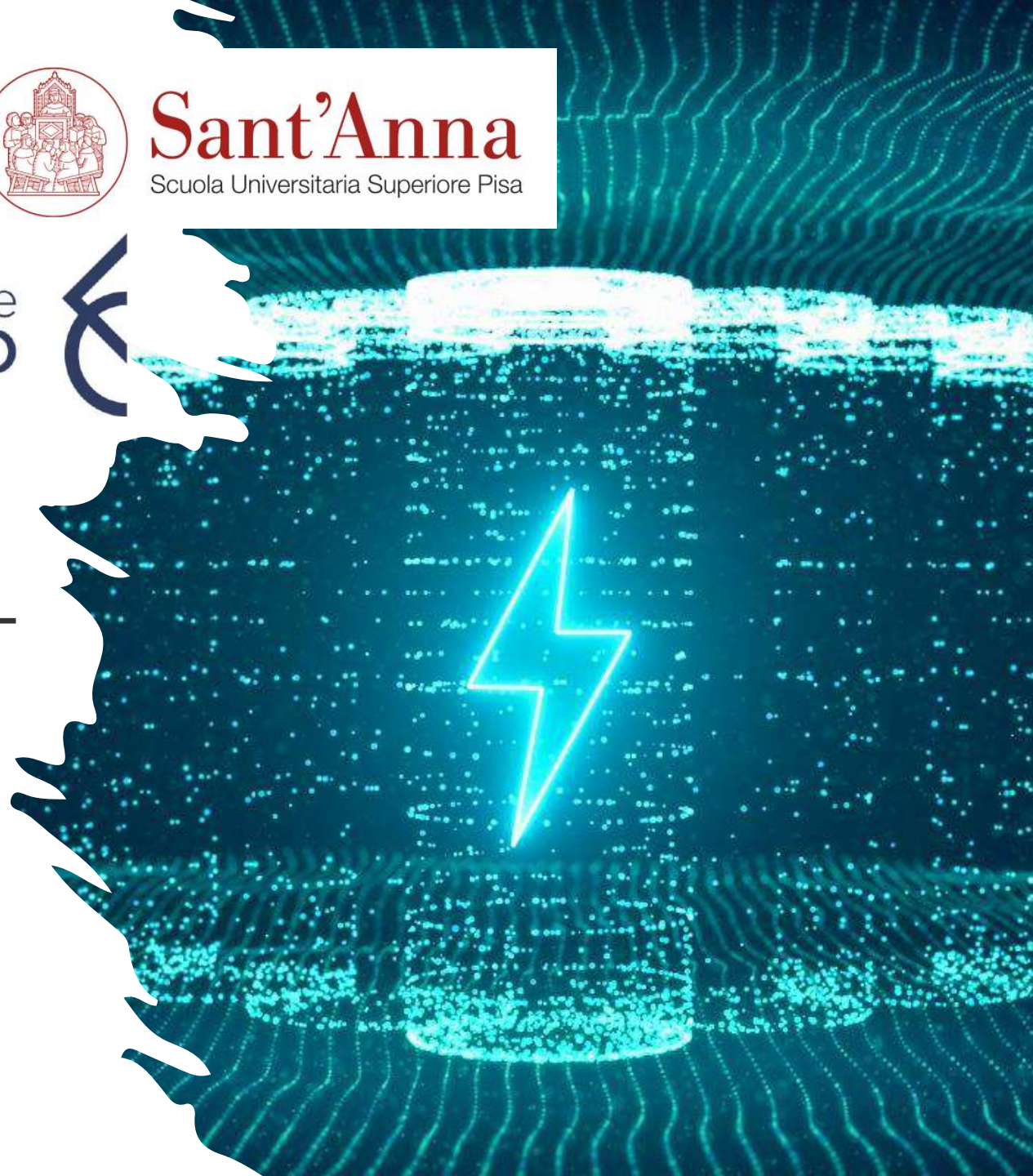
Il Progetto Tech4Lib:

https://tech4lib.unibs.it

Low-energy technologies for circular economy of spent lithium-ions batteries based on enhanced microwave effects



Ivano Alessandri

INSTM and University of Brescia ivano.alessandri@unibs.it

Fondazione CARIPLO

Bando Economia Circolare 2022: promuovere ricerca per un future sostenibile

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Tech4Lib

https://tech4lib.unibs.it

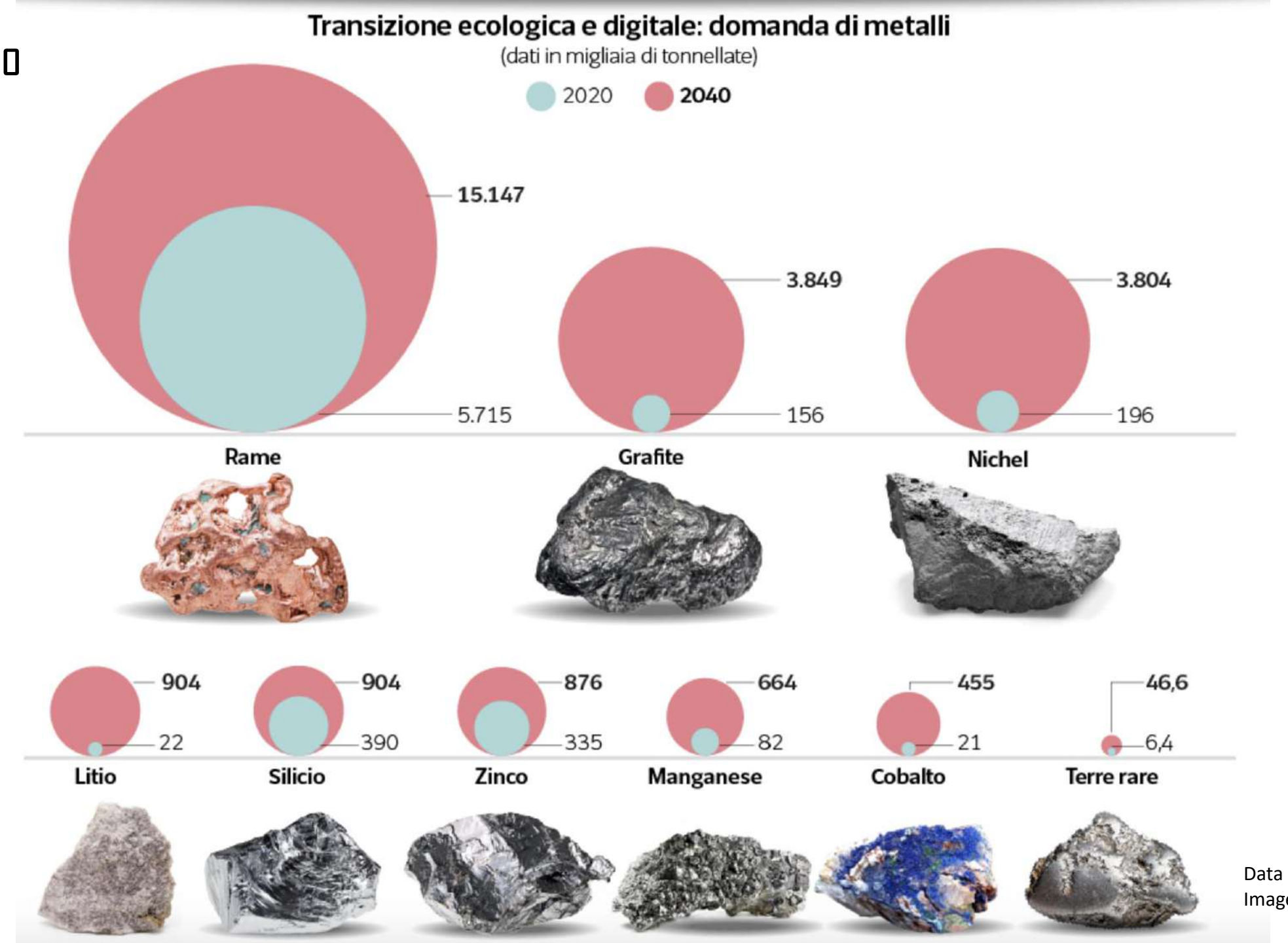
Sant'Anna
Scuola Universitaria Superiore Pisa

Coordinatore: Prof. Elza Bontempi, Università di Brescia

Low-energy technologies for circular economy of spent lithium-ions batteries based on enhanced microwave effects

Recupero di CRMs

Lo scenario



Data source: IEA
Image: dataroom@rcs.it

Urban Mining

Residual 41 kg

Steel 3 kg

Lithium 8 kg

Electronics 9 kg

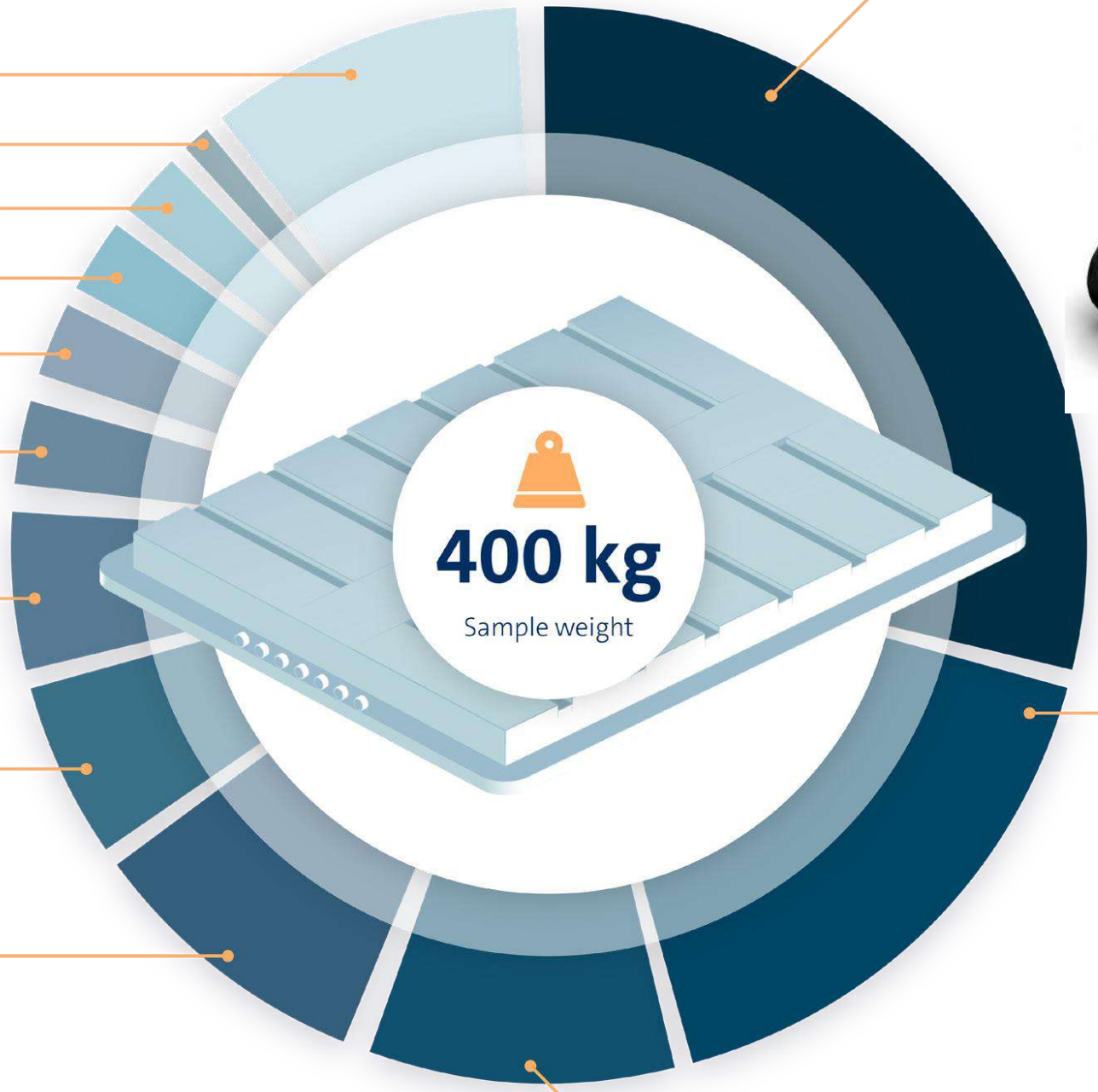
Cobalt 9 kg

Manganese 12 kg

Plastic 21 kg

Copper 22 kg

Electrolyte 37 kg



Aluminum 126 kg

Graphite 71 kg

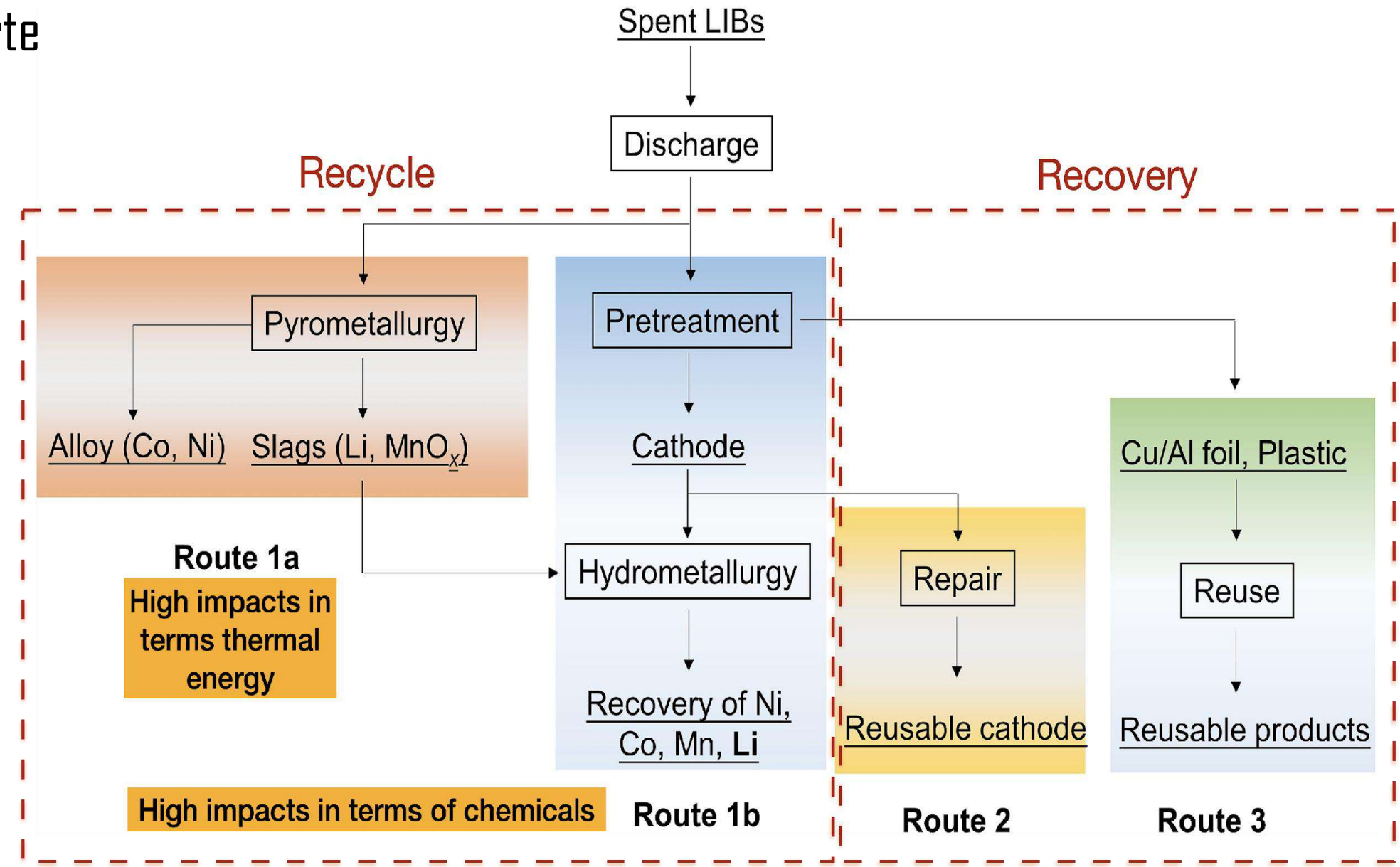
Nickel 41 kg

Source: Volkswagen

Black mass matters

Windisch-Kern et al., 2022

Stato dell'Arte

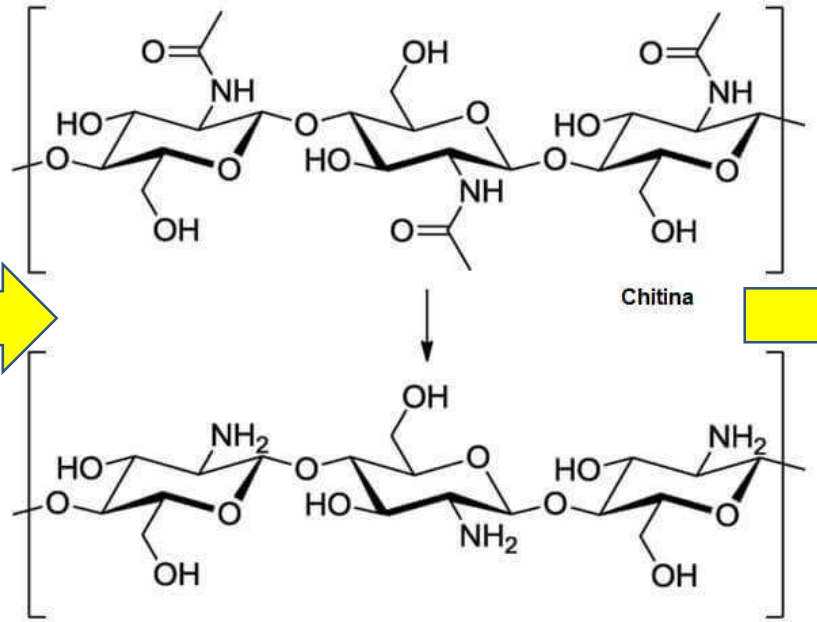


Liu *et al*., Nat. Energy 4, 180–186. https://doi.org/10.1038/s41560-019-0338-x2019

Food waste

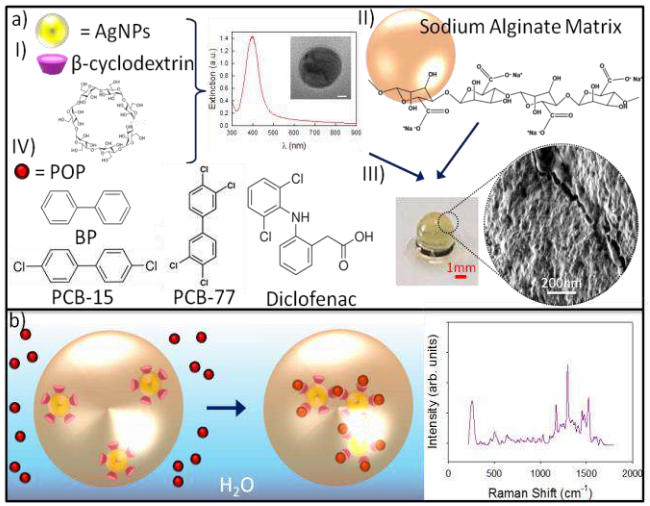
- 1,3 miliardi di tonnellate di rifiuti l'anno (circa 1/3 di quello che viene prodotto è sprecato)
- 3,3 miliardi di tonnellate di gas serra derivanti dai scarti alimentari
- Perdita di 936 miliardi di euro l'anno su scala globale

Esempio: nella sola UE, ogni anno 750mila tonnellate di **gusci di crostacei** diventano rifiuti

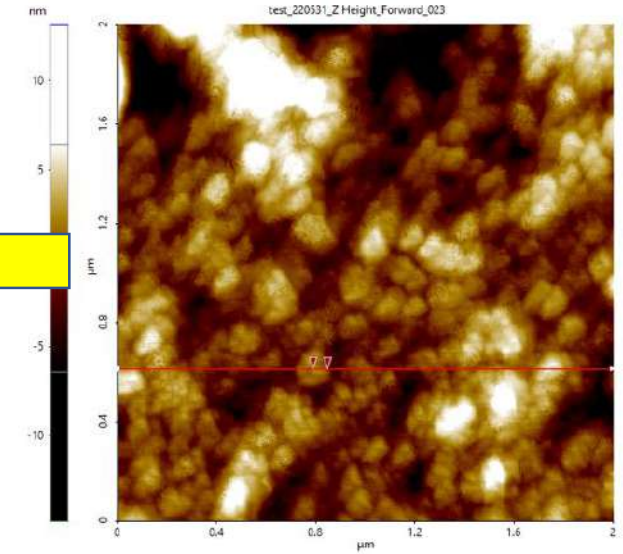


Chitosano estratto

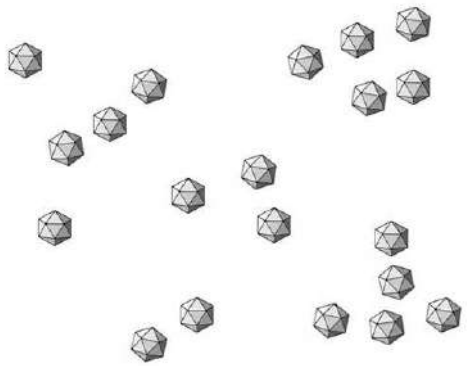
Hydrogel



Nanoparticelle



Tobacco Necrosis Virus

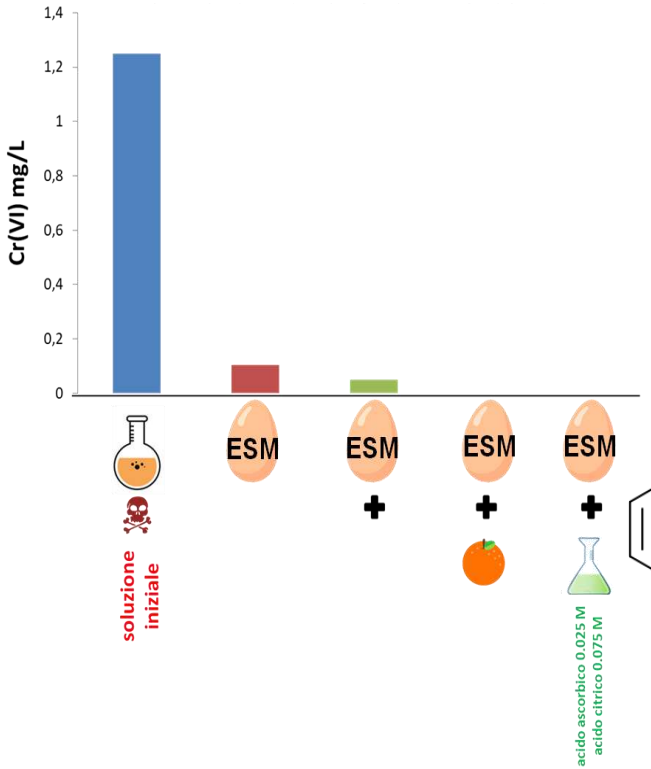


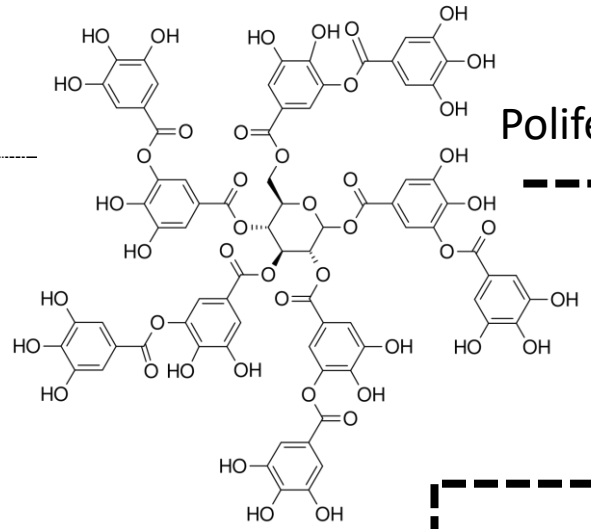
All food waste-based membranes for Chromium(VI) removal

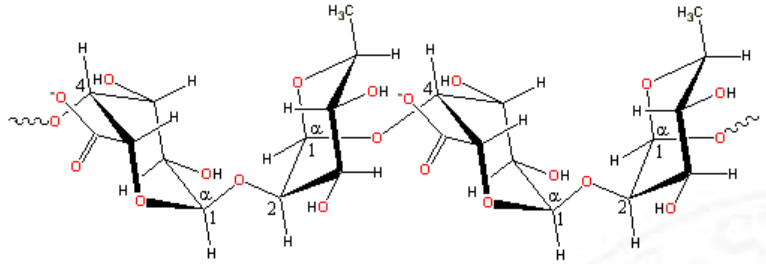
Irene Vassalini[1,2,3] · Marharyta Litvinava[4] · Ivano Alessandri[1,2,3,4]

Europäisches Patent Nr.
European patent No.
Brevet européen n°

3587358

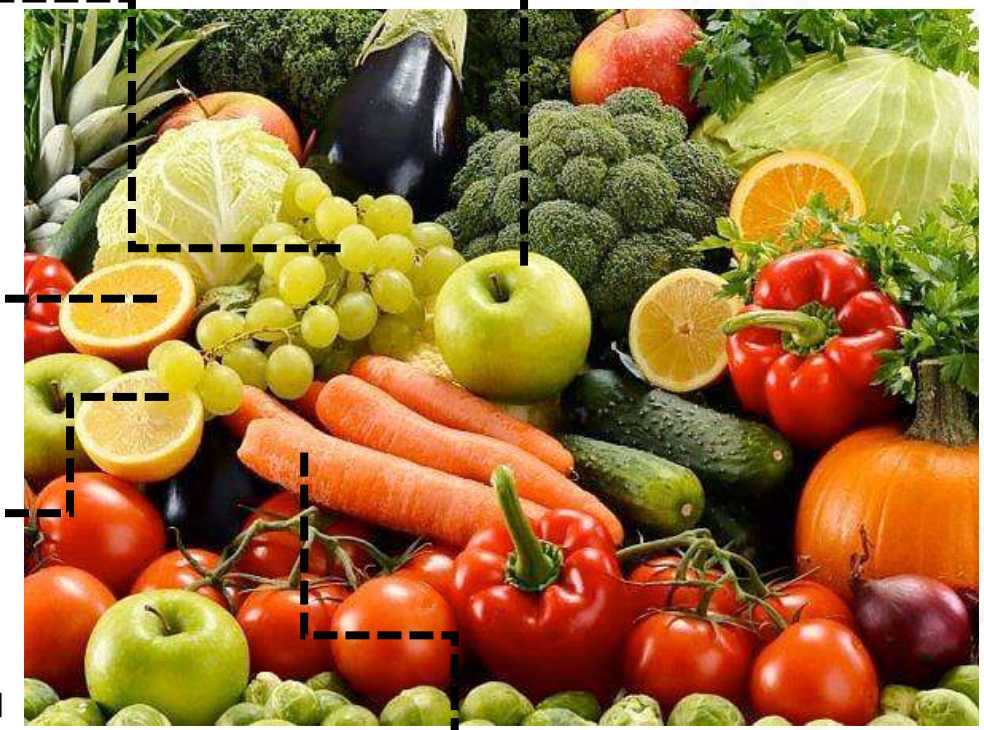


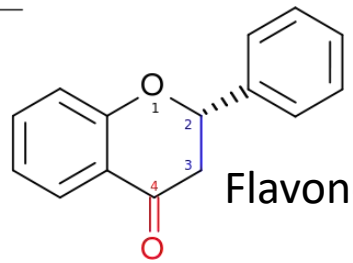




Polifenoli

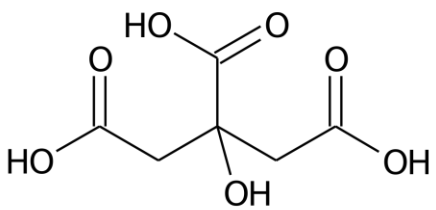
Pectina

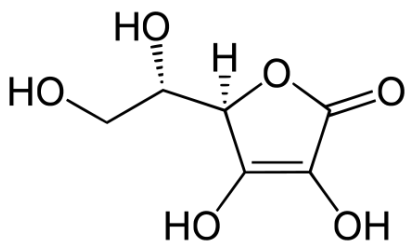




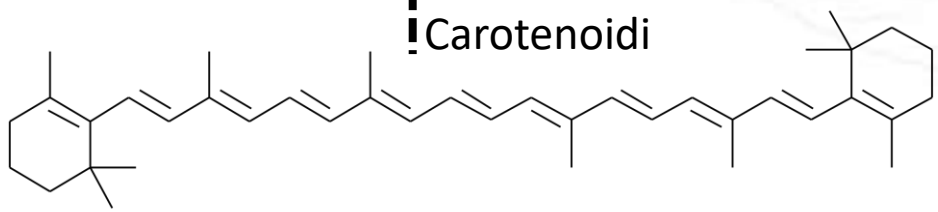
Flavonoidi

Acidi organici





Carotenoidi



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Il Progetto

Winner of the SusCritMOOC business idea competition on Critical Raw Materials

eit RawMaterials
Connecting matters

Fig.1 Malic Acid in Fruits and Berries
(Malic as percentage of total acids)

Microwave with new patented device

Biomass waste

Waste materials

Raw materials

Recovered materials

Ni

Co

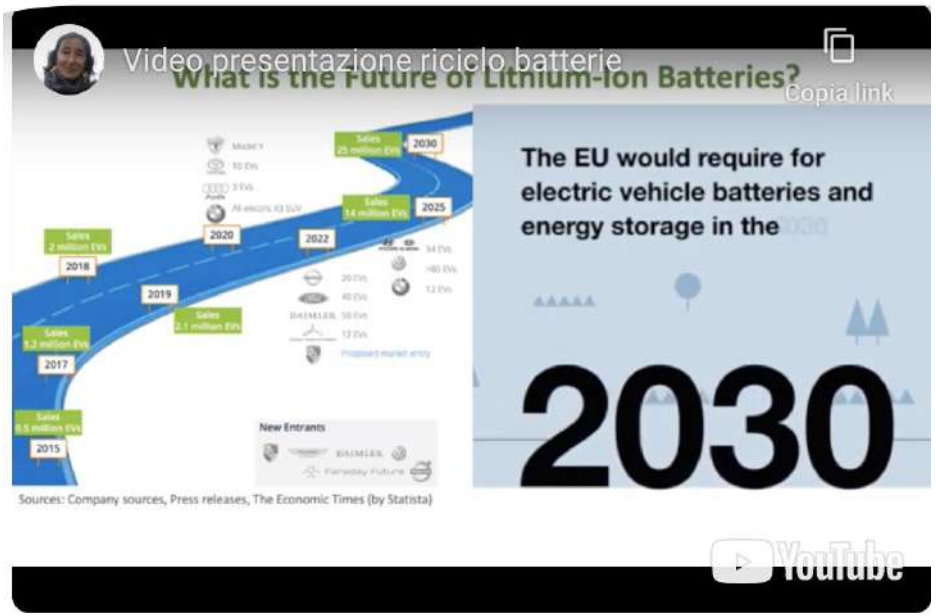
Mn

Li

Water

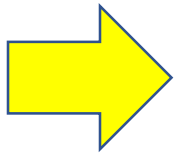
Black mass

New batteries



https://youtu.be/mcPac1kUr88

WPs and TASKS
WP1: FROM WASTE to intermediate products
TASK 1.1 - Waste collection and characterization
TASK 1.2 - MW treatments
WP2: from food waste TO VALUABLE PRODUCTS
TASK 2.1 - Food-based green extraction/production of organic acids for metal leaching
TASK 2.2 - Recovery of metals from MW-treated Black mass
WP3 - Impact assessement
TASK 3.1 - Key performance indicators (KPIs) optimisation
TASK 3.2 - Sustainability Assessment: technology state of art and evaluation of DNSH principles
TASK 3.3 - Comparative LCA analysis
Task 3.4 - Market analysis for an industrial scale up
WP4: Project management
TASK 4.1 - Project start /Kick-off meeting
TASK 4.2 - Coordination and monitoring of the activities
TASK 4.3 - Expenses monitoring
WP5: Project comunication and dissemination
TASK 5.1 - Project website and logo
TASK 5.2 - Management of social platforms, e-newsletter
TASK 5.3 - Promotional materials
TASK 5.4 - Scientific publications



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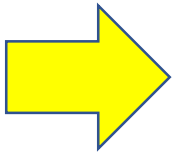

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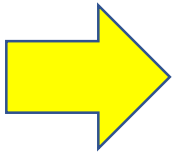
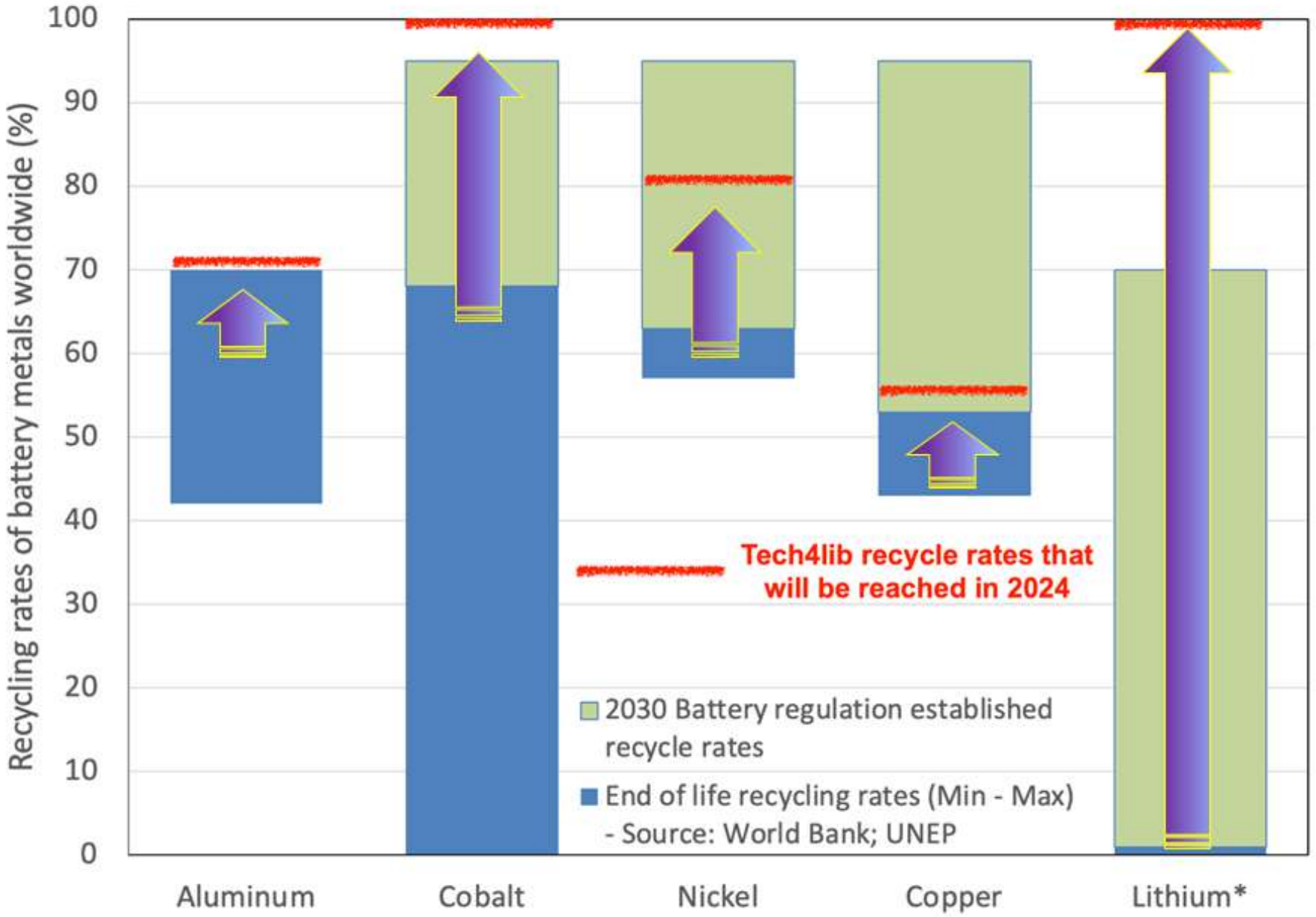


S.S.S.Anna

7 Giovani Ricercatori!!!

Obiettivi


Recycling rates of battery metals worldwide (%)
100
90
80
70
60
50
40
30
20
10
0
Aluminum
Cobalt
Nickel
Copper
Lithium*
Tech4lib recycle rates that will be reached in 2024
2030 Battery regulation established recycle rates
End of life recycling rates (Min - Max) - Source: World Bank; UNEP

Tech4lib

The Approach

Establish a circular economy approach for the raw materials necessary for LIBs production

Implement raw materials recovery by valorisinng different waste streams

The Solution

OBTAIN CARBOTHERMIC REACTIONS AT LOWER ENERGIES BY A NEW MICROWAVE TECHNOLOGY

Extract Li by using only a water solution

Extract the other metals (Li, Co, Mn, Ni, Cu) by combining leachate streams obtained by food waste

The Scenario

INCREASE IN DEMAND FOR RAW MATERIALS (Li, Mn, Co, Ni)

2019: Significant environmental impact and high amount of waste

2030: Risk of reserves exhausted Li – ion demand +30% each year

The Impact

Mining: Support urban mininig, reducing the dependence on imported critical raw materials

Technology: New know-how in secondary raw materials recycling, promote a circular battery industry and information for “battery passports”

Refinery: Reduced carbon footprint, more recycled content in new batteries second life

Fulfill regulation: Better recycling of waste batteries, **set higher recycling targets (>95% for Li and Co recovery)**

Ecological transition: enhable to reach target of reducing net greenhouse gas emissions by at least 55% by 2030

Winner of the SusCritMOOC business idea competition on Critical Raw Materials

eit RawMaterials
Connecting matters

EIT RawMaterials is supported by the EIT, a body of the European Union

Tech4Lib “Low-energy **tec**hnologies **for** circular economy of spent **li**thium-ions **b**atteries based on enhanced microwave effects”

Partners

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LE2C LOMBARDY ENERGY CLEANTECH CLUSTER

CSMT Haier Europe

rete di cooperative CAUTO

CANDY Haier

LA CASA DEI COMUNI anci LOMBARDIA

SWERIM

ARC AMBIENTE

innovando

ASSOFOND ASSOCIAZIONE ITALIANA FONDERIE

FLASH BATTERY

esm ENTWICKLUNGSFONDS SELTENE METALLE

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