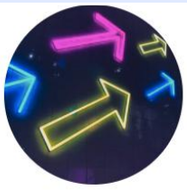
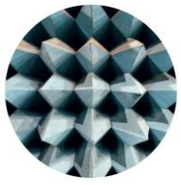
LONG LASTING BATTERIES

Bringing Ni-Zn back to accelerate the European Energy Transition



Improve cell Performance and cost



Up-scaling cell capacity to 100 Ah

Construction of battery packs(2.5 -10kWh)with BMS and sensors

Demonstration of 5 use cases in utility grids and industrial sites

Environmental impact limitation - Recycling, LCA, LCCA

Assessment of norms, business plan and market studies

A new promising battery chemistry, rechargeable NiZn Battery for stationary energy storage solutions :

- high performance able to combine heavy use and deep cycling
  - **2000 cycles** at 1C rate and 100% DoD (Depth of Discharge)
  - **200000 cycles** at 5% DoD
- high energy efficiency (**86-89%**)
- high power (Pmax more than **1000 W/kg**)
- high energy (**50- 90 Wh/kg, 80-200 Wh/l**)
- low cost 200-260 €/kWh (thanks to cheap, abundant and highly recyclable raw materials)
- low risk of thermal runaway
- high stability and calendar life (can be kept discharged for several years and be used again)
- high sustainability (abundant and recycling methods from other industries)
- high safety (nontoxic raw materials, aqueous electrolyte and gas recombination solution)

The KPI of LOLABAT are clear in terms of cost and cyclability

By achieving the high cyclability of 4000 cycles, the cycled cost per kilowatt hour can reach the lowest value of 0.05 E/kWh/cycle. Thus complying to European Union's goal.

LOLABAT Month	M0	M39
KPI-1: cyclability		+100%
cyclability @ 100% DOD	2000	4000
KPI-2: cell cost		-30%
cell cost (€/kWh)	200-260	140-180
cycled cost (€/kWh/cycle)	0.12-0.15	0.04-0.05

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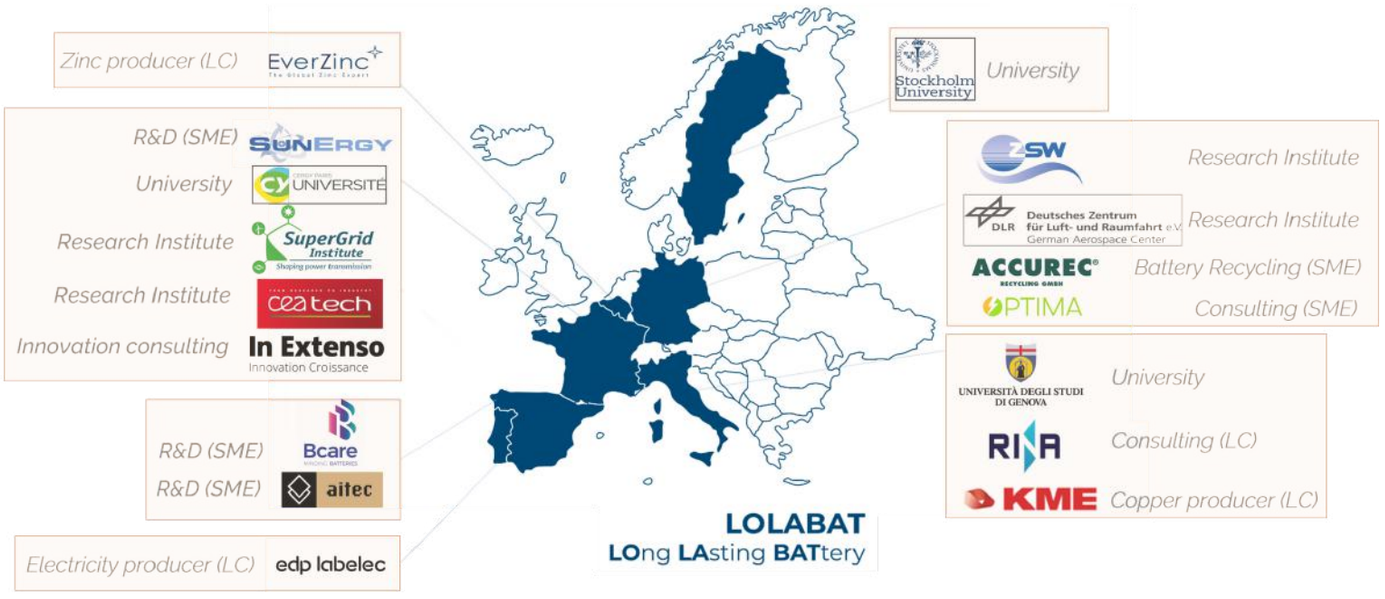
Project Summary



H2020 LOLABAT Project At a Glance

Title : Long LAsting BATtery

Topic: LC-BAT-8-2020 - Next-generation batteries for stationary energy storage

Grant number: 963576

Overall budget: € 7 080 216,25 (EU contribution)

Start date: 1 January 2021

End date: 31 March 2024

Project duration: 39 Months

Website: www.lolabat.eu

17 partners
7 European countries
5 advisory board members

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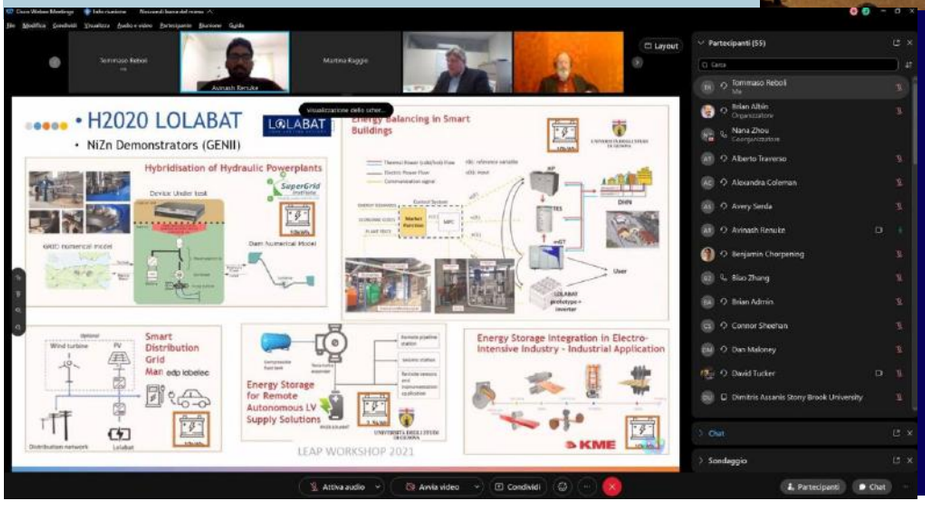
News Events

LOLABAT at Batteries Event in Lyon, France (October 2021)

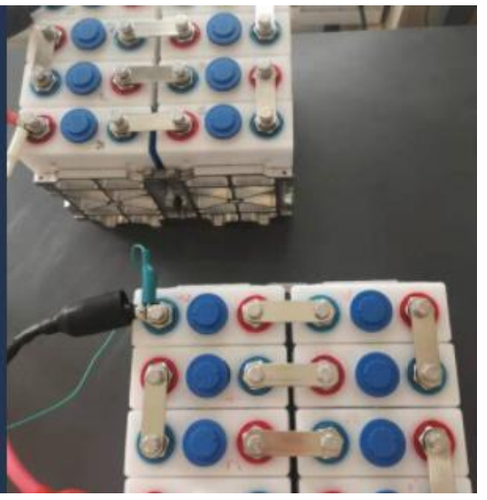
The event was a success, gathering international battery industry key players such as OEM, cell and pack manufacturers, end users, experts, researchers and recyclers who came together to discuss and exchange on new chemistries, manufacturing process, battery components, battery second life, recycling, regulation, future expectations and innovations.



LEAP - Low Emission Advanced Power workshop (virtual)

The sixth LEAP workshop was organised by the U.S. Department of Energy, National Energy Technology Laboratory (NETL), with a focus on the transition to net-zero carbon and the associated technology development. The LOLABAT project was presented by UNIGE under the section of micro-grids.

July 2021 NEWS :
First successful upscaling of GEN1 Ni-Zn batteries
Each module is comprised of 8 cells of 100Ah nominal capacity



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News Events

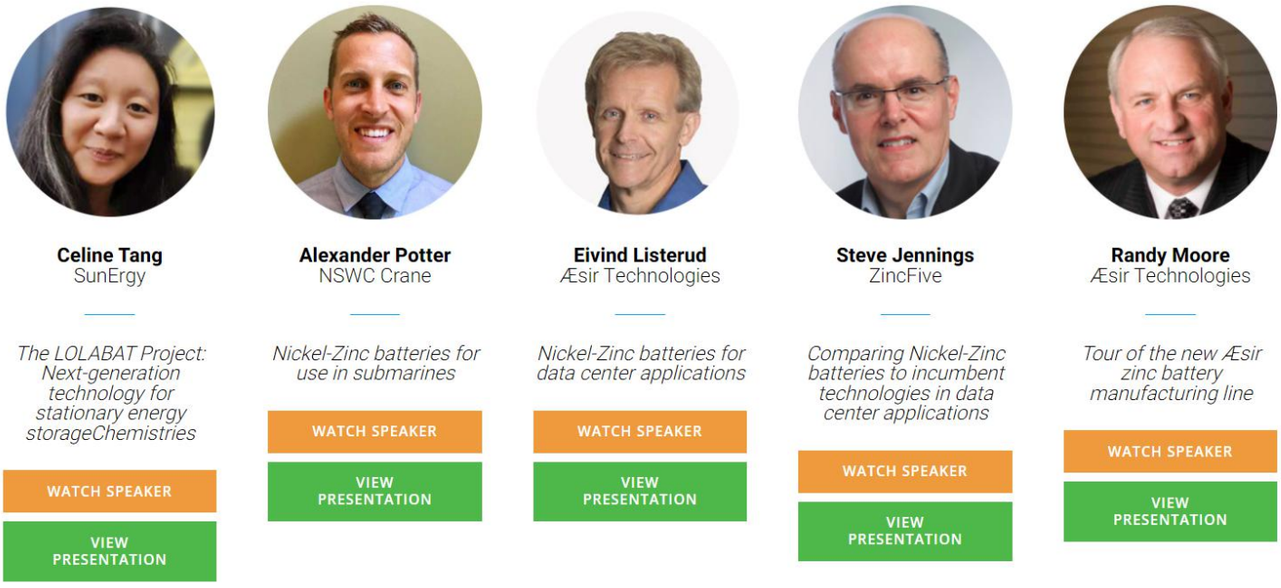
SUNERGY at NAATBatt Zinc Battery Workshop IV (December 2021)

Sunergy was invited to present at the Zinc Battery Technology IV Workshop organized by NAATBATT Zinc Battery technology workshop on the 16th of December 2021.

The workshop aims highlight the progress being made in producing rechargeable zinc-based batteries.
The workshop presented the rechargeable zinc-based batteries being sold in the market today, their potential uses, and new zinc-based battery technologies that may be coming to the market soon. Speakers outlined the potential advantages of zinc-based batteries–low cost, non-toxicity, recyclability, and the potential for greater energy storage–over lithium and lead-based battery technologies.

For Sunergy, it was the opportunity to present to LOLABAT project to a mainly north American public in session 1 (Case Studies in the Commercial use of Zinc battery Technology). Along with representants of NSWC Crane, Aesir Technologies and ZincFive, the three North American key-players in different zinc-based battery technologies, we talked about the products we develop and sell, where those products are finding accpetance in the marketplace, and what we believe the future for zinc-based battery technologies may hold.

Speakers



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News Events

European Commission

H2020 Battery Projects Online Clustering Workshop

European Climate, Infrastructure and Environment Executive Agency (CINEA)

LOLABAT project was featured in the CINEA cluster workshop that aims to promote Innovation and Networks of EU programs.

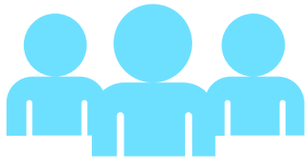
Sunergy was invited to present in the project in the presentation session.
Our project partners RINA and UNIGE were present for the Battery Standardization session.
Finally, the NiZn battery chemistry was part of the Novel Chemistries session on Day 2.

The objectives of this event are the following:

- Identify synergies between projects
- Feedback to/from Policy
- Showcase achievements of battery projects
- Avoid any unnecessary duplication
- Strengthen cooperation among projects
- Policy context & funding opportunities

Upcoming events : (for more detail - www.lolabat.com)

1. R-Zinc 2.0. - EverZinc,Sunergy - 03-04 May 2022 - Brussels
2. PhD course - UNIGE/SU - Sep 2022 - electrochemical accumulators and advances in aqueous rechargeable batteries
3. CINEA cluster event - CINEA - 2022 - Virtual
4. LEAP 2022 - UNIGE - Sep 2022 - Virtual/in presence



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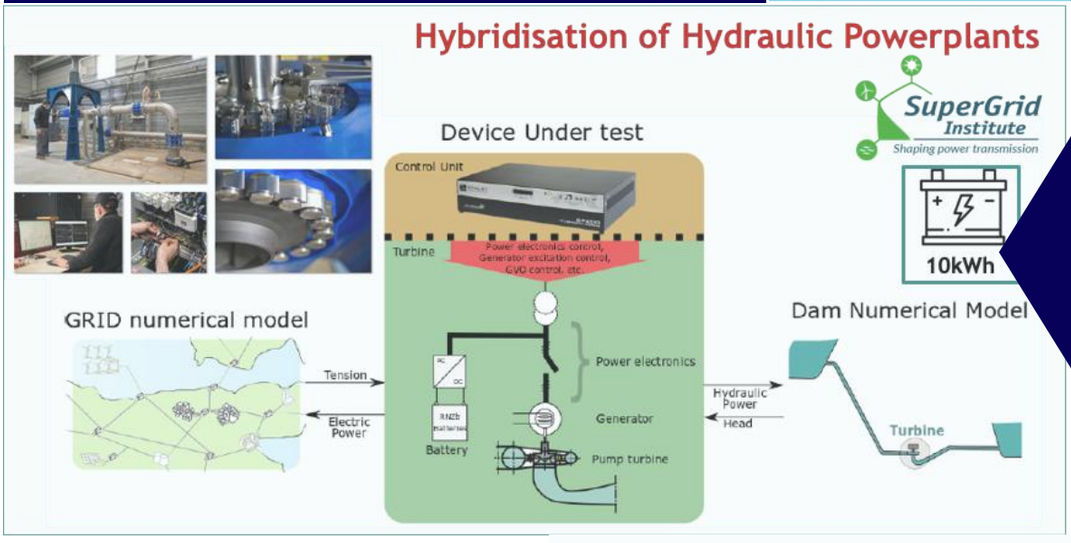
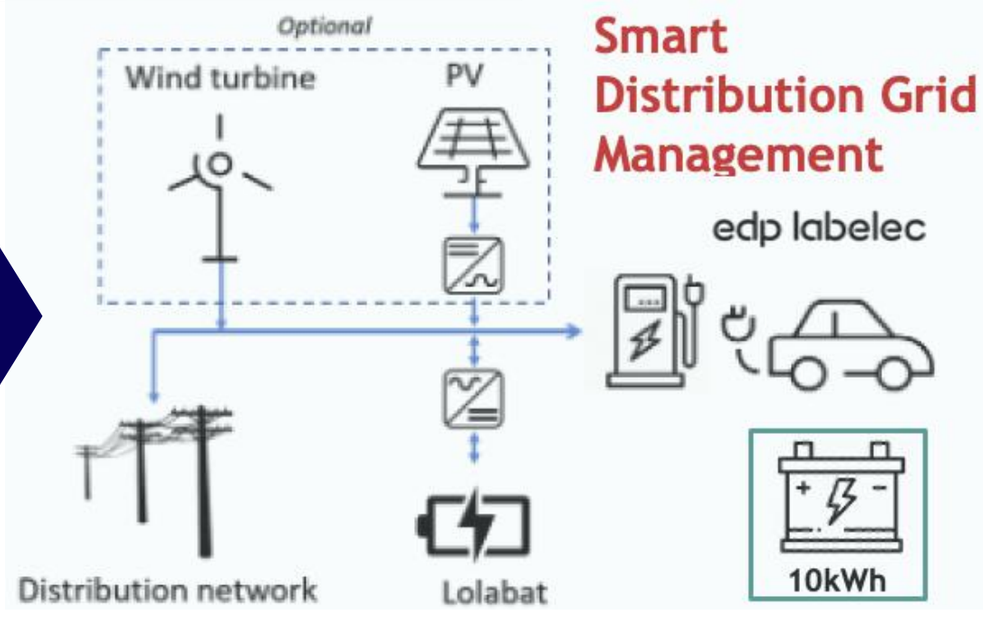
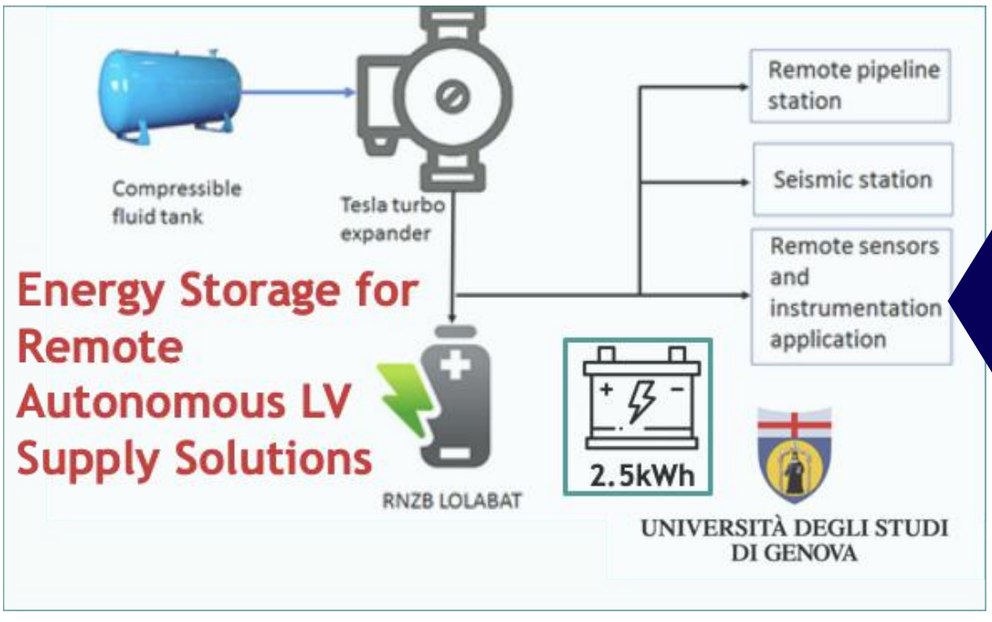
Demonstration Cases



To highlight the interesting features of 10 kWh/10kW NiZn battery technology at generation side i.e. for electricity producers - the test environment will use a turbine of 15 kW connected to a synchronous machine and to the BESS.

A validation of the assembled 10kWh/10kW NiZn prototype will be implemented using EDP Smart Grid laboratory and aims to validate the applicability of NiZn on grid application, by demonstrating this technology performance under different environments, aligned with the following relevant business use-cases:
- E-mobility integration
- smart grid operation





UNIGE will lead the 2.5kWh NiZn battery to be operated into an integrated system equipped with particular bladeless turbo expander that can convert any fluid stream in electricity and can therefore supply dedicated sensor systems in remoted and isolated areas. In this context, NiZn batteries will ensure an increasing of the reliability of this system.

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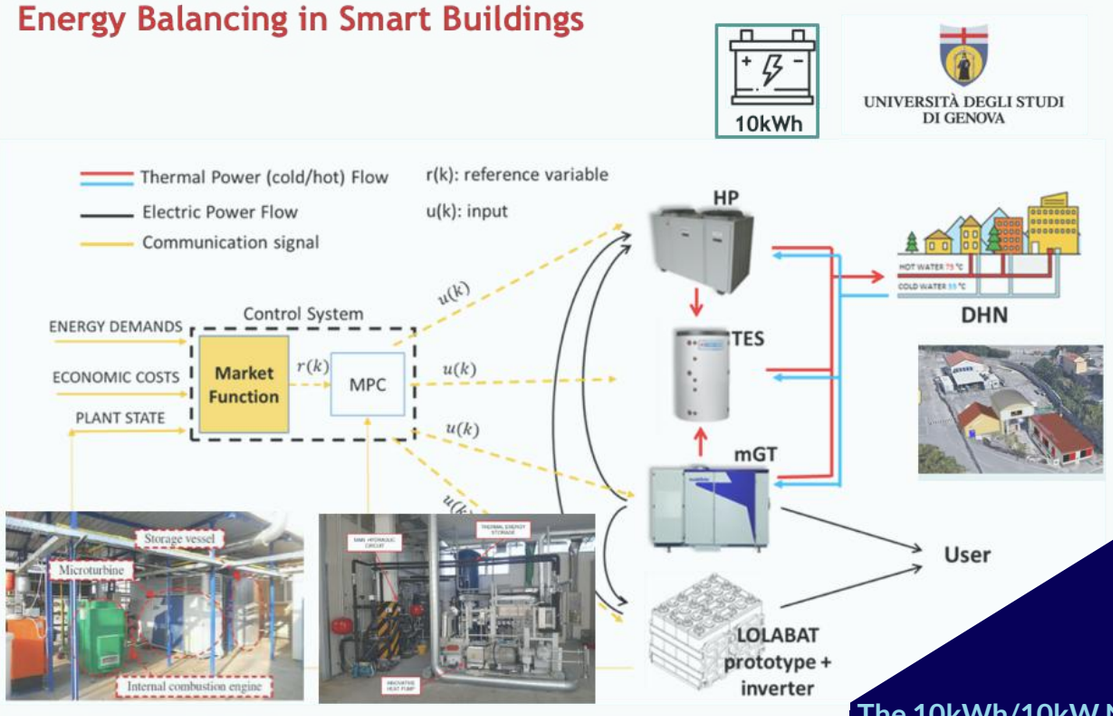
Demonstration Cases

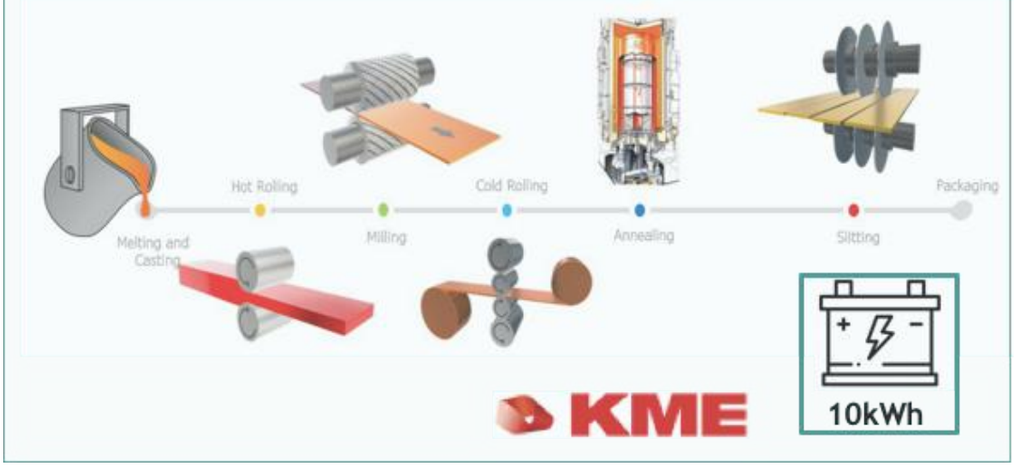
Energy Balancing in Smart Buildings



RINA-C will realize a pre-feasibility study to evaluate the potential future integration of a 10kWh/10kW NiZn battery in KME copper manufacturing process.
For validation, Supergrid Institute will develop an EMS according to the study and apply a demonstration of the concept on its test rig, emulating the grid and the KME's manufacturing process and using a real NiZn battery 10kWh / 10kW

The 10kWh/10kW NiZn battery pack will be integrated in the UNIGE IES plant demo site (Savona's Campus of University of Genova). The aim of this activity will be to evaluate the performance of the NiZn batteries and the synergy with rotating machine, thermal energy storage and heat pump in a real civil scenario, since IES plant is connected to the local Polygeneration grid serving the Campus in terms of heat (local Heating District Network) and electricity.

Energy Storage Integration in Electro-Intensive Industry - Industrial Application



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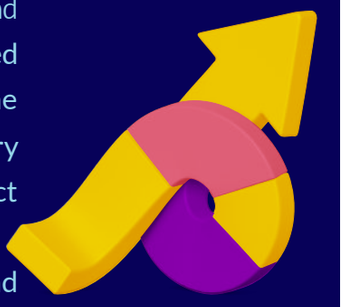
Project Technical Progress

WP2 : Specification of requirements, norms, and standards for the next generation of stationary batteries

Linked to the projects first stage objectives, LOLABAT's Work Package 2 was conducted and concluded within the first 9 months of the project, ending in September 2021.. It addressed the specifications of high-level technical and integration requirements applicable to the next generation of stationary batteries, and also aimed to assess the foreseen regulatory context for their development – norms and standards – and their compliancy to distinct end-use applications brought by NiZn solutions.



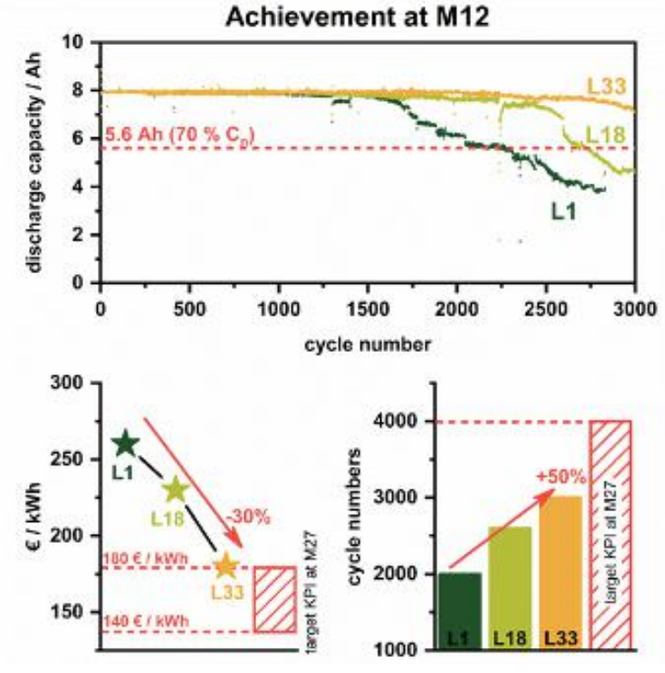
The sizing and configuration of different battery pack prototypes, to be tested and validated in several end-use application conditions, was determined, as well as the characterisation of the lab-based end-use application environments to be used during the validation phase, and the preliminary state-of-the-art review on the technology, reference standards, applicable guidelines, and regulatory aspects, integrability and operability compliances.

WP3: Improvements of NiZn cell components

This WP focuses on improving the components constituting the heart of the NiZn battery with respect to the cell technology available at the beginning of the project (GEN1).

The main challenge lies in improving the cyclability of the NiZn cells without increasing cell costs for the storage of electricity. Thus, dual main objectives are defined as key performance indicators (KPI):

- a reduction in battery cell costs, expressed in € / KWh, by a minimum of 30 % ;
- an increase by at least 100% of the NiZn cell durability upon successive load cycles at 100 % of depth of discharge (D.o.D).



These objectives shape intensive research works on electrode materials, at electrode and electrolyte levels, which are supported by physical-chemical characterisations and computational modelling.

All potential technological solutions are tested with 8 Ah full cells in a systematic fashion (1 C-rate, 100 % D.o.D), and down-selected for further scale-up of the cell-size capacity (WP4). A year after the project started (M12), the retention of the discharge capacity upon successive charge / discharge load cycles is improved by 50 %, attaining 3000 cycles, halfway through the path towards the objective of 4000 cycles. In parallel, a reduction by 30 % of the estimated cell cost took place, reaching 180 €/kWh, corresponding to the upper boundary of the price range KPI targeted for M27.

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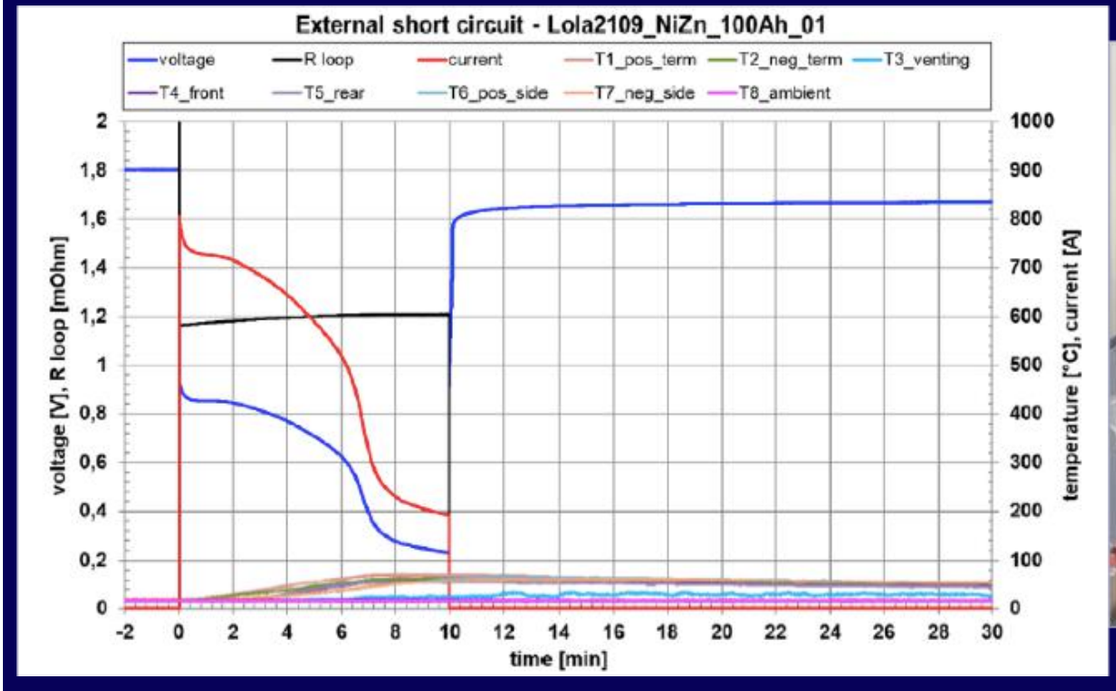
Project Technical Progress

WP4: Electrical characterisation and battery pack conception & design

WP4 acts as the cornerstone of LOLABAT by making a bridge between WP3 and WP6. While WP3 is focused on a continuous research work all through the project on NiZn cell components for the improvement of cyclability and cost of 8Ah NiZn cells, the selected cell configurations are sent to WP4 where they are characterised, upscaled to 100Ah cells, built in modules of 12V/100Ah and Battery Packs of 100V/10kWh with integration of BMS and sent to WP6 to be tested by the endusers in 5 different demo-case scenarios.



In order to enable the parallel advancement of WP3, WP4 and WP6 in the project's time frame, four cell generations are developed in WP3, three of them treated in WP4 and only one used in WP6. During the first project year, the main achievement of WP4 has been the upscaling of a first generation of NiZn cells from 8 to 100Ah.

The modules based on an 8 series connection of these cells have proved an initial successful performance by providing 105-110Ah. Characterisation of these cells is undergoing. The first safety test results (external short circuit on 100Ah cells) confirm the high robustness of NiZn system. Application of an external short circuit for 10 minutes, by an external resistance of 1.2mOhm, led to a short circuit current of 807A, and a temperature increase of only 69°C, leading to the conclusion that the cells are very stable against external short circuit condition. This conclusion was further confirmed by observation of a normal cycling performance of the cells after this test and by repetition of the test and achievement of same results.

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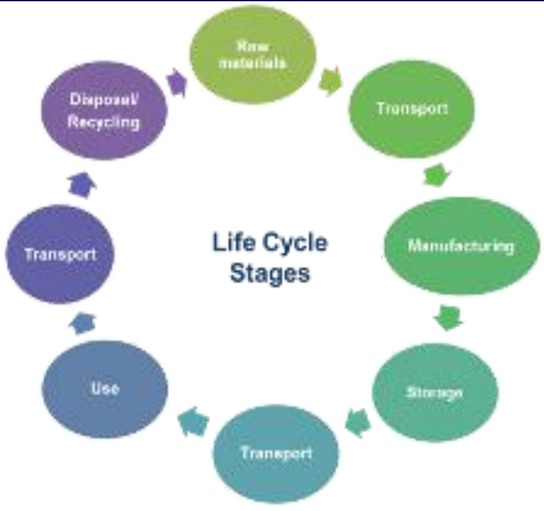
Project Technical Progress

WP5: Environmental impacts and cost analysis

The objective of this work package is evaluation and optimisation of the environmental impact and cost of the new NiZn battery from the design stage and the comparison of this technology with others from the point of view of environmental and cost performances.

Environmental framework : state of the art of the environmental performance of current battery **technologies**

The study of the environmental impacts of all the current market batteries was conducted. The results are presented in the Environmental Framework the state of the art regarding LCA (life cycle analysis) and LCCA (life cycle cost analysis).



The comparative study found in the literatures indicates that **NiCd batteries** are one of the batteries with the highest environmental impact, followed by PbA, NiMH, Li-ion and NaNiCl2. Regarding NiZn, some studies has shown it promising with lower energy needs compared to PbA and lower CO2 emissions.

Recycling of NiZn battery

The main objective of this task is to define specific scopes of recycling targets, second-life application potential and consequently propose a dedicated recycling process for NiZn battery in more economical and environmental friendly way. The possible recycling routes have been identified and first investigation of proposed recycling process implemented: **wet communition + subsequent separation**. These tests confirmed that there is no safety issue with the recycling and that known methods can be easily applied.

The following tasks will also be completed in WP5 :

Optimization of LCA and LCCA through Artificial Intelligence
Macroscopic analysis of technical and business risks affecting the security of supply of new NiZn batteries raw materials

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Interview With S&T Coordinator

How has the pandemic affected LOLABAT project?

From a general perspective, the pandemic remains an upheaval in our relationship to work. The periods of confinement forced us to work remotely and to communicate by video conference exclusively due to travel restrictions. Some have seen the advantages: saving time and money with the absence of travel, the comfort of staying at home in a less stressful and more pleasant setting. However, LOLABAT has 17 partners and 5 members of the Advisory board who have not had yet the opportunity to meet in person since almost 2 years now (taking into account the project proposal preparation stage) . The absence of direct social relationships could impede further developments after the LOLABAT project. From a more specific point of view, purchasing constraints with rising prices and delivery times have slowed down the completion of certain tasks. Some specific examples are: Four months of delay for the reception of the battery cycling benches at Sunergy, defects in the supply chains forcing us to select an alternative felt for the 100Ah cells of Generation 1 and opting for a battery supervisor (in the BMS) other than the one initially foreseen by the CEA due to the shortage of its related electronic components in the market.

Do you believe that these difficulties have affected the results obtained during this first year of 2021?

It is difficult to answer this question. Yet, we are proud of the results achieved during 2021, the first year of the project. The improvements in performance and cost of the cells demonstrated on small cells (8Ah) lead to results in line with the project's KPIs. Based on a cost estimation of 180€/kWh, 3000 charge-discharge cycles (achieved at 100% DoD at 1C rate) result in a 30% reduction for the cost and in a 50% increase for the service life, with respect to cell technology available at the beginning of the project. The capacity of the cells was increased to 100Ah and the production of a battery module with 8 cells in series delivers an energy larger than 1.25kWh.

"...The nickel in NiZn batteries could be recycled with a battery grade quality and therefore could be used again in NiZn batteries. This circular economy linked to existing and proven recycling methods makes possible to buffer fluctuations in the price of the raw materials while largely lowering the environmental impact. "

Dr. Fabrice Fourgeot, CEO of Sunergy and Consultant;
Chief Expert of NiZn battery at Chaowei Power Group Co. Ltd

Cell capacity upscaling has even been established with a 500Ah cell. The first abuse testing through external short circuit led to no damage and demonstrated the extreme robustness and reliability of NiZn system, being perfectly suited to the design of large storage batteries dedicated to stationary or industrial applications.

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Do you think that the surge in the price of Ni, at its peak at the start of 2022, above $20,000/ton, is likely to stop the rise of battery technology using a nickel cathode?

No, mostly the contrary, because the NiZn battery is recyclable. The nickel in NiZn batteries could be recycled with a battery grade quality and therefore could be used again in NiZn batteries.

A scale of $280/ton for recycling of battery seems reasonable, including about 20% Ni products that can be reused in an open loop doing such superalloys or stainless steel new products, or in a closed loop to rebuild batteries. In any case, having the active material available through recycling is an obvious advantage.

This circular economy linked to existing and proven recycling methods makes possible to buffer fluctuations in the price of the raw materials while largely lowering the environmental impact. Ni and Co, which are problematic raw materials in some Li-based battery technologies, are more of an advantage for an alkaline battery technology like NiZn thanks to recycling.

According to Bloomberg NEF, prices of lithium-ion battery packs were above $1,200 per kilowatt-hour in 2010 but plummeted down to $132 by 2021. However, the company estimates that average prices could reach $135 per kilowatt-hour in 2022. According to a December report from S&P Global, further growth in the demand during 2022 might even result in a lithium shortage this year, as its utilisation will exceed the production and depletes stocks. Benchmark prices of lithium carbonate ended 2021 at record levels.

In China, the biggest battery-producing country, the price was 261,500 yuan (just over $41,060) a ton, more than five times higher than last January. The price of cobalt has doubled since last January to $70,208 a ton, while nickel jumped 15% to $20,045.

There is a consensus that the challenges for Li production are not only the level of reserves, but also if the production can ramp up quickly enough to address the increasing demand in portable devices and electric cars markets. The main materials used in NiZn technology are non-toxic, abundant and with a geographic distribution of the reserves around the world. The proposition of the RNZB as a promising alternative to Li-ion technology for the stationary energy storage applications, where huge batteries are needed, could lower the pressure on the critical raw materials specific to Li-ion technologies that are need to power electro-mobility.

When do you think RNZB batteries will be able to break into the market?

This is already the case with the American company ZincFive, which will supply its nickel-zinc batteries to the Wyoming data center developer Hyperscale White Box to equip its next installation in Aspen, Wyoming. The data center will be the first of its kind to use a nickel-zinc battery-based uninterruptible power supply (UPS) as its sole source of backup energy storage, completing its commitment to minimizing its environmental footprint. A first phase provides 30 MW of capacity coupled with a wind farm.

The testing/validation of 10kWh battery packs in the LOLABAT project, to be initiated in March 2023 with five demo-cases in real environments, will demonstrate the applicability of our NiZn battery concept with a European-based technology. The corresponding future industrial and commercial structure may emerge in various ways as a European joint venture between some of the technical and scientific members, including the end users of the LOLABAT consortium and its Advisory Board, upon an association of the skills and growth objectives of the partners.

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Press Coverage

pv magazine

The research project on stationary batteries LOLABAT receives a European grant

Coordinated by the Lyon SuperGrid Institute, one of the work packages must demonstrate the viability of integrating stationary Nickel-Zinc batteries in the storage of renewable energies and in smart buildings. It was officially launched on January 19 for a duration of 39 months.

JANUARY 22, 2021 GWENAELLE DEBOUTTE

ENERGY STORAGE | TECHNOLOGY AND R&D | FRANCE

The LOLABAT research project on stationary batteries was officially launched on January 19.
Photo: Supergrid Institute

Zinc Batteries featured in B.E.S.T. Mag as the EU makes € 7M bet on Zinc

Feb 23, 2021 | Environment, Government, Grant, Press | 0 comments

Best (Batteries and Energy Storage Technology) Magazine featured Zinc recently in their winter 2021 issue: It's Time for Zinc to Swim. This comes as the LOLABAT (LOng LAsting BATtery system) program launches in Europe, a consortium of seventeen industrial and...

Best (Batteries and Energy Storage Technology) Magazine featured Zinc recently in their winter 2021 issue: It's Time for Zinc to Swim.

This comes as the LOLABAT (LOng LAsting BATtery system) program launches in Europe, a consortium of seventeen industrial and academic partners working to commercialize Zinc-Nickel battery technology for grid-scale energy storage for a single, smart European Electricity Grid. At the heart of the program is SunErgy, a French company specializing in Zinc-Nickel battery design whose earlier technology was sold to Chilwee Battery Group.

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