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sustainablemining 2023

8th International Congress on Environment and Social Responsibility in Mining

INTEGRATED RESEARCH ON THE LITHIUM CHAIN VALUE

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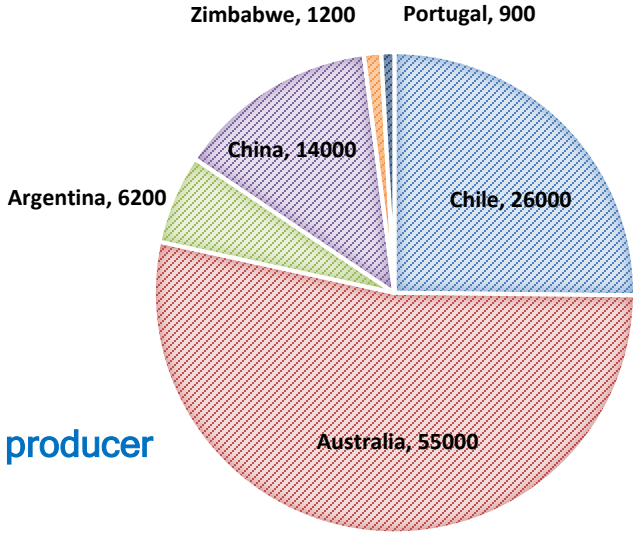
Introduction

Mine Production, 2021, m^3 (USGS)



6th world mine producer

Sources: LNEG (National Laboratory for Energy and Geology) and USGS

18th largest in the world

Actual Resources 2021 Mt Li	
Bolivia	21.0
Argentina	19.3
Chile	9.6
United States	7.9
Australia	6.4
China	5.1
Congo (Kinshasa)	3.0
Canada	2.9
Germany	**2.7**
Mexico	1.7
Czechia	**1.3**
Serbia	**1.2**
Peru	0.88
Mali	0.70
Zimbabwe	0.50
Brazil	0.47
Spain	0.30
Portugal	**0.27**
World total	85.8

Projects in EC and Europe

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Project	Country	Company	Ressources of Lithium (tonnes)	Expected annual production (LCE)
Cinovec	Czech Republic	European Metals	1.467.029	22
Keliber	Finland	Keliber Oy	114.252	10
Wolfsberg	Austria	European Lithium	5.104	9
Zinnwald	Germany	Deutsche Lithium	14.224	7
Upper Rhine Valley	Germany	Vulcan Energy Resources	315.969	15
Mina do Barroso	Portugal	Savanah Resources	132.916	26
Romano	Portugal	Lusorecursos	89.81	NA
Argemela	Portugal	Pann	44.905	NA
Retamar	Spain	Lithium Iberia	265.966	NA
Total EU			**2.450.175**	**89**
Jadar	*Serbia*		*51.162*	*58*
Valjevo	*Serbia*	*Eurolithium*	*2.977.644*	*20*

SOURCE: ***Gerardo HERRERA. European Commission. Directorate-General for Internal Market, Industry, Entrepreneurship and SME's (DG GROW)***

CAVALI PROJECT

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Guidelines, constrictions

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1. No mining without metallurgy
2. Metallurgical Alkaline Process
3. Metallurgical Plant processing different minerals
4. Maximization of the recovery of National Resources
5. Minimization of wastes
6. Life Cycle Assessment

CAVALI PROJECT

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- Development of the AI - LIBS Technology
- Ore Processing without generating tailings and using *green* reactants
- Metallurgy treating simultaneously spodumene and lepidolite
- Simulation, pre-dimensioning, CapEx and Opex
- Development of FEB Cells and a battery module for FEB cells
- Control System for *FEB* batteries
- Integrated Life Cycle Assessment for Extraction, Processing and Metallurgy

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Activity 3 – Mining & Ore Processing

- Development of processing flowsheets at the pilot scale allowing for an **integral recovery of all the minerals that exist in the ore** (micas, quartz, feldspar and, eventually, metallic minerals), thus driving **a process that does not generate solid wastes (tailings)**.
- Utilization of **green reactants** for flotation.
- This way, it becomes possible to attain the two main objectives assigned in the guiding principles of sustainable management of mineral resources: **integral recovery** and **absence of wastes**.

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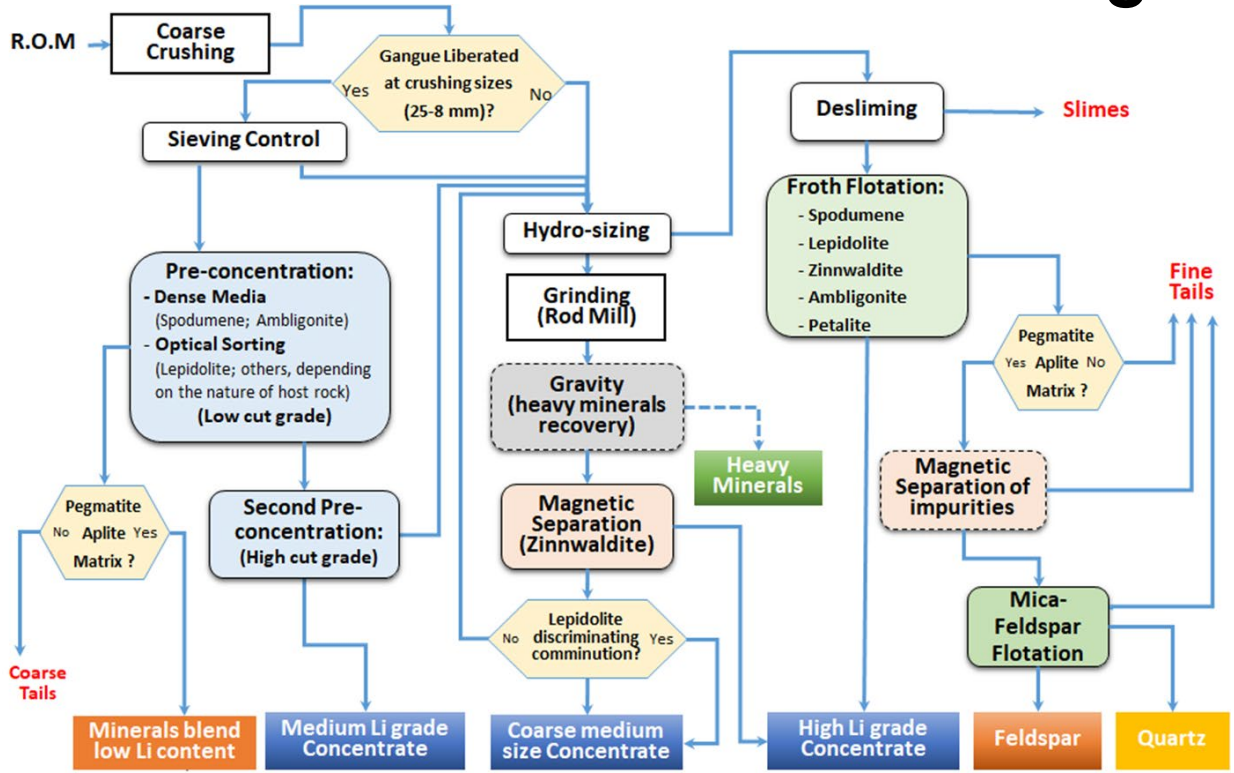
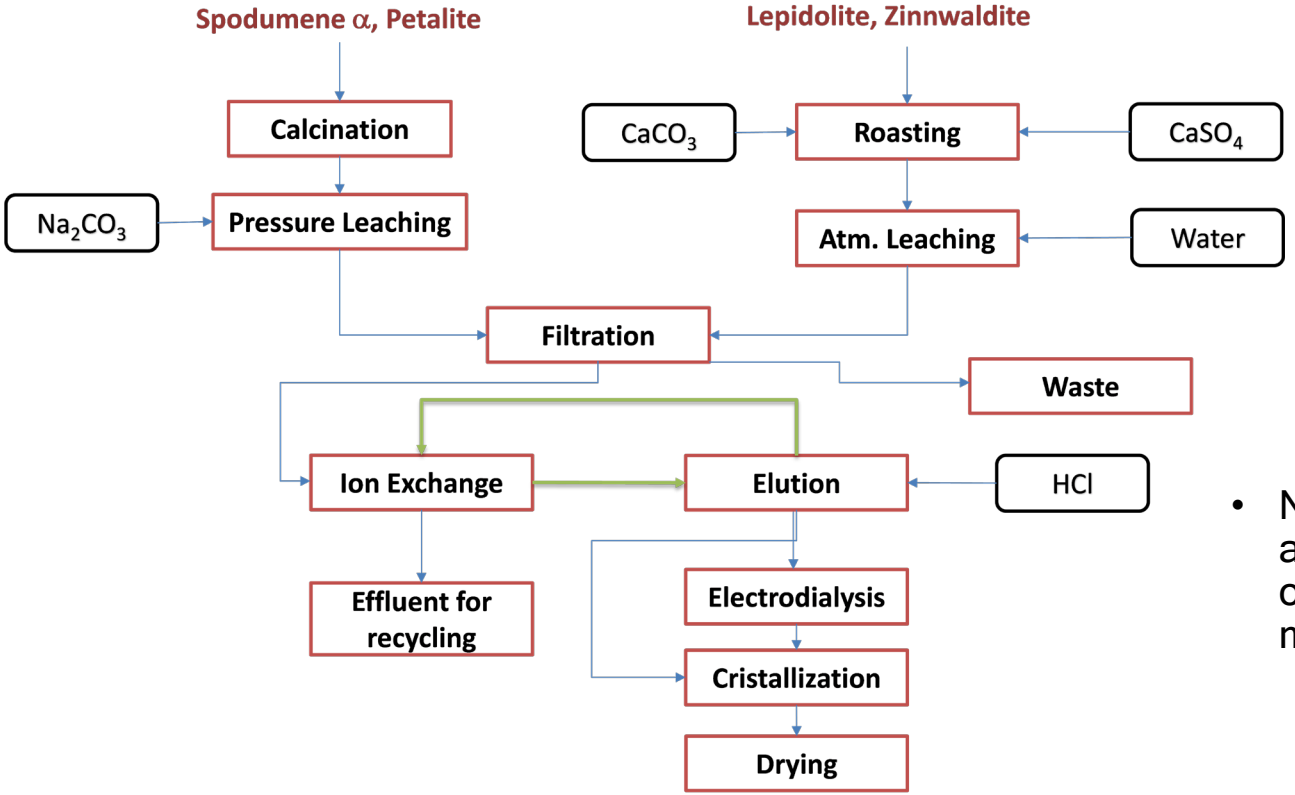
Achievements -Ore Processing



SOURCE: Machado Leite, Lítio em Portugal… do Recurso Mineral aos produtos de Lítio, 2017

Activity 4 - Hydrometallurgy

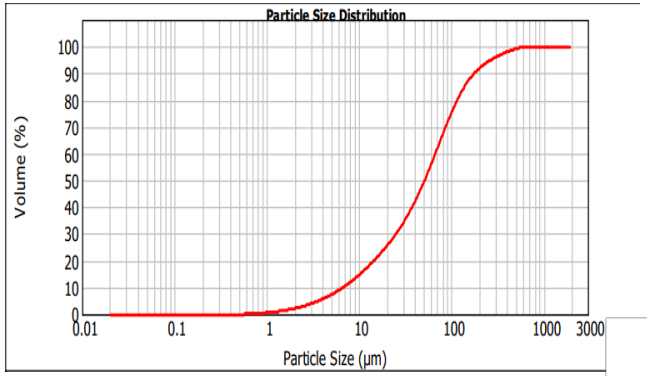


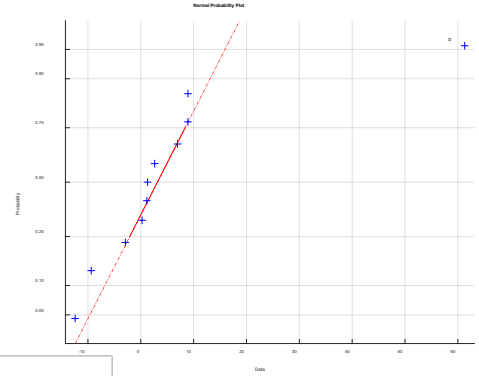
Pitfalls

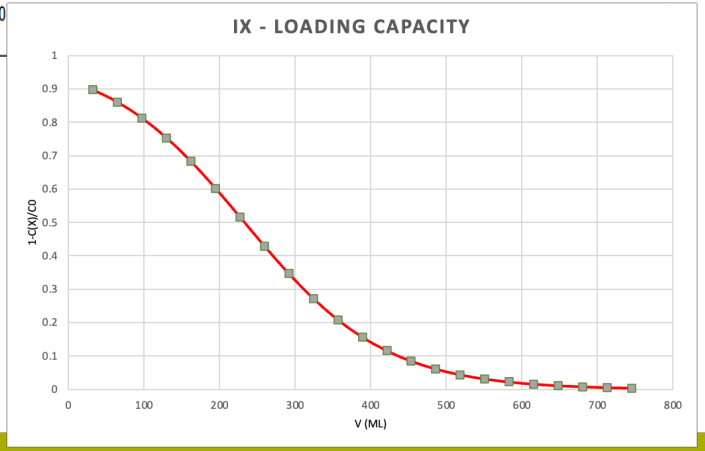
- Not yet considered: find alternatives for the reclamation of the residues from the metallurgical processing.

Activity 4 - Hydrometallurgy

Element	Li	K	Rb	Mn	Ca	Fe	Sn	Nb	Ta
Percentage	2.09	7.68	0.95	0.27	0.23	0.09	0.03	0.01	0.01



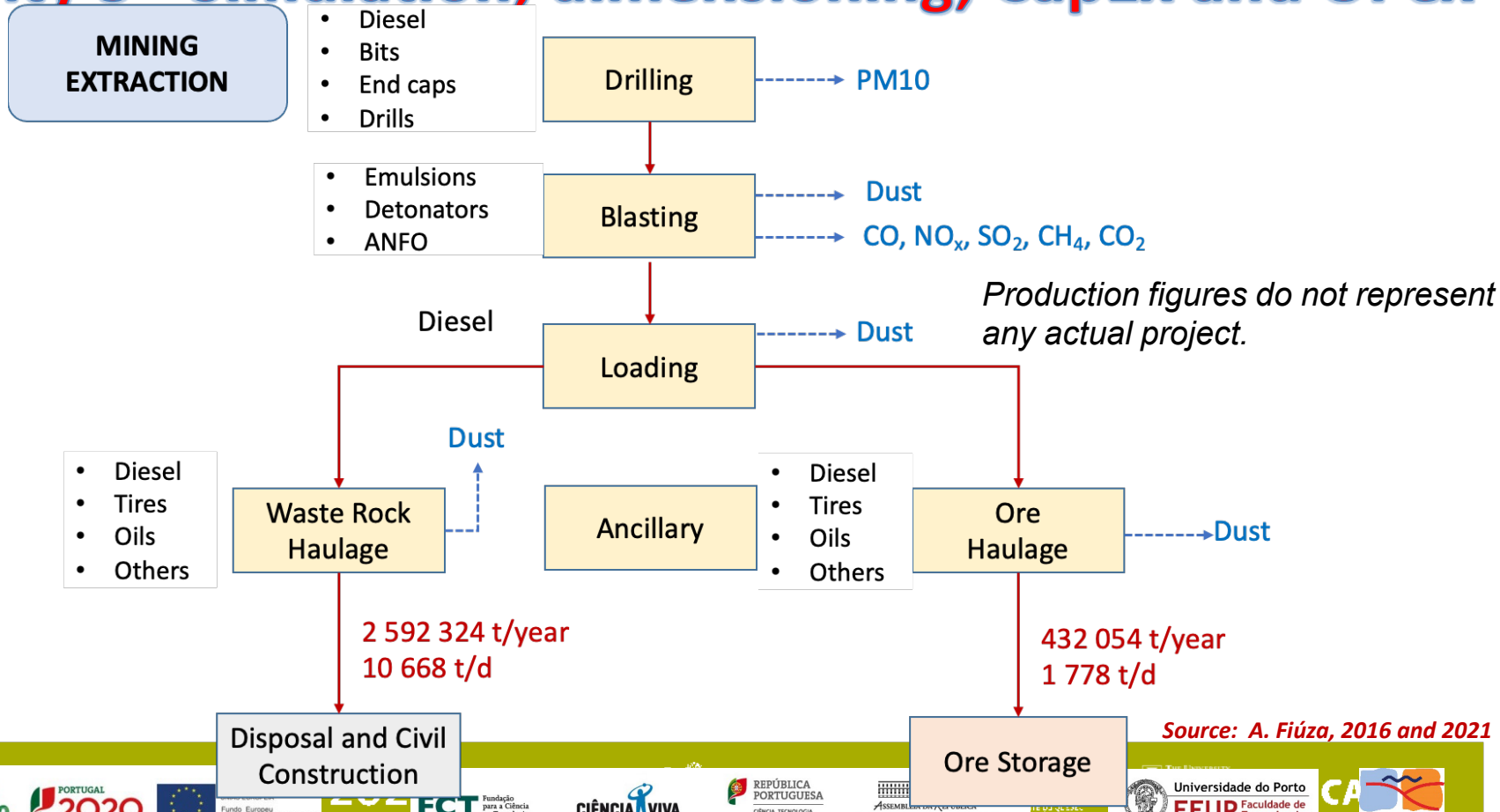




Activity 5 - Simulation, dimensioning, CapEx and OPex

1. Definition of the Production Flowsheet
2. Definition of the processing capacity
3. Mass and Energy Balances
4. Previous dimensioning of all the main equipment
5. Consumptions – Reactants and Energy
6. Estimate of Operating Costs (OpEx)
7. Estimate of Capital Cost (CapEx)

Activity 5 - Simulation, dimensioning, CapEx and OPex



Source: A. Fiúza, 2016 and 2021

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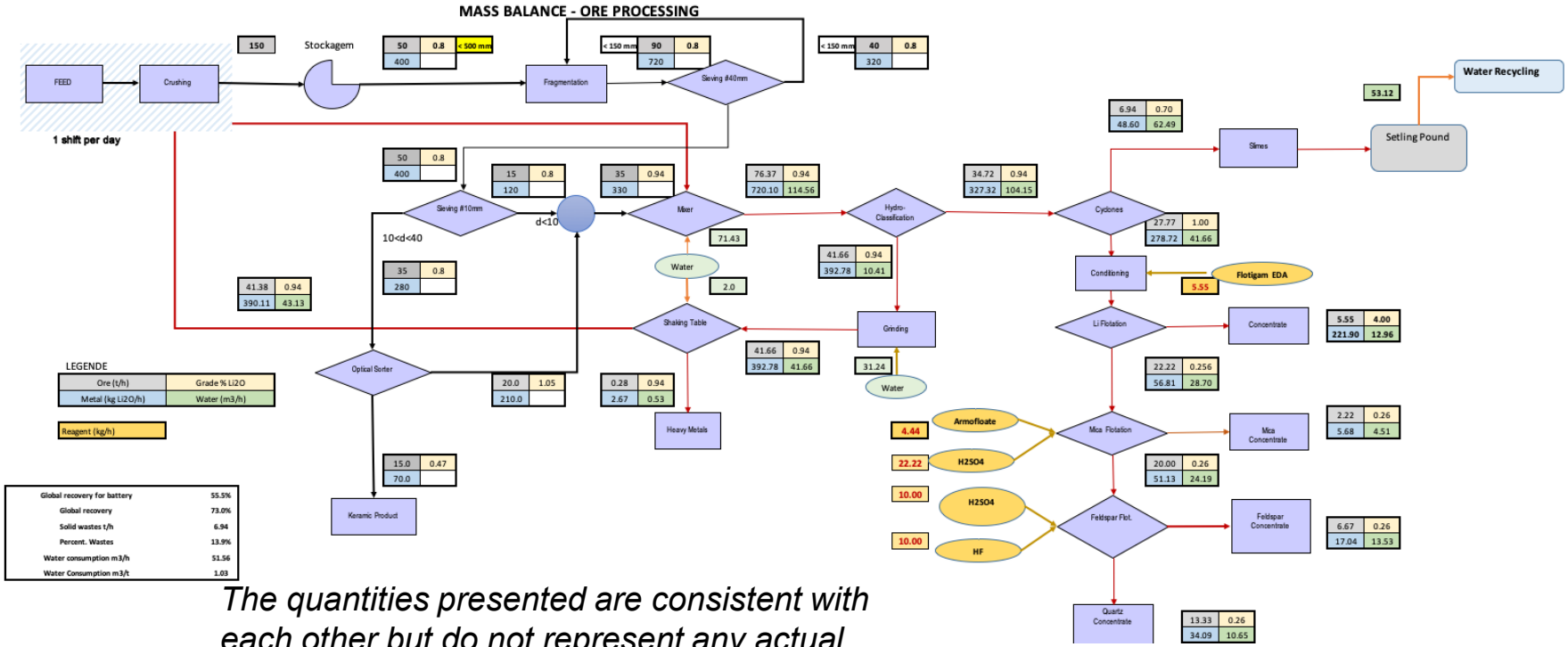
Activity 5 - Simulation, dimensioning, CapEx and OPex



The quantities presented are consistent with each other but do not represent any actual project.

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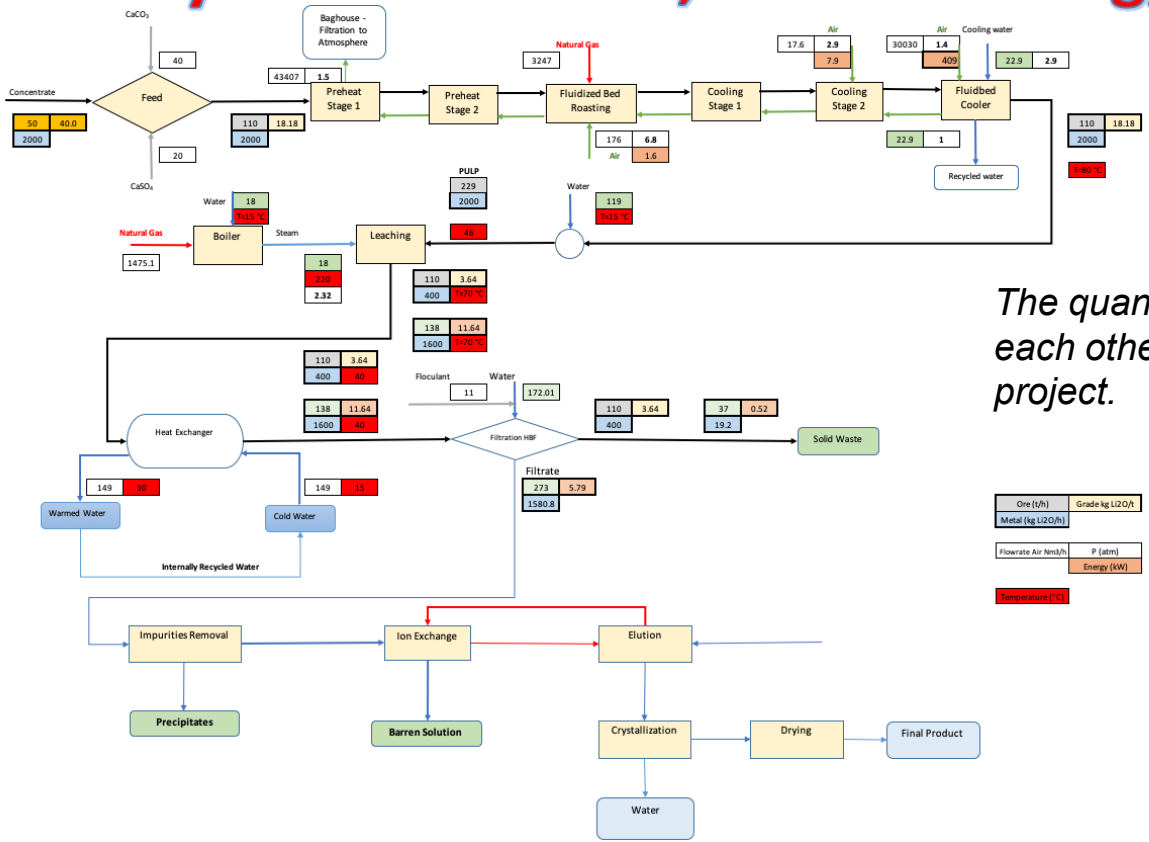

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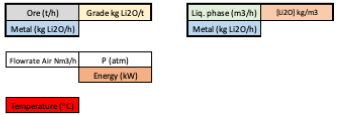

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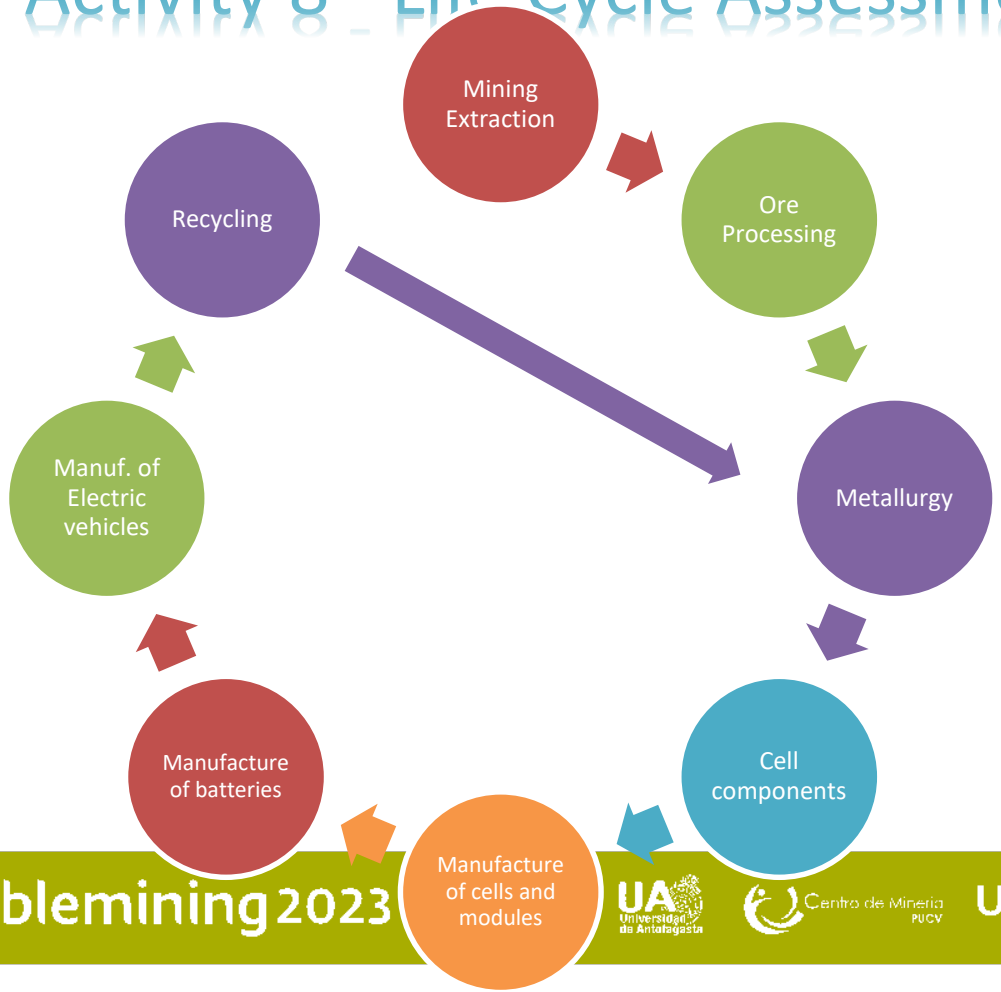
Activity 8 - Life Cycle Assessment



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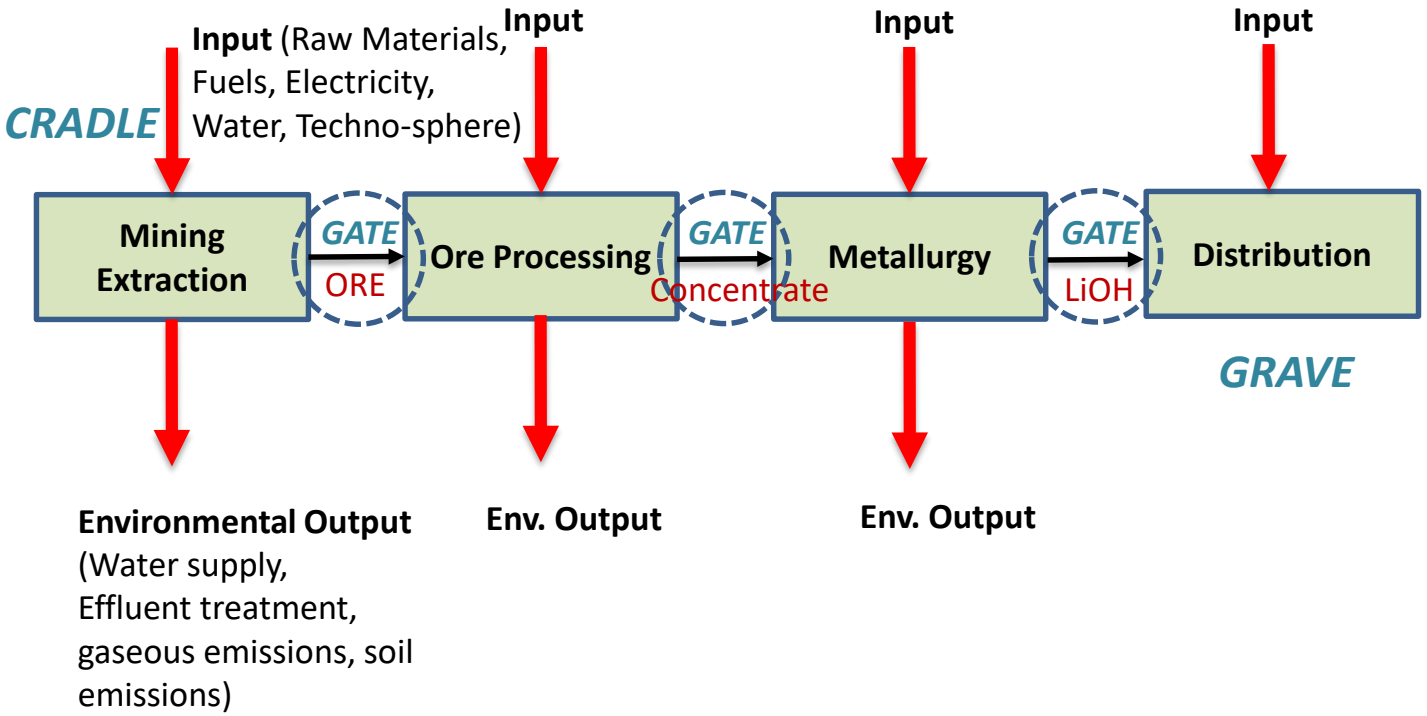
Activity 8 - Life Cycle Assessment



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Activity 8 - Life Cycle Assessment

Selected Impact Categories

- Climate Change ($kg\ CO_2 - eq$)
- Ozone Layer Depletion (kg CFC11 – eq)
- Terrestrial Acidification ($kg\ SO_2 - eq$)
- Eutrophication of Fresh Water (Kg P – eq)
- Human Toxicity (kg 1,4DB – eq)
- Inhalable Particle Formation (<10µ) (kg PM10 – eq)
- Water Depletion (m^3 water – eq)
- Depletion of Abiotic Resources (kg Sb – eq)

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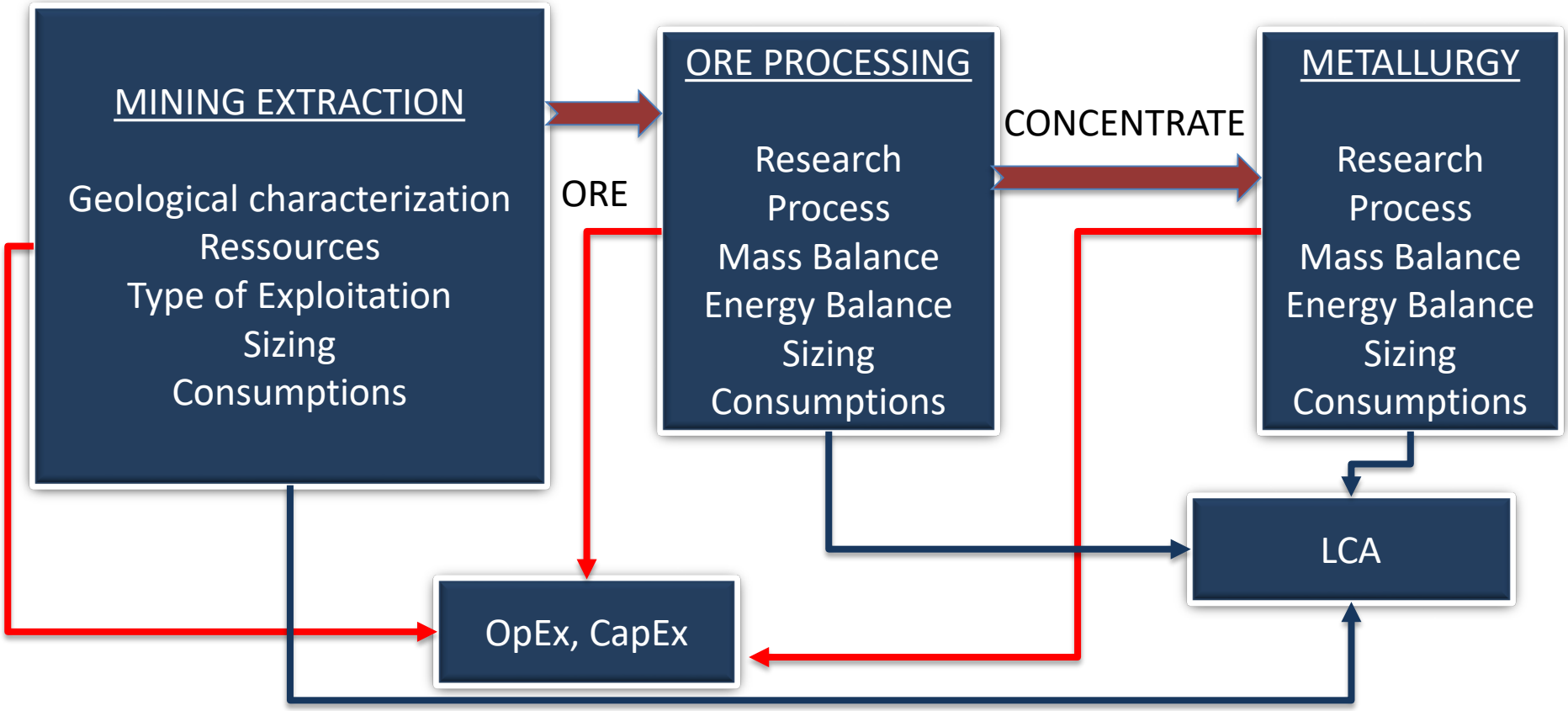

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