Battery Topics in Horizon Europe (2023/24)

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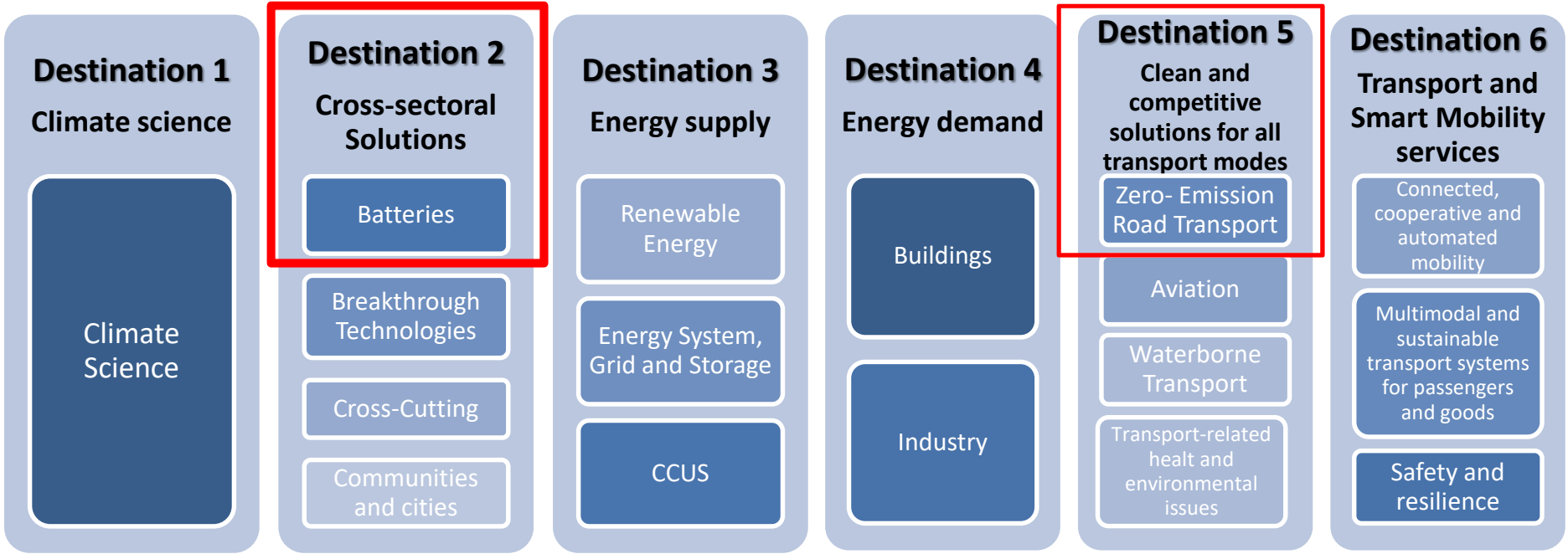
Battery topics in cluster 5



Battery topics (Batt4EU Partnership)

Call	Deadline	*Topics*	*Projects*	Budget
HORIZON-CL5-**2023**-D2-**01**	18.04.2023	5	12	77.0 M€
HORIZON-CL5-**2023**-D2-**02**	05.09.2023	3	6	42.0 M€
HORIZON-CL5-**2023**-D5-**01**	20.04.2023	1	2	10.0 M€
HORIZON-CL5-**2024**-D2-**01**	18.04.2024	3	7	47.0 M€
HORIZON-CL5-**2024**-D2-**02**	05.09.2024	4	8	54.0 M€
HORIZON-CL5-**2024**-D2-**01**	18.04.2024	1	2	10.0 M€

Budgets:

2023: 129 M€

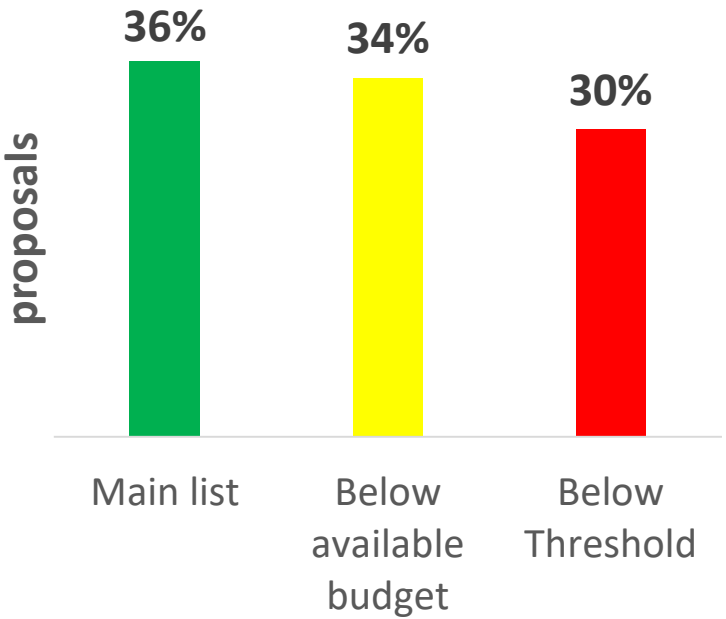
2024: 119 M€

Results of the battery call 2021

Summary:

- 153 M€
- 297 partners
- 22 (of 61) projects

→ Success rate: 36.1%



A competitive and sustainable European battery value chain

Focus:

- Increasing **technological performance** and **user appeal**
- New solutions for **reuse** and **recycling**
- Accelerated **growth of the battery production industry** in Europe
- Develop sustainable and safe technologies for **decarbonization** of **transport** and **stationary energy storage** applications
- Research of **alternative battery chemistries** using **non-critical raw materials**

CL5-2023-D2-01-01

Instrument	Topic budget	Budget / project	deadline
RIA (TRL: 5)	21	7	18.04.23

Technologies for sustainable, cost-efficient and low carbon footprint downstream processing & production of battery-grade materials

Expected outcome

- **Reduced dependency** on third countries for CRM
- Increased European competitiveness by offering **sustainable, safe, energy efficient** and low carbon, water and biodiversity footprint battery materials production technologies
- Battery-grade intermediates which are developed, produced and refined/purified in a **sustainable and socially** acceptable way
- **Proven technical feasibility** of downstream processing for battery-grade materials
- A **stronger European battery manufacturing industry**
- Use of European **post-mining primary materials and secondary material sources**

CL5-2023-D2-01-01

Instrument	Topic budget	Budget / project	deadline
RIA (TRL: 5)	21	7	18.04.23

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Technologies for sustainable, cost-efficient and low carbon footprint downstream processing & production of battery-grade materials

Scope (all)

- **Sustainable and cost-efficient** processing methods for battery-grade materials and components, coming from either primary or secondary streams
- Develope and demonstrate technologies to improve battery grade metals and materials **production, refining and/or recycling**
- **Zero waste and zero discharge** strategies for the valorisation of the generated waste materials
- Pre-assessing recycling concepts by their **life cycle sustainability and safety impacts**
- Addressing understanding of physico-chemical mechanisms for **more sustainable hydrometallurgical** steps
- Implementing of **continuous process** for cathode active materials and precursors synthesis related conditions **at larger scale**.

CL5-2023-D2-01-02

Instrument	Topic budget	Budget / project	deadline
RIA (TRL: 4)	15	5	18.04.23

New processes for upcoming recycling feeds

Expected outcome

- A **European economic base** which is stronger, more resilient, competitive and fit for the green and digital transitions
- The development of recycling technologies **targeting upcoming recycling feeds** and producing **high-quality** precursors, semi-products and battery materials
- Achievement of the **recycling efficiency and material recovery targets** as described in the proposed **Batteries Regulation**
- Recycling chains with a **cost-effective process** in comparison with primary materials
- Safeguarding of the **sustainability**, low CO_2 footprint, low chemicals usage and minimal emissions of newly developed recycling processes

CL5-2023-D2-01-02

Instrument	Topic budget	Budget / project	deadline
RIA (TRL: 4)	15	5	18.04.23

New processes for upcoming recycling feeds

Scope

- Improved and verified **circularity of collected, dismantled and pre-treated battery waste feeds**
- Recycling process development considering **specific areas of improvement** for each of the possible processes of battery recycling
- New recycling concepts targeting the **recycling of economically low value materials**
- Highly efficient recycling of battery **manufacturing scrap**

<u>At least one:</u>

- Highly **robust or flexible processes** for the recycling of streams of **varying composition and quality**
- Material feeds from **future battery technologies**
- Material feeds from **other industries**
- The processing of **side streams**

CL5-2023-D2-01-03

Instrument	Topic budget	Budget / project	deadline
RIA (TRL: 4-5)	14	7	18.04.23

Advanced digital twins for battery cell production lines

Expected outcome

- The **understanding of digital twins** as systems with automated data acquisition, connected digital models and value-adding applications.
- Capacity to go **beyond single process consideration** with potential perspective on the process chain.
- **Implementation and the transfer of digital twins** into existing and future battery cell production plants.
- **Safety and security, scalability, explainability, computational speed** as well as contributions to **sustainability** of battery cell production.
- **Optimise product quality**, improving the **resource efficiency** and, consequently, the **production time and cost** of battery cells in the manufacturing process at the targeted scale.

CL5-2023-D2-01-03

Instrument	Topic budget	Budget / project	deadline
RIA (TRL: 4-5)	14	7	18.04.23

Advanced digital twins for battery cell production lines

Scope (all)

- Developing **digital twins of battery cell manufacturing routes at pilot line**
- Design **robust digital tools** integrating multi-physics, data-driven models and hybrid modelling.
- Capable to evolve to **different battery chemistries**, new materials and new manufacturing processes.
- **Verify the transferability** from pilot to production plant level.
- Propose applications that will allow to replace single process considerations towards process chain perspectives.
- Implementation of the **sensorisation** of the manufacturing plant and **automatisation** of the data acquisition
- **Ensuring greater interoperability**, by implementing available data standards (e.g. MODA, CHADA) and a common semantic framework (e.g. EMMO) and the battery interface ontology (BattINFO).
- Promote the **control and decision making** of the manufacturing chain.
- Aspects like **safety and security, explainability of models** as well as contributions to **sustainability** of battery production will be addressed.

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 6-7)	15	7,5	18.04.23

CL5-2023-D2-01-04

Battery management system (BMS) and battery system design for stationary energy storage systems (ESS) to improve interoperability and facilitate the integration of second life batteries

Expected outcome

- Battery pack and Battery Management System design for **single module** operation or **recombination of modules** or battery packs for consolidated and new battery technologies.
- **Safe, accessible and reliable operation** of batteries and compatible with the battery passport concept.
- Battery system design to enable **disassembly and reconfiguration** for second life.
- Development of fast and efficient **qualification strategies and assessment** of EV batteries for second life applications and quantify it with respect to state of the art in terms of time and efficiency.
- **Reduction of 30%** of refurbishment cost for adapting EV batteries to stationary applications in second life.
- **Environmental impact assessment** for adapting EV batteries to second life applications.
- **Feasibility of operation** in the batteries extended life domain (second life).

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 6-7)	15	7,5	18.04.23

CL5-2023-D2-01-04

Battery management system (BMS) and battery system design for stationary energy storage systems (ESS) to improve interoperability and facilitate the integration of second life batteries

Scope (all)

- The BMS could be used for **first and second life** batteries ensuring **safety** during operation.
- The BMS and system design should be **technology agnostic** and not exclusive to second life EV batteries
- **Development and validation** of open-source algorithms and BMS
- Development of BMS software that can be adapted via **firmware update to other communication protocols**.
- Development of functionalities focused on **increasing the reliability** during the second life application
- Recommendation to **standardisation** of a BMS public structure and access to public SOX in order to ease the second use of a battery
- Development and demonstration of strategies to **recombine optimally and safely** used batteries to be operated in second life
- Design of **accessible and adaptable** BMS

CL5-2023-D2-01-05

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 7)	12	6	18.04.23

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Hybrid electric energy storage solutions for grid support and charging infrastructure

Expected outcome

- Demonstration of hybrid energy storage technologies for **long duration** and **provision of multiple grid services** with improved technical performances, sustainability and safety.
- Enable improved levelized cost of storage on the path to fall below **0.05 €/kWh/cycle by 2030** (for storage durations > 12 hours) while reducing the use of critical raw materials.
- Creating **synergies** between producers and strengthening the **European Battery Ecosystem**, improving the European battery value chain and thus contributing to the EU climate neutrality objectives.
- Increasing **digitalisation** of energy storage systems from design to operation phase
- Establishment of **multi-service approaches** to energy storage reducing costs and increasing benefits for the European electricity system.
- Promoting an **increased reliability and resilience** of the electricity system by demonstrating new multi-purpose energy storage solutions.

CL5-2023-D2-01-05

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 7)	12	6	18.04.23

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Hybrid electric energy storage solutions for grid support and charging infrastructure

Scope

The objective is to **design and demonstrate in at least three different use cases** a Hybrid Energy Storage System capable of long duration storage and provision of multiple services for supporting the electrical grid and EV charging infrastructure

- Use of **second life battery modules** is within the scope. The proposed storage solution should be **scalable and modular** and show clear innovation with respect to the state of the art
- Perform **a life cycle assessment** of the HESS
- Develop **physics-based and data-driven digital models** of HESS supporting optimal design, and real-time management and diagnosis
- **Develop and validate management policies and control systems** for HESS
- **Demonstrate HESS usage in at least three different use cases** in collaboration with relevant stakeholders
- Analyse **business cases** of the proposed hybrid solution

CL5-2023-D2-02-01

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 6)	24	8	05.09.23

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Advanced materials and cells development enabling large-scale production of Gen4 solid-state batteries for mobility applications

Expected outcome (I)

The selection of solid-state cell components and architecture meeting all performance indicators at ambient and operational temperatures necessary for mobility, as following:

- Safety: compatible with the **level 4 EUCAR** at module/pack level
- Gravimetric and volumetric energy density: **> 400Wh/kg and 1000Wh/l**.
- Cycling: up to **3000 cycles at 50% DoD** (Depth of Discharge) with a minimum of 500 cycles at 80% DoD.
- C Rate at charge up to **5 C at 80% SoC**
- Materials and cells design with mechanical properties and constraints that **enable large scale production processes at a competitive cost**
- **Atmospheric conditions** in factories.

CL5-2023-D2-02-01

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 6)	24	8	05.09.23

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Advanced materials and cells development enabling large-scale production of Gen4 solid-state batteries for mobility applications

Expected outcome (II)

- A demonstration of the **selected materials in a State-of-Art benchmark cell**
- A competitive cost level **towards 75€/kWh at pack level** by 2030
- An **optimised environmental footprint** of cell materials in terms of **carbon footprint and quantity of metals.**
- Cell manufacturing processes which allow the fabrication of performant, reliable, sustainable, and affordable solid-state cells, **demonstrated at industrial pilot level**.
- Cell materials and designs which are **compatible with a recycling process** that respects the requirements as put forward in the proposed Batteries Regulation

CL5-2023-D2-02-01

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 6)	24	8	05.09.23

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Advanced materials and cells development enabling large-scale production of Gen4 solid-state batteries for mobility applications

Scope (all)

- Develop or leverage the materials-specific models and digital tools for material and cell design to identify the **best combinations of materials** and **speed up the cell optimisation** process.
- Ensure **high ionic conductivity** (> 0.5mS/cm2) and **stability** of the solid electrolyte.
- Integrate **high voltage cathode** (> 4V) to reach the KPIs for mobility as listed in the exp. outcomes section.
- **Propose and evaluate interfaces and coating solutions** especially to suppress dendrite growth and enable a stable solid-electrolyte interphase (SEI) and cathode-electrolyte interphase (CEI).
- Optimise the cell design with respect to all the cell components to meet h**igh energy density** objectives.
- Anode current collectors and/or solid electrolyte capable of accommodating **volume changes**
- **Demonstrate the potential for scale up** of materials, cells and sustainable industrial processing methods with cells reaching a capacity of several Ah, produced in a statistical meaningful number to demonstrate the process repeatability.

Instrument	Topic budget	Budget / project	deadline
RIA (TRL: 5)	10	5	05.09.23

CL5-2023-D2-02-02

New Approaches to Develop Enhanced Safety Materials for Gen 3 Li-Ion Batteries for Mobility Applications

Expected outcome

- Advanced Li-ion batteries with **enhanced safety** behaviour.
- Advanced materials which lead to **improved cyclability and operational lifetime**, whilst **maintaining competitive performance for cost, energy and power density** with state-of-art advanced materials for Li-ion batteries.
- Improved **sustainability and recyclability**, in line with the proposed Batteries Regulation.
- A defined concept for **demonstrable, highly sustainable, circular manufacturing** for the selected advanced materials at **Gigafactory scale**, with sustainability measured in terms of recognised economic, environmental, social and ethical metrics.
- The improvement in safety has to be **demonstrated** at representative cell level for mobility applications by direct comparison with SOA Gen. 3 cells tested at the beginning of the project.
- A **EUCAR Hazard Level of 3** or other equivalent mobility standard should be validated.

Instrument	Topic budget	Budget / project	deadline
RIA (TRL: 5)	10	5	05.09.23

CL5-2023-D2-02-02

New Approaches to Develop Enhanced Safety Materials for Gen 3 Li-Ion Batteries for Mobility Applications

Scope (at least three)

- **New cathode materials** with no exothermal decomposition/reactions, reduced probability for oxygen and other gasses release, and preventing corrosion at current collector.
- **New stable anode materials** and electrode designs with non-swelling, or low degree of expansion over the whole cell lifetime, with no decomposition/exfoliation, high resistance against Li-dendrite formation – specially at high anode rate capabilities, and favouring the formation of a thermally stable, and low-resistivity SEI.
- **New electrolyte formulations** with shear thickening, flame retardant and over-charge/discharge properties, maintained high ionic conductivity, broad electrochemical stability i.e., voltage-operating window, and high onset point for Li-dendrite formation, SEI decomposition and CEI effectiveness.
- **New separator materials** with flame retardant and improved ion transport capabilities, high melting point, and mechanical stability
- **New binder materials** with thermal, mechanical and electrochemical stability, low ionic and electrical resistance, improved adhesion and cohesion, and preventing swelling and porosity reduction in electrodes.

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 7)	8	8	05.09.23

CL5-2023-D2-02-03

Creating a digital passport to track battery materials, optimize battery performance and life, validate recycling, and promote a new business model based on data sharing

Expected outcome

- A stronger European economic base
- Digital Product Passport (DPP), a proper **tracking and blockchain-, DLT- or an equivalent solution**.
- A set of **transparent calculation methods** for the relevant battery indicators stored in the DPP, which can be used as a base to set future standards.
- **Demonstration of new business models** in the different parts of the battery value chains and of circular data extraction, based on data sharing.
- The improvement of the battery transportation and workforce **safety**.
- A solution which has been tested **throughout the entire battery value chain**.
- At least **2 real life pilots capable** to exploit data generated by DPP
- Applicable to **3 or more use cases** among the main transport or mobile applications

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 7)	8	8	05.09.23

CL5-2023-D2-02-03

Creating a digital passport to track battery materials, optimize battery performance and life, validate recycling, and promote a new business model based on data sharing

Scope

- Promote the adoption of a downstream development and implementation of a battery pack Digital Product Passport (DPP) addressing **raw materials, cells and modules**, which is both scalable and energy efficient.
- Facilitate **real-time data recognition** for different indicators and at local device
- **Consider the key performance indicators** proposed by Batteries Europe or by the dedicated Partnerships. Contribute to the related **regulation standards**.
- **Engage a variety of stakeholders along the whole battery value chain** to assure the continuous traceability
- **Validate** its interoperable data sharing strategy.
- Develop a **safety second life-battery certification protocol**, and hazard alerts system
- Validate new **business models**, capable to demonstrate improvement in repurposing and recycling.
- Aim for **cross-sectorial applications**

CL5-2023-D5-01-02

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 6)	10	5	20.04.23

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Innovative battery management systems for next generation vehicle

Expected outcome

- A **simplified, efficient and connected** battery management system
- Improved and optimized **monitoring and predictive diagnostics**
- **Development of relevant interfaces** to allow access to the BMS and its database
- Generally improved **exploitation of battery performance and increased battery pack volumetric density, safety and prolongation of battery life-time**
- Improved **control of battery operating conditions** and determination of **key state estimators**
- New **simulation tools and test methods** for faster development, validation and integration of the battery pack
- **Enhanced communication** between battery and vehicle control unit

CL5-2023-D5-01-02

Instrument	Topic budget	Budget / project	deadline
IA (TRL: 6)	10	5	20.04.23

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Innovative battery management systems for next generation vehicle

Scope (all)

- **Predictive SoX diagnostics** to accurately predict the end-of-life, as well as high connectivity and data storage to optimize the life and general use of the EV.
- Advanced use of **physics-based, data-driven or hybrid models** in general, considering for example Artificial Intelligence with machine learning algorithms, model training and self-adaptive functions.
- **Secure, real-time and databased battery management** to reduce margins in a controlled manner and to ensure optimized, safe utilisation during all modes of operation and accurate classification for a second life.
- A **link between the BMS and the ECU of the vehicle to exchange data** about weather, temperature, speed, topographies, etc. and detailed information on battery operation, thereby achieving the best possible battery monitoring, diagnostics and lifetime, while optimizing driving range.

Battery topics in 2024

Identifier	Topic	Typ	Budget	Projects
CL5-2024-D2-01-01	Advanced sustainable and safe pre-processing technologies for End-of-Life (EoL) battery recycling	RIA	21	3
CL5-2024-D2-01-02	Non-Li Sustainable Batteries with European Supply Chains for Stationary Storage	IA	21	3
CL5-2024-D2-01-03	Development of technical and business solutions to optimise the circularity, resilience, and sustainability of the European battery value chain	RIA	5	1
CL5-2024-D2-02-01	Sustainable high-throughput production processes for stable lithium metal anodes for next generation batteries	IA	8	1
CL5-2024-D2-02-02	Post-Li-ion technologies and relevant manufacturing techniques for mobility applications (Generation 5)	RIA	15	3
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	IA	16	2
CL5-2024-D2-02-04	Accelerated multi-physical and virtual testing for battery aging, reliability and safety evaluation	IA	15	2
CL5-2024-D5-01-03	Advanced battery system integration for next generation vehicles	RIA	10	2