Battery Innovations for a Sustainable Europe:

Key Insights from six Horizon Europe Projects

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Brussels Research and Innovation Center for Green Technologies (BRING vzw)

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NextGeneration of Battery Management Systems to increase Interoperability, bridge the Gap between 1st and SL-BESS, Extend Adaptability and emPower battery value chains.

an initiative funded by the European Union's Horizon following a 42-month research plan



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Cluster 5

"fight climate change by making the energy and transport sectors more climate and environment-friendly, more efficient and competitive, smarter, safer and more resilient"



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ABOUT BIG LEAP

The BIG LEAP project aims to extend the operational lifetime of first-life batteries (FL) by repurposing them as second-life batteries (SL-BESS) reducing the costs and improving:

- Interoperability
- Safety
- Reliability
- Sustainability



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Inadequate Interoperability

Current BMS lacks seamless integration across different battery types, complicating use.



High Reconfiguration Costs

Significant financial investment and extended timelines hinder effective BMS adaptation.



Inefficient Reconfiguration Process

Current processes are time-consuming, leading to delays in battery deployment.



Main Challenges



Technical Standards Gap

Absence of widely accepted protocols and regulations for effortless battery dismantling

Safety Concerns

Unreliable operations pose risks, potentially leading to hazardous scenarios with SLBs.

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Objective 1 (O1) Novel ESS and BMS design

to interoperate FL and SL-BESS and provide adaptability, flexibility, updatability, and enhanced capabilities for BESS value chains.

Objective 3 (O3): Develop, integrate, and validate the next-gen of interoperable advanced BMS

to bridge the operational gap between FL and SL-BESS; running on all possible energy systems applications.

Objective 5 (O5) Ensure low environmental impact solutions

by assessing the sustainability of the solution, for enhanced market competitiveness by both, internally, rising cuttling-edge EU technology and, externally, bolstering/strengthening cooperation with Africa, USA, and India markets, underpinned by strong economic models and all business cases possibles to shorten pathways towards full deployment.



Objective 2 (O2) Develop and validate DT

for 1st to 2nd life batteries used in BIG LEAP, multi-physics, data-driven and semiempiric DL models, for adaptive battery SoX, Self-Diagnosis, and RUL estimators.

Objective 4 (O4) Demonstrate BIG LEAP's BMS and ESS

tangible solutions in the real world and their scalability through the development of 2 different SL-BESS stationary scale DEMOs, with different technical configurations (both in front the meter & behind the meter scenarios).

Objective 6 (O6) Lay down the Next-Generation of BMS and BESS

Technological standards to pave the path toward an empowered and more resilient EU battery value chain:

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CONSORTIUM

16 partners, including research organizations, industries, and NGOs

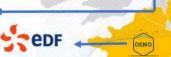


MASEN (Morocco): Virtual demonstration of SL-BESS with multiple battery technologies

AEIMIS











Fraunhofer















SoliTek

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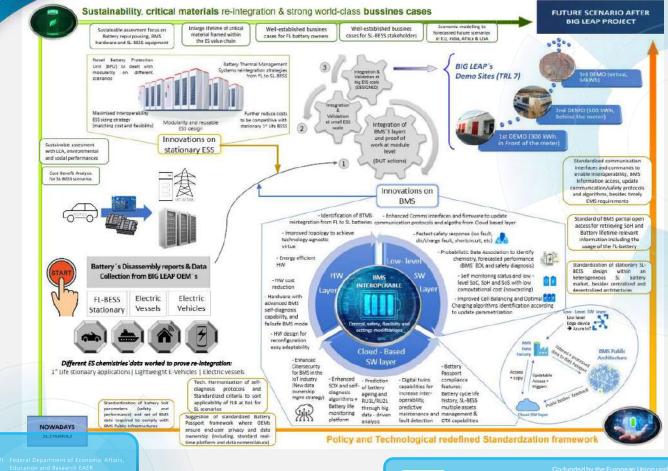
Schweizerische Eidgenossenschaft Federal Department of Economic Affairs







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Co-funded by the European Union under grant agreement N° 101137815. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union not the granting authority can be held responsible for them. Integration & Validation at big ESS scale (DESIGNED)

Integration Validation at small ESS scale

Battery's Disassembly reports & Data Collection from BIG LEAP OEM's

Electric Electric Vehicles

FL-BESS Vessels Stationary

Integration of BMS'3 layers and proof of work at module level (DUT actions)



3rd DEMO (virtual,



2nd DEMO (500 kWh, Behind the meter)

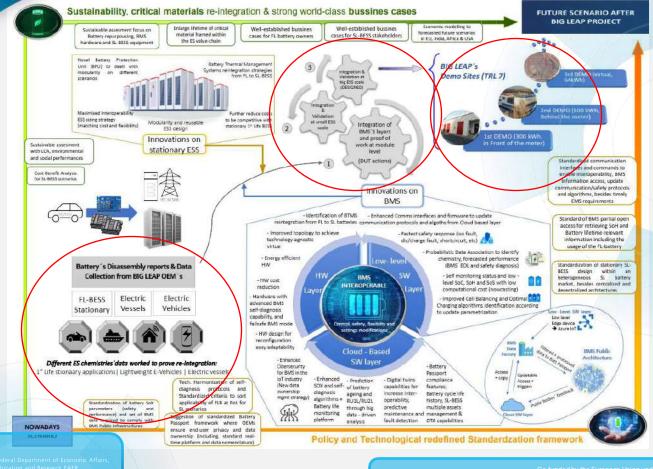
1st DEMO (300 kWh, in Front of the meter)





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Co-funded by the European Union under grant agreement N° 101137815. Yews and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. Novel Battery Protection Unit (BPU) to dealt with modularity on different scenarios

with Systems reintegration strategies from FL to SL-BESS

Maximised interoperability
ESS sizing strategy
(matching cost and flexibility)

Modularity and reusable ESS design

Innovations on stationary ESS Further reduce costs to be competitive with stationary 1st Life BESS

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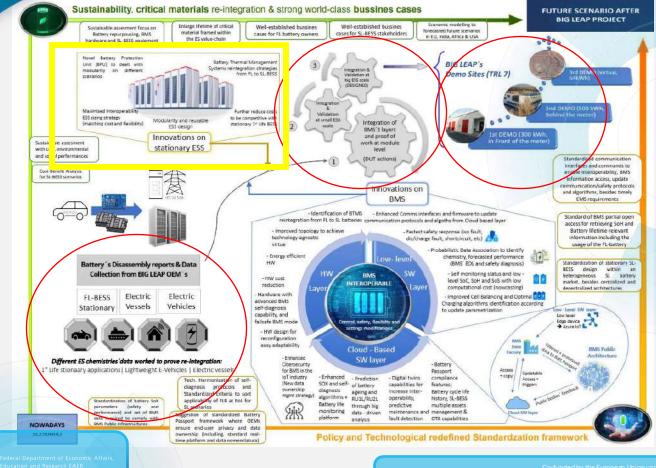


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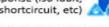
Innovations on BMS

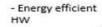
- Identification of BTMS - Enhanced Comms interfaces and firmware to update reintegration from FL to SL batteries communication protocols and algoths from Cloud based layer
- Improved topology to achieve technology-agnostic virtue

HW

Layer

- Fastest safety response (iso fault, dis/charge fault, shortcircuit, etc)







- Probabilistic Data Association to identify chemistry, forecasted performance (BMS' EOL and safety diagnosis)



- HW cost reduction

SW BMS INTEROPERABLE Layer - Self monitoring status and low level SoC, SoH and SoS with low computational cost (nowcasting)



- Hardware with advanced BMS self-diagnosis capability, and failsafe BMS mode

- Improved Cell Balancing and Optimal Charging algorithms identification according to update parametrization

- HW design for reconfiguration easy adaptability Control, safety, flexibilty and settings modifications

Cloud - Based

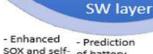
Low - Level SW laver Low level Edge device

BMS Public

Architecture

→ Azure IoT

- Enhanced Cibersecurity for BMS in the IoT industry (New data ownership mgmt strategy)



- of battery ageing and algorithms + RU1L/RU2L through big data - driven analysis
- Digital twins capabilities for increase interoperability, predictive fault detection

- Battery Passport compliance features; Battery cycle life history, SL-BESS multiple assets maintenance and management & OTA capabilities

BIMS Filtered * processed Data Factory Access Updatable + copy Access + Public bodies' feedback triggers Cloud SW layer

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diagnosis

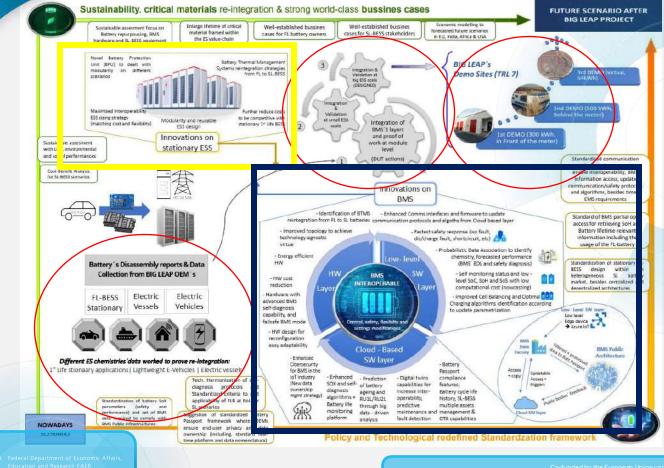
Battery life

monitoring

platform



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METHODOLOGY

BIG LEAP is structured into 9 **Work Packages (WPs)**. WP1 to WP7 will cover all the technical aspects undertaken in the project to develop the innovations of the BIG LEAP project, while WP8 will address its communication, dissemination, and exploitation plan and WP9 tackles the overall project consortium management.

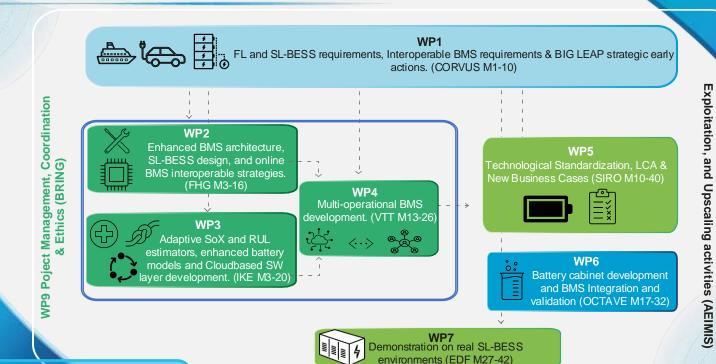


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METHODOLOGY



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Communication, Dissemination,

EXPECTED OUTCOMES



Enhancing battery system designs for SL applications:

- Reconfiguration
- Disassembly



Improving the sustainable pathway of Second-Life Battery reconfiguration:

- Environmental Impact Assessment
- European growth of market and employment



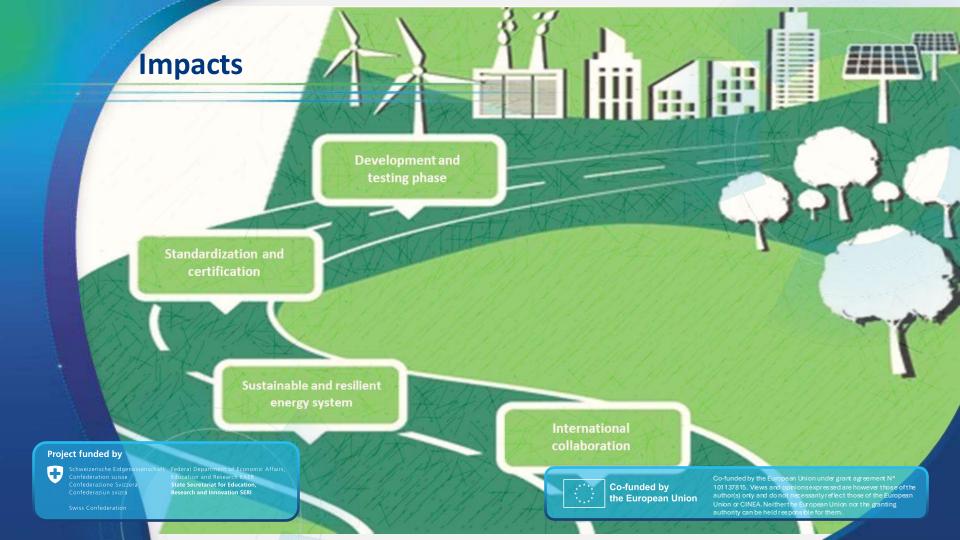
Accelerating the roll-out of cheaper and qualified SL-BESS:

- Safe, Accessible and Reliable battery operation
- Reduction of 30% reconfiguration costs





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