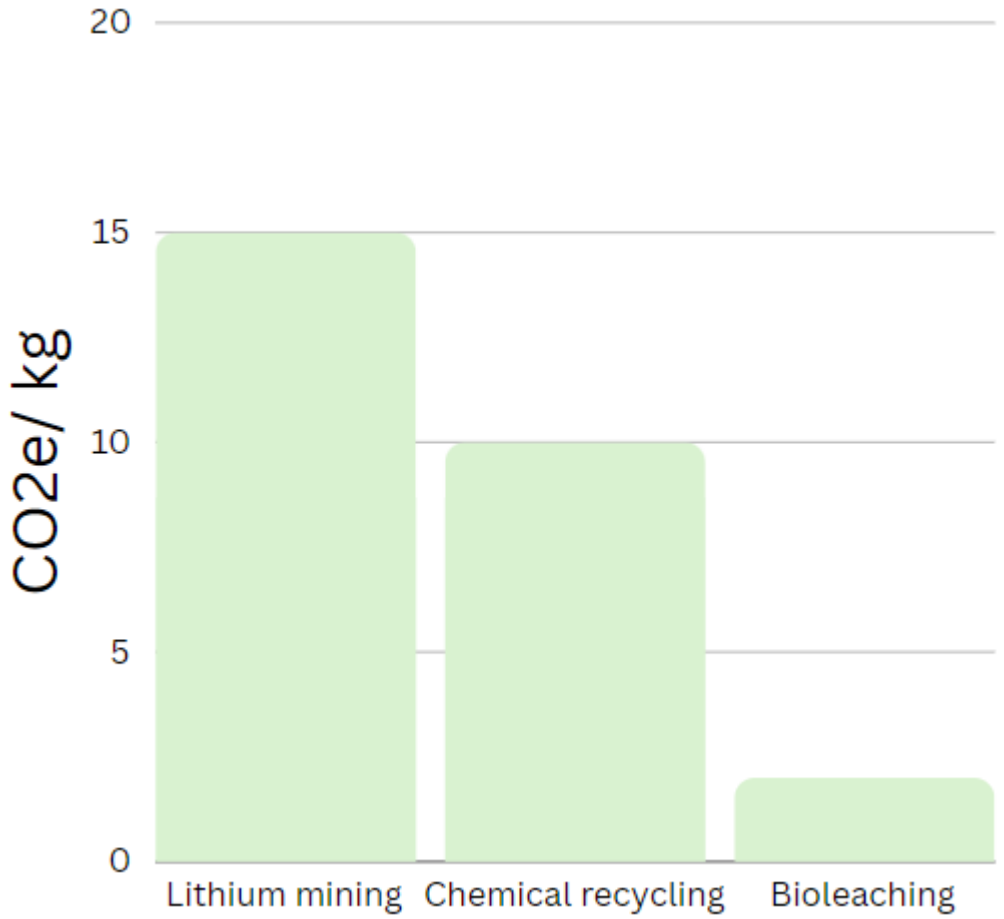
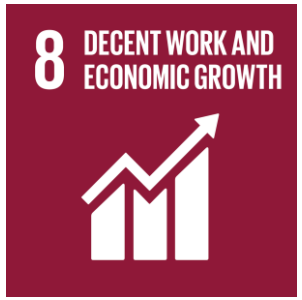
Sustainability





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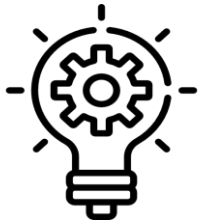
Conclusion



Innovative

Sustainable

Profitable

Get ready to invest with BACT-TERY:
A **green** and **profitable** used **battery recyling**

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Meet the BACT-TERY team

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Igor Sikorsky Kyiv Polytechnic Institute

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Thank you for your attention!

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Appendix: Assumptions

PROCESS DESIGN		
Li recovery for bioleaching	80%	
Leaching Time	6	days
Bioreactor size	0,5	m3
Culture Volume	0,3	m3
Bacteria	10%	
Li-mixture	90%	
Li IN	0,27	m3
Li OUT	0,216	m3
Li_precipitation	0,648	m3
Precipitation efficiency	90%	
Li_tot	0,7992	m3
density LiCoO2	5	kg/m3
Li_tot kg	3,996	kg
Li IN Cathode	1,35	kg
Li IN salts	3,24	kg

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Appendix: Scaling up risk assessment

Risk Type	Potential Issues	Likelihood	Impact	Mitigation Strategies
Equipment Failure	Bioreactor, pump, or critical equipment failure	Medium	High	Regular maintenance, quality equipment, backup systems
Scale-Up Challenges	Inconsistent performance, inefficient mixing	High	High	Extensive pilot testing, scalable designs, optimized strains
Microbial Contamination	Contamination by unwanted microorganisms	Medium	High	Sterile conditions, monitoring, resistant strains
Nutrient Supply	Inadequate/imbalanced nutrient supply	Medium	Medium	Robust supply system, monitoring, adjust formulations
Chemical Imbalance	Imbalance in pH, redox potential, etc.	Medium	High	Real-time monitoring, automated control systems
Leaching Kinetics	Variable leaching rates	Medium	Medium	Thorough feed material characterization, adjust parameters
Process Control	Inadequate control leading to suboptimal performance	Medium	High	Advanced control systems, real-time monitoring, feedback loops
Operational Safety	Safety hazards in handling chemicals/equipment	Medium	High	Strict safety protocols, training, PPE
Waste Management	Handling/disposal of residual waste	Medium	Medium	Efficient waste management plan, recycling, regulatory compliance
Supply Chain Reliability	Disruptions in supply of raw materials/inputs	Medium	Medium	Reliable supply chains, sufficient inventory, alternative suppliers
Economic Viability	Fluctuations in market prices and costs	High	High	Economic analysis, diversify revenue, long-term contracts