

# RESTART

(MAY 2022 – APRIL 2025)



# LEAP-RE

Long-Term Joint EU-AU Research  
and Innovation Partnership on Renewable Energy

## Pillar-1 project



The LEAP-RE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

## Consortium

The partners were selected considering the complementarity of their expertise and the international multidisciplinary to achieve the objectives of the project

### Project coordinator:

- Ismael Saadoune  
Cadi Ayyad University (UCA), **Morocco**

### Project partners:

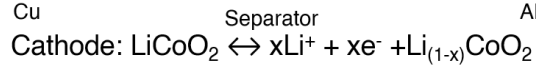
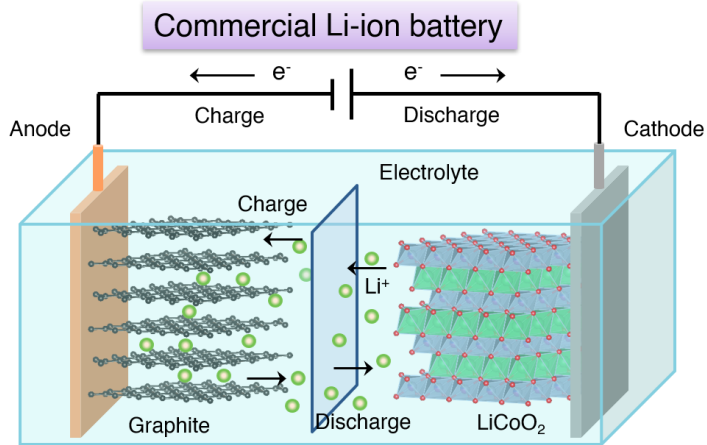
- King Salman International University (**Egypt**),
- Aalto University (**Finland**),
- Centre Européen de Recherche et d'Enseignement en Géosciences de l'Environnement - CEREGE (**France**),
- Cadi Ayyad University, Mohammed VI Polytechnic University - UM6P, and Green Energy Park (**Morocco**),
- Babeş-Bolyai University (**Romania**)

## Aim of the project

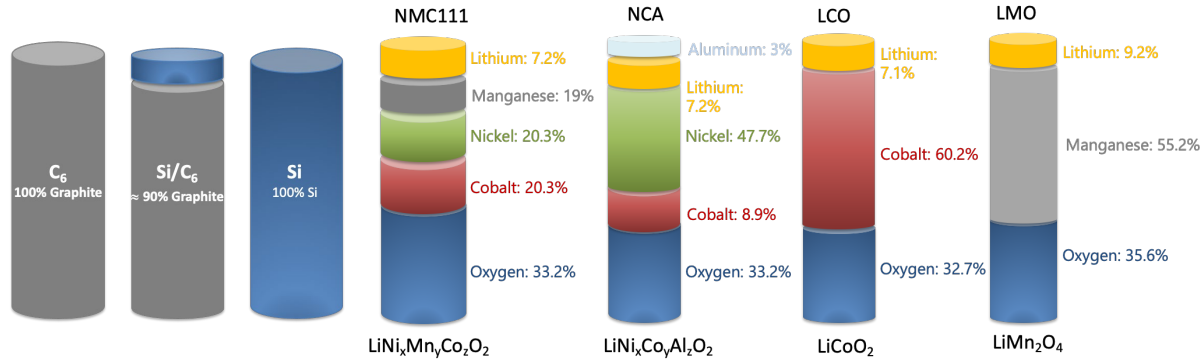
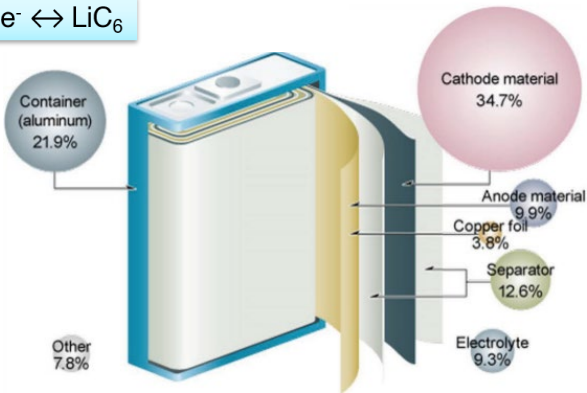
*The main objective of RESTART Project is to implement a full value chain for recycling End-of-Life (EoL) LiBs and PV, shifting from linear economy to circular economy, thus reducing waste disposal as well as minimizing dependence on important primary materials. The specific objectives are : **collect ; recycle ; implement; coordinate**. The Targeted metals Co, Ni, Li, Mn are considered actually as strategic ones for the deployment of an effective energy transition*

**Relevance vs MARs** : RESTART project's deliverables are in accordance with the following outcomes and impacts of MAR 2:

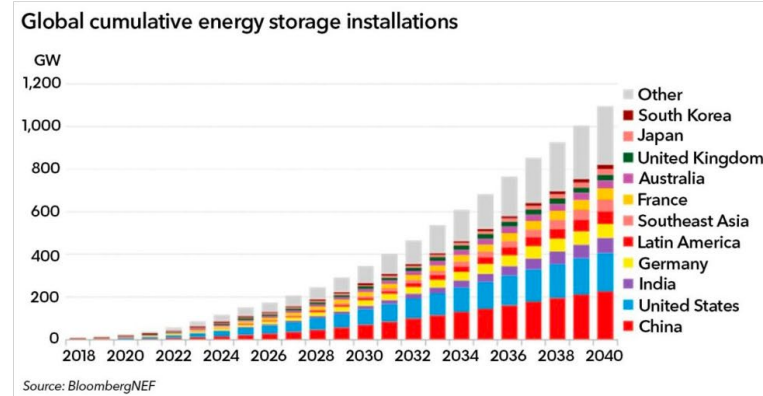
- **Map of the EoL/OoS component value chain**
- **Proposal of methods for EoL/OoS component recycling**
- **Identification of second life components with a benefit for African countries**
- **Dissemination of acquired knowledge**
- **Creation of jobs**
- **Promotion of environmental and ecological sustainability**



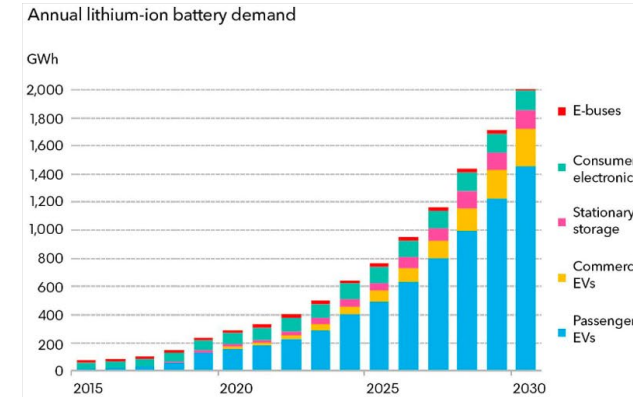
## Li-ion batteries cost breakdown



## Global Cumulative energy storage installations 2018-2040



## Annual lithium-ion Batteries



Need of i) Raw materials, ii) High performance Materials, iii) New technologies beyond LiBs

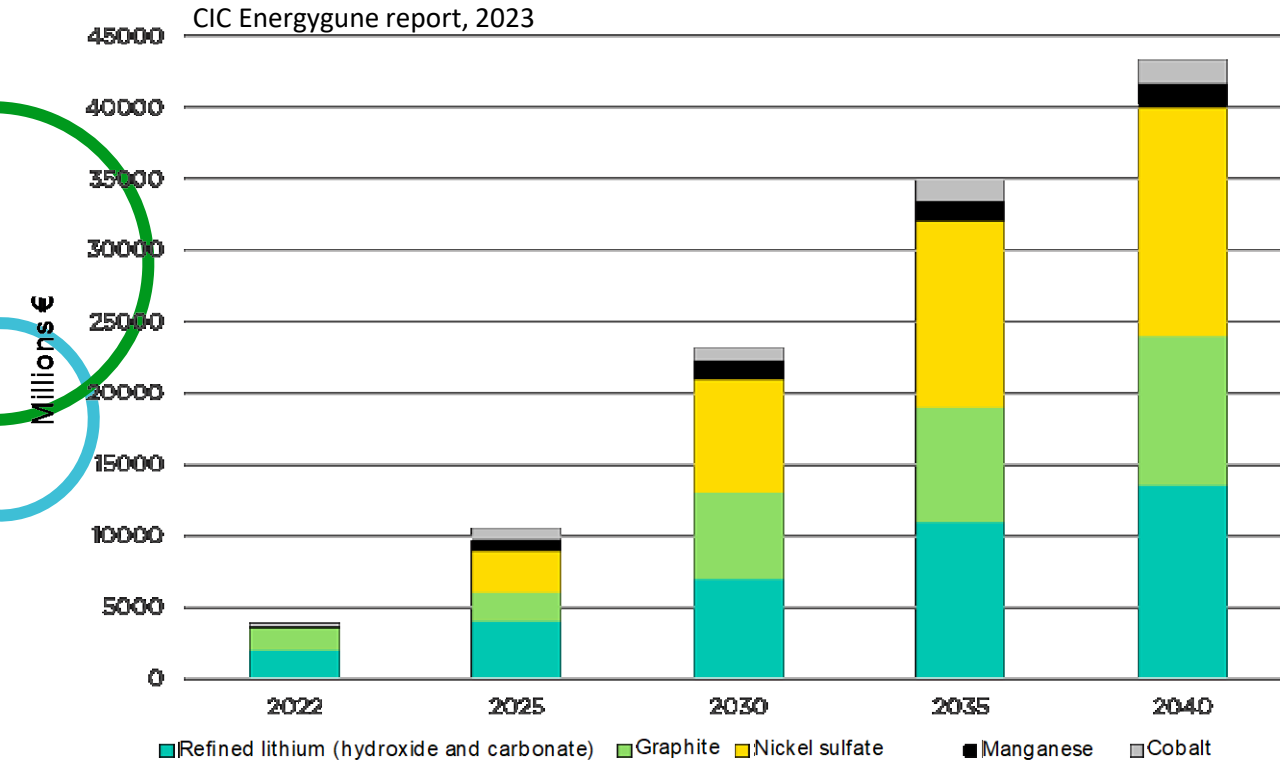
Environmental issue: End-of-Life LiBs (Impact on groundwater quality) : Recycling

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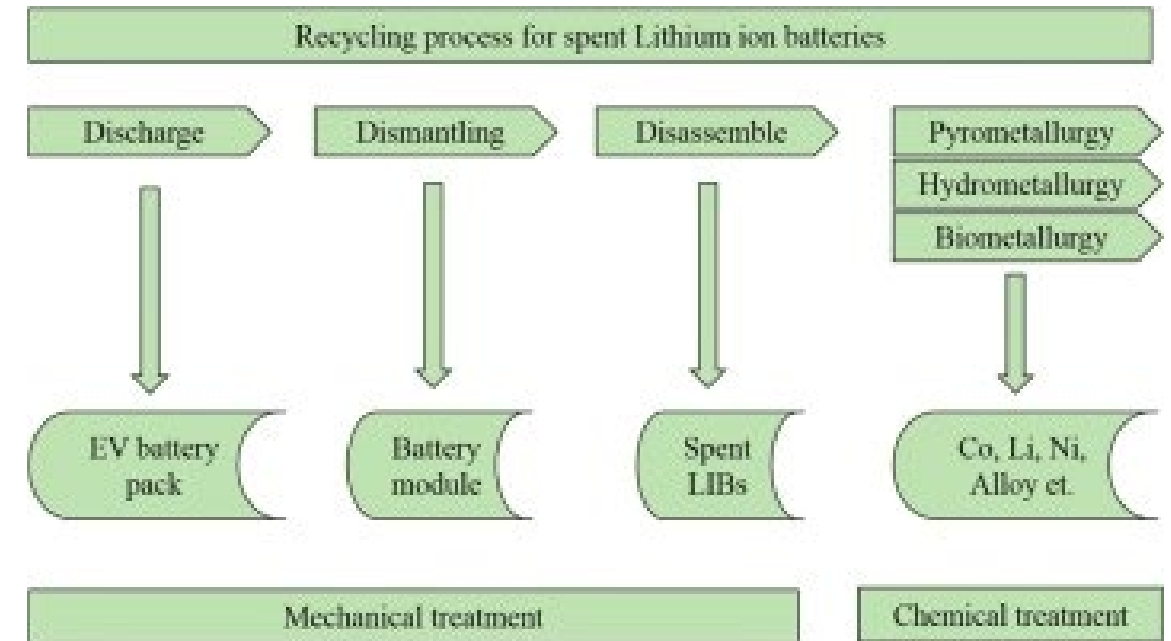
## EU Critical Raw Materials Act NEED FOR INVESTMENT IN RAW MATERIALS FOR BATTERIES TO MEET EU DEMAND



EU is almost exclusively dependent on imports for many critical raw materials

Meet with the circular economy approach

## Recycling of End—Life Lithium ion Batteries



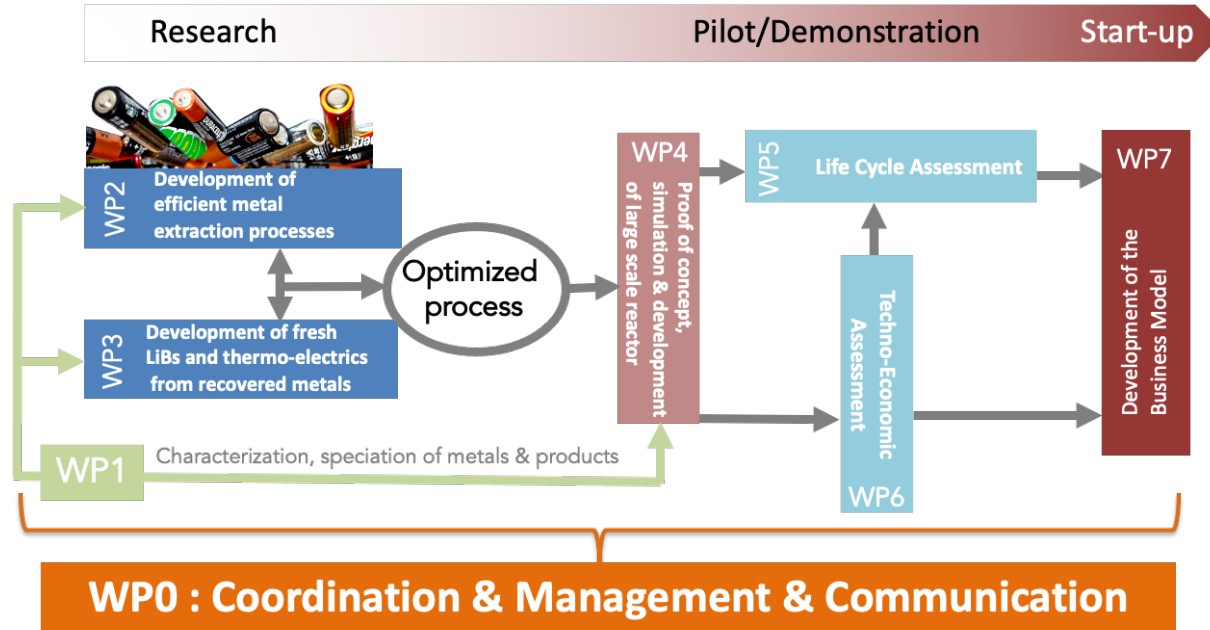
## EU targets

Rise to 20% for recycled cobalt, 10% for lithium, and 12% for nickel in the produced EVs

# RESTART: Presentation of scientific and/or technical objectives

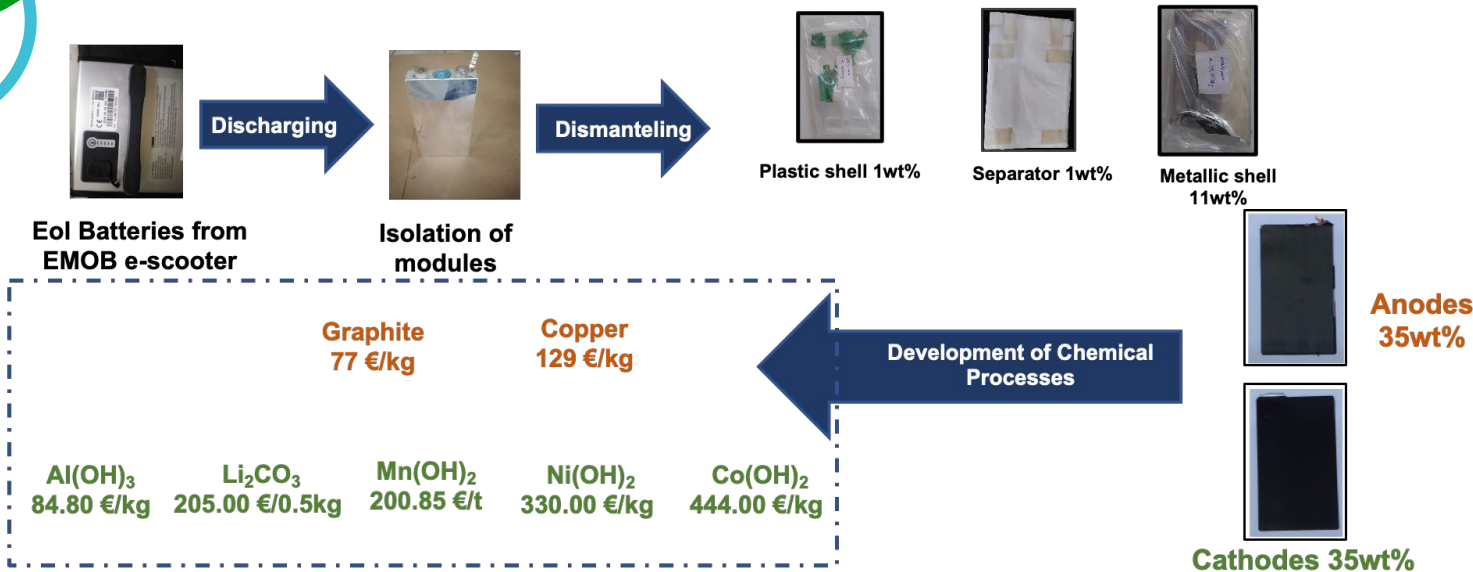


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## Key challenges addressed by the project

1. Collection, disassembling and characterization of EoL LiBs and PV
2. **Technology Development and scale-up** of metals recovery processes
3. **Demonstration** of fresh Batteries build-up from recovered chemical elements
4. **Sustainability:** Life Cycle Assessment; assessment of Modules collection and handling protocols
5. **Economy Business Plan** based on the best cost performing recycling processes
6. **Dissemination** of the Project's outreaches for identification of key stakeholders
7. **Implementation** of a Start-up



**Issue : Egyptian Partner !!!!**



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- **Results achieved :** *(Next Slides)*
- **Progress in compare with the state of the art :** *Successful except the WP related to the Egyptian Partner*
- **Increase in TRL (if relevant for the project) :** *TRL 3*
- **Possible evolutions of the objectives in progress of the project (explain), problems encountered during the project:** *The objectives are partially achieved. The activity initially attributed to the Egyptian partner is redistributed among the other partners.*
- **Specify whether the project has resulted in new products or developments (instruments, methods, software, etc.) :** *Process Development*

# RESTART: Scientific Results

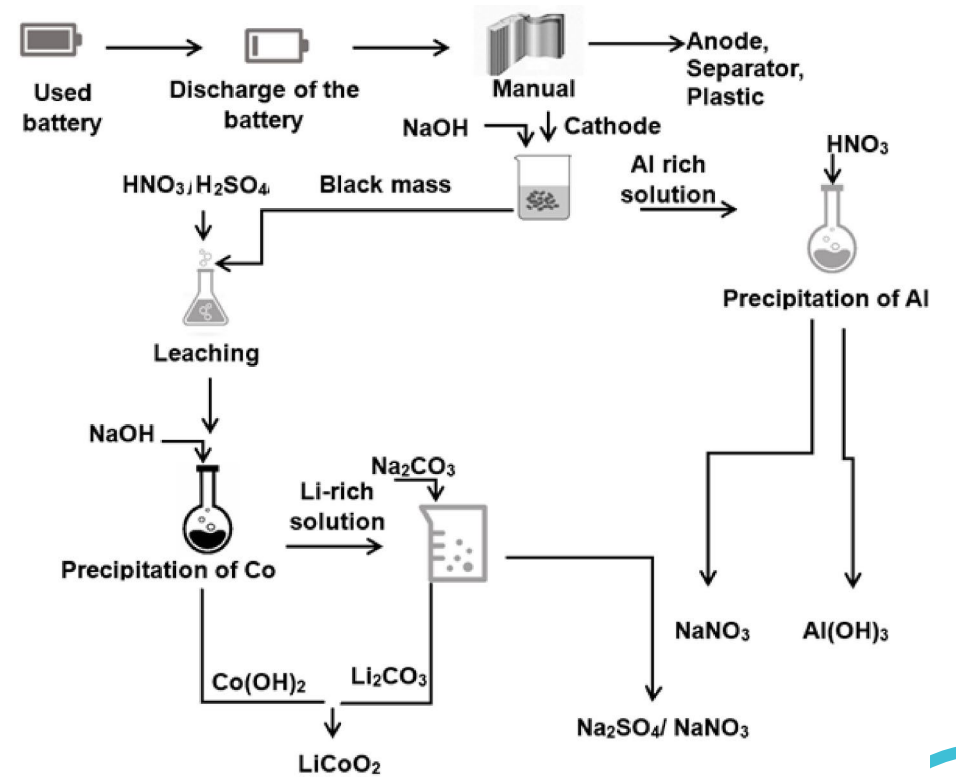


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UCA-UM6P-GEP (Morocco) ; CEREGE, AMU (France)

## Hydrometallurgical Process

Journal of Power Sources 580 (2023) 233341



# RESTART: Scientific Results

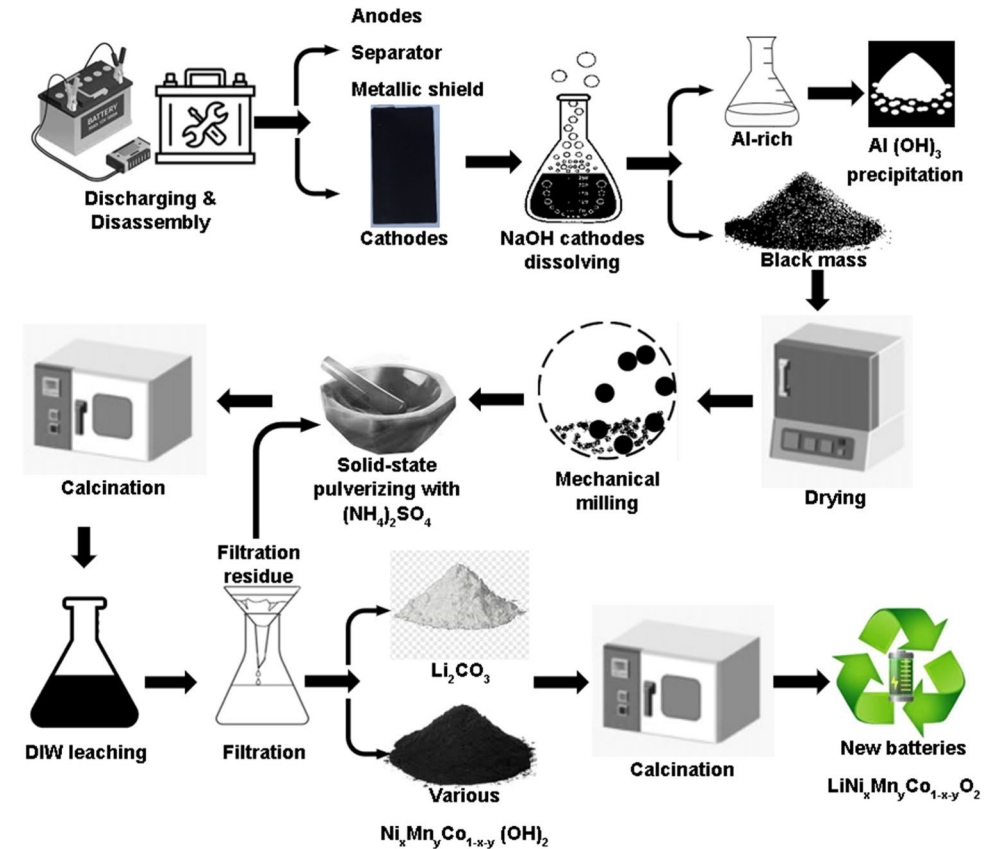


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## UCA-UM6P-GEP (Morocco)

### Molten Salt Process

Materials Today Communications 36 (2023) 106603



The leaching efficiencies reached 95.4%, 94.8%, 93.4%, and 92.6% for Li, Mn, Ni, and Co, respectively. The lithium carbonate obtained through ion-exchange exhibited a pure phase



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- **End of project expected results (2025)**
  - **Planned follow-up work, new pathway to explore...** : *Scaling-up of the most efficient process ; Techno-economic Assessment ; Life Cycle Assessment*
  - **Become of the consortium set up on this project** : *Creation of the start-up; Submission of proposals ; Co-supervision*
  - **New collaborations initiated thanks to the results of the project (following publications, conference presentations, etc.)** : *UNESCO Chair : e-waste Recycling (Polytech Montréal) ; SESA Project (H2020+)*
  - **New collaborations planned for the future (to answer what problem? Industrial or other perspectives?...)**
  - **New funded projects and/or funding applications (what type(s) of funding?)** : *RCLIB (LEAP RE)*



# ***Project acronym***

## ***Expected outcomes in case of success of the project (2030)***

*What could be the impact of the project at 2030 on the economy and/or society in case of scaling up the results of the project ?*

1. Characterization, speciation of metals & products
2. Development of efficient metal extraction processes
3. Development of fresh LiBs and thermo-electrics
4. Proof of concept, simulation & development of large-scale reactor
5. Analysis of Impacts: Life Cycle Assessment
6. Technico-Economic Assessment
7. Development of the Business Model

*Job Creation through the Start-up that could progress to SME*



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**THANK YOU. Any question....**

