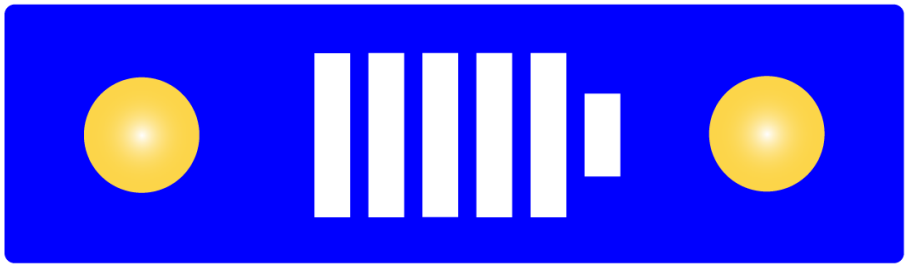

SPINMATE

Scalable and Sustainable Pilot Line based on innovative manufacturing technologies towards the industrialisation of Solid-State Batteries for the automotive sector

D3.2 Report on the conclusions of the dedicated workshops

SPINMATE project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101069712.

Document details

Project Information	
Project Acronym/ Name:	**SPINMATE**
Project URL:	**www.SPINMATE.eu**
Project Type:	**Research and Innovation Action (RIA)**
EU CALL:	**HORIZON-CL5-2021-D2-01-05 (Manufacturing technology development for solid-state batteries (SSB, Generations 4a - 4b batteries) (Batteries Partnership))**
Grant Agreement No.:	**101069712**
Project Start Date:	**01/08/2022**
Project End Date:	**31/07/2026**
Document details	
Work package:	**3**
Deliverable:	**D3.2 Report on the conclusions of the dedicated workshops**
Due date of Deliverable:	**31/07/2023**
Actual Submission Date:	**31/07/2023**
Name of Lead Beneficiary for this deliverable:	**Takwa Benissa (ABEE)**
Reviewed by:	**Marco Duarte (INOVA), Catarina Carneiro (INOVA)**
Revision:	**28/07/2023**
Dissemination Level:	**PU**

Document History			
Version	**Date**	**Comment**	**Modifications made by**
1	02/06/2023	1st draft	Takwa BENISSA (ABEE)
2	29/06/2023	General review	Marco DUARTE (INOVA)
3	14/07/2023	Second draft	Takwa BENISSA (ABEE)
4	28/07/2023	Final revision	Catarina Carneiro (INOVA)

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Glossary and Abbreviations

EVs	electric vehicles
PLD	Pulsed Laser Deposition
SSB	Solid State Batteries
Gen4b	Generation 4b
LIB	Li-ion batteries
IIoT	Industrial Internet of Things
ML	Machine Learning
Li-ion	lithium-ion
ASSB	anode-free all-solid-state battery
R2R	roll-to-roll

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Executive Summary

SPINMATE project took the initiative to engage with other projects under the topic HORIZON-CL5-2021-D2-01-03, HORIZON-CL5-2021-D2-01-05 and LC-BAT1-2019to establish a solid knowledge basis around Gen 4a and Gen 4b SSBs and share Gen 4b materials-related achievements.

SPINMATE, together with other six projects, established a cooperation framework – ***Solid4B cluster*** – to organise dedicated workshops and promote the internship of researchers between leading research institutions in Europe.

Solid4B cluster works to enhance research synergies among the European-level projects working on solid state batteries, translating research data into valuable knowledge for diverse stakeholders. This cluster was built to synchronize and conjointly promote the R&D topics in the electric vehicle field.

The knowledge and experience shared between different projects will support individual performance of the projects involved, while maximizing the dissemination range of achievements and respective impacts.

The dedicated workshops conducted by ***Solid4B cluster*** aim to discuss, promote, and disrupt ideas regarding safety, efficiency and sustainability of batteries and related e-mobility technologies by translating research data into valuable knowledge for diverse stakeholders, including industry leaders, researchers, and policymakers.

The first Webinar titled "Lithium metal anode production methods: State of the Art, challenges, and future perspectives." was held online on the 26th of June 2023. The topics included insights from different cluster members on Lithium’s production methods, deposition and protective coatings, anode-less production, and industrial scale production of Lithium metal anodes.

1. Introduction

This deliverable summarizes the planned joint activities among the ***SOLID4B cluster***, involving seven funded European projects under the Horizon 2020 program and Horizon Europe from the call HORIZON-CL5-2021-D2-01-03, HORIZON-CL5-2021-D2-01-05 and LC-BAT1-2019. **SPINMATE** project provides a clustering activities plan in this deliverable, considering the previously agreed activities between the SOLID4B partners.

2. SOLID4B cluster identity

A LinkedIn page under the name of the ***SOLID4B cluster*** (https://www.linkedin.com/company/solid4b-cluster/) was created last October 2022 with around 380 followers and experts on batteries worldwide. All the partners of this cluster agreed on the name and the slogan of this cluster last October after sharing a voting poll.

"""SOLID4B cluster: Going Solid for safer batteries"""

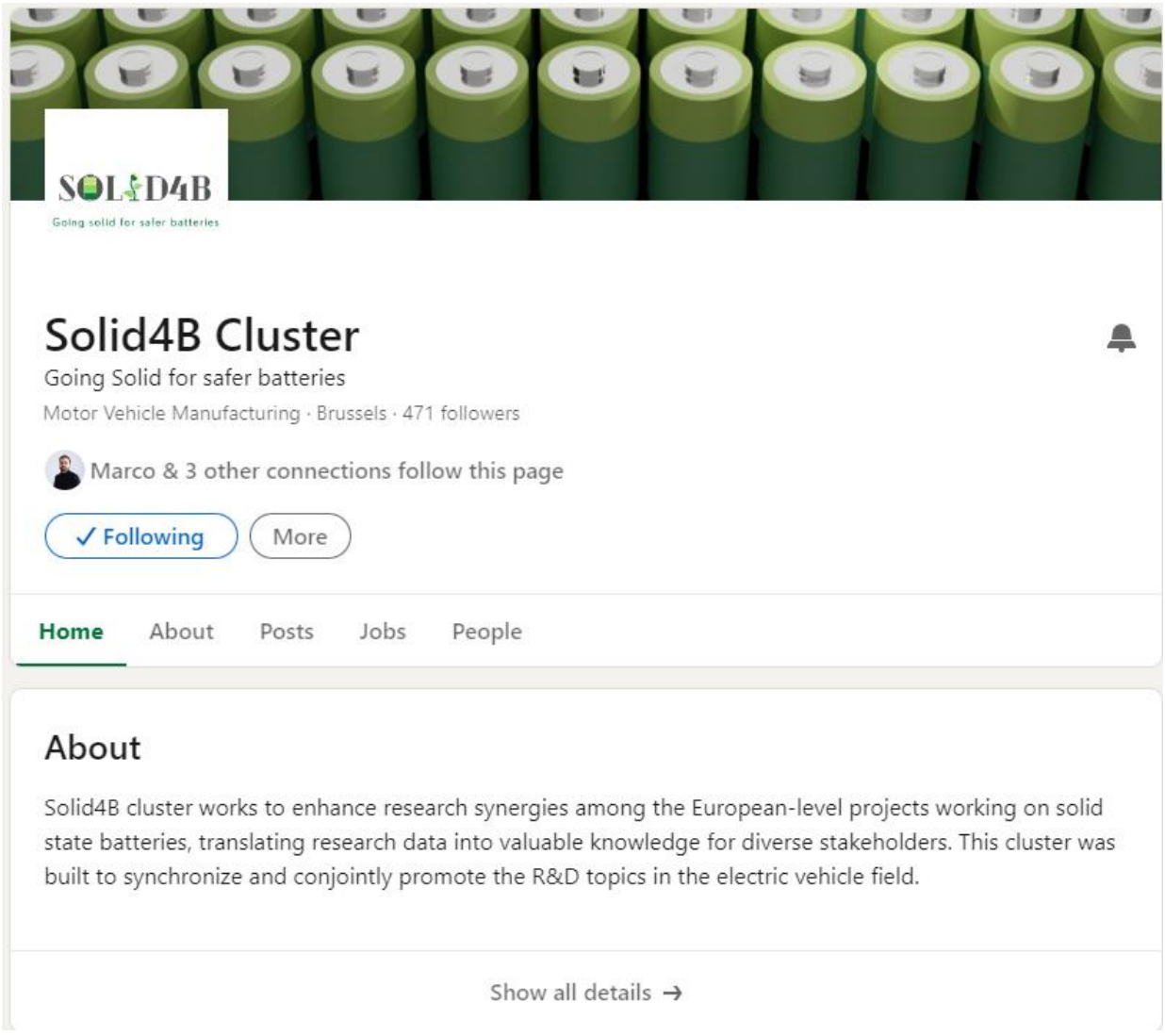

Figure 1: SOLID4B LinkedIn page.

We designed the logo below for all communication and dissemination materials to give this cluster a visual identity.

SOLID4B

Going solid for safer batteries

Figure 2: SOLID4B Logo.

3. Internal communication

To ensure easy but also effective communication and collaboration between the cluster's partners, Microsoft teams was implemented and all the projects' coordinators and the communication leaders of all the partners were added to this repository to ensure an easily accessible and reliable communication infrastructure has been created.

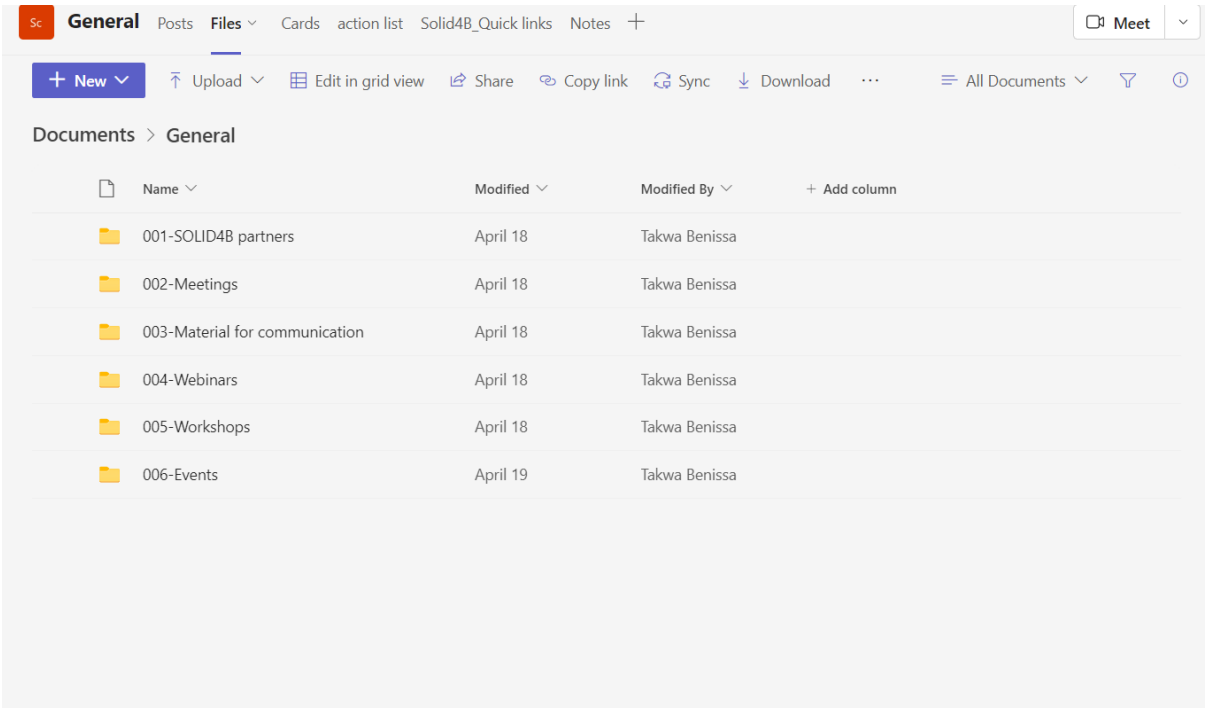

Figure 3: Teams Platform.

4. The cluster projects

This document reports the planned activities for the ***SOLID4B cluster*** led by ABEE, presented by its project manager Takwa BENISSA, Ph.D., and its technical coordinator Andrea Itziar Pitillas Martinez, Ph.D., as part of the **SPINMATE** project. Seven EU projects agreed to be a part of this cluster to share knowledge and exchange experiences around Gen 4a and Gen 4b SSBs and lithium metal, as it is a common topic among all the involved projects.

It also reports the main content and outputs of the first webinar of the **SOLID4B webinar series**.

In the following section, we will present the project members of the ***SOLID4B cluster***, the agreed plan, and the outcomes of the first webinar. Currently, ***SOLID4B cluster*** includes the following projects: **SPINMATE**, ADVAGEN, AM4BAT, HIDDEN, PULSELION, SEATBELT, and SOLID.

4.1 **SPINMATE** Project-Grant agreement ID: 101069712

SPINMATE aims to demonstrate a scalable, sustainable, safe, and cost-effective digital-driven proof-of-concept pilot line, at a TRL6 level, as a first step towards the large-scale manufacturing of generation 4b (Gen 4b) SSB cells and module, in order to support the electrification of the automotive sector. To do so, **SPINMATE** proposes the development and implementation of innovative and scalable manufacturing and processing solutions (notching/cutting, stacking and sealing/packaging steps, among others). Furthermore, new industry 4.0 and 5.0 concepts (Industrial Internet of Things - IIoT and Machine Learning - ML algorithms, Digital Twins, giga-factory line simulation,⋯) are proposed to be applied for the digitalisation of the proof-of-concept pilot line, as well as the assembly and manufacturing processes. Thus, **SPINMATE** will manufacture small 1 Ah and large 10 Ah SSB cells, after the development and optimisation of :

(i) advanced solid polymer electrolyte with high ionic conductivity and wide electrochemical stability,

(ii) Li metal foil with surface treatment enabling a more stable interface as anode and

(iii) Ni-rich layered oxide cathode with improved cycling stability.

Regarding electrodes (i.e. anode and cathode) and electrolyte processing, innovative solvent-free extrusion routes, roll-to-roll approach and optimised solvent casting methods are suggested. **SPINMATE**'s Gen 4b SSB cells will create a new industry value chain in Europe towards their commercialisation.

This new generation technology will ensure:

(i) enhanced energy densities, overcoming current LIB limitations,

(ii) improved safety in both solutions and workers;

(iii) increased sustainable mass production; and

(iv) decreased carbon footprint and cost.

4.2 ADVAGEN Project- Grant agreement ID: 101069743

To date, the battery market is dominated by lithium-ion (Li-ion) chemistries, as the energy density has more than doubled and their costs have dropped by a factor of at least 10. However, conventional Li-ion batteries (LIB) are reaching their performance limits in terms of energy

density and facing safety issues, is required the development and production of new battery generations, such as Solid-State Batteries (SSBs), to create a new industry value chain in Europe towards their commercialization. Consequently, high energy-density EU-made SSBs will ensure the supply of, among others, the automotive sector. To do so, the development and deployment of new manufacturing technologies, enabling the large-scale production of SSBs, is crucial. Indeed, among the overarching themes to develop and produce sustainable batteries in the future, the BATTERY 2030+ roadmap4 considers manufacturability as a cross-cutting key area. Innovative and scalable manufacturing techniques to produce SSBs will accelerate cost reduction, energy savings, and enhanced safety. ADVAGEN will develop a new lithium metal (LiM) battery cell technology based on a safe, reliable, and high performing hybrid solid-state electrolyte (LLZO-LPS based), gaining a competitive advantage over the worldwide (mainly Asian) competition. This will sustainably strengthen the EU as a technological and manufacturing leader in batteries as specified in the ERTRAC electrification roadmap and SET-Plan Action Point-7. ADVAGEN consortium contains key EU actors in the battery sector, from industrial materials producers (SCHT, CPT, ABEE), battery manufacturer (ABEE) to R&D centers (IKE, CEA, IREC, TUB, CICe, POLITO, INEGI, UL, FEV) and the automotive industry (TME), covering the complete knowledge and value chain. By developing high-performance, affordable and safe batteries, ADVAGEN aims to re-establish European competitiveness in battery cell production.

4.3 AM4BAT Project- Grant agreement ID: 101069756

Next-generation lithium-ion batteries will need to offer higher energy and power densities at a lower cost. Current battery manufacturing is struggling to further improve these key metrics. The EU-funded AM4BAT project will leverage additive manufacturing technologies for fabricating 3D lithium-ion batteries. Using vat photopolymerisation 3D printing, the aim is to develop a high-performance battery with energy density of 400 Wh/kg for electric vehicles. AM4BAT outcomes will contribute to the creation of a sustainable European battery manufacturing value chain, helping the EU to succeed in the electric mobility rollout.

AM4BAT will develop innovative component materials and assemble an anode-free all-solid-state battery (ASSB) manufactured by a cost-competitive and sustainable vat photopolymerization 3D printing. The objective is to reach a high-performance battery with an energy density of 400 Wh/kg and 1000 Wh/L for electric vehicle applications. This will be achieved by developing materials including

i) single crystal NMC811 with superior energy,

ii) LNMO Co-free and higher voltage for power AM4BAT variant,

iii) dopped LLZO with different size from 0.5 to 5µm and 50-100 nm for higher loading in the HSE,

iv) novel acrylic, nanocellulose, sustainable photocurable polymer.

The materials will be optimized for their processing by additive manufacturing. AM4BAT will then validate the technology via 3-Ah pouch cells reaching TRL5, and will carry out an evaluation of manufacturability, a full sustainability assessment and a recycling study to support 'customers' uptake. Identified stakeholder groups as well as other research initiatives will be actively involved to ensure dissemination of AM4BAT results and broader 'users' acceptance. With its ambitious concept based on cutting-edge 3D printed ASSB and a strong consortium involving the whole value chain from material providers to an OEM, AM4BAT aims to overcome the remaining technological obstacles of the Gen 4b technology as specified in the work programme and accomplish the urgent shorter-term needs of the battery industry: to make Gen 4b batteries a viable technology beyond 2025. On longer term, the AM4BAT outcomes will contribute to the

creation of a sustainable European battery manufacturing value chain helping the EU to succeed in the electric mobility roll-out and accelerate the energy transition.

4.4 HIDDEN Project -Grant agreement ID: 101069681

The EU-funded HIDDEN project plans to develop self-healing processes that could extend the lifespan of lithium–metal batteries by 50 % and thus allow production of durable next-generation batteries with 50 % higher energy density compared to traditional lithium–ion batteries over total lifetime. Major focus will be placed on producing novel self-healing thermotropic liquid crystalline electrolytes and piezoelectric separator technologies. Multiscale modelling of electrolyte design will enable researchers to gain valuable insight into dendrite growth that plagues lithium-metal batteries. The project brings together partners from both academia and industry with expertise in battery chemistry and physics, material modelling, printing and coating, and industrial battery cell assembly.

4.5 PULSELION Project- Grant agreement ID: 101069686

The EU aims to have at least 30 million zero-emission vehicles on the roads by 2030. In-house production of high-performance battery technology is key to the wider adoption of electric vehicles. The EU-funded PULSELiON project aims to develop the manufacturing technology for Generation 4b solid-state batteries. These batteries will comprise a lithium-metal anode, sulfide solid electrolytes and a nickel-rich nickel‑manganese‑cobalt cathode. A novel pulsed laser deposition technique will be adapted and modified into a single-step vacuum process for safe and efficient manufacturing of the 'batteries' anode components. The cathode layer will be produced using conventional wet processing techniques.
Europe's objective to have 30 million electric vehicles (EVs) by 2030 can only be achieved by large scale, in-house production of highly effective and performant batteries. Development of solid-state battery technologies could improve the energy density and safety of lithium metal solid state batteries. PULSELiON project aims to develop the manufacturing process of Gen 4b solid-state batteries (SSBs) based on lithium-metal anode, sulfide solid electrolytes, and Nickel-rich NMC cathode. Novel pulsed laser deposition technique developed by PULSEDEON will be adapted and modified into a single-step vacuum process for safe and efficient manufacturing of anode components composed of lithium metal, protective layers, and sulfide based solid electrolytes. The cathode layer will be made based on conventional wet processing techniques. Initially, the anode and cathode layers will be developed in small scale for making coin cells and monolayer cells for optimising the materials and process. SSB cells will be developed with optimised process routes and will be upscaled to a pilot line proof-of-concept (TRL 6) by manufacturing large scale solid-state batteries (10 Ah). Digitalisation will be incorporated in the process modelling task with the inputs obtained from process upscaling and cell testing tasks, which will enable efficient process optimisation.

4.6 SEATBELT Project- Grant agreement ID: 101069726

Electric vehicles are powered by batteries, which are the most important part. But the demand for electric vehicles is increasing so fast that it will soon outpace battery cell production. The EU-funded SEATBELT project will help to pave the road towards a cost-effective, robust all-solid-state lithium battery comprising sustainable materials by 2026. Specifically, it will achieve the first technological milestone of developing a battery cell that meets the needs of the electric vehicle industry. The low cost cell will be safe by design with sustainable and recyclable materials, reaching high energy densities and long cyclability in line with the 2030 EU targets. The project will be the start point of the first EU all solid-state battery value chain.

As of 2025, new generations of Li batteries based on silicon/carbon (Gen. 4a) and Li metal (Gen. 4b) anode, where flammable liquid electrolyte is replaced by a non-flammable solid-one, will take

over the current Li-ion device. However, only all-solid-state Gen. 4b Li batteries are expected to fulfill the needed cell gravimetric energy density specifications demanded by electromobility and stationary applications. Therefore, SEATBELT ambition is to generate a local EU industry that revolves around a cost-effective, robust all-solid-state Li battery comprising sustainable materials by 2026. SEATBELT intends to achieve the first technological milestone of developing a battery cell (TRL5) meeting the needs of Electric Vehicle (EV) and stationary industry. The low-cost SEATBELT cell is safe-by-design with sustainable and recyclable materials, reaching high energy densities (>380 Wh/kg) and long cyclability (>500 cycles) by 2026 in line with the 2030 EU targets. The cells are produced by low-cost solvent-free extrusion process comprising a combination of innovative materials: thin Li metal, hybrid electrolyte, a safe cathode active material without critical materials and thin Al current collector. The cell design being optimized by interface (operando and atomistic modelling) and process (machine learning) methodologies. In addition, new in situ imaging instrumentation will be developed to investigate safety properties and mechanical deformation to assess cell safety in real conditions. An innovative recycling cycle from materials to cell level will be also established. Thus, SEATBELT will be the start point of a first EU all-solid-state battery value chain, whose main players in RTD and Industry sectors are within the consortium. So, cells and modules will cycle using industrially relevant protocols dedicated to EV and stationary applications. SEATBELT consortium is composed of 14 beneficiary partners and 3 affiliated entities, and one associated partner, from 7 European countries with an overall budget of 7851448.50€.

4.7 SOLiD Project- Grant Agreement No.: 101058179

In the world of batteries, a solid-state design has advantages over batteries that use a liquid – including lithium-ion batteries. Safer and higher in energy density, the solid-state battery is considered the future generation of batteries. The EU-funded SOLiD project will create a sustainable and cost-efficient pilot-scale manufacturing process. It will use roll-to-roll (R2R) dry extrusion coating for the blend of cathode active material, solid polymer electrolyte, and conducting additives. The metallic lithium anode will be produced by R2R pulsed laser deposition. SOLiD aims to enable sustainable manufacturing of advanced high-performance Generation 4b (solid-state) Li-ion batteries to support electromobility with minimised amount of critical raw materials (Co and Li), and with superior performance and safety.

The SOLiD project will create a sustainable and cost-efficient pilot scale manufacturing process for a high energy density, safe and easily recyclable solid-state Li-metal battery. We will use roll-to-roll (R2R) dry extrusion coating for the blend of cathode active material, solid polymer electrolyte, and conducting additives. R2R slot die coated primers on the cathode current collector will enhance adhesion, performance and corrosion resistance of the cell. The polymer electrolyte layer will be R2R coated, using an optimal design for the slot die head. For the Li metal anode, we will utilize cost-efficient R2R pulsed laser deposition, which enables minimizing the Li thickness down to 5 µm. The Li metal production will be combined with an inline process for interfacial engineering to ensure compatibility with the other layers and stability. The process development will be supported by digitalization methods to go towards zero-defect and cost efficient manufacturing.

The proposed methods enable sustainable manufacturing of Gen. 4b solid state batteries with minimised amount of critical raw materials (Co and Li), and with superior performance and safety: The protective layers enable the use of NMC811, which reduces the amount of Co into minimum without compromising the lifetime, and PLD process helps to minimize the Li thickness. Dry coating eliminates the use of toxic solvents and energy-consuming drying steps, and the digital quality control will reduce the amount of waste. The thickness of each layer will be minimized to reach energy density above 900 Wh/l. Cost will be reduced by cost-effective

production methods and by maximizing the yield. Safety and long cycle life are guaranteed by the solid electrolyte and the protective interlayers. Supported by the life-cycle thinking and stakeholder engagement, the SOLiD project will enable the design of a sustainable solid state battery factory of the future.

5. Cluster activities plan

Solid4B cluster works to enhance research synergies among the European-level projects addressing the safety of batteries and related technologies by translating research data into useful knowledge for diverse stakeholders. This cluster was built to synchronize and conjointly promote the R&D topics on electric vehicles.

After a meeting with all the project coordinators and the communication partners of all the project partners on the 18th of April 2023, an action plan has been established as below:

- Online events/ webinars and workshops will take place every six months.
- **SPINMATE** and **AM4BAT** will organize two onsite clustering workshops (one workshop per project).
- The first workshop will take place around the mid-term report to secure that the maximum of partners will be able to join.
- From the **SEATBELT** project, **INP Grenoble,** represented by **Didier Devaux**, organizes a Workshop/training to disseminate project results every two years at the European level. The Cluster results can use used to disseminate cluster activities and results on the next Workshop/training that will take place in **2025**.
- As the publication target for all the cluster partners is challenging, we agreed to have at least one white paper to disseminate the cluster results around **2025**. All the partners agreed that the peer-reviewed results could be used in the white papers.
- The advisory boards of the projects can join as keynote speakers for the workshops or webinars.
- Create a list of the potential events the partners can attend jointly as a cluster.

6. SOLID4B cluster: 1st webinar

6.1. Webinar agenda and topics

The first webinar of the **SOLID4B webinar series** took place on the 26th of June, 2023, from 10 AM to 12.30 PM under the name "Lithium metal anode production methods: State of the art, challenges, and future perspective", as illustrated in the below agenda (Figure 4).

Since advertising the webinar on social media for the first time on the 7th of June 2023, the webinar attracted the attention of 175 subscribers, which reflects the cluster's impact on the battery world, specifically as it is the first edition. It indicates that a considerable number of people were interested in receiving updates and notifications about the webinar.

The first advertisement of the agenda and office forum (https://forms.office.com/e/Uqja6C9YK2) was created and shared on social media and through emails with all the cluster partners based on privacy regulations and data protection guidelines. The aim of creating that subscription forum was essentially to

- Simplify Subscription: The office forum provides a centralized platform where individuals can easily subscribe to receive updates and notifications about upcoming steps. By having a dedicated space for subscriptions, we were able to streamline the process and make it more convenient for interested participants to sign up.

- Collect Data: The forum included different fields where participants could provide information about themselves or their organizations. This can include data such as the company or institution they belong to, their country of origin, and their interest in interacting with the speakers. Gathering this data helps us in understanding the audience demographics, interests, and preferences, which can inform future webinar planning and content creation.
- Identify targeted Engagement: With the data collected, we were able to tailor our communication and engagement strategies accordingly.
- Evaluate the interaction with the experts: The office forum served as a platform to show our participants' interest in engaging with the experts or speakers involved in the webinar. Considering this information, we designed the teams platform by creating a Q&A section where the participants can ask questions, share their thoughts, or request specific topics or speakers for future events. This interactive element fostered engagement, encourages participation, and strengthens the connection between the audience and the experts.
- Analyze the Data: The data collected through the office forum were analyzed to gain insights into the audience composition, preferences, and needs. This analysis helped to identify trends, understand the impact of the webinar on different segments, and make informed decisions for future webinar planning and content creation.

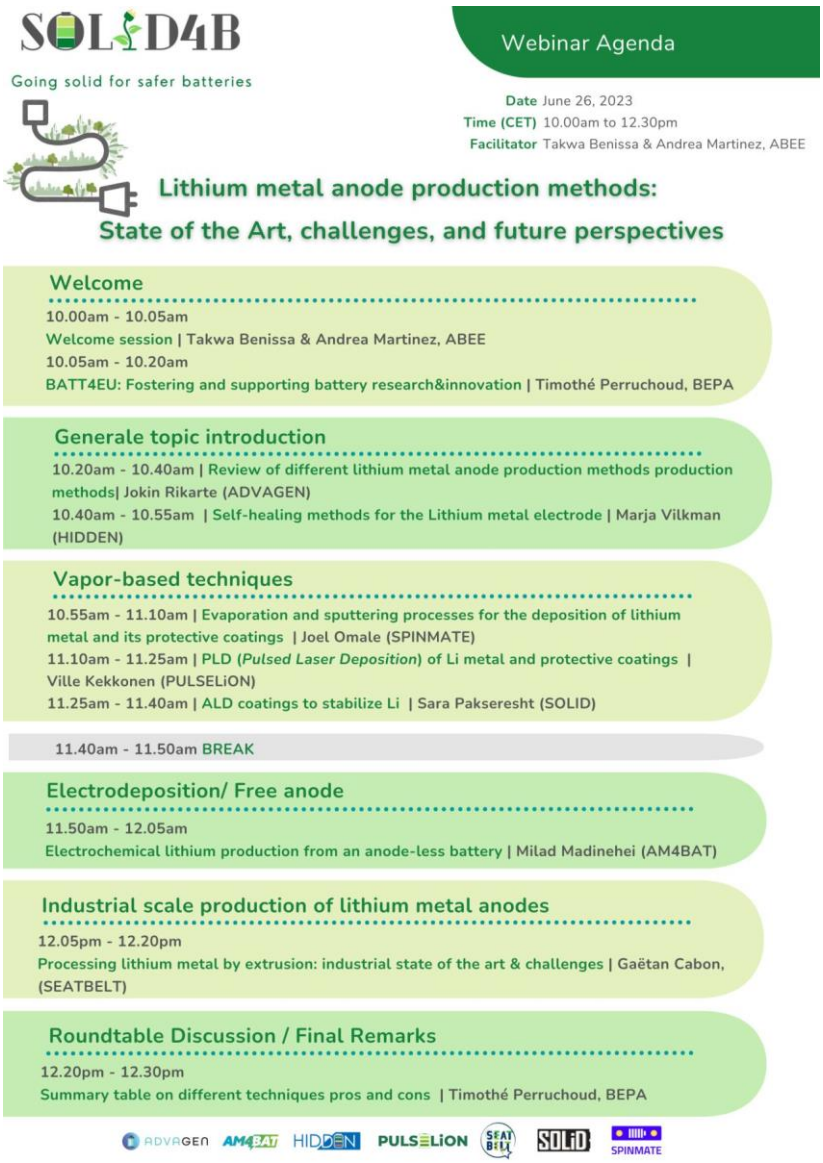

Figure 4: Agenda of the first webinar.

6.2. Main Results

This webinar focused on the different Lithium metal anode production methods that are utilised in the ***Solid4B cluster*** European projects. The session was opened by Solid4B founders Takwa Benissa and Andrea Martinez (**SPINMATE**), who explained the ***Solid4B cluster*** goals and scope, as well as introduced the involved partners. After a welcome by BEPA (Batteries European Partnership), the ADVAGEN and HIDDEN project representatives introduced the topic and discussed the different Lithium metal production methods (Jokin Rikarte), as well as the self-healing methods employed (Marja Vilkman). The next block of presentations focused on vapor-based techniques for lithium metal production, including talks from **SPINMATE** (Joel Omale), PULSELiON (Ville Kekkonen), and SOLID (Sara Pakseresht) project representatives. Next, Milad Madinehei (AM4BAT project) presented electrochemical lithium production for an anode-less battery. The final talk of the webinar by Gaetan Cabon (SEATBELT project) focused on the industrial state of the art and challenges of lithium metal anodes processing by extrusion. Finally, a roundtable discussion led by Timothe Perruchoud (BEPA) closed the webinar.

The welcome session delivered by BEPA focused on introducing the Batt4EU Partnership. The Batt4EU Partnership is a co-programmed partnership under Horizon Europe that gathers the European Comission and BEPA and brings together all the European battery stakeholders that are interested to get involved in Horizon Europe. The Batt4EU vision and scope, as well as the working groups were explained, providing the webinar attendees with a clear understanding of how Batt4EU fosters the solid-state battery projects. Lastly, the attendees were also encouraged to join BEPA and attend the upcoming BEPA events and workshops to create erg in the European battery community.

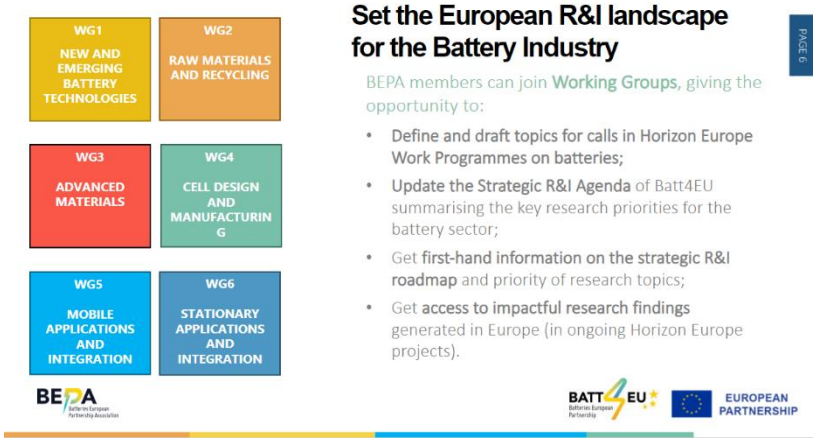

Figure 5: Snapshot of **BEPA** session presented by **Timothe Perruchoud.**

Jokin Rikarte from ADVAGEN project introduced the topic of the webinar by delivering a presentation about the state of the art, challenges, and future perspectives of the lithium metal anode production methods. The lithium metal anode benefits and challenges, as well as improvement strategies, were introduced first to provide the webinar attendees with the necessary background. Afterward, the standard industrial process of lithium production was compared with the alternative methods, which included the PVD techniques, melting and slurry approaches, as well as electrodeposition and anodeless routes. The different methods were compared in regards to the process feasibility and the resulting lithium metal anode quality, providing the webinar attendees with a comprehensive overview of the different lithium metal anode production routes.

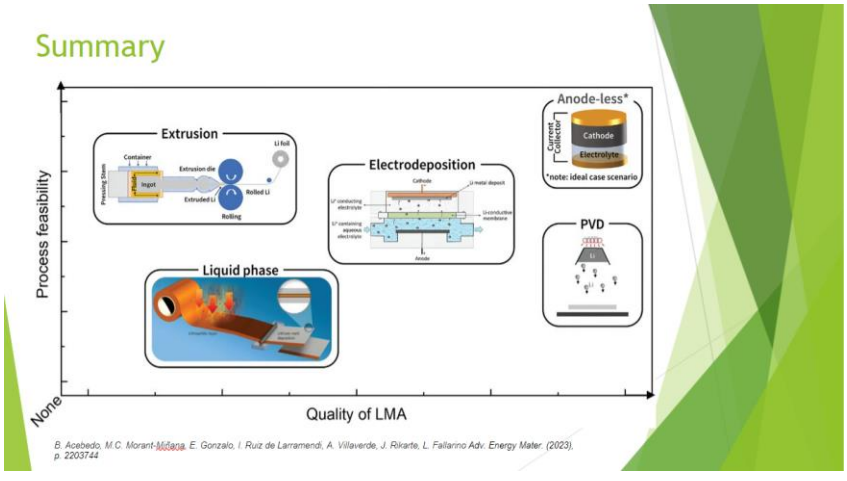

Figure 6: Snapshot of session presented **ADVAGEN** by **Jokin Rikarte.**

Marja Vilkman from HIDDEN project has introduced Li-metal batteries and their benefits for the automotive sector, as well as the Li-metal issues that impact the lifetime of the battery. After an overview of different electrolytes that can be used in the Li-metal battery, different methods to increase the lifetime of the Li-metal batteries, which included both preventative/autonomous and curative self-healing methods were discussed. Once the webinar attendees were familiarized with the different self-healing methods, the HIDDEN project approach was explained.

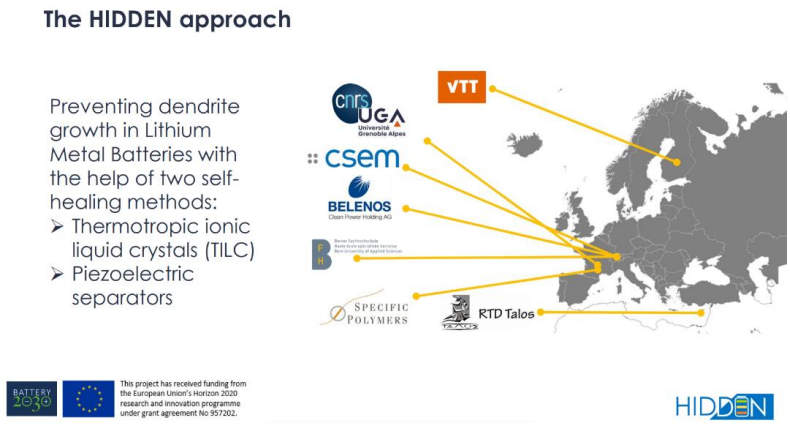

Figure 7: Snapshot of **HIDDEN** session presented by **Marja Vilkman.**

The next block of presentations focused on the vapor-based lithium metal production techniques was opened by Joel Omale (**SPINMATE**) and focused on physical vapor deposition processes, including evaporation and sputtering. These two processes were explained in great detail and it was explained why evaporation is more suitable for large scale lithium production, while sputtering is most suited for lithium protective coatings. It was also explained how both of these vapor-based techniques for lithium production are integrated into **SPINMATE** project, familiarizing the webinar attendees with the **SPINMATE** concept.

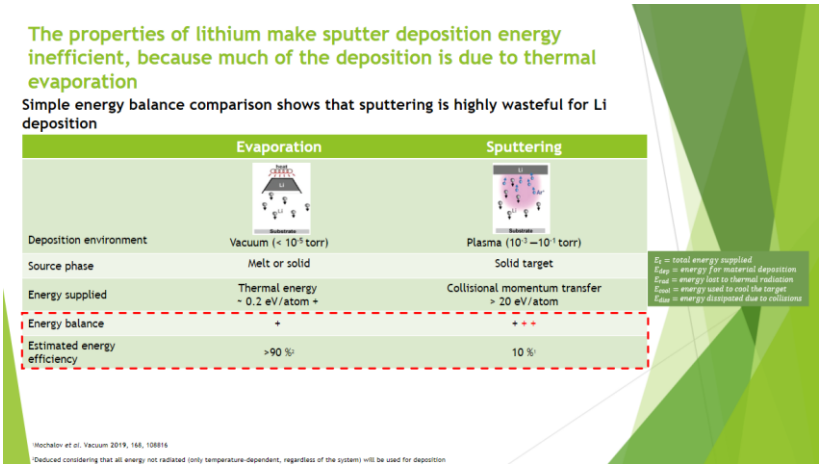

Figure 8: Snapshot of **SPINMATE** session presented by **Joel Omale.**

Next talk on vapor-based techniques was delivered by Ville Kekkonen (PULSELiON project) on the subject of pulsed laser deposition (PLD) of lithium metal and protective coatings. The PLD

technique was explained in great detail, highlighting the key benefits of this lithium production method, as well as illustrating different examples of tools that are used iin this process. The webinar attendees were able to see some experimental data showcasing what the lithium metal deposited on copper current collector using PLD looks like, as well as its performance. Finally, the upscaling of PLD was discussed as well.

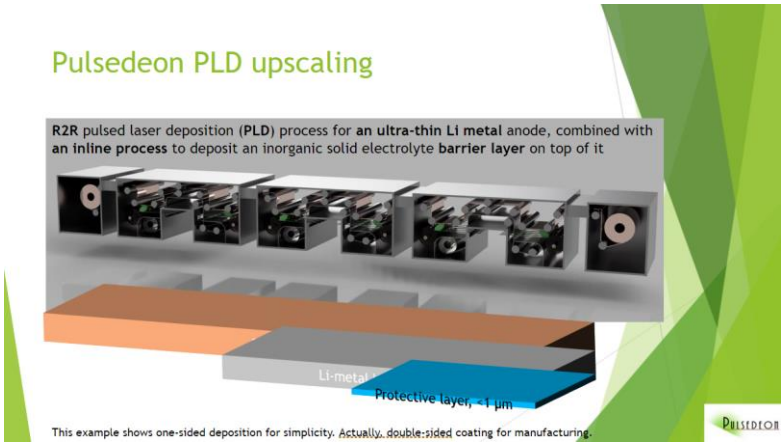

Figure 9: Snapshot of **PULSELiON** session presented by **Ville Kekkonen.**

Sara Pakseresht (SOLiD project) has presented about atomic layer deposition (ALD) coatings for lithium metal stabilization. The webinar attendees got a chance to familiarize themselves with the unique benefits of the ALD technique. An overview of different ALD coatings mentioned in the literature was provided and the experimental data showcasing how ALD coating improves the battery performance was discussed, engaging the webinar attendees.

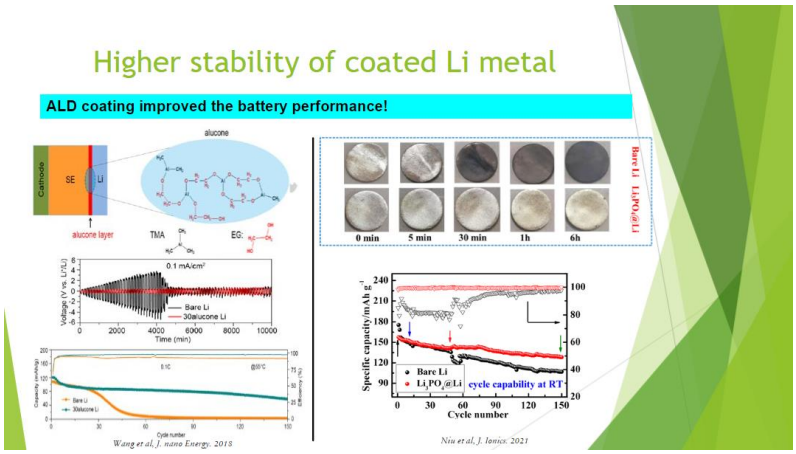

Figure 10: Snapshot of **SOLiD** session presented by **Sara Pakseresht.**

Next presentation by Milad Madinehei (AM4BAT) was centered around the electrochemical lithium production for an anode-less battery. The AM4BAT project concept and objectives, as well as the workflow and work packages were described, familiarizing the webinar attendees not only with the AM4BAT project but also with the typical structure and organization of a European project. The challenges of designing an anode-free battery were explained, as well as AM4BAT strategies to address these challenges. A few remarks about the manufacturing costs of an anode-

free battery vs conventional lithium ion battery were made as well, allowing the webinar attendees to conceptualize the anode-free battery in an economical context.

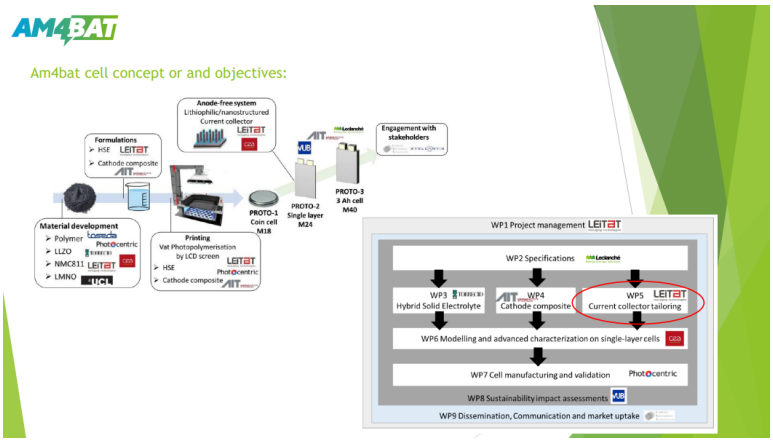

Figure 11: Snapshot of **AM4BAT** session presented by **Milad Madinehei.**

The last talk of the webinar was delivered by Gaetan Cabon (SEATBELT project) on the subject of lithium metal processing by extrusion in the industrial setting. The process of lithium extrusion, lamination and stacking was explained. The talk also focused on the Blue Sloutions company's ambition and vision for the Gen4 solid state batteries, allowing the webinar attendees to learn about the best practices of lithium production and SSB manufacturing at the industrial scale.

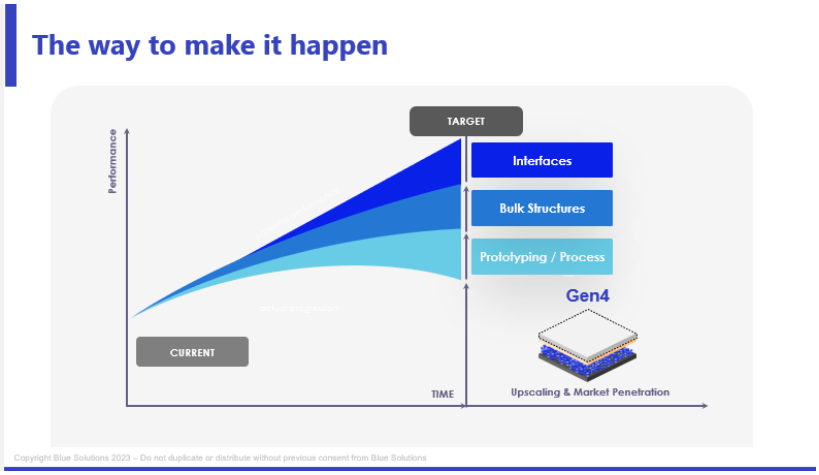

Figure 12: Snapshot of **SEATBELT** session presented by **Gaetan Cabon.**

The webinar closed with a roundtable session led by BEPA, where the webinar attendees were able to ask questions and engage in a fruitful discussion with the presenters, fostering synergy and collaboration within the ***Solid4B cluster***.

6.3 Statistics and Impact:

Out of the 175 subscribers from different countries and different organizations, 100 individuals attended the webinar. This indicates an attendance rate of approximately 57%. While it is not uncommon for a portion of subscribers to not attend the live event due to scheduling conflicts or other reasons, a 57% attendance rate suggests a relatively high level of interest and engagement.

To engage more the audience and the speakers, an online poll was shared at the end of the webinar to reply to three main questions:

- **How would you overall rate this webinar?**
- **What percentage of the information was new to you?**
- **What are your suggestions for the next editions?**

When participants were asked to rate the overall webinar experience, the average rating received was 4.5 out of 5 as illustrated in Figure 5. This indicates a highly positive response from the participants, as the majority of them provided a rating that is close to the maximum score.

A 4.5 out of 5 rating suggests that the participants found the webinar informative, engaging, and valuable. It indicates a high level of satisfaction with the webinar's content, delivery, and overall experience. Participants likely felt that the webinar met or exceeded their expectations and provided them with meaningful insights or knowledge on the topic.

Moreover, it's worth noting that a rating of 4.5 out of 5 leaves a small margin for improvement, as it is a very positive rating. However, it also suggests that some minor areas could be enhanced to achieve an even higher rating in future editions.

Overall, the average rating of 4.5 out of 5 reflects a successful webinar that the participants received well and indicated that the organizers and presenters effectively delivered a valuable and engaging session.

Moreover, the feedback provided by the audience regarding the percentage of information that was new to them indicates that, on average, they estimated it to be between 50% and 75%. This range suggests that a significant part of the webinar content contained new and valuable information for the participants.

Elaborating on this feedback implies that the webinar successfully delivered a substantial amount of fresh insights, knowledge, or perspectives to the audience. Participants found a significant portion of the content to be informative and thought-provoking, expanding their understanding of the topic discussed.

A range of 50% to 75% indicates that while a substantial portion of the webinar covered new information, there may have been some aspects that were familiar or already known to the participants. This could be due to variations in the participants' prior knowledge or expertise in the subject matter.

Nevertheless, the fact that a majority of the content was perceived as new highlights the value provided by the webinar. It suggests that the organizers and presenters effectively presented novel information or provided fresh insights that resonated with the audience's interests and needs.

The feedback on the percentage of new information showcases that the webinar successfully fulfilled its purpose of delivering valuable and engaging content that expanded participants' knowledge and understanding of the topic. It indicates that the organizers and presenters could present material that was informative and aligned with the participants' expectations and desire for new insights.

Moving forward, this feedback can be used to further enhance future editions of the webinar.

By continuing to provide substantial new and relevant information to ensure continued engagement and interest from the audience, building upon the first edition's success.

Figure 13: Overall rate

Regarding the third question of the online poll, the audience's suggestions for the upcoming webinar topics provide valuable insights into their interests and areas of focus. Here below is an analysis of each suggested topic:

- Cost assessment and techno-economic analysis of solid-state battery production: This topic suggests that the audience is interested in understanding the economic aspects of solid-state battery manufacturing. They want to explore the costs involved, evaluate the feasibility of production, and assess the economic viability of solid-state battery technology.
- Progress in solid-state electrolytes: This topic indicates that the audience is keen to learn about advancements and developments related to solid-state electrolytes. They are interested in staying updated on the latest research, breakthroughs, and innovations in this specific area of battery technology.
- Way of optimizing anodes for the next battery generations: This topic highlights the audience's interest in exploring ways to optimize anodes for future battery generations. They want to delve into the techniques, materials, or strategies that can enhance battery anodes' performance, efficiency, and lifespan, which play a crucial role in overall battery performance.
- Real technical challenges in projects and detailed discussions on those: This suggestion indicates that the audience is seeking in-depth discussions about the practical challenges faced in real-world projects related to battery technology. They are interested in understanding the complexities, hurdles, and solutions encountered during the implementation of battery projects.
- Raw material availability and cost of production: This topic suggests that the audience is interested in the availability and cost aspects of raw materials used in battery production. They want to explore the supply chain, sourcing strategies, pricing factors, and potential challenges related to acquiring the necessary raw materials for battery manufacturing.
- Recycling of Li-metal batteries: This suggestion highlights the audience's interest in sustainable practices and the circular economy. They want to learn more about the recycling methods and processes specific to lithium-metal batteries. This topic reflects their concern for environmental impact and the desire to explore sustainable approaches to battery waste management.

Overall, the audience's suggestions indicate a strong interest in various aspects of battery technology, including economic analysis, technical advancements, optimization strategies, sustainability, and challenges in practical implementation. These topics provide valuable guidance for curating relevant and engaging content that aligns with the audience's interests and expectations.

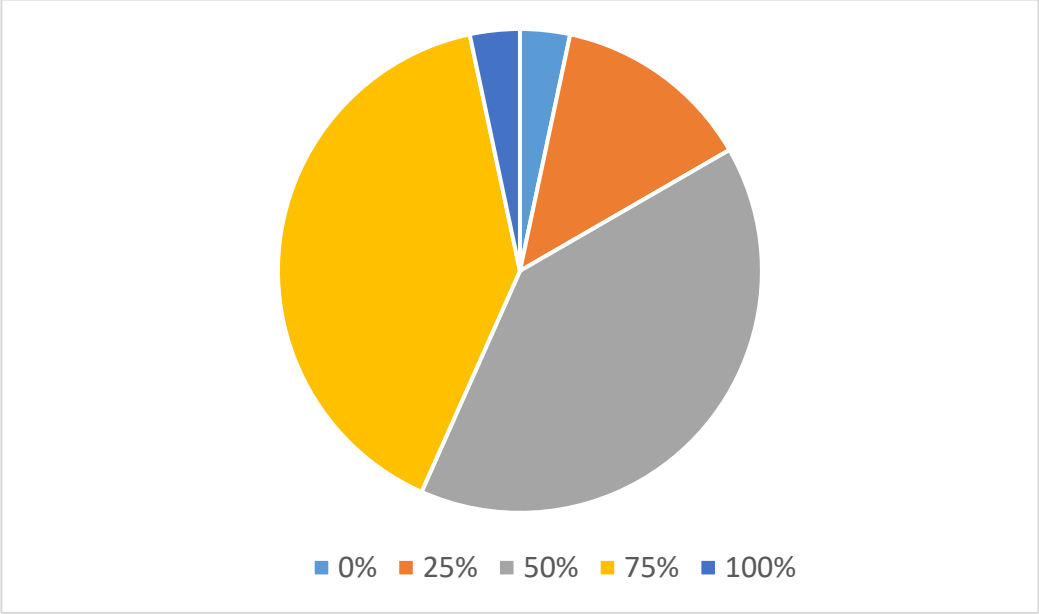

Figure 14: Percentage of new information delivered to the audience.

6.4. Next steps

The next edition will be an onsite workshop at the end of 2023 or the beginning of 2024.