



# BACT-TERY

26-05-2024

Team 4

# The problem

## Global LIB waste

Small electronic devices (>80%)



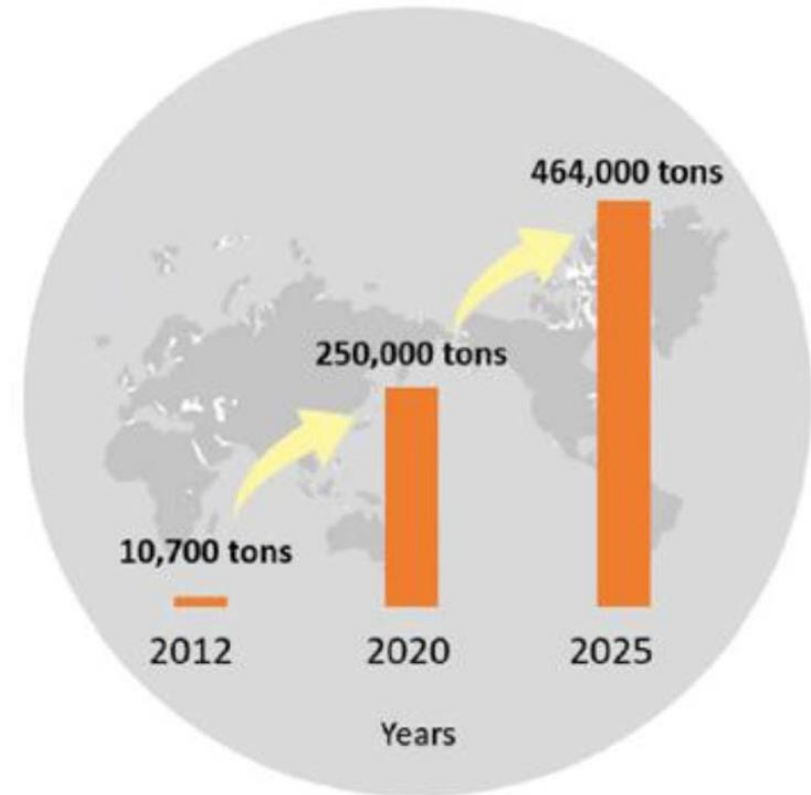
Life time  
2-3 years



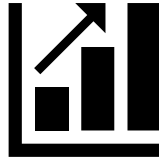
Large electronic devices (>80%)



Life time  
5-10 years



# 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**

# Our idea

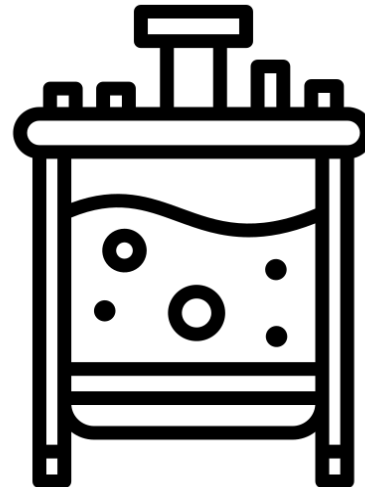


## Consortion of bacteria

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

Lithium oxides

Lower environmental impact



Bioleaching

Recycled lithium



Final product:  
Lithium carbonate



**BACT-TERY**

# Our process



76.5 kg

**Lithium battery waste**

SEPARATION

CATHODE

Milling

1.35 kg  
Li, Co, Ni, Mn oxides

**Bioleaching**

ph 1      32°C

Metal ions

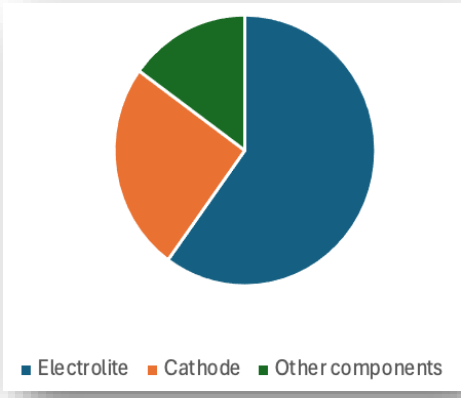
Precipitation

Electrolytes

3.24 kg  
Lithium salts

Lithium carbonate; Ni, Co, Mn sulphates

Li\_OUT = 4 kg



Li_cathode	2%
Li_salts	4%
Co_cathode	3.75%

MICROORGANISM PREPARATION

Microorganism consortia, additional substrates



# 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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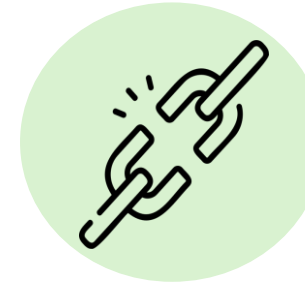


# SWOT analysis



- Environmentally friendly
- Low energy costs
- Rapidly growing market

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



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

- Established competition from existing recycling methods



# Economic feasibility

## CAPEX

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

## OPEX

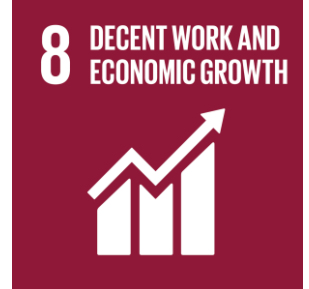
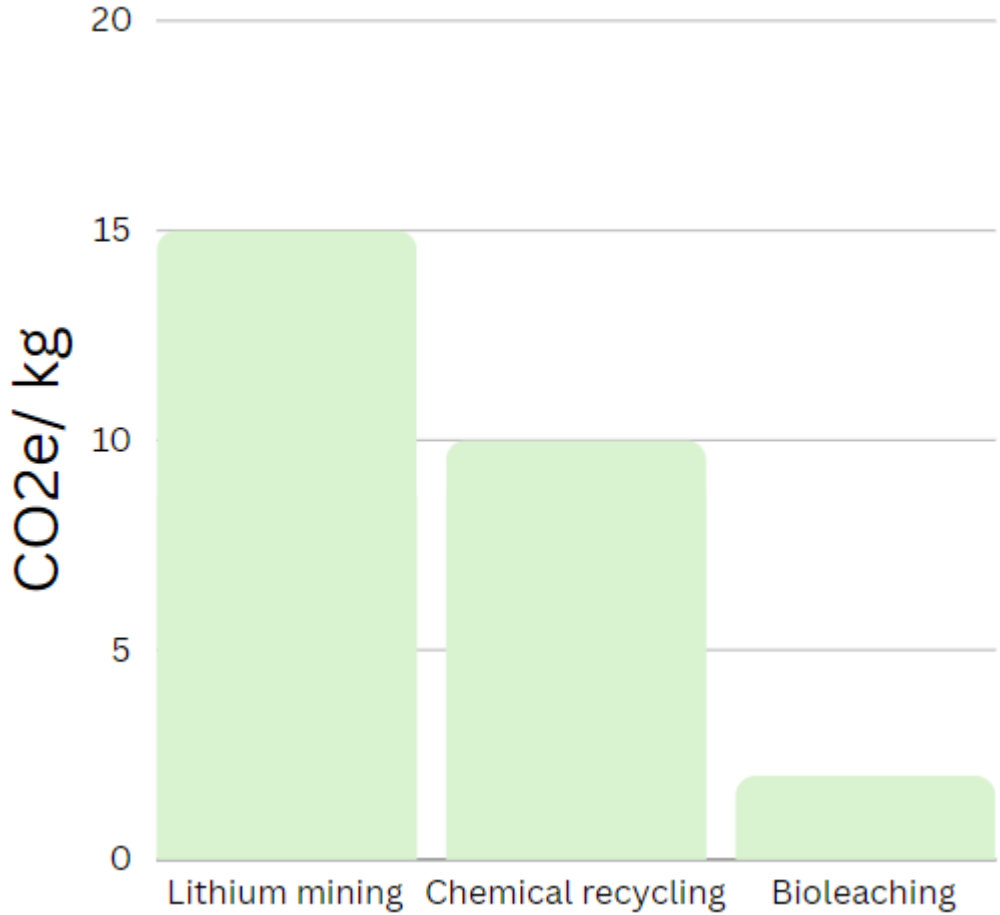
- Maintenance and monitoring
- Optimization of the process
  - Temperature regulation
  - pH regulation (acid + water)
- Labor work
- Logistics of battery waste
- Cost of battery waste

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!**



# Sustainability



# Conclusion



Innovative



Sustainable



Profitable

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

# Meet the BACT-TERY team



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Igor Sikorsky Kyiv Polytechnic Institute



**Thank you for your attention!**



**BACT-TERY**

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# Appendix: Assumptions

<b>PROCESS DESIGN</b>		
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

# 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	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
Scale-Up Challenges	Inconsistent performance, inefficient mixing	High	High	Extensive pilot testing, scalable designs, optimized strains	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
Microbial Contamination	Contamination by unwanted microorganisms	Medium	High	Sterile conditions, monitoring, resistant strains	Supply Chain Reliability	Disruptions in supply of raw materials/inputs	Medium	Medium	Reliable supply chains, sufficient inventory, alternative suppliers
Nutrient Supply	Inadequate/imbalanced nutrient supply	Medium	Medium	Robust supply system, monitoring, adjust formulations	Economic Viability	Fluctuations in market prices and costs	High	High	Economic analysis, diversify revenue, long-term contracts
Chemical Imbalance	Imbalance in pH, redox potential, etc.	Medium	High	Real-time monitoring, automated control systems					