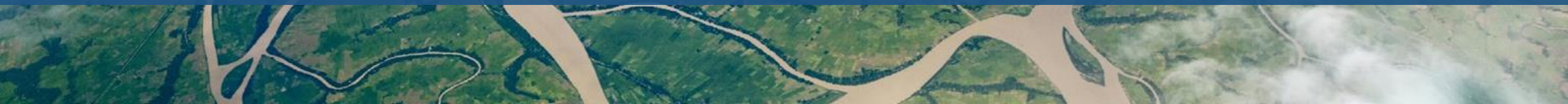
BEPA
Batteries European Partnership Association

7th General Assembly Matchmaking Session (14:00-17:00)

info@bepassociation.eu

2023



BATT4EU topics in 2024 Horizon Europe Work Programme

Advanced sustainable and safe pre-processing technologies for End-of-Life (EoL) battery recycling

CL5-2024-D2-01-01

Expected EU contribution per project: **8m€ (2 projects)**

TRL: **5**

- Battery2030+
- CL5-2023-D2-01-02 (New recycling process…)
- JRC

In few words:

- develop and integrate new advanced pre-processing & pre-treatment concepts including:
  - ✓ Battery sorting at component level including recommendations for the standardisation of labelling of battery components
  - ✓ Advanced pre-processing methods
  - ✓ Recovery of anode materials, separator, and electrolyte
  - ✓ Recovery of CC (methods for binder removal)
- LCA for pre-assessment
- preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan)

BATT4EU Batteries European Partnership

CL5-2024-D2-01-02

Non-Li Sustainable Batteries with European Supply Chains for Stationary Storage

Expected EU contribution per project: **7m€ (3 projects)**

TRL: **6-7**

- Route to the Innovation Fund
- International cooperation (India, Africa and Australia)

In few words:

- ✓ stationary storage applications, from a few kWh in small-scale
- ✓ domestic behind-the-meter units, to many MWh in large utility-scale front-of-meter installations
- ✓ Projects are encouraged to develop (not discover!) post-lithium cell chemistries
- ✓ Towards the storage costs of less than 0.05 €/kWh/cycle by 2030
- ✓ Special focus on European-based supply chain (of CRM) and safety
- ✓ Demonstration of system operated in end-user conditions for at least 3,000 hours.
- ✓ Projected product cycling life 5,000 cycles
- ✓ BMS development is within scope

Development of technical and business solutions to optimise the circularity, resilience, and sustainability of the European battery value chain

CL5-2024-D2-01-03

Expected EU contribution per project: **5m€ (1 projects)**

TRL: **5**

- Battery2030+
- JRC

In few words:

- Proposals should cover at least two of three scope categories:

1. business models
   - Definition of assessment approaches for sustainable business models
   - business methods for technical, economic, and
   - environmental evaluation of cycle life options: retrofit, second life, and recycling

2. Cross-industry tools
   - Quantitative methodologies and tools that enable understanding whether recycling or second life is the preferred sustainable option

3. Sustainable design
   - Innovations in battery design and architecture at all levels (system, pack, cell) supporting dismantling and recycling at the end of life.

CL5-2024-D2-02-01

Sustainable high-throughput production processes for stable lithium metal anodes for next generation batteries

Expected EU contribution per project: **8m€ (1 projects)**

TRL: **6-7**

- Projects on: Advanced materials development enabling large-scale production of Gen4 and Post-lithium

In few words:

- demonstrated up to pilot level
- Control of the passivation of Li metal films, and to understand how the passivation is linked with the dry room conditions and requirements
- guarantee safety of the Li film production and handling, which
- has to be demonstrated in a process that is compatible for large scale production

CL5-2024-D2-02-02

Post-Li-ion technologies and relevant manufacturing techniques for mobility applications (Generation 5)

Expected EU contribution per project: **5 M€ (3 projects)**

TRL: **4**

- Battery2030+

In few words:

- Generation 5
- Recyclability addressed at the step of cell design
- Conversion systems based on metallic anodes
- Metallic anode protection and/or activation for conversion systems
- Excluding Sodium-ion
- Show credible path to 500 Wh/kg and cost of <75 Euros/kWh

CL5-2024-D2-02-03

Size & weight reduction of cell and packaging of batteries system, integrating lightweight and functional materials, innovative thermal management and safe and sustainable by design approach

Expected EU contribution per project: **8m€ (2 projects)**

TRL: **6-7**

- Innovation fund

In few words:

- innovations in the manufacturing processes that result in size and weight reduction of the packs
- Enhanced thermal management to enable fast charging
- safety measures should be demonstrated by simulation at pack level
- cell to casing integration
- SSBD as a reference

CL5-2024-D2-02-05

Furthering the development of a materials acceleration platform for sustainable batteries (combining AI, big data, autonomous synthesis robotics, high throughput testing)

Expected EU contribution per project: **20m€ (1 project)**

TRL: **3-4**

- Battery 2030+

In few words:

- Develop new tools and methods for significantly accelerating the development and optimisation of battery materials and interfaces
- Demonstrate a fully autonomous battery-MAP
- Scale-bridging, multi-scale battery interface models

- Infrastructure tools for secure remote data access, data analysis and predictive modelling: Develop a FAIR5 data infrastructure for raw and curated experimental and modelling data

- Automated high throughput characterisation and integrated experimental and computational workflows

Prof. Dr. Emre Erdem
Sabanci University

Physics & Engineering of Energy Materials

- Materials Engineering
- Supercapacitor device production

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Materials Science and Engineering
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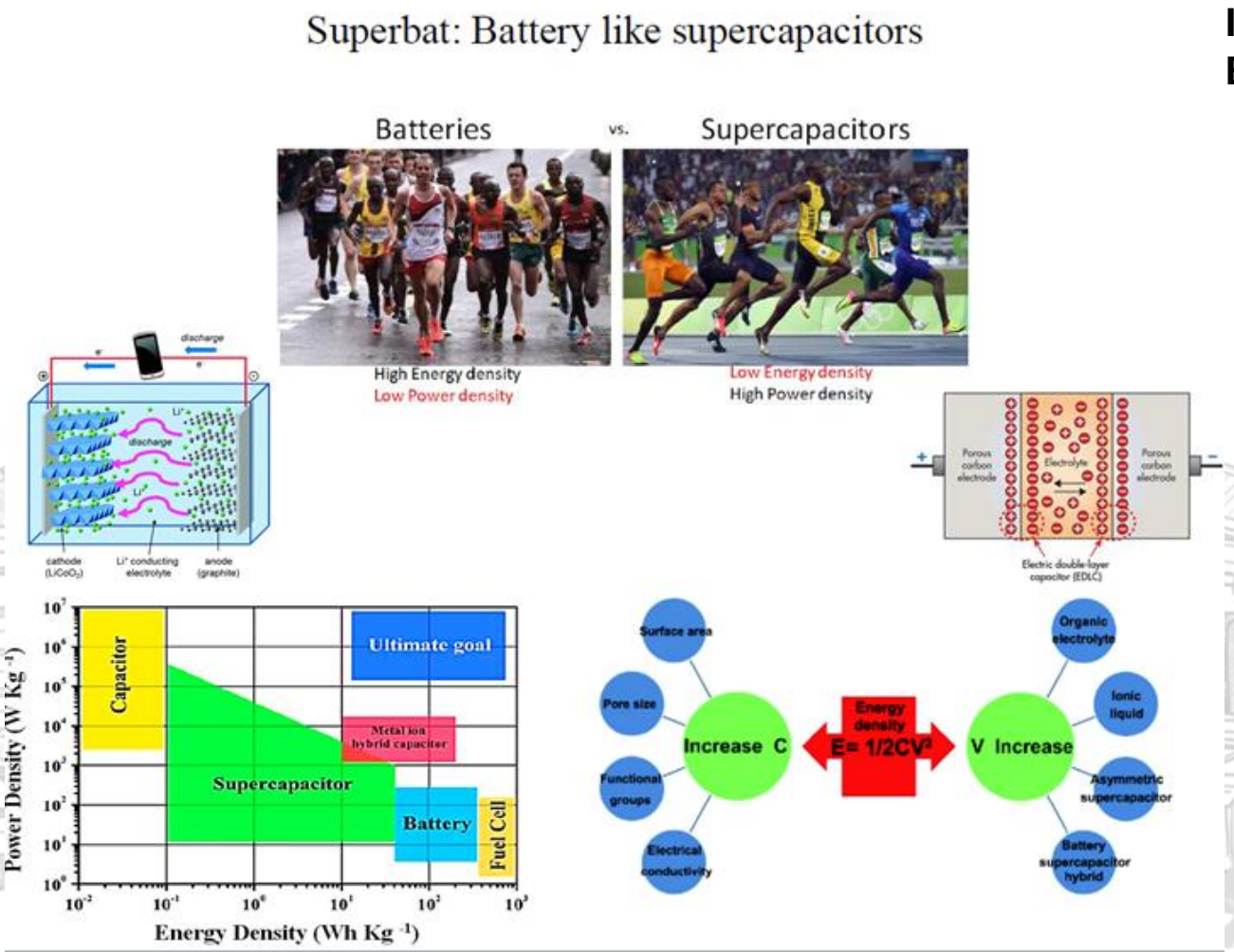


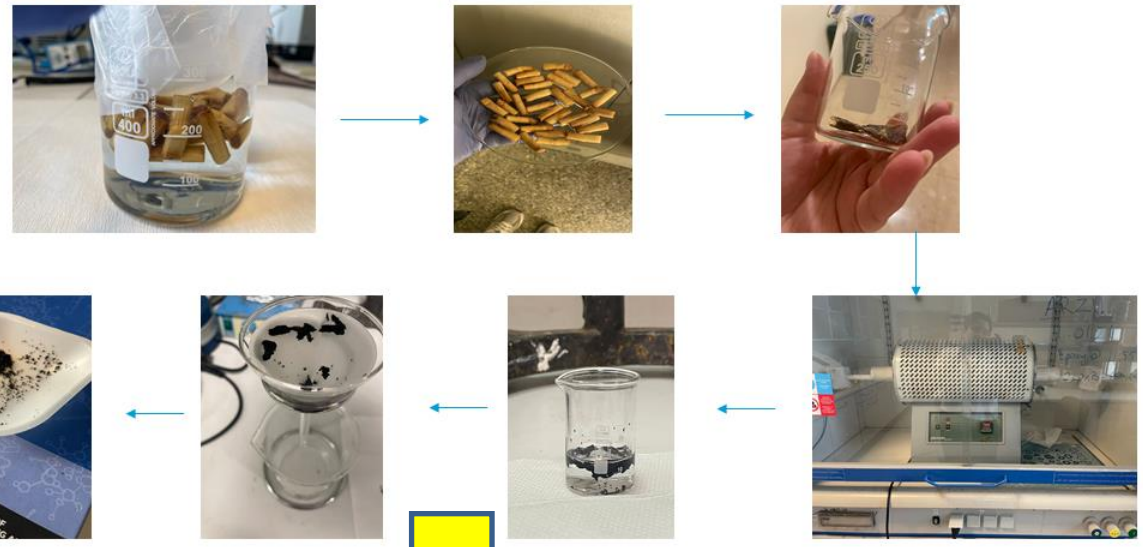
HORIZON-CL5-2024-D2-02-03 (Deadline 7 May 2024): Size & weight reduction of cell and packaging of batteries system, integrating lightweight and functional materials, innovative thermal management and safe and sustainable by design approach TRL 6-7

Physics & Engineering of Energy Materials

Sabancı Üniversitesi

- Materials Engineering
- Supercapacitor device production

Synthesis of Active Carbon from Cigarette-butts



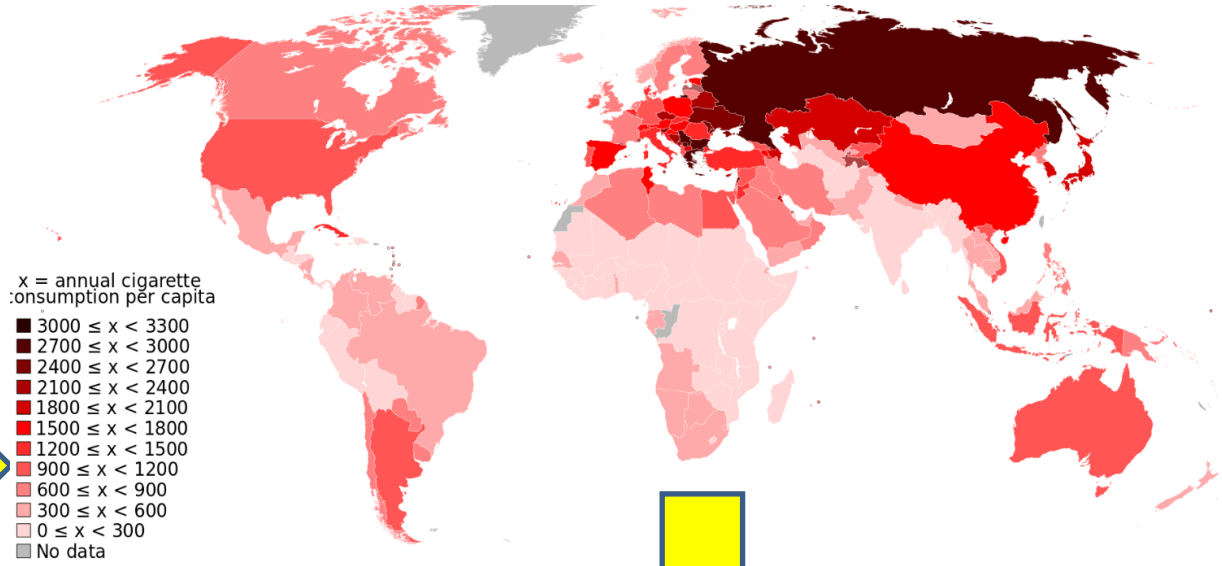
Lab scale (gram):
1 pack cigarette ~20 butts~ 1 g AC

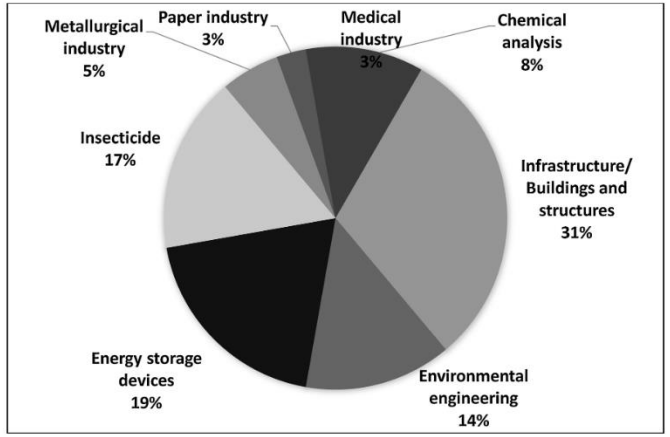
Pilot scale (kilogram)
1000 g AC ~ 1 kg ~ 1000 packs

Industrial scale (0.2 Ton, 200 kg)
200 kg ~ 200.000 packs

Physics & Engineering of Energy Materials

- Materials Engineering
- Supercapacitor device production



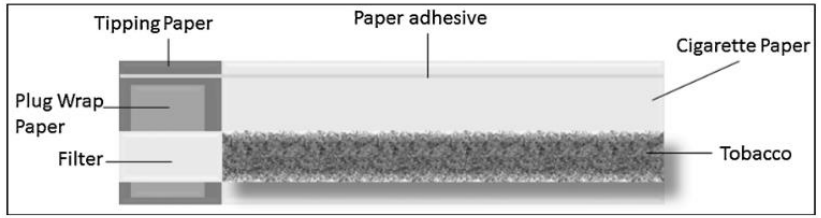


Lab scale (gram):
1 pack cigarette ~20 butts~ 1 g AC

Pilot scale (kilogram)
1000 g AC ~ 1 kg ~ 1000 packs

Industrial scale (0.2 Ton, 200 kg)
200 kg ~ 200.000 packs

Turkey
1 person ~ 75 packs cigarette ~1500 butts~ 75 g AC
15 persons ~ 1125 packs ~ 1.1 kg AC
2700 persons ~ 200 kg AC



Physics & Engineering of Energy Materials

Sabancı Üniversitesi

Synthesis of Active Carbon from Cigarette-butts

Physics & Engineering of Energy Materials

Sabancı Üniversitesi

- Materials Engineering
- Supercapacitor device production

A battery for a large electric vehicle needs over 20 kg of graphite.

Potential Uses

End-of-Life Tires (ELT)
- 300.000 tons of ELT per year in Turkey
- 26 million tons of ELT per year in Europe

Industrial Waste Filters
- HEPA Filters
- Air Filters
- Carbon Filters

Bio-waste
- Coffee grounds waste
- Tea grounds waste
- Useless seeds, peels, stem, etc.

Current Work

Cigarette Butts;
Lab Scale Research

1 person ~ 75 packs cigarette ~1500 butts~ 75 g AC
15 persons ~ 1125 packs ~ 1.1 kg AC
2700 persons ~ 200 kg AC

Agricultural Wastes
- Used Composts
- Greenhouse Cover Films
- Sediment and pulp

*** 5 g of activated carbon is required for every 1 kg of battery.**
*** 0.5 kg AC → 500 kg battery → 1 EV**

Bio-waste could help power future energy storage systems

A battery for a large electric vehicle needs over 20 kg of graphite.

- Zero-cost resource
- Energy density of roughly ~1–10 kW/kg
- Large shelf-life
- Long cycle-stability
- High-conductivity
- High Surface Area
- Ability to control pore-size distribution

ISSN 1023-1935, Russian Journal of Electrochemistry, 2022, Vol. 58, No. 9, pp. 844–854. © Pleiades Publishing, Ltd., 2022.

Improving the Electrochemical Energy Storage Capacity of the Renewable Carbon Derived from Industrial Tea Waste

Ayşenur Karamustafa[a], Sözer Sözer[a], Kürşad Oğuz Oskay[b], Merve Buldu-Akturk[c], Emre Erdem[c], and Gökçen Akgül[a, *]

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[b] *Department of Metallurgy, Engineering Faculty, Cumhuriyet University, Sivas, 58140 Turkey*

[c] *Department of Materials Science and Nano Engineering, Sabancı University, Istanbul, 34956 Turkey*

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Abstract—Energy storage is gaining a vital role since the usage of portable electric/electronic devices and vehicles have been growing. Capacitors, called as electrochemical double layer capacitors or supercapacitors, find application on wide scale devices from mobile vehicles to huge electric vehicles with high energy and power densities, fast charge and discharge properties. Hence, energy is stored at the electrode–electrolyte interface, the electrode material forms the heart of this energy storage system. When the decreasing reserves of fossil resources and their environmental damages are considered, renewable 3-dimentional carbon could be a solution in the capacitor as carbon electrodes. Biomass-derived renewable carbon is cost-effective, abundant, sustainable, safety and environmentally friendly material. In this work, renewable carbon material was derived from industrial tea waste and three methods of graphitization, activation and heteroatom doping were implemented alltogether to develop the energy storage capacity of material. The structural ordering, surface area growth and capacitive contribution promoted the energy storage capacity to 25 F/g and high power density to 2.6 kW/kg of biowaste derived carbon.

Biomass Conversion and Biorefinery
https://doi.org/10.1007/s13399-022-02447-8

ORIGINAL ARTICLE

Upcycling process of transforming waste coffee into spherical graphene by flash pyrolysis for sustainable supercapacitor manufacturing with virgin graphene electrodes and its comparative life cycle assessment

Kuray Dericiler[1,2] · Atakan Kocanali[1,2] · Merve Buldu-Akturk[2] · Emre Erdem[1,2] · Burcu Saner Okan[1,2]

Received: 3 November 2021 / Revised: 24 January 2022 / Accepted: 6 February 2022

Abstract
In the present study, the fabrication of scalable and eco-friendly supercapacitor electrodes by upcycling process of transforming waste coffee into spherical graphene by applying flash and spinning pyrolysis with low energy consumption was reported, and two different supercapacitor configurations with virgin graphene electrodes obtained from graphite source were developed in a custom-designed system. Initially, waste coffee was directly converted into spherical graphene structures in the rotary furnace without applying any post-treatment. Extensive characterization indicated the formation of spherical graphene with an average particle diameter of 200 nm by flash pyrolysis with a significant increase in the C/O ratio from 8.45 to 19.78 and a high density of sp^2 bondings. This upcycled graphene was assembled with functionalized graphene and graphene oxide obtained from graphite acted as counter electrodes by using glass fiber as a separator and liquid electrolyte of KOH. The supercapacitor with upcycled graphene and reduced graphene electrodes has shown high capacitance retention of 93%, and Coulombic efficiency of 99% with a higher charge transfer resistance of 58 Ω. Furthermore, a comparative life cycle assessment study was carried out to investigate the carbon footprint and ecological impact of different graphene types received from virgin and recycled sources. The process of upcycling waste coffee was much more desirable from an ecological aspect and the release of CO_2 emissions to obtain sustainable supercapacitor electrodes compared to conventional graphene manufacturing techniques.

Jean-Paul Gueneau de Mussy

Pôle Mecatech

Pitch for 2024 HE Calls

Jean Paul Gueneau de Mussy,
Pôle Mecatech

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16 November 2023

Dans le cadre de sa stratégie de développement de l'économie circulaire « Circular Wallonia », le Gouvernement wallon a confié au Pôle Mecatech la coordination de la Task Force « Métallurgie, transport et batteries ».

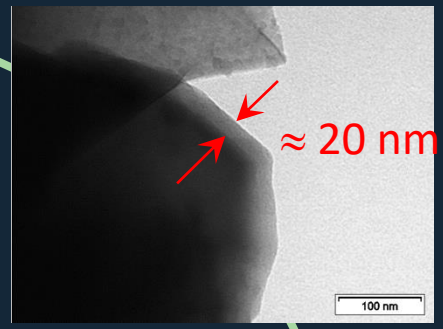
Supoort
CIRCULAR WALLONIA
Wallonie

Partners
Wallonia.be
EXPORT
INVESTMENT

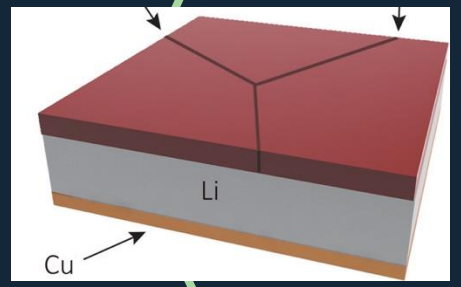
High throughput Li metal anode production

HORIZON-CL5-2024-D2-02-01

Zn: > 5 µm/min, pure, defect free.

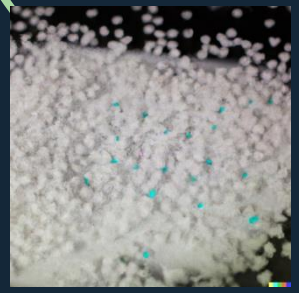


Li_3N: up to 5 µm/min, pure, solid electrolyte, pin-hole free



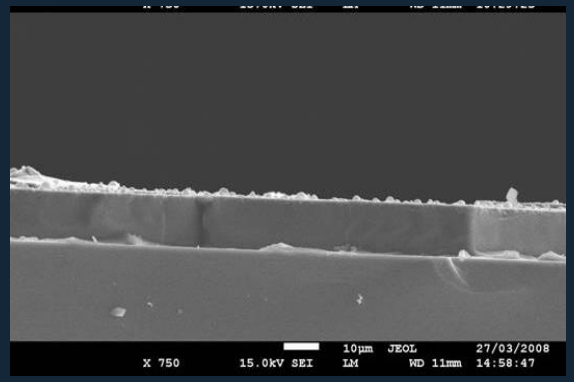
Coating on active powder material: water compatible process

Li : 20 µm / min, precise thickness and density



Specialized in coating deposition for batteries.

Very dense **10 µm** Li coating deposited in 1 minute



High throughput Li metal anode production

HORIZON-CL5-2024-D2-02-01

specialized in coating deposition for batteries.

Prof. Stéphane Lucas
Founder, CEO

Ph.D. Emile Haye
Product Development

Customers

Pôle Mecatech
Jeanpaul.demussy@polemecatech.be
www.polemecatech.be

In silico materials design
Combining Artificial intelligence, big data and high-throughput simulations

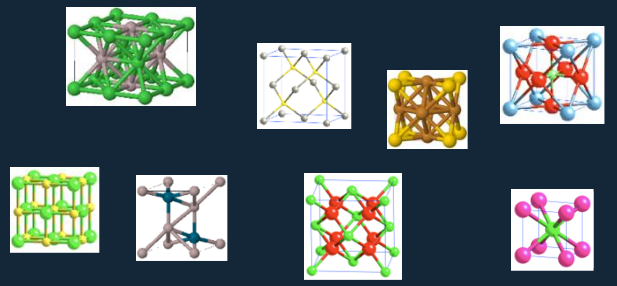
HORIZON-CL5-2024-D2-02-05

Matgenix

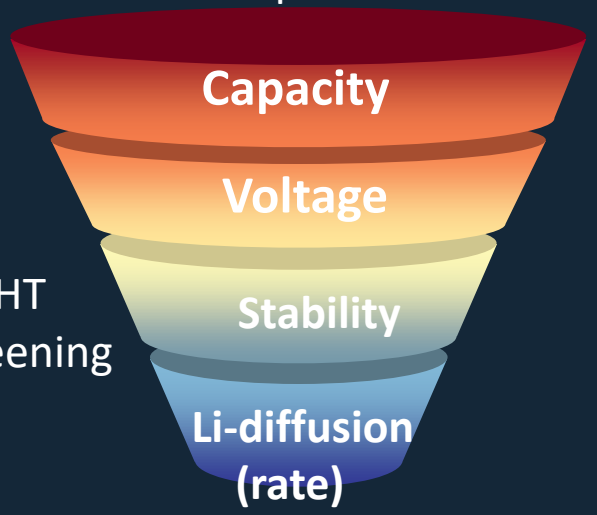
Artificial Intelligence

Data consolidation

High-Throughput simulations



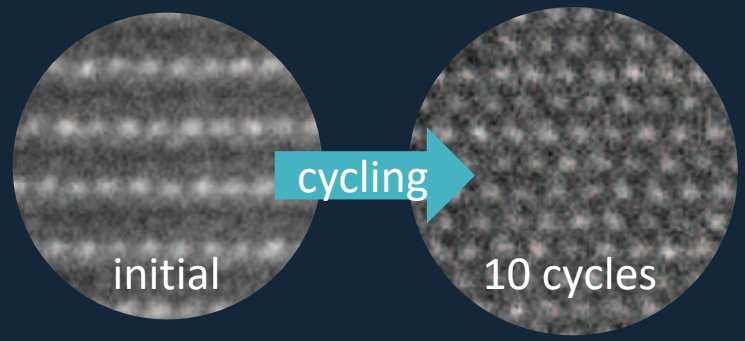
Thousands of potential materials

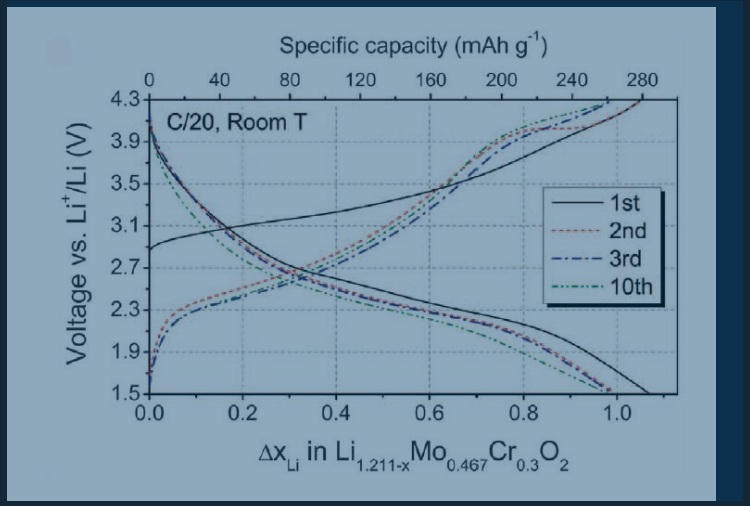


HT screening

New cathodes

Li-Ion Cathodes





In silico materials design
Combining Artificial intelligence, big data and high-throughput simulations

HORIZON-CL5-2024-D2-02-05

Matgenix

Prof. Geoffroy Hautier

Matthew Evans, Phd

Prof. Gian-Marco Rignanese

Matgenix

Guido Petretto, PhD

Guillaume Brunin, PhD

David Waroquiers, PhD

EU Projects (partner)

- BESS (Feb /23)
- NICKEFFECT (Jun /23)

Customers

umicore materials for a better life

BASF The Chemical Company

TOYOTA

SYNFUELS CHINA

RICHEMONT

Pôle Mecatech
Jeanpaul.demussy@polemecatech.be
www.polemecatech.be

Mathieu Saraiva

French Automotive & Mobility Network

01-03 – *Development of technical and business solutions top optimise the circularity, resilience, and sustainability of the (…) value chain.*

French Automotive & Mobility Network
Smart & Green

NOWOS

- **Nowos is the specialist in Lithium-Ion batteries repair.** Nowos is interested in extending the network of the circular economy of batteries and could bring its experience in repair & Eco-engineering

- Since 2020, Nowos has been developing the **lithium-ion battery circular economy** by offering manufacturers of electric vehicles, of power tools, of small household appliances and fleet owners the opportunity to extend the life of lithium-ion batteries. With **92% of batteries repaired**, Nowos helps to extend battery life over the long term. Nowos also provides eco-engineering services to enable manufacturers to improve the design of their batteries to extend their life. Nowos has also succeeded in developing a revolutionary process for **reusing and repurposing** the cells and moduls of the non-repairable batteries

- Nowos won in 2022 :
  - the gold award of the European Start-up price for Mobility
  - the Special Prize electro-mobility


French Automotive
& Mobility Network
Smart & Green

Renata Orinakova
University in Košice

Pavol Jozef Šafárik University
in Košice, Faculty of Science, Department
of Physical Chemistry Slovakia

Novel materials for advanced sustainable batteries

Topic 1:

HORIZON-CL5-2024-D2-01-01

Advanced sustainable and safe pre-processing technologies for End-of Life (EoL) battery recycling TRL5

WE OFFER

- Expertise in materials characterization, modelling and simulations
- Cooperation with Fecupral recycling company – pyrometalurgical processes
- Preparation of new cathode materials from recycled batteries

Vaše odpady, naše riešenie
FECUPRAL spol. s r. o.

InoBat

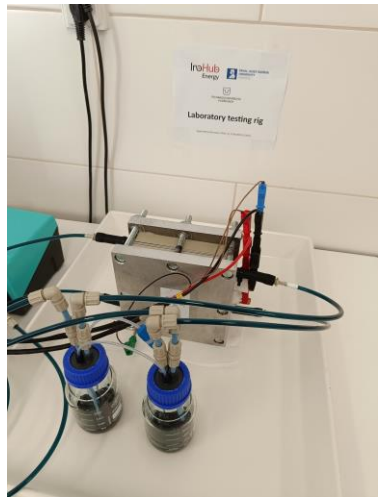
Topic 2:

HORIZON-CL5-2024-D2-01-02

Non-Li Sustainable Batteries with European Supply for stationary Storage TRL6-7

WE OFFER

- Expertise in redox-flow batteries – synthesis of novel organic electrolytes
- Novel design of redox-flow battery in cooperation with Ino-Hub Energy



Ino-Hub Energy

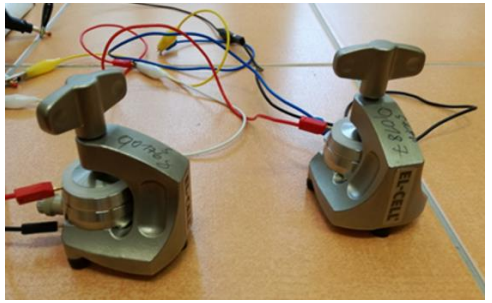
Technical University of Košice

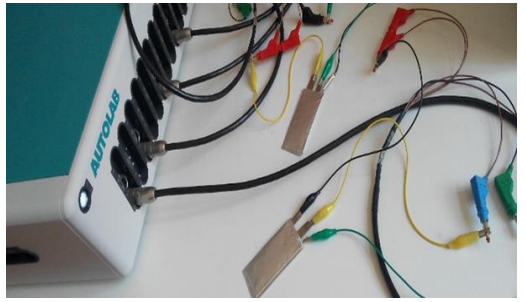
Topic 5:
HORIZON-CL5-2024-D2-02-02

Post Li-ion technologies and relevant manufacturing techniques for mobility applications TRL 4

WE OFFER

- Testing of Li-S lab prototypes and commercial cells in cooperation with Inobat and Theion
- Electrochemical sensing, improved safety and lifetime
- Digitalization – data analysis





THANK YOU FOR YOUR ATTENTION

Assoc. Prof. RNDr. ANDREA STRAKOVÁ FEDORKOVÁ, PhD.

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SBaA
SLOVENSKÁ BATÉRIOVÁ ALIANCIA

Laurent Paris

Efectis

TESTING AND SIMULATIONS OF BATTERY FIRES & EXPLOSIONS

Laurent Paris – Technical Director

Efectis

STANDARDIZED AND CUSTOMIZED FIRE TESTS

Efectis can perform

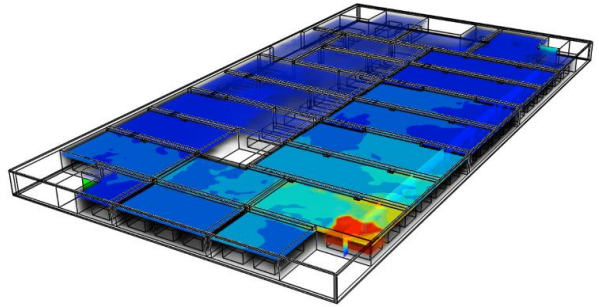
- Fire tests on all types of batteries according to existing standards
- Special tests adapted to your need: evaluation of safety elements, protection, extinguishing system, etc.
- All scales from small-scale cells and modules up to several containers with accurate characterization of (flammability parameters, heat release rate, gas analysis, etc.)

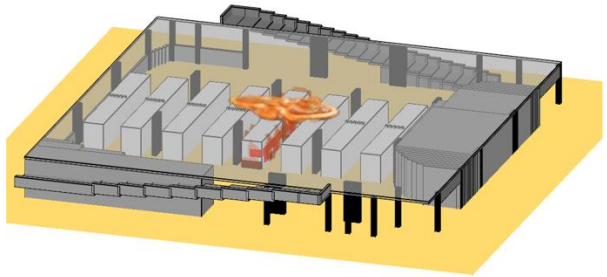
Possibility of carrying out accredited tests on the applicant's site

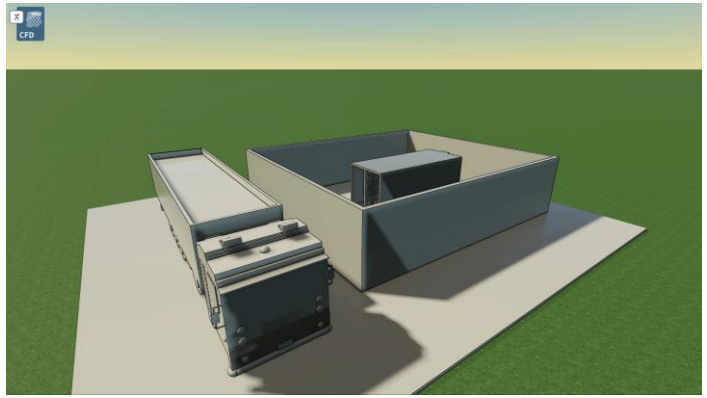
BATTERY FIRE & EXPLOSION NUMERICAL SIMULATIONS

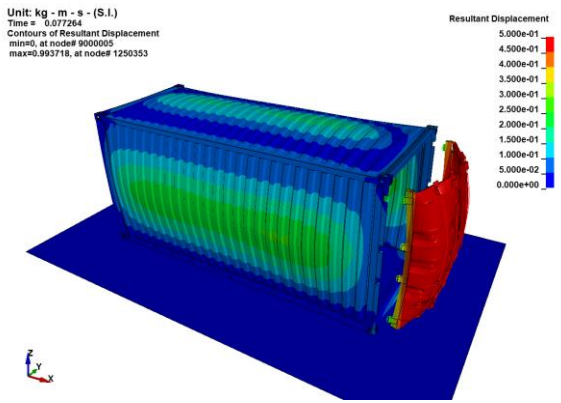
Fire test are complemented with risk analysis and numerical simulations to evaluate:

- Fire development, heat flux & safety distances
- The sizing of the discharge walls
- Assessment of the explosion effects outside of BESS on adjacent containers, through walls and doors
- Thermomechanical calculations to characterize the fire resistance of doors and walls and resistance to overpressure
- Simulations of dispersion/accumulation
- Impact of smoke on human safety (personnel and means of intervention)









LET'S WORK TOGETHER!

We are looking to team up with other partners to answer the calls:

- **HORIZON-CL5-2024-D2-01-02** (Deadline 18 April 2024): Non-Li Sustainable Batteries with European Supply for stationary Storage TRL6-7
- **HORIZON-CL5-2024-D2-02-03** (Deadline 7 May 2024): Size & weight reduction of cell and packaging of batteries system, integrating lightweight and functional materials, innovative thermal management and safe and sustainable by design approach TRL 6-7

In both projects, we can cover the following aspects:

- Demonstrating and validating the safety of a battery in the event of failure through fire testing and thermal propagation measurements.
- Conducting fire & explosion simulations under different scenarios.
- Evaluating the effectiveness of safety measures at every level (module, pack, system).
- Conducting a comprehensive analysis of fire and explosion risks to ensure compliance with established societal toxicity and safety standards.

MERCI DE VOTRE ATTENTION

Avez-vous des questions ?

Contacter nous :

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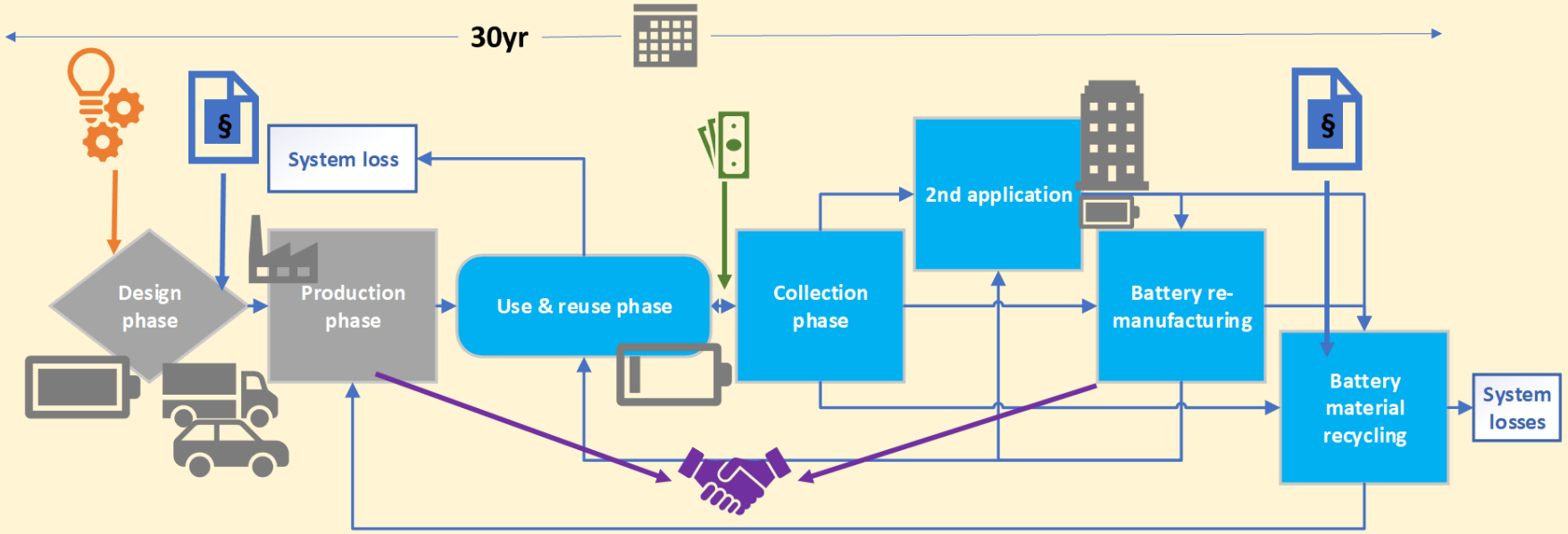
Martin Kurdve
RISE

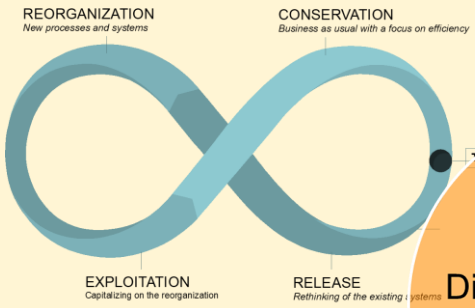
Sustainability and resilience through circularity

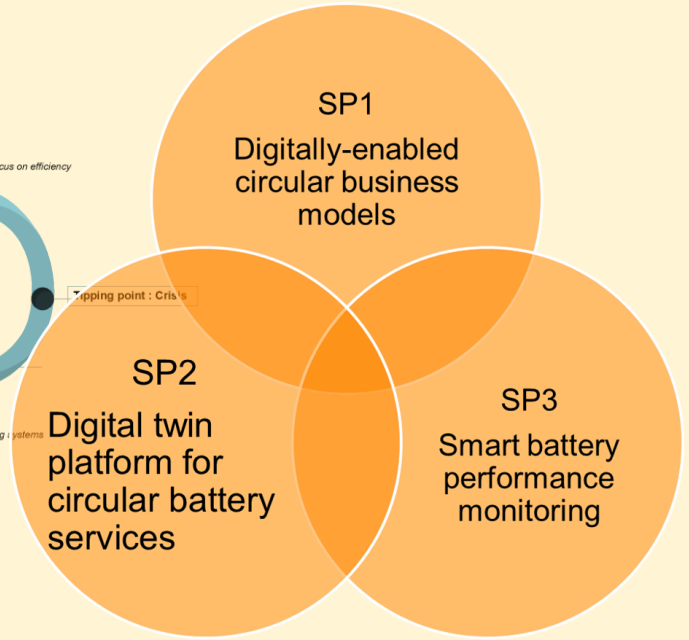
Martin Kurdve RISE martin.kurdve@ri.se



Kurdve, M., Zackrisson, M., Johansson, M. I., Ebin, B., & Harlin, U. (2019). Considerations when modelling EV battery circularity systems. *Batteries*, *5*(2), 40

Circul-∞





HORIZON-CL5-2024-D2-01-03: Development of technical and business solutions to optimise the circularity, resilience, and sustainability of the European battery value chain TRL5

RI. SE

Per H. Svensson
RISE

Robotised Screening for Accelerated Discovery of Novel and Sustainable Energy Materials

Per H. Svensson, RISE

HORIZON-CL5-2024-D2-02-05

Background & Problem

A grand challenge for humanity is to discover new sustainable materials to solve many of the existing societal challenges. Currently this takes an alarming long time and consequently there is an urgent need for development and progress in the area.

To meet these challenges, society requires new methodologies and techniques. We have for many years been engaged in materials screening efforts and concurrently pursuing an initiative to develop a novel robotised screening platform to accelerate the discovery of sustainable energy materials.

Previous Platform Generation

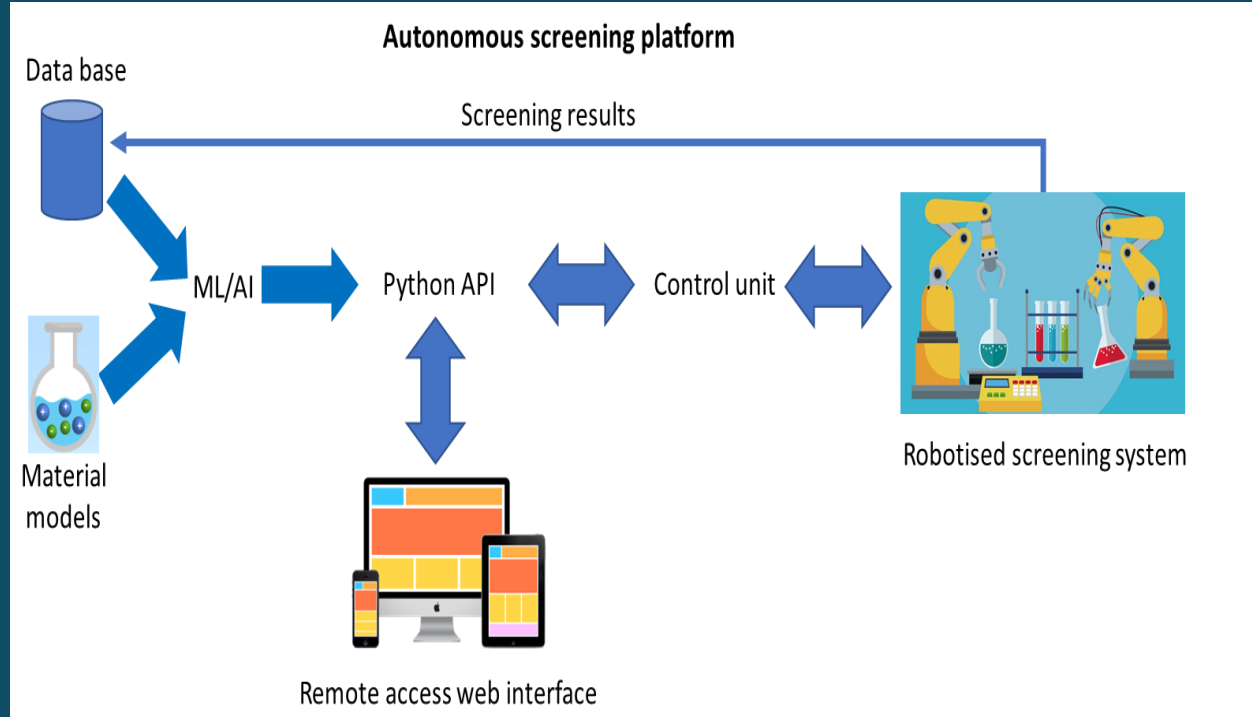
- Expensive, high maintenance & space-demanding
- Platform development very challenging
- Significant waste generation

Solution & Benefits

Given the rapid advancements in the field of robotics and AI/ML, it is now feasible to design intelligent, compact, and versatile screening platforms capable of replacing larger ones with smaller, modular counterparts equipped with AI/ML capabilities.

This type of modular system can therefore be tailored for specific tasks at a relatively low cost, which opens exciting new possibilities for accelerated & intelligent screening of novel and sustainable energy materials.

- AI/ML compatible → autonomous platform
- Low material usage & waste generation
- High repeatability & throughput
- Streamlined platform development
- "Low cost" platform & low maintenance



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Selected Publications

J. Am. Chem. Soc. 2020, 142, 43, 18437.

Chemical Engineering Journal, 2023, 455, 2, 140955.

Digital Discovery, 2023, 2, 799–808 , 799.

SVT News, 2021-03-02 , Robotic screening of the future energy materials.

Gabriel Espinosa
IREC

Shaping Energy for a Sustainable Future

Institut de Recerca en Energia de Catalunya (IREC)

Gabriela Espinosa (gespinosa@irec.cat)

Areas of expertise

IREC
Shaping Energy for a Sustainable Future

Characterisation, fabrication, assembly and testing

1. **Electrode and battery materials characterisation:** The physiochemical properties of the cell components (carbon, binders, active materials, electrolytes, etc..) can be characterised using a large spectrum of techniques, including XRD, SEM, TEM, Raman spectroscopy, XPS, UV-vis spectrophotometry, AFM, N2-physisorption, thermogravimetric analysis, ellipsometry, PSD, ICP, AC impedance spectroscopy and conductivity measurements (4- and 2- point).
2. **Electrode fabrication and cell assembly:** Standard activities performed at IREC to evaluate new components and the effect of impurities, including new electrolyte formulations. Electrodes from fresh or recycled materials can be fabricated using the Doctor Blade technique and calendaring to mimic commercial high-loading electrodes. IREC can assemble specific coin cells: half-, symmetric-, 3-electrode and full-cells for the electrochemical characterisation of electrodes and cell components.
3. **Electrochemical testing:** IREC has several cell and battery testers and potentiostats with > 100 coin cell channels available, some installed inside a glove box for electrode characterisation in inert conditions. Galvanostatic and potentiostatic techniques are combined with ac impedance spectroscopy using equivalent circuit analysis to identify the main electrical contributions. Also, the diffusivity and conductivities of cell components can be evaluated and correlated to post-mortem studies.
4. **Ageing tests:** Battery cell (≤30 Ah) testing can also be conducted at high temperatures using an ACS/ATT climate chamber model FM600 in the temperature range of -35/100 ˚C and relative humidity range of 10-98%.
5. **Post-mortem characterisation:** End-of-life battery cells can be dismantled and components investigated to identify degradation mechanisms. For post-mortem analysis the following techniques are available: XRD, SEM, TEM, Raman spectroscopy, XPS, UV-vis spectrophotometry, AFM, chemisorption, N2-physisorption, thermogravimetric analysis, ellipsometry, PSD and ICP.

Interest areas

HORIZON-CL5-2024-D2-01-01: Advanced sustainable and safe pre-processing technologies for End-of Life (EoL) battery recycling TRL5

Battery characterisation, fabrication, assembly and testing described on previous slide.

IREC can provide valuable insights and assessments on innovative solutions that align with European and national regulations, particularly in the context of batteries and the new EU battery regulation and battery passport. IREC's vast experience life cycle assessment (LCA) of products and energy technologies, incorporating eco-design concepts, and aligning LCA project models can greatly contribute to the project's objectives. This is in commitment to facilitating the transition towards a more sustainable and circular economy by prolonging the useful life of goods/products and enabling their recovery at the end of their life cycle. IREC can provide considerations for the potential for reuse of components and understand the impacts on the recycling supply chain and the reuse markets. Evaluate the ageing and performance difference between batteries manufactured from raw materials and from recycled ones.

HORIZON-CL5-2024-D2-01-03: Development of technical and business solutions to optimise the circularity, resilience, and sustainability of the European battery value chain TRL5

Battery characterisation, fabrication, assembly and testing described on previous slide as well as LCA/LCC, sustainable design, and circular economy concepts described above. Additionally, IREC can evaluate new business models leveraging considerations for reuse through remanufacturing, refurbishing, repairing and recycling of battery components, modules or entire systems (e.g., integrate reuse into electric car fleet and sharing models). Assess preferred strategy for recycling, reuse, etc. based on environmental/cost assessment (LCA/LCC) considering the battery health, expected second-life performance for different applications (with RUL calculation) and recycling value.

Interest areas

HORIZON-CL5-2024-D2-01-05: Furthering the development of a materials acceleration platform for sustainable batteries (combining AI, big data, autonomous synthesis robotics, high throughput testing TRL 3-4

Battery characterisation, fabrication, assembly and testing described on previous slides.

IREC can offer expertise in identifying lightweight and functional materials, and innovative thermal design from a sustainable design perspective to help achieve the project's objectives. Also, contribute to identifying sustainable design solutions for implementing innovative thermal management practices to improve the battery system's performance and efficiency.

HORIZON-CL5-2024-D2-02-01: Sustainable high-throughput production processes for stable lithium metal anodes for next generation batteries TRL 6-7

Battery characterisation, fabrication, assembly and testing described on previous slides.

This call could be interesting to build on work proposed in the ULTRADRY project (currently it has passed the second phase of evaluation). We can offer valuable insights and assessments on innovations that enhance resource efficiency and promote the reuse of materials as secondary raw materials in the production cycle. Additionally, analyzing the life cycle of products and energy technologies, incorporating eco-design concepts, and aligning LCA project models with European and National regulations, particularly in relation to batteries and the new EU battery regulation, can greatly contribute to the project's objectives.

IREC

Shaping Energy for a Sustainable Future

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Omar Perego
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RSE Ricerca Sistema Energetico | we move

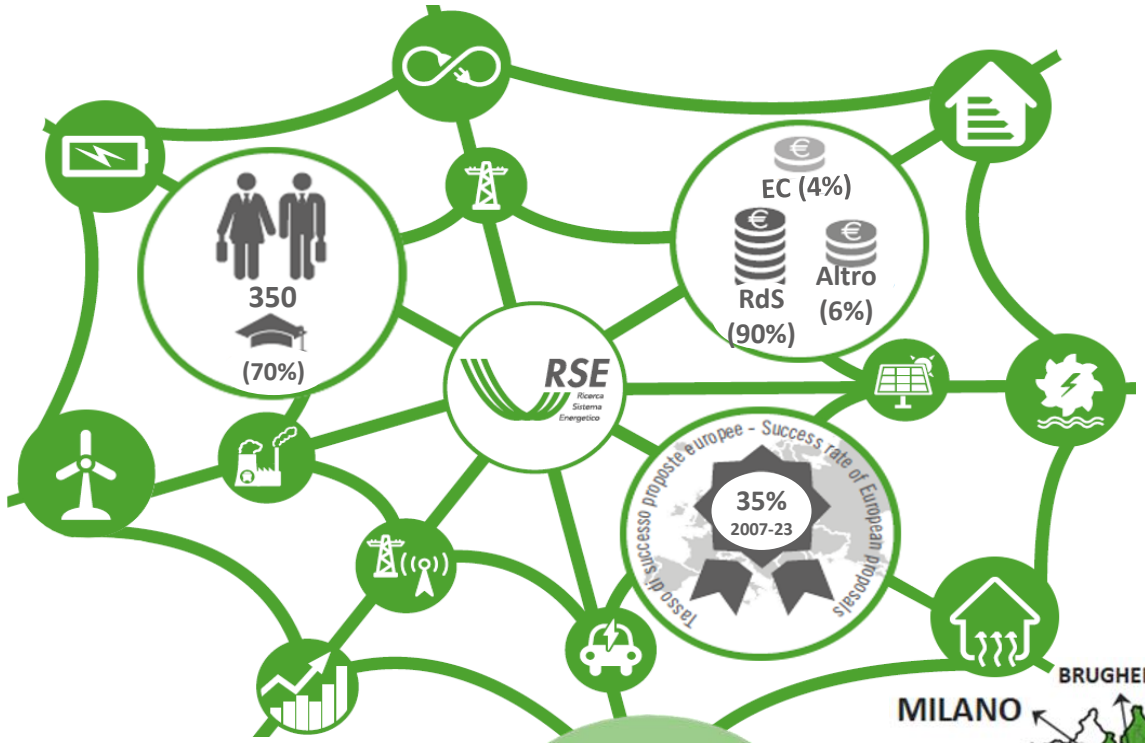
ANODES, BMS AND LCA/LCC FOR SODIUM-ION BATTERIES

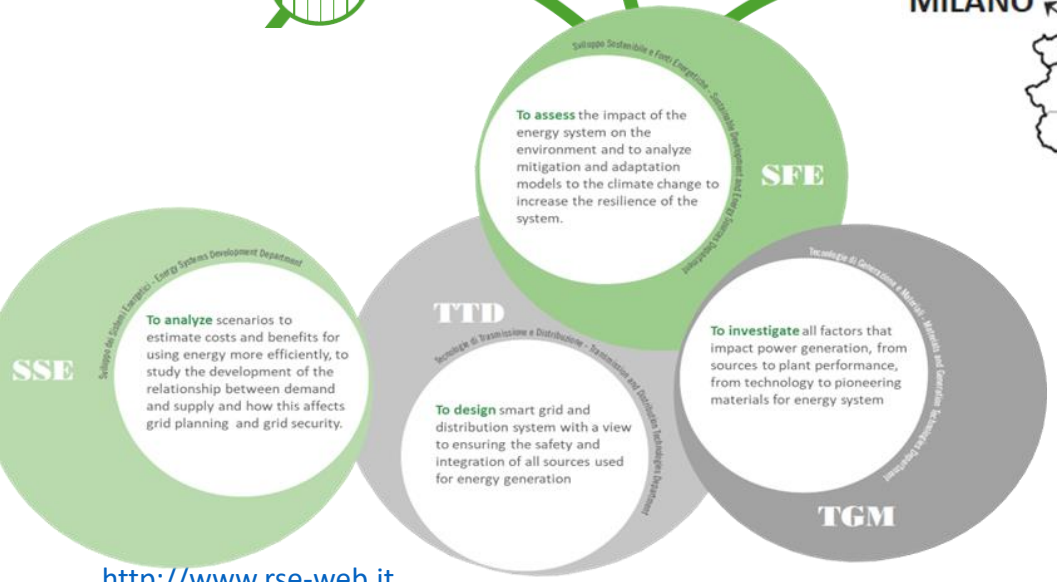
Irene Quinzeni

Omar Perego

Ricerca sul Sistema Energetico – RSE S.p.A.

RSE Ricerca Sistema Energetico | we move





2023

SENERGY NETS

SCARLET
Superconducting CAbles foR sustainaLe Energy Transition

ADMIT
AC & DC High Frequency Instrument Transformers

2022

AUDIT2MEASURE

2021

LIFE REMY

REMY

2020

ERIGRID 2.0
Connecting European Smart Grid Infrastructures

IT4PQ
Instrument Transformers for Power Quality

http://www.rse-web.it

RSE ACTIVITIES

COVERED THE WHOLE VALUE CHAIN

TOPICS FOR COLLABORATION

- New anode material: **MXene** $Ti_3C_2T_x$ **MAXphases** $(Ti/Sn)O_2$
- Evaluation of environmental (LCA), **economic** (LCC) and **social sustainability**
- Development of **BMS** for any type of battery

FOR SODIUM-ION BATTERIES WE ALSO RESEARCH :

- Medium/high potential **Cathodes** materials
- **Solid Electrolyte**
- Conversion and **Alloy anodes**

HORIZON-CL5-2024-D2-01-02

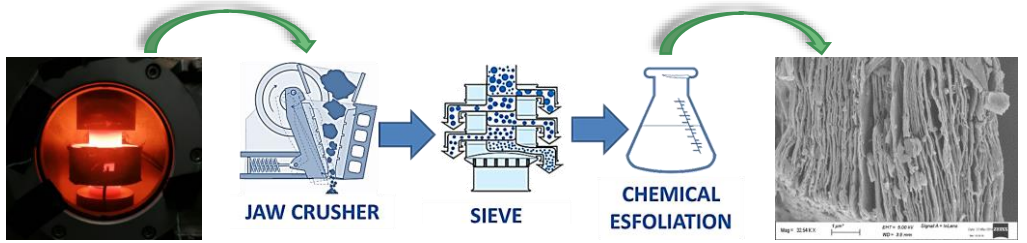
- Develop **new materials** that improve techno-economic performances and/or the ability to meet sustainability targets.
- Demonstrate a credible commercial and technical path, from end-of-project outcomes to a stationary-energy-storage product, and which takes account of future manufacturing and recycling requirements. **Provide evidence of current and future sustainability**, viable European supply chains and rigorous analyses of the complex sustainability and recyclability issues including compatibility with regulation, including recycling regulations.
- **BMS** development is within scope where relevant but should not be the main focus of the project.

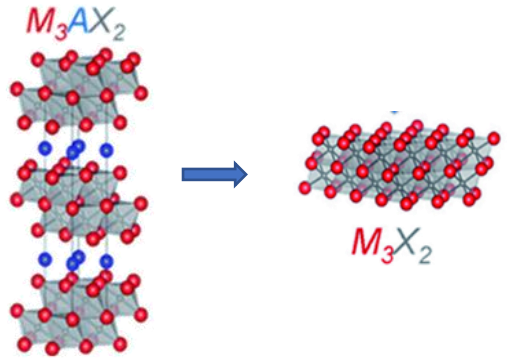
MXene

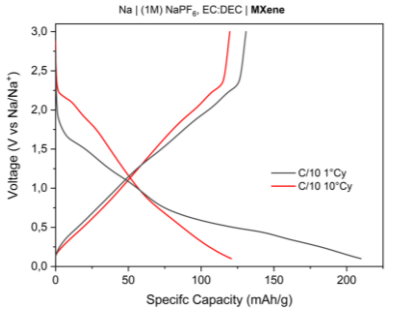
$Ti_3C_2T_x$ (T_x = O, F, OH)

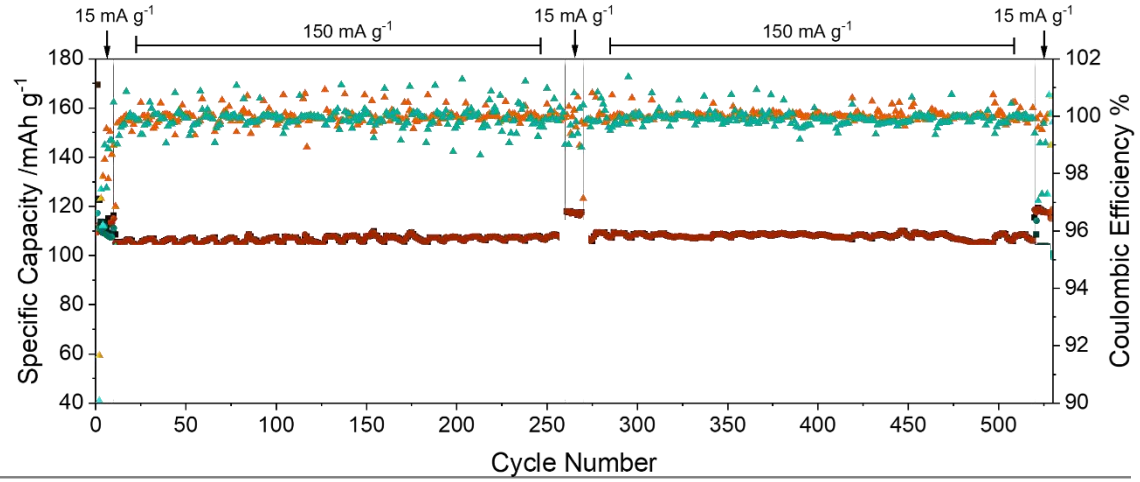
$2TiC+Ti+Al \rightarrow Ti_3AlC_2+HF \rightarrow Ti_3C_2T_x$ (T_x = O, F, OH)

- With the current synthesis we can guarantee a **purity of 98% of $Ti_3C_2T_x$ phase**
- **MXene** can be a good material **comparted** with **hard carbon**.
- RSE is working on **Scalability of synthesis process**
- **Work potential range: 0,1 - 3 V** (average: 1,3 V)
- **Mxene** has been cycled **in a full cell**









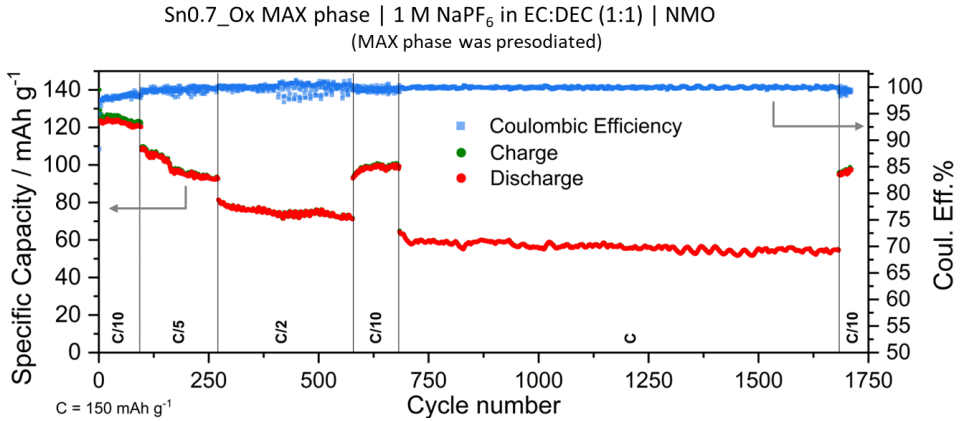
Nano Lett. 2021, 21, 19, 8290–8297,
https://doi.org/10.1021/acs.nanolett.1c02809

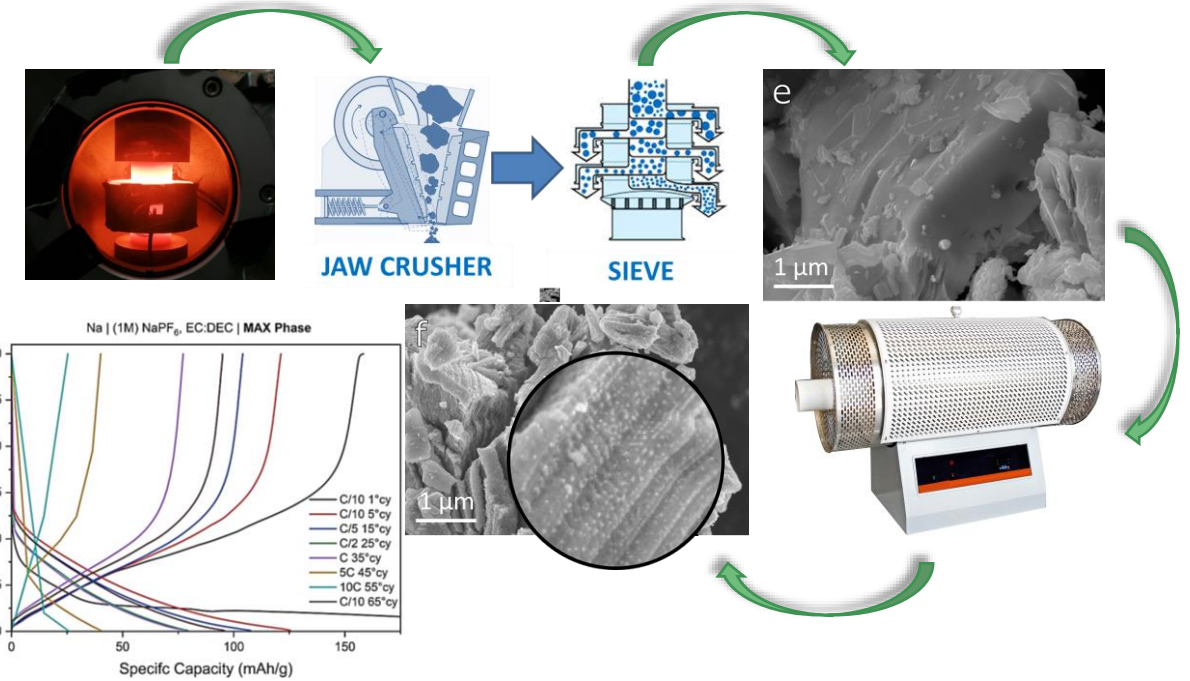
MAXphase

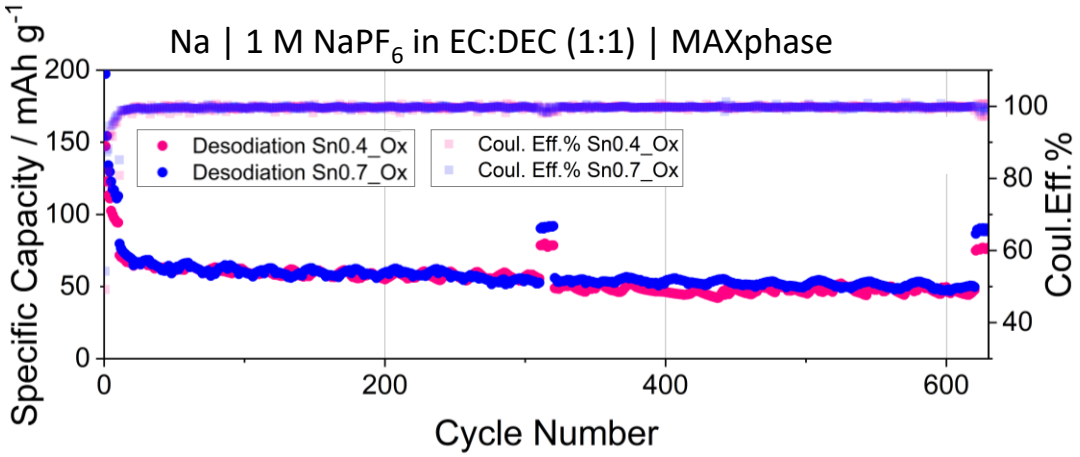
$(Ti/Sn)O_2$

$xSn+2TiC+Ti+1-xAl \rightarrow Ti_3SnxAl_{1-x}C_2+O_2 \rightarrow (Ti/Sn)O_2$
$(0<x<1)$

- Same synthesis of MXene but **without hydrofluoric acid**
- RSE is working on **Scalability of synthesis process**
- With the actual synthesis we can guarantee a maximum of **impurity equal to 2% of TiC phase**.
- **Work potential range: 0,1 - 3 V** (average: 1,3 V)







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Çağla Odabaşı Özer
SIRO

siro

BEPA Horizon ‘24 Project Ideas Pitch Presentation

BEPA Batteries European Partnership Association

Dr. Çağla Odabaşı Özer
R&D and Engineering

BEPA Horizon ‘24 Matchmaking Workshop, 16November 2023, 14:00-17:30

Outline

- Siro Energy Introduction
- Siro Interests and Horizon Europe Projects
- Project Pitch for HORIZON-CL5-2024-D2-01-01

Advanced sustainable and safe pre-processing technologies for End-of Life (EoL) battery recycling

- Project Pitch for HORIZON-CL5-2024-D2-02-05

Furthering the development of a materials acceleration platform for sustainable batteries (combining AI, big data, autonomous synthesis robotics, high throughput testing)

Siro Introduction

siro
Clean Energy
For New Generations

Togg FARASIS

Strategic business partner manufacturing highest energy density, carbon neutral and safe cells who believes in growing together

2022
Module and Pack Development

Prototype Production

April 2023
Starting the construction of Siro Battery Development and Production Campus

2024
Stationary Energy Storage Solutions 4+ GWh

2031
Capacity Increase - 1 20 GWh

2023
Module and Pack Serial Production

Cell Development

2024
Fully automated Production in Siro Battery Development and Production Campus

2026
siro

Start of Production of Cells 8 GWh

New Customers

We founded Siro on September 21th 2021 with the goal of creating a regional massive battery player

Siro HQ,
Battery Development Center
@Bilişim Vadisi, Gebze

Siro Battery Technology Center
Siro -1 @Gemlik

Siro HQ & Battery Development Center
@Bilişim Vadisi, Gebze

Siro Battery Technology Center
Siro -1 @Togg Teknoloji Kampüsü, Gemlik

We are aiming at becoming Europe's battery and clean energy base with additional undertakings in the Battery Ecosystem

- BIG-LEAP
- EFFEREST

Project Pitch Idea #1

HORIZON-CL5-2024-D2-01-01:
Advanced sustainable and safe pre-processing technologies for End-of Life (EoL) battery recycling

Project Pitch Idea #1

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HORIZON-CL5-2024-D2-01-01:
Advanced sustainable and safe pre-processing technologies for End-of Life (EoL) battery recycling

- Deadline: 18 April 2024 TRL 5

Introduction:

- Addressing the critical role of pre-treatment in lithium-ion battery (LIB) recycling.
- Emphasizing the significance of reducing strategic dependencies and promoting a circular economy.

Project Objectives:

- Develop advanced pre-processing methods for efficient and safe LIB recycling.
- Focus on improving recovery yield, enhancing the circularity of battery materials, and minimizing waste side products.
- Align with the zero-waste concept, contributing to the EU's green and digital transitions.

Project Pitch Idea #1

HORIZON-CL5-2024-D2-01-01:
Advanced sustainable and safe pre-processing technologies for End-of Life (EoL) battery recycling

- Deadline: 18 April 2024

TRL 5

Holistic Battery Sorting

AI-driven sorting system for efficient identification and separation of diverse cell types and chemistries.

Advanced Pre-processing Methods

Integration of physical, mechanical, dry, thermal, and aqueous pre-treatment methods, including microbial bioleaching and selective dissolution.

Laser based techniques for precise separation of battery components.

3D printing for customizable and efficient battery recycling equipment.

Anode Material Recovery and Electrolyte Valorization

Focus on recovering anode materials and valorizing Li-salts through sustainable processes.

Comprehensive Material Separation

Innovative processes to separate steel, plastic, and other materials, including non-metallic elements, and recover electrode current collectors (Al and Cu) by enhancing separation methods for metal foils

Life Cycle Sustainability and Safety Assessment

Pre-assessment for life cycle sustainability and safety impacts, ensuring techno-economic solutions that minimize environmental impact and cost.

Strengthening the European Economic Base

Battery Industry Circular Transition

Circularity of Battery Materials

Environmentally Beneficial Pre-treatment

Improved Process Viability

- Pack/Module/Cell provider
- Pack/Module/Cell testing and validation
- Pack/Module dismantling
- Evaluating the performance of the recycled materials at lab scale

Project Pitch Idea #2

HORIZON-CL5-2024-D2-01-05

Furthering the development of a materials acceleration platform for sustainable batteries (combining AI, big data, autonomous synthesis robotics, high throughput testing)

Project Pitch Idea #2

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HORIZON-CL5-2024-D2-01-05

Furthering the development of a materials acceleration platform for sustainable batteries (combining AI, big data, autonomous synthesis robotics, high throughput testing)

- Deadline: 18 April 2024

TRL 3-4

Introduction:

- Addressing the critical need for a fully autonomous and chemistry-neutral Materials Acceleration Platform (MAP) for battery materials and interfaces.
- Highlighting the slow and insufficient trial-and-error approach, emphasizing the necessity for acceleration in battery material discovery.

Project Objectives:

- Develop a fully autonomous MAP integrating computational modeling, materials synthesis, characterization, and testing.
- Accelerate the discovery of new battery chemistries with ultra-high performances by at least a factor of five.
- Contribute to the BATTERY 2030+ initiative and increase autonomy in the discovery and development process.

Project Pitch Idea #2

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HORIZON-CL5-2024-D2-01-05

Furthering the development of a materials acceleration platform for sustainable batteries (combining AI, big data, autonomous synthesis robotics, high throughput testing

Development of an infrastructure for Secure Remote Data Access and Predictive Modelling

Establishing a secure cloud infrastructure for remote data access in European HTE labs, following FAIR data principles.

Implementing blockchain for data transparency and reliability

Developing a business model for regional datacenters.

Enhancing the autonomous battery-MAP by efficiently screening materials, providing real-time device diagnosis.

Integrating physics-based models.

Prioritizing dynamic observation of battery interfaces for improved performance and extended lifespan.

Automated High Throughput Characterization and Experimental Workflows

Autonomous Synthesis Robotics and Orchestration Software

Building fully autonomous systems for battery material synthesis, overcoming challenges in multi-step and high-temperature processes.

Integrating reinforcement learning for autonomous HTE systems.

Providing a real-time knowledge extraction platform for quick insights into

Creating SOH prediction algorithms to shorten battery testing.

Using ML for battery design and new material discovery.

Implementing an evaluation strategy for model robustness and accuracy.

AI-Assisted Models for Multiple Scale Battery Processes

IPR Strategy of the discovered materials with AI

Accelerate the discovery of sustainable battery materials.

Strengthen European competitiveness in the battery material and cell industry.

Foster a community-wide collaborative environment for data access and automated workflows, utilizing European HPC architectures and large- scale facilities.

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- Cell development and testing lab infrastructure for secure remote data access
- Development of predictive models using big-data
- Cell characterization

Let’s come together for a c.l.e.a.n.© future!

siro

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Siro Energy

#c.l.e.a.n.©energy