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Alliance for Batteries Technology, Training and Skills

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Analysis of Future Needs – Release 2

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Deliverable D3.8 Analysis of Future Needs - Release 2

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Alliance for Batteries Technology, Training and Skills

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Executive Summary

Workshops and face-to-face public interviews, as the skills need gathering techniques, were used to discuss the EU battery sector needs with participants and speakers - sectoral stakeholders. The focus of the events that were organised by the project ALBATTS consortium was to gather skills needs and have a debate on the sector development in three interviews: (1) building a gigafactory; (2) the impact of the battery passport on skills needs; (3) battery energy storage in sustainable islands; and in four workshop events with the following themes: (1) servicing of electric vehicles; (2) EU battery regulation proposal; (3) recycling of electric vehicles; and (4) autonomous operation and virtual reality in maritime.

The document outlines trends, job roles, skills/competences and knowledge, education, training offer, and re- and up-skilling delivery for each workshop event if the information was available. Additional ongoing activities concerning the project ALBATTS are summarised in the document.

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Introduction

This document summarises key findings, data and needs gathered during the second iteration of ALBATTS interviews, workshops and other events held in late 2021 and 2022. Overall, three **interviews**[1] were held, with:

1) Katarina Borstedt, director of Growth at Northvolt on European Battery Ecosystem – "*Job roles and competences now and in the future: Building a Gigafactory*";
2) Duarte Conde Silva, plant Manager at Graciolica – "*Battery energy storage enabling sustainable islands*"; and
3) C. Gamon, the member of the European Parliament on European Battery Ecosystem – "*Job roles and competences now and in the future: The impact of the Battery Passport on the battery value chain*".

Overall, four **workshops**[1, 2] were held, titled:

4) Servicing of Electric Vehicles: Future Qualifications Needed;
5) New EU Battery Regulation Proposal: Possible Implications on Job Roles and Skills;
6) Recycling Electric Vehicles' Batteries; and
7) Autonomous Operation and Virtual Reality in Maritime Applications: Job Roles and Skills.

Other events that are outlined, in terms of skills needs, in this document are: (1) Lithium – European Sourcing and Skills, event organised by ALBATTS in collaboration with EIT RawMaterials and held on the 27th of April; (2) Automotive Skills Alliance Battery Group meeting series; (3) Automation operator training by VUX in Skelleftea.

Each event is highlighted, described, and findings concerning skills, education/training, and job role need connected to the ongoing battery ecosystem development and related trends. These findings will be further used in the context of other findings of project ALBATTS, especially the Sectoral Skills Strategy update in November.

[1] ALBATTS report D4.6, available at https://www.project-albatts.eu/Media/Publications/63/Publications_63_20220309_163435.pdf (last accessed on 09/05/2022)
[2] ALBATTS report D5.6, available at https://www.project-albatts.eu/Media/Publications/62/Publications_62_20220228_15859.pdf (last accessed on (09/05/2022)

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List of Abbreviations

ALBATTS	…	Alliance for Batteries Technology, Training and Skills
EU	…	European Union
R&D	…	Research and Development
HR	…	Human Resources
ID	…	Identification Document
QR	…	Quick Response (code)
BES	…	Battery Energy Storage
BESS	…	Battery Energy Storage System
CO2	…	Carbon Dioxide
EV	…	Electric Vehicle
VR	…	Virtual Reality
ICT	…	Information and Communication Technology
DC	…	Direct Current (electricity)
ADAS	…	Advanced Driver-Assistance Systems
BEV	…	Battery Electric Vehicle
PHEV	…	Plug-in Hybrid Vehicle
OEM	…	Original Equipment Manufacturer
STEM	…	Science, Technology, Engineering, and Mathematics
IT	…	Information Technology
VET	…	Vocational Education and Training
ELV	…	End-of-Life Vehicles
LLL	…	Life-Long Learning
ASA	…	Automotive Skills Alliance

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1 Building a Gigafactory

The interview discussed job roles and skills needed during the building of the Northvolt Gigafactory in Skelleftea, Sweden. The interview was kept with a Director of Growth at Northvolt, Katarina Boerstedt. The interviewer was Dr Svatopluk Štolfa from the Technical University of Ostrava. The event was organised on the 15th of September 2021 and 42 participants, were present.

1.1 KEY HIGHLIGHTS AND NEEDS

This section provides a summary of key aspects that were discussed during the interview in terms of needs.

1.1.1 Skelleftea Gigafactory Status

The first production line of the Skellefteå gigafactory is commissioning right now on most process areas; the machines are being installed and set up. The machines are then run with material to see that everything works, and the objective is to start production of the first "C-samples" to the customers in the coming months, to proceed to full production later.

Figure 1: Skelleftea Gigafactory

Here is production starting, and our C-samples for customers will be produced. In Figure 1, we see the upstream unit to the right and downstream I and II units and the formation block at the end. Northvolt is now commissioning the upstream building and the

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first downstream building, and the formation and ageing building. The unit in the forefront is a company producing the casings for batteries – and then a storage unit.

1.1.2 Number of Employees in Production and Recruitment Difficulties

In Skellefteå, we have now hired about 300, so we have some way to go to the 3000, which has been seen as a kind of "roof", but with raised production goals, probably this figure is going to more of a floor instead. There are a lot of challenges in this industry, and we see a lot of interest in joining. We have around 10 000 applications per week to join our company. But still, the battery industry is just in its starting phase in Europe, and it is hard to find people in Europe with exactly the right experience as well as the resources (to recruit from) are still very scarce. It is difficult to find people with experience in building and setting up a factory, and having experience in large scale production, for example, is very rare. So it is not only about battery experience. So there are different challenges. We have been talking before about the difficulties of finding experienced cell design engineers, etc., from Asia, but also for the volume segment of operators, this will be a challenge as well, especially going forward.

1.1.3 Difficult and Easy Competence to Recruit

For the situation that we are in, it is very important that we find people with the right mindset. It is not only about hard competencies but also about soft ones. We need people who can also flourish in a surrounding where everything is not clear and the production is a greenfield (*not restrained by earlier practices*).

I cannot say that anyone (competence) is easy to find, but perhaps some are less difficult. We recruit people from industries with similarities in different process steps to the one we are building. There, we can find people with the right hard competencies and also the right mindset and introduce them to this new industry. So we still need some up- and re-skilling.

On the engineering side, we have had quite big challenges since there is a war on talent going on when many similar plants are starting and also to find the people with the right experience and experience from greenfield production – and also related to batteries.

We have, after all, managed quite well, especially in the green sector – Northvolt is aiming to build the greenest battery in the world, not just a battery. Our sustainability approach is attracting a lot of people that really want to make a difference.

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1.1.4 Training Role of the Demo line in Västerås

We call that our industrialisation line, besides our R&D entity. This is very important for us, first because we built this first and learnt a lot from it, by our mistakes – and that learning we can bring to Skellefteå. It is also now used for our training purposes. Most operators we employ spend between a month and up to half a year in Västerås for training and to work in production. In that way, they will have as much experience as possible when joining the factory in Skellefteå, which they are doing right now. That has been very important for us, that we have more people that actually have been part of the production.

1.1.5 Employee Scale-up and Training Speed

We are still developing our training program – from using Västerås for the first shifts, and then the recruitment will increase. This year has been low-pace in comparison with the years to come. Then we will have training programmes that are much more adapted to volumes, and training has to be adapted to use, for example, VR. But still, a lot of things are adjusted, so we won't form this too early. We aim at becoming 3000 by 2025/2026, four years of massive growth.

1.1.6 Recruitment Scope and Logistics

We are really recruiting worldwide, and I think we are more than 55 nationalities in Northvolt. A lot of the needed competence is very difficult to find if we only look at the Swedish market. We need to bring the people to Skellefteå to be up and running to the quality standards that we have. The interest in building this industry is also worldwide, so also applications that we get. We think that will continues. Looking at the local work market, it is also one of the regions in Sweden with the lowest employment rates. So there are not enough people up there to recruit for us.

1.1.7 Covid Pandemic Effects

It has required quite many adaptions but hasn't changed our plans. Hopefully, we are at the end of the worst right now. It has been problematic for some people that have decided to

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move here, it has required more testing, and there has been no possibility to come and visit before, and so on. The bit we have continued our global recruitment during Covid.

1.1.8 Apprenticeships

We have a lot of this going on. Every summer, we have a summer internship. This year, around 200 spent two or three months at Northvolt's different sites, and many were converted into employment. Then we also have internships running during the year, based on different needs.

1.1.9 Future Recruitment – Connection to new Trends (AI, Machine Learning, etc.)

To be able to handle this volume of recruitment, a lot of development is needed to make it efficient. We are, as an example, looking for ways to evaluate ability, not only experience – to try to open up the industry to as many as possible. This is a new industry, and new tools can help us to give people an insight into what it is all about and what work could actually mean.

1.1.10 First Job Roles Identified at Northvolt

A lot of focus was on cell design as well as digitalisation, what should a battery look like, and the production process around that. Now the manufacturing teams are growing.

1.1.11 Cooperation with Regional Universities and Schools

In many different ways, and both short- and long-term. We have discussions, especially with universities in Sweden, about master's programmes. We have also had summer courses in chemistry for the battery industry to create awareness among chemists around Europe concerning future opportunities. We are also trying to arrange fast-track training for immigrant engineers together with the Luleå University of Technology and the employment agency in Sweden. We are also doing machine operator training together with adult education in Skellefteå. These are only a few examples. We are piloting several set-ups, and then they have to be scaled up. Bo both have to build the education system for those who are young, but also solutions for up-and re-skilling later in life.

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1.1.12 Recruitment Competition

No, we are not that afraid -but the next few years will really be a war on talents. We see that already now. There will be more factories built, we hope, and this is only good – we can't do everything on our own. This also means that there will be more education infrastructure in place – which will benefit all. There will be more people to recruit, for all, in the long-term perspective we will all benefit.

1.1.13 Recruitment outside Europe

There are some practical challenges, as families often also follow. It has often been possible to solve, but there are questions about English schools and support systems around employment. We need to not only attract them to come here but also to stay for a longer time to come.

1.1.14 Growth in Northvolt

Growth is people with the right skill sets. In the case of Skellefteå, it is also about getting the municipality to grow, so we work very close to the municipality to ensure schools, housing and services. This is a partnership that I really want to lift as a success factor because if we hadn't had them engaged from the beginning, it would mean a lot bigger challenge. We are happy to be in Skellefteå, but there are challenges, of course, when we are going from the PowerPoint to the actual thing, challenges that are difficult to solve in the short term. It takes some time. For people that build a gigafactory, you can't start too early with getting the infrastructure in place.

1.1.15 Blue-collar Workers in Automated Factories

We see that there are 75-80% blue-collar workers, perhaps more needed. The requirements of these workers are getting higher. It is no manual work – it is about steering the machinery, troubleshooting, preventive maintenance, and so on. It will require some other skillsets for the workers. When it comes to automation and reducing the number of blue-collar workers, we don't see that as a risk at all. The production is so huge that people are needed. Especially in cell assembly in downstream production, the machines are smaller, and more machines are needed and more operators. We need people that monitor and solve the issues during the 24/7 production.

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1.2 ANALYSIS OF JOB ROLES, SKILLS, AND EDUCATION/TRAINING

The following job roles were discussed during the interview: (1) blue-collar workers - machine operators, blue collars workers in general, and maintenance operators; (2) white-collar workers - chemists, cell designers, HR roles, management consultants, director of HR growth, and cell developers.

Needed education and training mentioned during the interview: training programmes for workers in high volumes, chemistry courses, university programmes and long-term cooperation, fast track courses for engineers from abroad, apprenticeships, vocational courses, demo lines and practical training, and internships.

Skills, knowledge and competences raised during the interview are visible in Figure 2 below.

Figure 2: Battery Manufacturing - Identified Skills, Competences, and Knowledge

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2 The impact of the Battery Passport on the battery value chain

The interview discussed Battery Passport, a part of the coming Sustainable Batteries Regulation. The interview was kept with an Austrian Member of EU Parliament, Ms Claudia Gamon. The interviewer was Mr Tauno Kekäle, a Project Manager at Merinova Technology Centre (Vaasa, Finland). The event was organised on the 12th of October 2021, and 62 participants were present.

2.1 KEY HIGHLIGHTS AND NEEDS

This section provides a summary of key aspects that were discussed during the interview in terms of needs.

2.1.1 What is a Battery Passport?

The Battery Passport is an electronic record of individual industrial batteries. That will also include the batteries used in electric vehicles. The record is located in an online database accessible with a QR code on the Digital ID card. The ID card is provided with each battery sold in the EU. The online database supporting the Battery Passport mechanism is updated by the manufacturers. The purpose of the passport, with the related regulation, is to provide transparency about batteries for all the stakeholders.

The Battery Passport is only informative, and it is supposed to serve as a tool for the different stakeholders. The rest of the legislation deals with the responsibilities that producers have. It defines what the batteries will look like and what information there will be in Battery Passport. The aim is to implement the Battery Passport and the related legislation by the 1st of January 2026. Currently, amendments related to the process are being worked on within different committees.

The legislation defines for producers what is a sustainable battery produced in Europe. The legislation has different elements to it:

- the QR code with Battery Passport to enable access to the information about the battery and
- the declaration, for factories and importers, functioning as quality control of the activities of all the actors in different parts of the value chain.

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2.1.2 How does Battery Passport support sustainability and European competitiveness?

With the available information per individual battery, sustainability will be supported along with complying with legislation.

Ms Gamon believes in market-based solutions for climate change. According to her, the Battery Passport will enable consumers to make informed decisions. That is where the power of the market can produce innovative and new products that are much more climate-friendly and sustainable. She also reminds us that it also supports European **Fit for 55**[3] initiative. The availability of battery-related information increases European competitiveness by letting customer and consumer behaviour move in the direction of sustainable, greener European made batteries.

2.1.3 How does the Battery Passport serve stakeholders?

The battery-related producers can monitor their compliance with the battery legislation. Consumers can compare batteries and have much more easily accessible information. The second life operators will need and benefit from the information provided by the Battery Passport system when they plan their operations.

The Battery passport also supports recycling by improving efficiency. It also enables better monitoring and harnessing of big data for governments and producers who can track, for example, what batteries are in the market.

2.1.4 Do the importers of batteries from outside the EU need to comply?

Producers outside Europe must comply with the same rules as the European ones to ensure both are operating equally in the market. There is a European authority responsible for monitoring the compliance of producers. According to Ms Gamon, we should also pay attention to how we can use the market power of the European internal market to influence the rest of the world to comply with European sustainability standards.

[3] Fit for 55. Consilium. (2022, March 25). Retrieved May 15, 2022, from https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

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2.1.5 What are the ambitions regarding green batteries in Europe?

Having a functioning circular economy with the goals that have been set. With sustainable batteries, we also need to look into sustainable mining with respect to human and labour rights. Political and strategic goals on global competitiveness for the European market with the battery legislation need to be achieved. A lot of battery raw materials in the European Union are needed to achieve the other green deal goals and be a self-sufficient battery producing continent. It is a significant strategic goal for European foreign policy because relying too extensively on the producers outside of Europe can be a risk factor.

2.1.6 Promotion to consumers and a rise of potential for innovation

There is a responsibility for legislators and for the state itself to a certain extent. The market ought to begin providing the information as well as ensuring that consumers also comprehend Battery Passport and how to benefit from it. According to Ms Gamon there may be business opportunities to emerge for start-ups to create business ideas out of the sustainable battery market and how the Battery Passport related data can be leveraged.

2.2 ANALYSIS OF JOB ROLES, SKILLS, AND EDUCATION/TRAINING

Job roles raised during the interview are visible in Figure 3 below.

Figure 3: Battery Passport - Identified Job Roles

When it comes to the related training and education, it should be mainly coordinated and managed by member states.

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Skills, knowledge and competence raised during the interview are visible in Figure 4 below.

Figure 4: Battery Passport - Identified Skills, Competences, and Knowledge

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3 Battery energy storage Enabling Sustainable Islands

Interview and workshop called "**Battery Energy Storage (BES) Enabling Sustainable Islands"** aimed at investigating the opportunities and challenges of installing a Battery Energy Storage System in isolated areas such as islands, as well as a better understanding of the possible implications in the context of job roles and skills. The interview was kept with an expert Mr. Duarte Conde Silva, a Plant Manager at Graciólica (Graciosa Island, Azores). The interviewer and event moderator was Mr Jakub Gajdusek, Sales Manager at HE3DA. The event was organised on the 17th of November, 2021, and 43 participants were present.

3.1 KEY HIGHLIGHTS AND NEEDS

Depending on external sources for energy fuel and the consequent expensive import costs represent a challenge for islands when it comes to energy security. The integration of renewable energy represents, therefore, a fundamental alternative, both from an economical and sustainable perspective.

The Graciosa Island, a Portuguese territory located in the northern Azores, is now one of many islands pursuing a hybrid approach to island grid energy generation, combining wind, solar[4], and energy storage using lithium-ion batteries and thermal generation. The project represents a journey towards a 100% renewable energy future with an integrated power system combining renewables, engines and energy storage.

The idea behind creating this project first started in 2005 with great support from local government and utility companies. The island was chosen as the first small prototype to then present its results for future larger-scale projects or even land projects.

3.1.1 Benefits and Challenges

The benefits of a BESS are, first of all, the reduction of the island's carbon footprint, but above all, the cost of energy for the island and its customers going forward. In particular, the use of the BESS has brought real improvements in the **power stability** while using batteries within

[4] Graciosa Island Grid - wartsila.com. https://www.wartsila.com/docs/default-source/power-plants-documents/downloads/reference-sheets/graciosa-island-grid.pdf

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the grid. In terms of real power, the wind power plant is 4,5 MW, solar is 1MW and 2,6 MW power of usable capacity and 7,5 MWh capacity power. When it comes to electricity quality and electric grid reliability (which is usually an issue when addressing small grids), the BESS has brought significant improvements in **power quality** across the island. There are days when the island works 100% from renewable energy. Overall, it runs 62% of the year from renewable energy sources only.

The sustainability and **reduction of CO2 emissions** related to electricity generation are on the agenda of Graciólica, with a real reduction of 2 million litres of Diesel fuel per year = 5.000t of CO2 reduced annually.

In addition, **environmental hazards** were also addressed: buildings and energy sources were constructed to prevent damage from unpredictable weather conditions.

A key asset of the project is also represented by a **trained and skilled workforce**. At Graciólica, the main requirements are at least two electrical engineers on-site for current system optimisation processes, as well as qualified electricians for maintenance: indeed, electricians are required to have skills in power electronics as well. The company is mostly based on full-time employment, while also outsourcing is used sometimes. Training for new employees is held by current staff on the island, and currently, no direct cooperation with universities, even if in the early stages of the project, employees worked closely together with NASQTECH (Research Centre of the University of Porto) to establish the process with utility connection system.

One of the main **challenges** of installing the BESS was, of course, the **remoteness of the place**, in particular the logistics and transportation from different countries for the hybrid power plant equipment. Also another challenge relates to **connecting the power plant to the local utility grid** using different technical approaches and sources.

As a way forward at Graciólica, the objectives for the future include the optimisation of renewable energy in order to achieve one day 100% renewable for the Azores Islands. The

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longest consecutive period running 100% on renewables was five days but the cumulative value throughout the year was 121 days last year, equal to 35% of all time.

3.2 ANALYSIS OF JOB ROLES, SKILLS, AND EDUCATION/TRAINING

The following job roles were discussed during the interview: (1) blue-collar workers – electricians and construction employees; (2) white-collar workers – HR, project managers, plant managers, service managers, HR managers, planners, and assistant site engineers, and electrical engineers.

When it comes to education and training, it was stressed that university programmes and internal training within the companies are relevant.

Skills, knowledge and competences raised during the interview are visible in Figure 5 below.

Figure 5: Sustainable Battery Energy Storage - Identified Skills, Competences, and Knowledge

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4 Servicing of Electric Vehicles

The webinar **"Servicing of Electric Vehicles: Future Qualifications Needed"** was organised, including rehearsals etc., by a small organisation team led by ALBATTS project members APIA, where EUPPY, AIA, Merinova, ACEA and other project partners also participated. It was held on **the 29th of September, 2021,** from 10.00 to 11.30 CET.

The webinar was attended through the Cisco Webex platform by 80 participants. It also was live-streamed to Facebook. In addition, presentations and the video from the workshop have been available on the ALBATTS website, thus enabling an even wider reach to the stakeholders.

4.1 KEY HIGHLIGHTS AND NEEDS

Concerning the EU goal of becoming a climate-neutral continent by 2050, the transport and mobility sector must also contribute. In addition, new legislation has been proposed by the European Commission to decrease CO2 emissions from vehicles, which will translate into an increasing number of EV registrations. The topic of **EV servicing** was therefore chosen to discuss current and future competencies and qualifications of personnel needed by **the repair and maintenance sector.**

The webinar aimed to provide a useful and valuable overview of the **actual and future needs** in servicing and maintenance operations for electric vehicles (EV) in terms of skills, competencies, and job roles, focusing on the needs and offers of training, the views of car manufacturers, repairers, and training providers.

4.1.1 Key Statements from the Speakers

- InnoEnergy estimates **3 – 4 million new jobs** in the battery sector will be created in the EU, and at least **800.000** current workers will need to be re-trained.
- Key **changes in the automotive sector** – decarbonisation, digitalisation, new mobility concepts, the impact of Covid-19.
- **Lifelong learning** is essential – an open mind is a key prerequisite.
- Training is needed particularly for battery-electric vehicles but also for **hydrogen vehicles.**

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- Different levels of EV servicing qualifications developed in Belgium:
  - Level 1 – **Aware** (employees especially need to know and be trained) – workers who do not touch the HV (high voltage) system but **still need to be aware**
  - Level 2 – **Qualified** – disconnecting the HV system
  - Level 3 – **Specialised** – situations where it is not possible to take the electrical risk away by disconnecting the HV system – e. g. working inside the battery pack
  - Level 4 – **Expert** – this level is being developed now in Belgium – experts are developing the procedures for others.
- Practical examples are used within the training – e. g. opening of the battery pack, **VR (virtual reality)** training they developed is being used for some situations (e.g. working on the battery pack).
- Battery **remote monitoring** to predict a failure – a system is being developed to understand and follow battery State of Health on the individual and fleet level.
- The most important recommendations of the Polish Chamber of E-mobility Development Association were:
  - To include a new profession in the Polish national ministerial list to create a core curriculum of the profession **Electromobility Technician** on the technical secondary school level
  - Creating a course for engineers at the **university level**
  - To establish short forms of education to upskill/re-skill the **current workers** in the automotive sector.
- Different **variants of batteries** make the situation more complex.
- Lithium-ion HV batteries – **transport is difficult** – dealerships shall be ready for the repair to avoid unnecessary transport.

4.2 ANALYSIS OF JOB ROLES, SKILLS, AND EDUCATION/TRAINING

Missing knowledge and skills (Figure 6) in the car repair segment (e.g. for electromobility technicians) mentioned by speakers were **electricity** and **high voltage batteries, insulation testing, potential equalisation, ICT knowledge and EV diagnostics (interpretation of fault codes), MMLV repair, electric propulsion, inverters, DC/DC converters, ADAS, connectivity or cybersecurity**.

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Prediction of **pack deviations** (remote monitoring of the state of health of the battery) and **preventive repair**, **traceability** of the battery pack **during the lifetime**, **handling and transportation of damaged packs, end-of-life vehicles,** and **recycling** are areas to play a significant role in the future. Apart from knowledge of electric vehicle specifications and diagnosis of defects, **occupational safety** issues linked to the high voltage come into place.

In Belgium or Germany, for instance, they work with four qualification levels of personnel, where each level comprises certain qualifications and tasks the worker can perform. Since there is **no harmonisation at EU level** (such as directive, regulation or methodical guidenance), each country is dealing with the topic on its. **It recommended by the ALBATTS project that EV servicing qualifications get harmonised at EU level.**

Investment in special tools and equipment, including personal protective equipment, is essential. It is instrumental in using **practical examples within the training** – e. g. opening the battery pack, using **virtual reality,** etc. **Lifelong learning** is essential. Besides instructions for repair, information for **first responders/emergency** is also created.

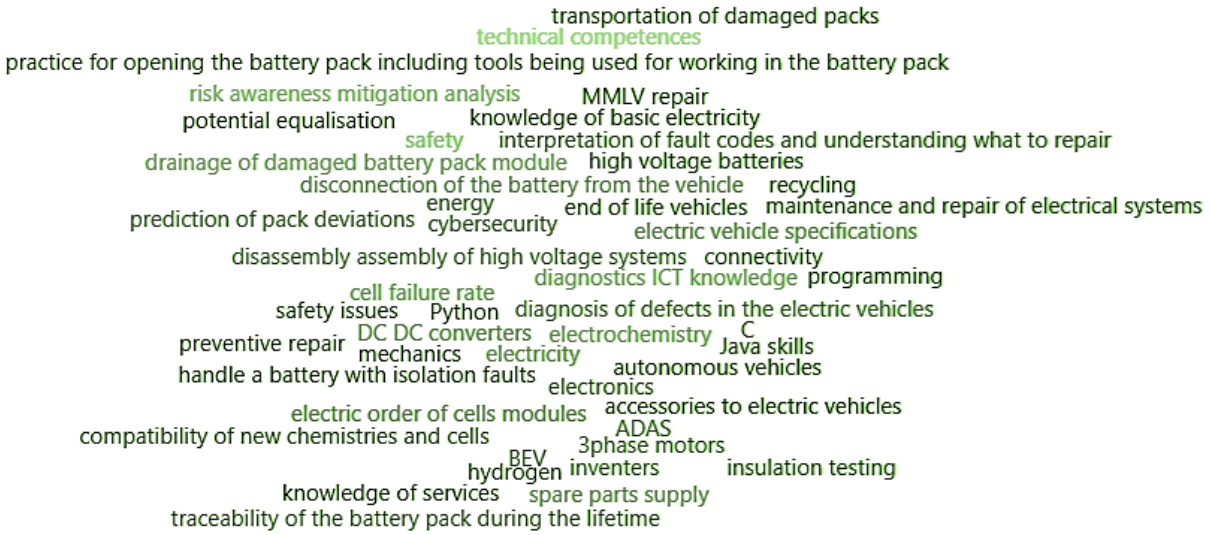

Figure 6: Electric Vehicle Servicing - Identified Skills, Competences, and Knowledge

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Education and education needs identified are the following: (1) 4 level high voltage training for EV servicing in Belgium; (2) short form of education to up-skill and re-skill the current workers of the automotive sector; (3) life-long learning; (4) training guidelines for all EV relevant skills; (5) hydrogen servicing education and training needed; (6) training on electromagnetism.

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5 EU Battery Regulation Proposal

The webinar was held on **the 22nd of October, 2021,** from 11.00 to 12.30 CET. It was organised by a team led by ACEA in cooperation with AIA, EUPPY, EFACEC, Merinova and other project partners. Fifty-two persons participated in the webinar through the Webex platform. Others could follow the event via Facebook. Registration requests came from 21 countries (5 from outside the EU), most of them from the Czech Republic, Germany, Belgium, Portugal, Finland and Sweden. 55% of the registrations were from the industry sector and 20% from the education sector. Presentations and the video from the workshop are available on the ALBATTS website, enabling a wider reach to the stakeholders.

5.1 KEY HIGHLIGHTS AND NEEDS

The proposal for a **Regulation concerning batteries and waste batteries** also belongs to the European Green Deal framework. After it is adopted, it will set requirements in areas like sustainability, safety and labelling, recycled content, electrochemical performance and durability, carbon footprint, due diligence in the supply chain, restriction of hazardous substances or collection, treatment, and recycling of waste batteries. The aim of the workshop was to learn about implications for the automotive value chain and electricity sector and the job roles and skills needed for the future.

5.1.1 Key Statements from the Speakers (selection)

- Electric vehicles are gradually accepted by customers, BEVs and PHEVs form an increasing share of newly registered passenger cars, which requires **changes in dealerships and repair shops;** authorised personnel working on EVs and especially batteries needs to be able to work on **high voltage**; this is also relevant to **rescue teams.**
- It has implications for jobs and skills in automotive production as well, as **OEMs also become producers** of batteries. A lot of OEMs organise **in-house capacity** building, not only for blue collars but also for white collars jobs, inviting teachers from universities to help with **lifelong learning.**
- The electronic exchange system and “battery passport” will require **monitoring and data sharing**.
- Due diligence, including responsible sourcing of raw materials, will have an impact on

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procurement departments and the knowledge of their employees. Interaction and cooperation with other sectors, like extraction and mining, are **necessary**.

- In the **automotive supply chain**, some skills can be converted from job roles related to conventional vehicles - like assembly; some jobs will become obsolete, and some will need intensive re-training; **STEM education** and attractiveness of the sector will be key to ensuring a sufficient number of workers. **Internships** and cooperation in changing curricula are taking place.
- **Recycling technologies** will become one of the primary activities of the sector.
- Electromobility means interaction and **merging of mobility and energy** industries – more discussion between the sectors are needed.
- The size of the transition is immense – labour demand in the battery sector will increase, and **requalification and relocation** of the workforce will be necessary.
- **Batteries will empower consumers** and can **lower their carbon footprint.**

The use of batteries allows the creation of **new tools and business services** and triggers **communication platforms** with security and personal data protection challenges.

5.2 ANALYSIS OF JOB ROLES, SKILLS, AND EDUCATION/TRAINING

As new battery factories in Europe will demand thousands of workers, requalifications and relocations will be necessary. More **development and testing engineers**, **electronics engineers, material scientists, electrochemical and chemical engineers,** or **software developers** will be needed. Competences related to **quality control and applying standards**, **certification activities, processes of compliance, testing, and inspection** will be highly relevant as well. **Repurposing and remanufacturing** EV batteries will require **specific skills** in authorised workshops. Rules on **carbon footprint** will require competences and professions like **emissions modelling and simulation**, **climate scientists**, as well as **lawyers** and **accountants**. New requirements will also necessitate increased **monitoring and data sharing**. Due diligence, including responsible sourcing of raw materials, will have an impact on employment in the **procurement departments**. **The use of batteries in the grid** allows creating of new tools and business services, triggering communication platforms with **security and personal data protection challenges**, which will require **IT, digital skills (installers and support), programmers, application developers, service security experts, cybersecurity**

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experts, data scientists (forecasting tools), knowledge of **mathematical formulas, battery,** and **system optimisation**. **STEM education** and the attractiveness of the sector will be key to ensuring a sufficient number of workers. Skills, competences, knowledge and job roles are seen in Figures 7 and 8, respectively.

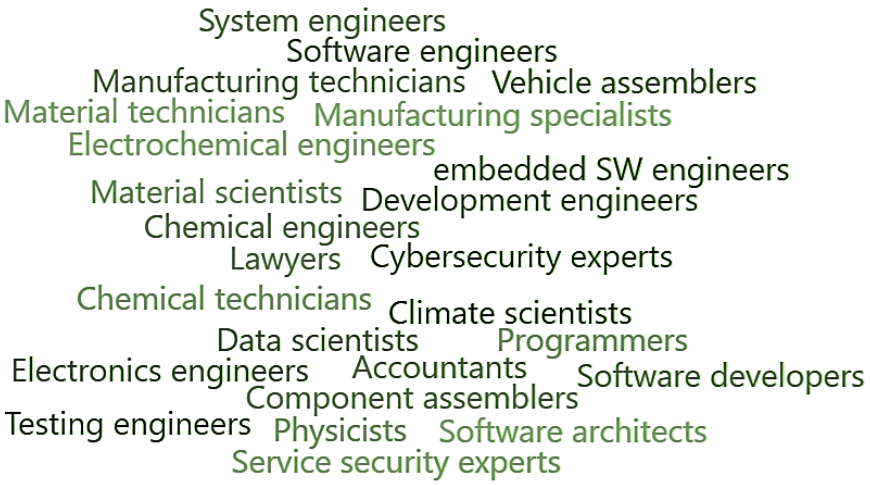

Figure 7: Battery Regulation - Identified Job Roles

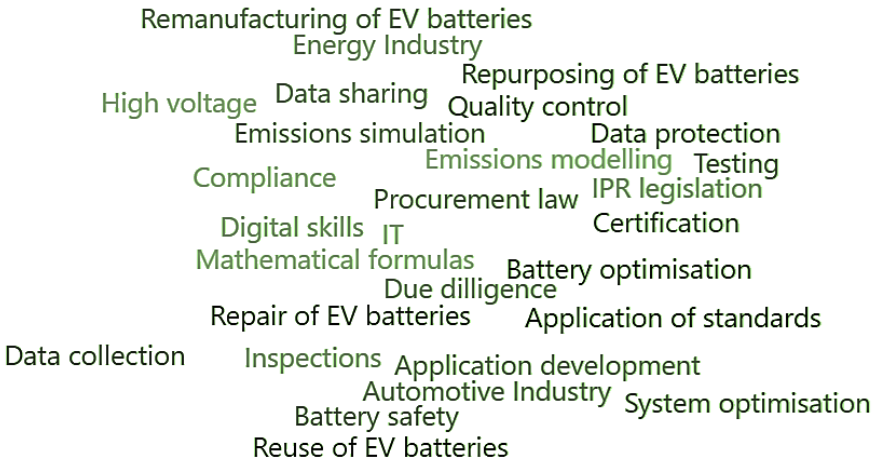

Figure 8: Battery Regulation - Identified Skills, Competences, and Knowledge

When it comes to education and training – STEM education, internships, lifelong learning and cooperation on curricula change and development should be prioritised as well as training on automation, data sharing economy, and forecasting tools.

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6 Recycling Electric Vehicles' Batteries

The webinar **"Recycling EV Batteries: Skills and Qualifications Needed in Auto Workshops"** was held on **the 30th of November, 2021,** from 10.30 to 12.00 CET. The webinar was organised, including rehearsals etc., by a small organisation team led by ALBATTS project members APIA, where EUPPY, AIA, Merinova, ACEA and other project partners also participated. There were 199 registration requests from 28 countries, of which nine were from outside the EU. Most of them represent industry and education sectors. The top 3 countries in terms of the number of registered were Spain, Portugal, and the Czech Republic. The number of viewers has so far been a total of 124, about which 106 followed the live stream of the event, and the rest have accessed the recording on the ALBATTS website. In addition, presentations from the workshop have been available on the ALBATTS website, thus enabling an even wider reach to the stakeholders.

6.1 KEY HIGHLIGHTS AND NEEDS

When it comes to the key highlights and needs of the event, it was identified that the biggest challenge is with engineers and researchers in the recycling facility set-up, where the emphasis shifts from white to blue collars when entering the later stage of maturity as well as with battery disassembly (especially legislation or technical challenges). Thus the European Union should push legislation which forces the manufacturers to open the documentation for battery repair and diagnostics since the current legislation does not ensure it (you can buy the workshop manuals, but they usually do not include internal battery information). Currently, it depends very much on the make and model and how well the information is available. Some vehicles are easy to access. The following video can serve as an example[5].

In addition, the participants were asked to answer some topics such as:

- How to create an effective system of training for employees?
- How to use existing competencies and update them with the new, green ones – in the context of a circular economy?
- Are employers prepared to engage in teaching and training those new skills?

[5] Dala's EV Reapir. (2021, November 13). Performance upgrade for the LEAF, [Part 3] 160kW. [Video]. YouTube. https://www.youtube.com/watch?v=TR4CN2_rRh4

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- What kind of support do they expect from the authorities on the local, national, and European levels?

6.1.1 Key Statements from the Speakers (selection)

- Recycling is not just good for the environment but also a source of key raw materials. It takes a particular set of skills to recycle used batteries safely and effectively.
- The knowledge of the physical and chemical recycling processes is needed and is supported by skills and knowledge of the environment, circular economy, battery design, and the design of components. The challenge is to properly address and support these education training needs
- The technology and processes with chemical and physical recycling techniques need to be educated along with other knowledge and skills.
- The design of batteries and components should be with the orientation on recycling at the end of the lifecycle.
- Strategies for used battery collection and suitable methods/systems are needed to be developed
- There is a need for high voltage batteries employee training and dialogue with standardisation bodies
- Training along the whole value chain for batteries in terms that include obviously car manufacturers, battery manufacturers, service companies, waste management companies, battery and material recyclers, producers, cell manufacturers, and so far, is needed. In this regard, **cooperation with academia and VET providers** is very important to be developed
- As with every model of electric and hybrid vehicles, there is a dismantling manual on how to safely remove the battery. It would be necessary to have common guidance at the European level for all brands, to ensure a common level of training
- Most auto industry OEMs are also becoming battery producers, and they also will need to deal with the recycling
- From the perspective of the automotive industry, the electric vehicle is one product. Even if we are talking about a car and the battery, it is still one product.

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- Authorised operators must perform repair, reuse, remanufacturing, and repurposing/recycling in repair shops. The personnel need to be trained to assess the status of the battery and to be able to decide if it goes to recycling or to its second life.
- It is vital to pay attention to **the training of also those who do not work directly with vehicles**. The entire staff needs to know how to operate to avoid incidents and how to respond if an incident occurs.
- The relevant training and education with secondary, VET schools and universities need to be supported by the new versions of the legislation coming with the ELV directive
- Lifelong learning (LLL) is needed to lead the transition with the people who are now of working age. The related training need to be implemented through apprenticeship and different types of training.
- Recycling is going to be a key part of the industry in terms of the commitment to sustainability

6.2 ANALYSIS OF JOB ROLES, SKILLS, AND EDUCATION/TRAINING

Concepts such as digitalisation, AI and VR are and will be essential. High-voltage training and special tools used by qualified employees for dismantling and preventing electrocution of operators or pack short-circuiting are needed. Knowledge of the physical/chemical recycling processes is needed and should be supported with environmental skills/knowledge, circular economy, and design of batteries and components.

Other skills, competence and knowledge identified are seen in Figure 9 below.

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Figure 9: Electric Vehicle Recycling - Identified Skills, Competences, and Knowledge

The following job roles were identified during the event: (1) blue-collar workers – mechanics, blue-collar recycling workers, electricians, car repairers, operators, and car maintenance staff; (2) white-collar workers – recycling engineers, researchers, trainers, teachers, education staff, engineers, and technology development staff.

Identified education and training are visible in Figure 10 below.

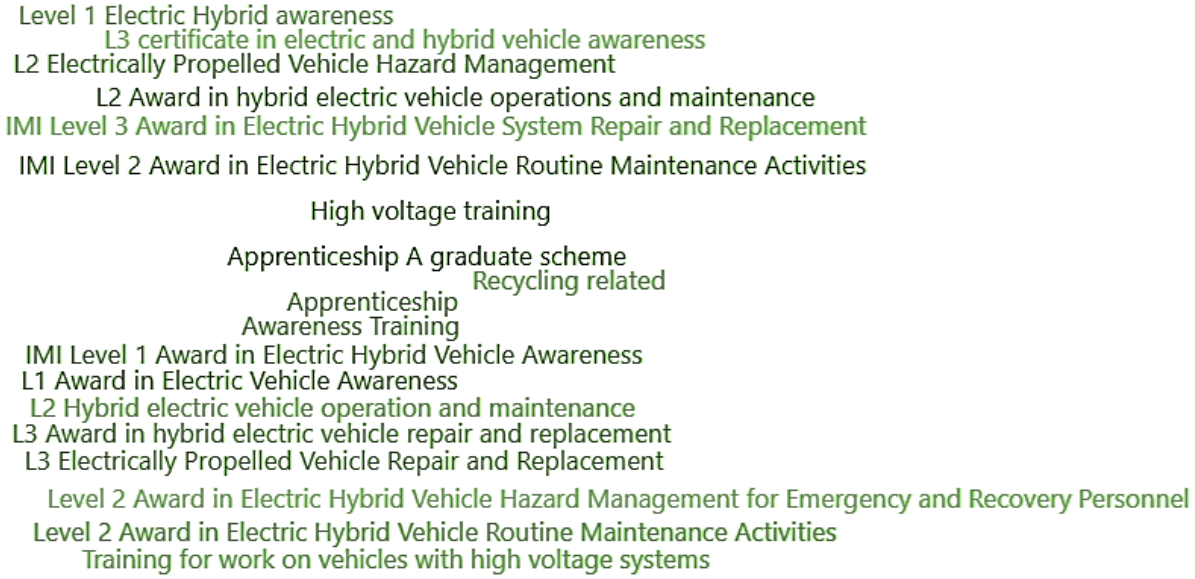

Figure 10: Electric Vehicle Recycling - Identified Training and Education

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7 Autonomous Operation and Virtual Reality in Maritime

The webinar **"Autonomous operation and Virtual Reality in Maritime – Job Roles and Skills"** was organised by an organisation team (Corvus Energy, AIA, EUPPY, and other partners). It was held on **the 7th of November, 2021,** from 13.00 to 14.30 CET.

The webinar was attended through the Cisco Webex platform by 46 participants. It also was live-streamed to Facebook. In addition, presentations and the video from the workshop have been available on the ALBATTS website, thus enabling an even wider reach to the stakeholders.

7.1 KEY HIGHLIGHTS AND NEEDS

The key topics of the webinar were the innovations, trends, and technologies in the maritime sector and what is the relevance for other innovative industries, including the emerging battery sector, future job roles and skills needed there.

7.1.1 Key Statements from the Speakers (selection)

- Overall future skills needs within the maritime sector are: (1) IT and cybersecurity, (2) tools handling, (3) seamanship, (4) safety awareness, (5) communication, (6) emergency response, (7) green skills, (8) digital skills.
- The maritime industry is at the forefront of autonomous operations (driving the use of Virtual Reality and advanced simulation technology to train new skills and competence for new job roles in the maritime sector) as the innovation and technology development is rapid and advanced – battery technology development is key for the industry.
- Autonomous vessels are connected to Big Data (data acquisition and transmission), and the development of new business models where the electric vessels are ideal for the autonomous operations: (1) lower operational costs, (2) improved safety, efficiency (3) zero/low emissions, (4) reduced maintenance and fuel costs.
- When it comes to the simulation, it is important to take into account the concepts of digital twins (rapid simulation of test operations, functions and assets, improvement of data-driven decision making, and more) and virtual prototyping.

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- Needed talent and skills for virtual prototyping, simulation, and digital twinning are automation, computer science, user interface design, gaming technology, computer engineering and software engineering/development. It is also important that there is knowledge of specific 2D/3D engines, such as Unity.
- Lifelong learning approaches are stressed.

7.2 ANALYSIS OF JOB ROLES, SKILLS, AND EDUCATION/TRAINING

The following job roles were identified during the event: software developers and computer engineers.

Needed education and training that was mentioned during the webinar: education related to maritime safety, VR and overall lifelong learning programmes.

Skills, knowledge and competences raised during the interview are visible in Figure 11 below.

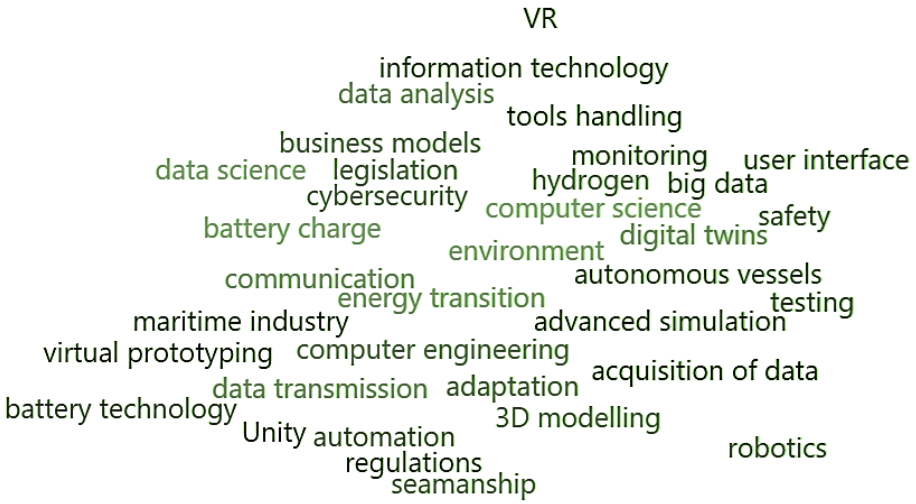

Figure 11: Autonomous Electric Vessels - Identified Skills, Competences, and Knowledge

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8 Other Events

This section describes other events related to the ALBATTS activities in terms of skills needs. Events and initiatives outlined in this section cover: (1) Lithium – European Sourcing and Skills, an event organised by ALBATTS in collaboration with EIT RawMaterials and held on the 27th of April; (2) Automotive Skills Alliance Battery Group meeting series; (3) Automation operator training by VUX in Skelleftea.

8.1 LITHIUM MINING AND EXTRACTION: EUROPEAN SOURCING AND SKILLS WEBINAR

Project ALBATTS organised a **"Lithium Mining and Extraction: European Sourcing and Skills"** webinar in collaboration with EIT Raw Materials on the 27th of April 2022. The webinar was moderated by Dr Laurence Lamm (Senior Advisor – Mineral and Metallurgical Processes, EIT Raw Materials), and the ALBATTS project was presented by Kari Valkama (Project Manager, WP4 lead, Merinova). The panellists included industry specialists from various European organisations:

- Dr Gerardo Herrera, Policy Officer – Raw Materials, DG GROW, European Commission
- Dr Patrice Christmann, Consultant, Krysmine
- Mr Asko Saastamoinen, Chief Human Resources Officer, Keliber Oy
- Dr Blandine Gourcerol, Economic Geologist, BRGM
- Dr Carlos Nogueira, Head of the Materials for Energy R&D Unit, LNEG
- Dr Nathalia Vieceli and Ms. Lea Rouquette Ph.D. Student, Chemistry and Chemical Engineering, Industrial Materials Recycling, Chalmers University

The basis for the webinar was that the rapidly growing global battery industry needs lithium. The event was divided into a presentation part followed by a round-table discussion. In the first part, the panellists provided presentations about their topic areas. For example, the presentations addressed topics such as European self-sufficiency, where the deposits are, and how lithium is mined and extracted. The processing and recycling of lithium were also discussed. Job roles and skills were also covered in the presentations. The round-table discussion addressed the job roles, skills, and competences needed in lithium mining and extraction.

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In the webinar we learned about the complexity of the mining and processing of lithium and how numerous are the job roles and skills needed by the operators working with the processes from mining to processing to recycling. For example, just mining and related functions, as was presented by Keliber, require manpower to mines, concentrator and chemical plants, maintenance, laboratories, logistics and supportive/administrative functions. What they for example employ include process operators, maintenance technicians, laboratory workers, supervisors, and engineers as well as those working with the actual mining such as geologists, drillers, loaders, and drivers. The required skills depend on the position, but required basic education includes for example process, chemical, mechanical, electricity and automation engineering as well as geology and chemistry. General skills or qualities include for example IT team working, safety and environment related.

8.2 AUTOMOTIVE SKILLS ALLIANCE BATTERY GROUP MEETING SERIES

Automotive Skills Alliance (ASA), as a sustainable continuation of the project, DRIVES with broader objectives, engages various stakeholders within the automotive-mobility sector (industry, education and training providers, social partners, regions and municipalities, and others) to work within dedicated working groups with specific topics (horizontal issues; skills intelligence – repair and maintenance, batteries, hydrogen, information technology, digitalisation, electronics packaging, systém and software international standards; and regional perspective).

When it comes to the batteries, project ALBATTS highly collaborates with ASA on the European-wide level. Example meeting series (example meeting on 02/02/2022 where project ALBATTS sectoral skills intelligence and strategy was presented alongside the initiative within the Vaasa region, the GigaVaasa project) related to a presentation of topics by stakeholders, discussion and brainstorming can be mentioned – it is envisioned to further present and review the results of project ALBATTS in terms of training material and other.

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8.3 AUTOMATION OPERATOR TRAINING

Ongoing 24 weeks long course package in the Skelleftea municipality and in relation to the Northvolt in collaboration with project ALBATTS to train future automation operators (started in 2020), covering skills needs and consists of:

- **Skills needs and certification:** (1) warehouse trucks/forklifts and traverse canes and wheel loaders; (2) ergonomics, heavy lifting; (3) first aid, CPR and defibrillator use; (4) ADR 1.3, handling of dangerous goods; (5) fire-land, basic firefighting knowledge; (6) battery industry and working environment.
- **Core modules and subjects:** (1) industry-specific English; (2) digitalisation – practical digital competences, business adapted; (3) solid chemical safety; (4) industrial processes; (5) remedial maintenance; (6) production equipment; (7) internal transports; and (8) employed in the industry.
- **The importance is given to:** (1) environment and society – environmental impact, raw material sourcing, local region's dependence on companies; (2) social transformation and industrialisation – industry 1.0-4.0 (5.0), historical context, technology development, Innovation; (3) conflict management and group dynamics; (4) lean management and production; (5) vocational knowledge and practical vocational knowledge – automated industrial production, preventive and remedial maintenance, automated industrial production components.

8.3.1 Soft Skills for Battery Gigafactories 4.0

Two Skellefteå-based ALBATTS persons, Anders Norberg and Ann-Sofi Wincent hosted a round-table discussion about **"Softs skills for battery gigafactories 4.0"** at the Networked Learning Conference NLC2022 in Sundsvall, at Mid-Sweden University Campus, the 18th of May, 08.30-10.00. The co-author for the abstract was Dr Nicholas Bowskill from Derby University, UK.

The background was some discoveries we had made in the project; the emphasis on soft skills was high for work in the battery sector. This was obvious in job ads, surveys and interviews in our sectoral intelligence work, not only for white-collar staff as engineers but also for machine operators, technicians and logistics staff. We wanted to discuss what this phenomenon meant and soft skills training as part of the university and vocational education.

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The discussion among the 12 participants, two online, became very interesting. All considered soft skills necessary, but there were differing views on how much soft skills could be trained. It is interesting that soft skills are never evaluated as part of education and training programmes, considering their importance for students and future employers. The methods for assessment would be complex, though. There was a common conception that the choice of teaching and learning methods in education was relevant for soft skills development. Group work, problem-based tasks, project-based learning, etc., are interesting in the context.

However, it is sometimes difficult to evaluate who has done what in group-based tasks and if all students have reached the learning goals. An interesting example came up with co-writing in Google docs, where all contributions can be seen. This can work as an easy learning analytics tool if the group work result is text-based.

Lave and Wenger's ideas on "situated learning were discussed, as well as Luciano Floridi's Philosophy of information. Both are interesting theoretical references.

The discussion then deepened on discussion relation between the level of automation and the emphasis on soft skills. In contrast to what can be guessed, it is possible that human work will not become more and more machine-like with further automation; on the contrary: Higher levels of automation will place focus on what the genuine human contributions can be and which machines do not seem to be able to provide, such as complex problem solving and critical thinking. These skills are now becoming relevant also for machine operators. The rationale why the production cannot be simply done without staff or with less staff is the solid emphasis on quality and the economic importance of continuous production flow.

The discussion created interest among participants in following the Albatts project. The increased importance of research on soft skills in teaching and learning will also be followed up by some of the participants, of which the majority were professors in pedagogy and in management.

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