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TURKEY in HORIZON 2020
COOPERATION. INNOVATION. COMPETITIVENESS

Technical Assistance for Turkey in Horizon 2020 Phase-II
EuropeAid/139098/IH/SER/TR

Focus Group Training 17

Dr Ian Gee & Dimitrios Papageorgiou

Istanbul, 09 May 2022

Session 2:
A Detailed Look: HE Batteries Calls 2022

Batteries Partnership: 2022 Call in figures

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- Call - HORIZON-CL5-2022-D2-01 Cross-sectoral solutions for the climate transition
- 10 topics for the Batteries Partnership (7 RIA; 2 IA; 1 CSA) + 1 relevant topic (….)
- Deadline: 06 September 2022
- Overall indicative budget: 133M€ + ….

Note 1: Based on Workprogramme Version Final, 15/12/2021.
Note 2: Applicants should use the official call documents (including Horizon Europe Cluster 5 Workprogramme; Admissibility conditions, eligibility conditions, financial & operational capacity and exclusion, award criteria, etc. This presentation serves informative purposes.

Overview of 2022 Call Topics (1/2)

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HORIZON-CL5-2022-D2-01-01

Sustainable processing and refining of battery grade graphite

IA(60% for profit); TRL6-7; 5M€; 2 projects to be funded

HORIZON-CL5-2022-D2-01-02

Interface and electron monitoring for the engineering of new and emerging battery technologies

RIA; TRL3-4; 5M€; 2 projects to be funded

HORIZON-CL5-2022-D2-01-03

Furthering the development of a materials acceleration platform for sustainable batteries

RIA; TRL3-4; 20M€; 1 project to be funded

HORIZON-CL5-2022-D2-01-04

Towards creating an integrated manufacturing value chain in Europe: from machinery development to plant and site integrated design

IA(60%; 70 pages); TRL3 -> TRL6 (machinery); TRL6 ->TRL 7 (manufacturing supply chain); 7-8M€; 2 projects to be funded

HORIZON-CL5-2022-D2-01-05

Next generation technologies for High-performance and safe-by-design battery systems for transport and mobile applications

RIA; TRL5; 5M€; 3 projects to be funded

HORIZON-CL5-2022-D2-01-06

Embedding smart functionalities into battery cells (embedding sensing & self-healing functionalities to monitor &self-repair battery cells)

RIA; TRL2-4; 5M€; 3 projects to be funded

Overview of 2022 Call Topics (2/2)

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HORIZON-CL5-2022-D2-01-07

Digitalisation of battery testing, from cell to system level, including lifetime assessment

RIA; TRL5-6; 5M€; 3 projects to be funded

HORIZON-CL5-2022-D2-01-08

Coordination of large-scale initiative on future battery technologies

CSA; 3M€; 1 project to be funded

HORIZON-CL5-2022-D2-01-09

Physics and data-based battery management for optimised battery utilisation

RIA; TRL4; 5M€; 3 projects to be funded

HORIZON-CL5-2022-D2-01-10

Streamlined collection and reversed logistics, fully automated, safe and cost-efficient sorting, dismantling and second use before recycling

RIA; TRL5-7; 5M€; 3 projects to be funded

Why is the call text so important

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- Can help to define the scope of a project
- Can define the Impact section & metrics
- Sometimes really defines the problem to be solved
- Helps to identify project gaps and potential partner roles
- Identifies potential opportunities for organisations to join consortia
- Helps to keep our project in scope
- Helps to maximise the proposal score

Sustainable processing and refining of battery grade graphite (1/5)

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HORIZON-CL5-2022-D2-01-01

IA(60% for profit; 70pages); TRL6-7; 5M€; 2 projects to be funded

Relevance: *European Partnership 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'*

Outcome

For graphite, both **natural and synthetic graphite** production for the EV market take place almost exclusively in China

Relevant project: ICARUS

Innovative eco-efficient processing and refining routes for secondary raw materials from silicon ingot … Focus on PV manufacturing

Sustainable processing and refining of battery grade graphite (2/5)

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HORIZON-CL5-2022-D2-01-01

Project results to contribute to all following:

- **Decreased dependency** of Europe on imported battery grade graphite and **decreased risk** in European Battery supply chains
- Graphite (both natural and synthetic) **competitively produced and refined in Europe** in a sustainable and socially acceptable way
- Graphite leveraging the potential for **fast charging of batteries** (key factor for the user acceptance of electric vehicles)
- **Reduced carbon and environmental emissions** from the anode material supply chain
- European Raw Materials Alliance objectives

Sustainable processing and refining of battery grade graphite (3/5)

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HORIZON-CL5-2022-D2-01-01

Synthetic graphite projects to focus additionally on:

- System **prototype demonstration** of battery grade anode graphite material with high energy density, long lifetime and quality (enabling fast charging, produced with increased yield and lower environmental footprint)
- Biocarbon alternatives to petroleum coke are expected to be developed to ensure long term sustainable supply

Natural graphite projects to focus additionally on:

- Advanced **refining** of Natural graphite to **improve the yield** of battery grade products and lower the environmental footprint

Sustainable processing and refining of battery grade graphite (4/5)

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HORIZON-CL5-2022-D2-01-01

Scope

- ✓ Enabling **European graphite production** – with vertical integration into the battery production
  - ✓ Resource efficient sustainable production of synthetic & natural graphite emphasising reduction of energy consumption, CO2 emissions, chemical use and the optimisation of recovery yield and raw material consumption
  - ✓ Enhance versatility regarding products and usable primary/secondary raw materials
- ✓ Development of solutions for combined use of natural and synthetic graphite

- ✓ **For natural graphite**: improving purification, milling, shaping and coating technologies that improve the performance characteristics of natural graphite
- ✓ Improving yield of spheronised products from **natural graphite** concentrate
- ✓ Development of a non-HF purification technology to produce battery-grade anode material from spheronised natural graphite

Sustainable processing and refining of battery grade graphite (5/5)

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HORIZON-CL5-2022-D2-01-01

Scope (continued)

- ✓Developing improved coating technologies for **natural graphite** to increase performance characteristics of natural compared to synthetic
- ✓For **synthetic graphite**: Improving graphitisation, calcining, milling, shaping and coating that improve graphite performance characteristics
- ✓Other available European carbon options to be developed (e.g. biobased anode carbon and by-products from anode material production as raw materials for **synthetic graphite**)
- ✓Development of new processes for **synthetic graphite** production from natural gas pyrolysis
- ✓Reduction of process discharge & emissions in synthetic graphite production

Interface and electron monitoring for the engineering of new and emerging battery technologies (1/4)

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HORIZON-CL5-2022-D2-01-02

RIA; TRL3-4; 5M€; 2 projects to be funded

Relevance: BATTERY 2030+; European Partnership 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'

Outcome

- State-of-the-art in **experimental and computational techniques for characterisation of battery materials** and interfaces are targeting the scale of the atoms and ions (still a lack of understanding; the time and the length scale of the electron transfer reactions remain almost completely underexplored)
- Pushing the frontiers of present in situ analytical techniques is a must to more efficiently pursue **research on sustainable materials** and to develop **greener Li-ion & future battery chemistries**

Relevant project: BATNMR

Interface and electron monitoring for the engineering of new and emerging battery technologies (2/4)

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HORIZON-CL5-2022-D2-01-02

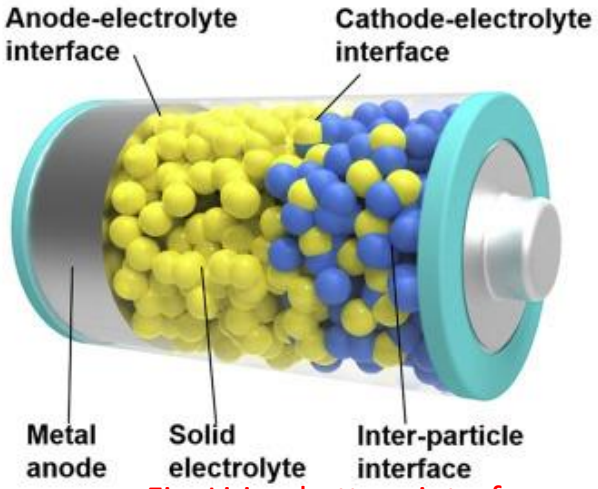

Fig. Li-ion battery interfacces

Source: Xu, Lin, Shun Tang, et. al. "Interfaces in solid-state lithium batteries." *Joule* 2, no. 10 (2018).

Project results (contributing to all following):

- **New methods** for studying electrode/electrolyte interfaces for liquid-based electrolytes and batteries and for studying solid-state and buried interfaces.
- **Models** for explaining the **degradation** of battery interfaces.
- Deeper understanding of the **formation and evolution of battery interfaces**

leading to new insights on how to increase the lifetime and safety of new and emerging battery technologies, and therefore contributing to the long-term competitiveness of the European battery industry

Interface and electron monitoring for the engineering of new and emerging battery technologies (3/4)

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HORIZON-CL5-2022-D2-01-02

Scope

- ✓To increase the **fundamental understanding of processes** in batteries
- ✓To support development of novel **experimental and computational techniques** targeting the time and length scales of interface reactions in a battery cell including electron and ion localisation, mobility and transfer reactions
- ✓Develop novel analytical techniques, supported by **modelling and simulation**, able to follow interface, electron and ion dynamics in battery materials and cells, and selecting controlled model systems

Interface and electron monitoring for the engineering of new and emerging battery technologies (4/4)

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HORIZON-CL5-2022-D2-01-02

Scope (continued)

- ✓**Examples** of **experimental tools** include operando Transmission Electron Microscope (TEM), Electron Paramagnetic Resonance (EPR), operando ambient pressure photoelectron spectroscopy techniques, operando X-ray scattering techniques, NMR, soft X-ray spectroscopy with RIXS, neutron spectroscopy, ultra-fast spectroscopic methods as well as Free Electron Laser (FEL) facilities, etc.

- ✓The goal is to give advice and new insights on how to **increase the life time and safety** of new emerging technologies

Furthering the development of a materials acceleration platform for sustainable batteries (1/7)

(combining AI, big data, autonomous synthesis robotics, high throughput testing)

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HORIZON-CL5-2022-D2-01-03

RIA; TRL3-4; 20M€; 1 project to be funded

Relevance: BATTERY 2030+; European Partnership 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'

Outcome:

- To accelerate the **finding of new material's** and their combinations for existing &future **battery chemistries** the iterative & fragmented trial and error approach needs to be replaced
- Need to develop a fully autonomous and chemistry neutral **Materials Acceleration Platform** (MAP)

Relevant project: NExtNCNaBatt

Furthering the development of a materials acceleration platform for sustainable batteries (2/7)

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HORIZON-CL5-2022-D2-01-03

<u>Project results</u> (contributing to all following):

- Develop **new tools and methods** for significantly accelerating the development and optimisation of battery materials and interfaces (increase the competitiveness of the battery material and cell industry in Europe)
- **Demonstrate** a fully autonomous **battery-MAP** capable of integrating computational modelling, materials synthesis and characterisation of both Li-ion and beyond Li-ion chemistries
- Scale-bridging, multi-scale **battery interface models** capable of integrating data from embedded sensors in the discovery and prediction process, e.g. to orchestrate proactive self-healing

Furthering the development of a materials acceleration platform for sustainable batteries (3/7)

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HORIZON-CL5-2022-D2-01-03

Project results (continued):

- Community wide state-of-the-art **collaborative environment** to access data and utilise automated workflows for **integrated simulations and experiments** on heterogeneous sites (e.g. exploiting European HPC architectures and Large-scale facilities in collaboration with LENS and LEAPS)
- Demonstrate a **robotic system** capable of **material synthesis** for inorganic, organic or hybrid compounds (following standard synthesis routes via automated characterisation of intermediate and final products and autonomous decision-making)
- Deploy predictive hybrid physics- and data-driven models for the **spatio-temporal evolution of battery interfaces** and demonstrate inverse design of a battery material/interface

Furthering the development of a materials acceleration platform for sustainable batteries (4/7)

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HORIZON-CL5-2022-D2-01-03

Scope

- ❖Infrastructure tools for secure remote data access, data analysis and predictive modelling:
  - ✓Develop a FAIR data infrastructure for raw and curated experimental and modelling data
  - ✓Develop the software infrastructure required to operate this platform
  - ✓The software should provide specific access right and allow remote data access, complemented by distributed workflows using software-agnostic workflow engines that provide rapid-prototyping.
  - ✓Demonstrate inverse materials design using hybrid physics- and data-driven battery interface genome models

Furthering the development of a materials acceleration platform for sustainable batteries (5/7)

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HORIZON-CL5-2022-D2-01-03

Scope (continued 1)

- Automated high throughput **characterisation** and integrated experimental and computational **workflows**:
  - ✓ To optimize high throughput, multimodal operando **experimental techniques** using standardised battery cells and established protocols (to perform effective screening of new materials and on-line diagnosis of realistic devices)
  - ✓ To establish, structure, operate and dynamically refine such facility platform to harmonise, mutualise and optimise the global demand for battery characterisation
  - ✓ Attention should be paid to battery interfaces and direct observation of interfaces under dynamic conditions (key to improve performance and lifetime)

Furthering the development of a materials acceleration platform for sustainable batteries (6/7)

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Scope (continued 2)

- Autonomous **synthesis robotics and orchestration software**:
  - ✓ The transition from low/no automated robotics for the synthesis of battery materials requires several R&I steps towards **fully autonomous systems**
  - ✓ Within scope: **Partially autonomous** systems following standard synthesis routes for inorganic and organic battery materials, especially also multi-step and high-temperature synthesis (so far are challenging to automate for high throughput)
  - ✓ **AI-based orchestration and optimisation** software modules and packages specifically targeting battery materials and interfaces

Indicative publication: 'Autonomous Discovery of Battery Electrolytes with Robotic Experimentation and Machine Learning'

Furthering the development of a materials acceleration platform for sustainable batteries (7/7)

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HORIZON-CL5-2022-D2-01-03

Scope (continued 3)

- Inverse design and AI-assisted scale-bridging models for multiple time- and length-scale processes:
  - ✓ To develop scale-bridging models correctly describing the multiple mechanisms occurring at atomistic scale & mesoscopic scale on cell level
  - ✓ The new model approaches should be able to incorporate data from the advanced sensing in virtual design optimisation and battery control algorithms for SoX estimation
  - ✓ Apply sensitivity analysis and uncertainty quantification of the developed SoX models to assess the robustness of the developed models
  - ✓ Models should accurately describe actual state of system, and enable diagnosis & prediction e.g. when self-healing procedures are initiated
  - ✓ Multiscale Modelling approaches should be developed for the control of safety between BOL (Beginning Of Life) and EOL (End of Life) of a battery system

Towards creating an integrated manufacturing value chain in Europe: from machinery development to plant and site integrated design (1/4)

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HORIZON-CL5-2022-D2-01-04

IA(60%; 70 pages); TRL3 -> TRL6 (machinery); TRL6 ->TRL 7 (manufacturing supply chain); 7-8M€; 2 projects to be funded

Relevance: LiPLANET battery experts network; European Partnership 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'; IPCEI on batteries

Outcome

- Strengthening Europe's battery cell industrial manufacturing value chain by **building-up its Giga scale manufacturing capabilities** distributed in the member states territories

Towards creating an integrated manufacturing value chain in Europe (2/4)

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HORIZON-CL5-2021-D2-01-04

Outcome (continued)

- Development of new battery cell manufacturing machinery (priority on **minimising energy** needed for cells production; enhancement of plant **efficiency rates**; integration of intelligent control processes to **minimise scrap**)
- Enabling **deeper collaboration** between (i) battery process equipment companies (ii) industrial-scale cell manufacturing, (iii) material, energy and other supply chain sectors

- To stimulate and intensify the **collaboration** between pilot line operators, industrial-scale academia, cell manufacturing companies and European equipment companies to push innovations (economically & ecologically sustainable cell production in Europe)

Towards creating an integrated manufacturing value chain in Europe (3/4)

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HORIZON-CL5-2022-D2-01-04

Scope

To build globally competitive Li ion battery (LIB) cell production plants in Europe

1. To be able to supply machinery which is developed and built locally, Europe has to develop a leading position in the production of resource efficient, intelligent **electrode and cell manufacturing machinery**

- ✓ Important **aspects for success** include: minimising energy consumption, eliminating air and water pollution and integration of intelligent control processes to minimise scrap
- ✓ Machinery is expected to operate at very high productivity levels with incorporate **intelligent quality control systems**
- ✓ Strategies of **industry 4.0** should be intensively integrated in new European cell production plants to yield economic success

Towards creating an integrated manufacturing value chain in Europe (4/4)

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HORIZON-CL5-2022-D2-01-04

Scope (continue 1)

2. Battery cell production as a whole is currently confronted with enormous **cost pressure**. One major factor is highly **energy consuming** manufacturing processes. A significant **reduction** and/or utilisation of **low-carbon and low-emission energies** will bring economic benefits, and reduce ecological footprint. **Horizontal integration** of the European supply chain for battery process equipment into the growing production of giga-scale battery cells is a major challenge

- ✓ Closing the gap and enabling deeper **collaboration** between industrial-scale cell manufacturing, battery process equipment companies, and material and other industrial sectors potentially benefitting from sector coupling with cell manufacturing (e.g. grid power or material suppliers)
- ✓ Existing cell production lines and their material and energy flow internal and external interaction should be investigated and evaluated (investigate ecological impact of different machinery, production line configurations and factory designs; implement ecological standards along the production)

Next generation technologies for High-performance & safe-by-design battery systems for transport and mobile applications (1/4)

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HORIZON-CL5-2022-D2-01-05

RIA; TRL5; 5M€; 3 projects to be funded

Relevance: European Partnership 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'

Outcome

- Next-generation battery system technologies for electrification of transport and mobile applications (including road, waterborne, airborne, and rail transport, & non-road mobile machinery)
- Demonstrating increased performances (energy density, power density, lifetime) and safety of battery systems (improved competitiveness)
- Novel design and process to reduce manufacturing, refurbishment, dismantling and recycling costs of battery systems

BATTERIES EUROPEAN PARTNERSHIP

Next generation technologies for High-performance and safe-by-design battery systems for transport and mobile applications (2/4)

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HORIZON-CL5-2022-D2-01-05

Scope

- ✓ High-performance and safe battery systems in support of the electrification of transport and mobile applications (**fire is a critical safety risk** for several transport modes)
- ✓ Projects will develop innovative battery systems technologies that will benefit several transport and mobile applications, by significantly improving **performances and safety**, as well as **environmental sustainability and cost**
- ✓ Projects should consider the adaptation of battery system design to novel cell chemistries that will reach the market in the short-to-medium term (e.g., advanced lithium-ion or solid-state cells). Enhancing the **cell-on-system volume ratio and/or weight ratio** will increase the energy density and/or power density at the battery system level

Next gen technologies for High-performance and safe-by-design battery systems for transport and mobile applications (3/4)

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HORIZON-CL5-2022-D2-01-05

Scope (continued 1)

- ✓Projects should consider **new technologies** (battery system materials, mechanical design, electrical architectures, thermal management strategies, etc.) for **enhancing performances and safety** (for **example**: novel lightweight materials with optimum thermal characteristics to decrease battery module and pack weight and simultaneously enhancing safety; new dielectric cooling liquids with enhanced fire-retardant properties; etc.)
- ✓Manufacturability & recyclability to be addressed (to reduce manufacturing, refurbishment, dismantling and recycling costs & carbon footprint)

Next gen tech for High-performance and safe-by-design battery systems for transport and mobile applications (4/4)

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HORIZON-CL5-2022-D2-01-05

Scope (continued 2)

- ✓ To develop and assess **methodologies to ensure the safety** throughout the full battery lifetime
- ✓ Focus on the **battery system level**, i.e., on the integration of battery cells into a battery system (e.g., a battery pack), considering mechanical, electrical and thermal aspects
- × The integration of battery systems into larger systems of application (e.g., into vehicles) is **out of scope** for this topic; projects are expected to provide for requirements of the chosen use cases
- ✓ Project outcomes should be applicable to one or several use cases; e.g. road, waterborne, airborne and rail transport, non-road mobile machinery and industrial applications
- ✓ KPIs proposed by Batteries Europe, etc. may be considered

Embedding smart functionalities into battery cells (1/3)

(embedding sensing and self-healing functionalities to monitor and self-repair battery cells)

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HORIZON-CL5-2022-D2-01-06

RIA; TRL2-4; 5M€; 3 projects to be funded

Relevance: BATTERY 2030+; European Partnership 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'

Outcome

- Increased **quality, reliability and life** (QRL) of the battery system by integrating both sensing and self-healing functionalities at the battery cell level
- Disruptive **battery cell and battery management system** (BMS) technologies, to support a competitive and sustainable battery manufacturing industry in Europe

BATTERIES EUROPEAN PARTNERSHIP

Embedding smart functionalities into battery cells (2/3)

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HORIZON-CL5-2022-D2-01-06

Scope

- ✓ To **embed sensors and self-healing functionalities** into single battery cell, with sensors being capable to detect defective operation and trigger self-repairing functionalities via the BMS
- ✓ Combined approach with the development of sensors capable of **continuous, long term ope**ration within the cell and on the development of self-healing functionalities which can be triggered by **external stimulus**
- ✓ Sensors and self-healing functionalities need to be adapted to **detection of the critical degradation processes** during cell electrochemical or chemical ageing
- ✓ Different battery chemistries can be addressed with a focus on most critical degradation processes

Embedding smart functionalities into battery cells (3/3)

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HORIZON-CL5-2022-D2-01-06

Scope (continued 1)

- ✓Proof of concept of coupling sensors and self-healing agents via BMS should be demonstrated
- ✓Clear benefit of embedding smart functionalities into battery cells should be demonstrated and approach needs to be adaptable to battery cells mass production processes and not hinder subsequent recycling process.
- ✓Estimation of QRL over the life span should be assessed and the competitive advantage over alternative approaches like replacement or recycling or second-use should be demonstrated

Digitalisation of battery testing, from cell to system level, including lifetime assessment (1/3)

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HORIZON-CL5-2022-D2-01-07

RIA; TRL5-6; 5M€; 3 projects to be funded

Relevance: European Partnership on 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'

Outcome

- Competitiveness of the European battery industry across the value chain (from cell manufacturers to cell integrators);
- Shorter time-to-market;
- Reduced time and/or cost of battery development by at least 20% to 30%;
- Improved battery design, for longer lifetime, and better reliability and safety;
- Reduced investment and operational costs of battery systems

Digitalisation of battery testing, from cell to system level, including lifetime assessment (2/3)

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HORIZON-CL5-2022-D2-01-07

Scope

- To provide novel methods and tools to **accelerate and improve** the battery testing process.
- A **multi-scale approach** should be used, by covering the value chain from battery cells to battery systems (a battery system refers to an energy storage unit integrating battery cells, excluding power converters)
- Full documentation of new modules, models or tools developed from scratch or substantially improved

- To propose and validate a **new paradigm** based on intelligent design of experiment, the smart combination of physical and virtual testing, hardware in the loop solutions, and the development and use of advanced models describing battery cells and systems (physics-based, data-driven, or hybrid models) and the relevant expected evolution in **multiple different conditions of usage**
- Full documentation of new modules, models or tools developed from scratch or substantially improved

Digitalisation of battery testing, from cell to system level, including lifetime assessment (3/3)

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HORIZON-CL5-2022-D2-01-07

Scope (continued 1)

- ✓Particular attention should be paid to the **assessment of battery lifetime, reliability and safety**, including the development of innovative **methods for testing** of safety in transport and safety in usage, based on representativeness of the method for the various potential failures (failure initiation, propagation control, mitigation means, etc.)
- ✓Projects should have an ambition for **cross-sectorial applications**, and **focus on battery chemistries** currently on the market or that will reach the market in the short term (i.e., advanced lithium-ion chemistries), with the potential to quickly adapt to next-generation battery chemistries (i.e., solid-state lithium-based chemistries)

Coordination of large-scale initiative on future battery technologies (1/4)

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HORIZON-CL5-2022-D2-01-08

CSA; 3M€; 1 project to be funded

Relevance: BATTERY 2030+; European Partnership 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'

Outcome – Project results:

- Fostering the scientific, technological, economic and societal impact of the initiative and **paving the way to industrial exploitation** of future battery technologies in key energy and transport application domains
- Well-coordinated European research initiative on future battery technologies **gathering excellent scientists and innovators** as well as involving other relevant stakeholders and linked with relevant international, national and regional programmes

Coordination of large-scale initiative on future battery technologies (2/4)

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HORIZON-CL5-2022-D2-01-08

Outcome - Project results (continue)

- **Spreading of excellence** in future battery technologies across Europe, increased awareness of European activities and availability of European curricula in the field.
- **Increased synergies and collaboration** between the relevant research and innovation stakeholders in Europe as well as with major initiatives that already exist or are under preparation

Coordination of large-scale initiative on future battery technologies (3/4)

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HORIZON-CL5-2022-D2-01-08

Scope

- ✓To network and coordinate the **BATTERY 2030+** large scale research initiative and its contribution to the broader efforts of the European research and innovation stakeholders in battery technologies foreseen at European level and in the SET Plan and to tackle long-term research challenges expected to result in 'game changing' impacts on future battery technologies paving the way for providing a technological competitive advantage to the European battery industry.
- ✓To support a long-term, coordinated and sustained effort at European level, by building on large scale research cooperation across academia and industry and with other research initiatives at regional, national and European level, and by mobilising Europe's best researchers around an ambitious long-term research agenda
- ✓To coordinate the research activities and the stakeholders participating in the initiative

Coordination of large-scale initiative on future battery technologies (4/4)

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HORIZON-CL5-2022-D2-01-08

Scope (continued)

- ✓To facilitate communication, dialogue & cooperation on crosscutting topics
- ✓To monitor the initiative's progress and maintain its roadmap
- ✓To provide support for its governance;
- ✓To establish a robust and reliable knowledge base
- ✓To promote & communicate its objectives and achievements;
- ✓To identify training and education needs and promote European curricula in future battery technologies
- ✓To identify and coordinate relevant efforts for modelling and data sharing, standardisation, intellectual property rights
- ✓To help networking and collaboration with other relevant national and international activities in the field (Batteries Europe, ETIP on battery etc.)
- ✓To be driven by representatives of the relevant actors of the field

Physics and data-based battery management for optimised battery utilization (1/3)

Bu proje Avrupa Birliği ve Türkiye Cumhuriyeti tarafından finanse edilmektedir
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TURKEY in HORIZON 2020

HORIZON-CL5-2022-D2-01-09

RIA; TRL4; 5M€; 3 projects to be funded

Relevance: BRIDGE

Outcome – Project results:

- New physics and data-based approaches for **battery management**, with the potential to **enhance performances, lifetime, reliability and safety** of battery systems for transport and stationary applications.
- New physics and data-based approaches for **battery management facilitating predictive maintenance, and/or knowledge-driven end-of-life management** of battery systems, and/or the development of more accurate degradation models

REPUBLIC OF TÜRKİYE MINISTRY OF INDUSTRY AND TECHNOLOGY

COMPETITIVE SECTORS PROGRAMME

TÜBİTAK

Physics and data-based battery management for optimised battery utilization (2/3)

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HORIZON-CL5-2022-D2-01-09

Scope:

- To substantially advance the state of the art in the field of battery management, by **developing innovative physics and data-based approaches**, both at s/w & h/w levels to ensure optimised and safe utilisation of the battery system during all modes of operation
- To pave the way towards **next-generation BMS**; leverage on increased computational capability enabling the execution of advanced s/w, and on the ability to acquire, communicate & analyse large amount of data
- To lead to significantly enhanced performances, lifetime, reliability and safety of the battery system, by a **dynamic update of battery usage limitations** and the possibility to **widen the battery operating range** in a controlled manner

Physics and data-based battery management for optimised battery utilization (3/3)

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HORIZON-CL5-2022-D2-01-09

Scope (continued 1):

- To provide **open access** to FAIR data, enabling the development of effective degradation models, and facilitating predictive maintenance and end-of-life management
- To develop technologies at both the S/W & H/W levels (**lab validation**)
- Several of the following items should be addressed:
  - The development & implementation of physics-based battery **models** (e.g. **ageing**)
  - Adaptable battery models (e.g., based on operation data)
  - **Sensor-based solutions** at the battery system level (e.g. sensor integration, communication with the battery management, data fusion, data analysis)
  - Advanced **state estimators** (e.g., state of health, state of function, state of energy, state of power, state of safety)
  - Methods for the **prognosis of remaining useful lifetime and ageing**; methods for the early detection or prediction of failures
  - Solutions for **management special situations** (e.g. unbalanced or dysfunctional cells)

- Results applicable to a broad range of **transport OR stationary** applications

Streamlined collection and reversed logistics, fully automated, safe and cost-efficient sorting, dismantling & second use before recycling (1/5)

Bu proje Avrupa Birliği ve Türkiye Cumhuriyeti tarafından finanse edilmektedir
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HORIZON-CL5-2022-D2-01-10

RIA; TRL5-7; 5M€; 3 projects to be funded

Relevance: European Partnership 'Towards a competitive European industrial battery value chain for stationary applications and e-mobility'

Outcome – Project results

- Achieving the objectives of the Circular Economy Action Plan by enabling second life of batteries and increasing rates for recycling and recovery, in line with upcoming regulatory requirements.
- Revolutionize and re-freshen recycling industry, by applying best-in-world innovations based on automatisation, efficiency & sustainability

BATTERIES EUROPEAN PARTNERSHIP

Streamlined collection and reversed logistics, …, sorting, dismantling and second use before recycling (2/5)

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HORIZON-CL5-2022-D2-01-10

Outcome – Project results (continued)

- Create **new circular business models**, such as second life, to reduce the need for primary raw materials, and to maximize the use of battery cells reducing the cost per cycle.
- Develop a **community for actors** involved in the management of the recycling value chain for batteries (including second life) for sharing best practices (health and safety, transport, dismantling, refurbishing, recycling).
- **Improve safety**, through automatisation and reducing accidents

Streamlined collection and reversed logistics, … sorting, dismantling and second use before recycling (3/5)

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HORIZON-CL5-2022-D2-01-10

Scope

- Development of standardized **common diagnostics protocols** and cut-off criteria between product (2nd life application) and waste (recycling)
- Elaborate critical **stage of diagnosis of batteries as a waste-prevention measure** (to define which batteries or components are fit for 2nd life application)
- **Automate the dismantling** of E-mobility and stationary batteries, reducing costs by avoiding manual work and improving sorting of parts (allowing selective extraction of materials and lead to a higher value creation for the downstream recyclers)

Streamlined collection and reversed logistics, … sorting, dismantling and second use before recycling (4/5)

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TURKEY in HORIZON 2020

HORIZON-CL5-2022-D2-01-10

Scope (continued 1)

- Development of **novel safe dismantling processes and safety procedures** along all steps of EoL management chain (focus on battery burning process (thermal runaway), identification of Limiting Oxygen Index (LOI) and Lower Explosive Limits (LEL))
- Development of technologies **preventing or reducing thermal runaway** during transportation, storage and dismantling of batteries
- Design and demonstration of standardized and cost-efficient **storage & transportation containers** with visual & thermal load monitoring systems (inert atmosphere or measures reducing risk of fire or thermal runaway)
- Development of technologies for **fast and efficient discharge of used batteries**, possibly integrated with SoH diagnostic equipment, with flexible connectivity and adjustable to various kinds of batteries.

Streamlined collection and reversed logistics, … sorting, dismantling and second use before recycling (5/5)

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HORIZON-CL5-2022-D2-01-10

Scope (continued 2)

- Development of **standardized battery labelling system** enabling interested parties to automatically obtain necessary data on each battery. Potential integration of labelling system with battery passport database project and with labelling systems from other regions of the world (e.g. China).

- Research on batteries **sorting and dismantling technologies**, particularly automated sorting including machine learning applicable to small & EV batteries

- Identify all potential risks and **develop safe processes and safety procedures** to reduce accidents.

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European Partnerships

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Webpage on europa.eu:
https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe_en

New approach to European partnerships

Key features of objective-driven and ambitious partnerships:

- **Strategic orientation**
- **Systemic approach**
- **Simple architecture and toolbox**
- **Common set of criteria for the life-cycle**

CO-PROGRAMMED
Based on Memoranda of Understanding/contractual arrangements; implemented independently by the partners and by Horizon Europe

CO-FUNDED
Based on a joint programme agreed and implemented by partners; commitment of partners for financial and in-kind contributions

INSTITUTIONALISED
Based on long-term dimension and need for high integration; partnerships based on Art 185/187 of TFEU and the EIT legal acts for 2021-2027

Food for thought & Q&A SESSION

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- …?

Learn more: Horizon Europe info-days: https://ec.europa.eu/info/research-and-innovation/events/upcoming-events/horizon-europe-info-days_en

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Contact:

Office Address

Turkey in Horizon 2020 Project

And Sokak 8/12 Akasya Apt. 06680 Çankaya

06520 Çankaya/Ankara,Turkey

Tel: +90 312 467 61 40

http://www.turkeyinh2020.eu/

info@TurkeyinH2020.eu