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Alliance for Batteries Technology, Training and Skills

2019-2023

Report on curriculum analysis and proposed solutions

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Deliverable 6.4

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Report on curriculum analysis and proposed solutions

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Executive Summary

This deliverable summarizes the work done and the achievements of Task 6.4 - Curriculum analysis and proposed solutions. Based on the gathered information from previous deliverables from all ALBATTS workpackages, this task worked on the **ALBATTS Education and Training Framework** Pillar 1 - Curricula for all levels, by defining new curricula, learning outcomes and assessment criteria for the battery sector, addressing the gaps identified through previous ALBATTS deliverables.

The primary objective of Task 6.4 is to contribute to Pillar 1 of the ALBATTS Education and Training Framework, which emphasizes curricula for all levels. The approach included the use of information from the ALBATTS framework to develop training modules and courses, using a modular approach based on micro-learning, and addressing transversal, cross-sectoral, sector-specific, and occupation-specific skills.

The methodology involved a comprehensive analysis of existing curricula, battery sector needs, and stakeholder requirements, including a deep analysis of the developed competency matrix and skill cards to map job roles and skills required in the battery value chain.

The work done under this task resulted in the development of several training modules and courses designed to meet the needs of the battery sector, including batteries introduction courses for th entire value chain, safety, English for the battery sector, automotive and stationary applications or soft skills for teachers and trainers.

The report concludes that the developed curricula address the identified gaps in the battery sector's educational needs. Future work will focus on refining and expanding these curricula, ensuring they remain aligned with industry needs and technological advancements. Further efforts will include ongoing collaboration with industry stakeholders to validate and enhance the training programs.

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Introduction

ALBATTS Education and Training Framework, as proposed on the Deliverable 6.2 - Preparatory development of the education and training framework and choice of tools, identifies four central pillars that constitute the guiding principles for the battery sector:

- Pillar 1 – Curricula for all levels
- Pillar 2 – Innovative and flexible learning
- Pillar 3 – Competent trainers and tutors
- Pillar 4 – EU wide recognition

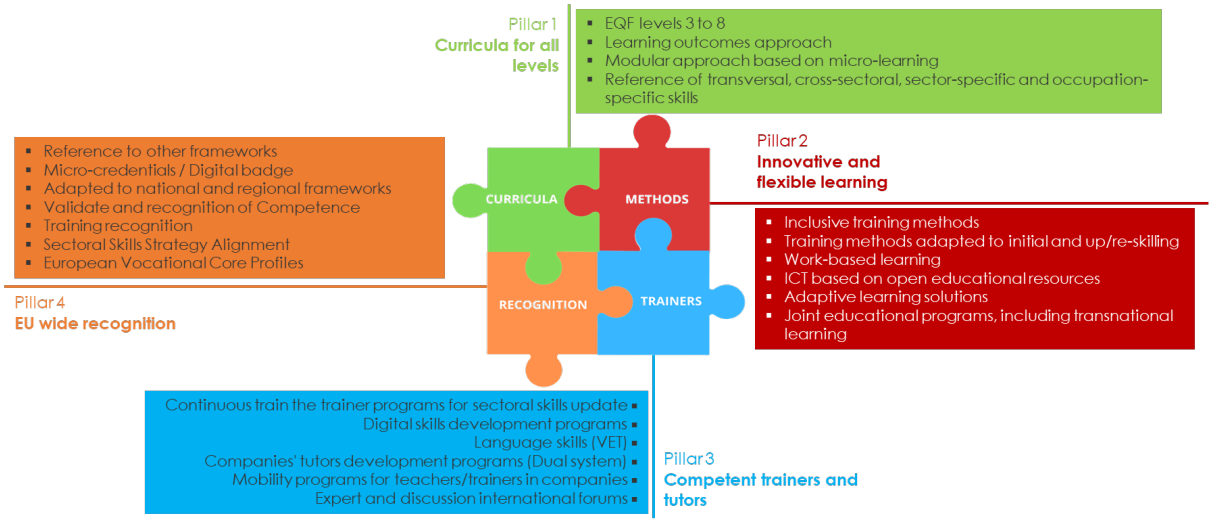

Figure 1 ALBATTS Education and Training Framework

Task 6.4 work is mainly focused on Pillar 1, by developing curriculum analysis and proposed solutions, taking in consideration the guiding principles identified in the framework, namely:

- EQF levels 3 to 8
- Learning outcomes approach
- Modular approach based on micro-learning
- Reference of transversal, cross-sectoral, sector-specific and occupation-specific skills

The first 9 months of work of the task 6.4 were mostly dedicated to buiding and aligning the team, analysing needs and competences inside the consortium, defining priorities for the development of training curricula and designing introductory learning outcomes for the battery sector.

In paralel, a training programme for adults for entering jobs as machine operators in the battery cell factory Northvolt Ett in Skellefteå was developed to function as a European pilot for many coming European battery plants.

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List of Abbreviations and definitions

Abbreviations used are in accordance with the ones defined in Deliverable 6.2 - Preparatory development of the education and training framework and choice of tools.

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1 Methodology

This section provides an overview of the methodological approach (Figure 1) used to Curricula analysis, definition of learning objectives, validation options and course/module creation for all levels.

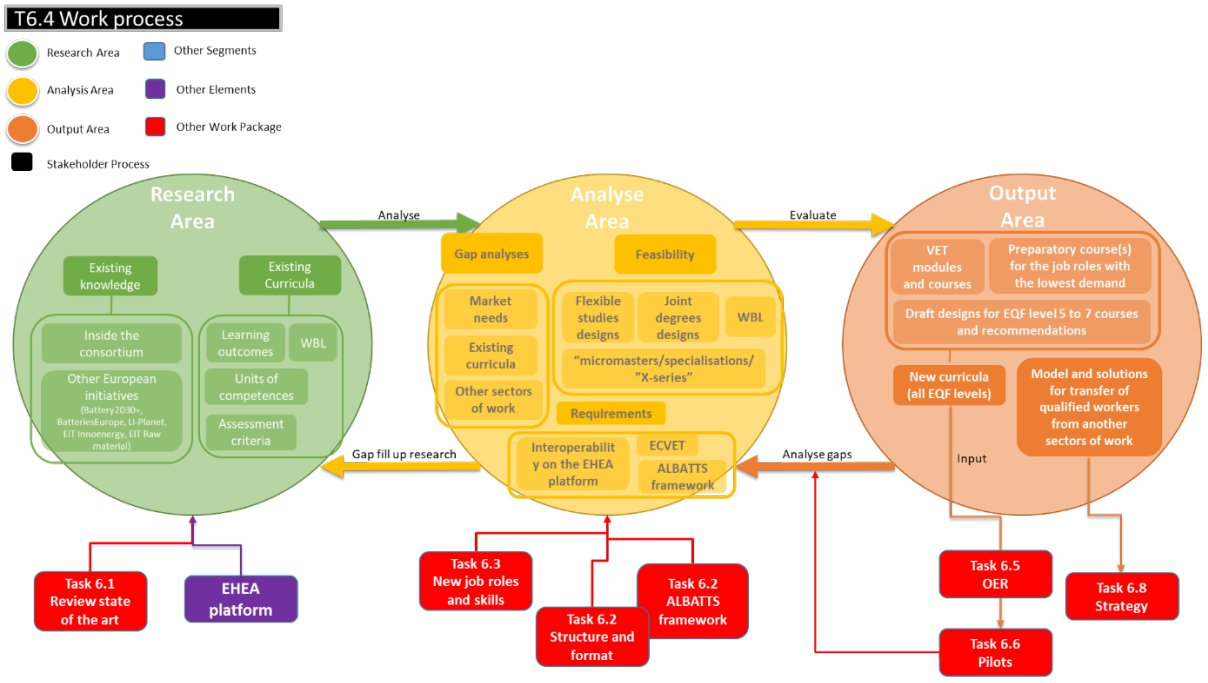

Figure 2 The Work process on curriculum analysis and proposed solutions

Knowledge inside the consortia and available in other European Initiatives is being identified together with already existing curricula on for the battery sector. Analysis to this information is to be made and compared with the new job roles and skills provided as needed from the Sectoral Intelligence work, by WP 3, 4 and 5, leading to the identification of the training gaps.

Taking into consideration the guidelines and principles from the ALBATTS framework, structure and formats (D6.2), task 6.4 will then deliver new curricula and solutions/recommendations for learning objectives, validation options and course/module creation for all levels of qualifications.

1.1 PURPOSE OF THE DOCUMENT

The purpose of this document is to describe and report the work done during the first 9 months of work of task 6.4 on Curricula analysis, definition of learning objectives, validation options and course/module creation for all levels (Figure 3).

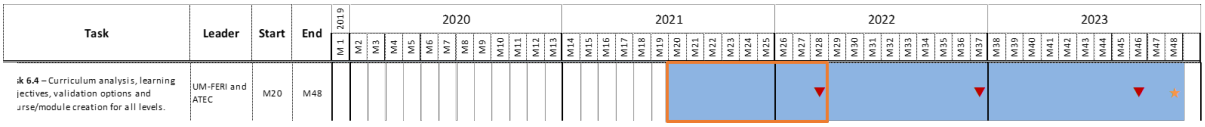

Figure 3 Task 6.4 Work calendar

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1.2 COHERENCE WP6 TASKS

Task 6.4 was in close connection with most other WP6 tasks, which are related either by giving inputs for its work or receiving its outputs to the work that followed. This can be seen in Figure 4 which shows how all the tasks interact with each other.

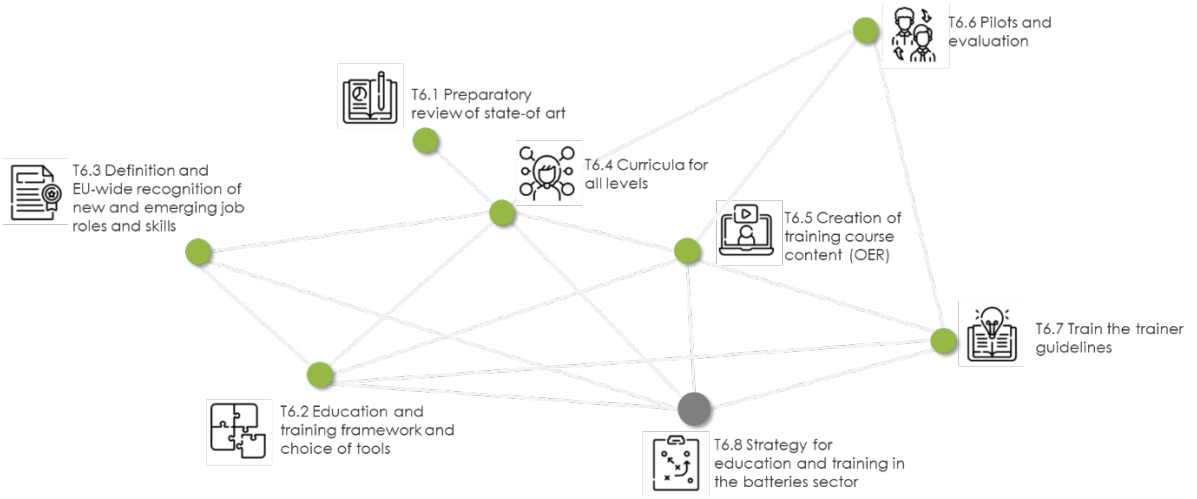

Figure 4 Work package 6 Training and Education structure

Task 6.4 started its work by using the available information from T6.1 Preparatory review of state-of-art and focusing on the guidelines set by ALBATTS Education and Training Framework delivered in report D6.2. Additional developments were using the outputs from the work done by Task 6.3 which is related to new job roles and skills, mainly by filling in the training gaps for the most important/relevant job roles of the sector.

Partners involved in the development of new curricula have jointly worked on this task with a close (weekly) follow-up by the coordination, to which Task 6.5 and Task 6.6 also joined, as the work of all can't be dissociated.

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2 Needs analysis

2.1 EXISTING CURRICULA

In the very beginning of the ALBATTS project (February 2019), information was collected all over Europe concerning available education and curricula relating to batteries and also, to some extent, concerning electromobility. At the time, there were some orientation courses on batteries, not part of any programme, at the undergraduate university level (EQF6), and private education providers in different countries offered courses. Most of these seem to be provider-based instead of empirically need-based. Information available on Deliverable 6.1 Report on state-of-art of job roles and education in the sector.

EITInnoenergy offered some master classes and online and blended courses. There were some cooperative ERASMUS Mundus Master concepts around Europe, as MESC, today named IMESC https://i-mesc.eu/ focused mostly on Energy storage and fundamental science in relation to energy storage technology applications. EITInnoenergy also developed and supported a concept with three cooperating European universities offering master programmes in Energy storage. Some MOOC courses of orientation character from universities were also available. In addition, at universities with research activities in Electrochemistry, as Uppsala university in Sweden, offered post-graduate courses. One longer and more comprehensive vocational level course package was found, *Batterijspecialist* – a fee-based blended education focused on working with applications of batteries. *https://www.syntrapxl.be/opleidingen/batterijspecialist*. On the the more general chemistry and automotive technology area, some courses and programmes on various levels were found. However, there was a lack of courses in battery cell production. Moreover, most of the curricula we found seems to have been provider-based (what do we know and what relevant can we offer?) more than actually need-based (what does the battery value chain need?). Therefore, an important mission for the ALBATTS project became sectoral intelligence to map up present and future needs, on which later curricula can be based.

2.2 BATTERY SECTOR NEEDS (COMPETENCE MATRIX/SKILL CARDS)

As a basis for Job Roles and Skills research, relevant battery sector job advertisements were collected from various companies in WP3 Sectorial Intelligence. This led to the Competence matrix – a list of job roles and skills and competences. These findings were mapped to the Battery Value Chain steps as well as a defined framework that normalizes the description and mapping of skills/competence to the job roles.

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Competence Matrix																				
Element Name: / Skill/Knowledge: / ESCO or related Skills and Knowledge in ESCO:		Department													Value Chain						
		Maintenance	Production	Logistics	quality	purchasing	HR	Finance	Sales	RnD	Construction	Intellectual, Legal	Recycling	Environment	IT, Digital	WP	raw materials	components	modules & pack	integration	operation, r, m	second life	recycling
Source	Job Role																						
DRI	Battery Assembler		X													Both			X	X			
DRI	Battery Business Developer								X							WP5					X		
DRI	Battery Design Senior		X		X											both			X	X			
DRI	Battery Engineer		X							X						Both			X	X			
DRI	Battery Management System (BMS) Engineer														X	WP5			X	X			
DRI	Battery Management System QA Engineer														X	WP5			X	X			
DRI	Battery Materials Engineer		X	X	X	X										Both	X	X					X
DRI	Battery Materials Engineer High Density Anodes		X	X	X	X										Both	X	X					
DRI	Battery Repair Engineer		X		X											WP5					X	X	
DRI	Battery System Consultant														X	both				X			
DRI	Battery System Engineer									X					X	Both		X	X	X			
DRI	Battery Test Technician		X		X											Both			X	X	X	X	
DRI	Blueprint Data Scientist														X	Both	X	X	X	X	X	X	X

Figure 5 ALBATTS competence matrix

Based on this mapping, each step of the battery value chain contains the list of relevant job roles and analytical approaches to the skills and knowledge listed by the occurrence. This analysis was then used to create and define skills cards (SKills Cards) based on which a specific dashboard with analyzed ALBATTS skills cards to identify core competence for the battery sector was developed, as seen in Figure 6.

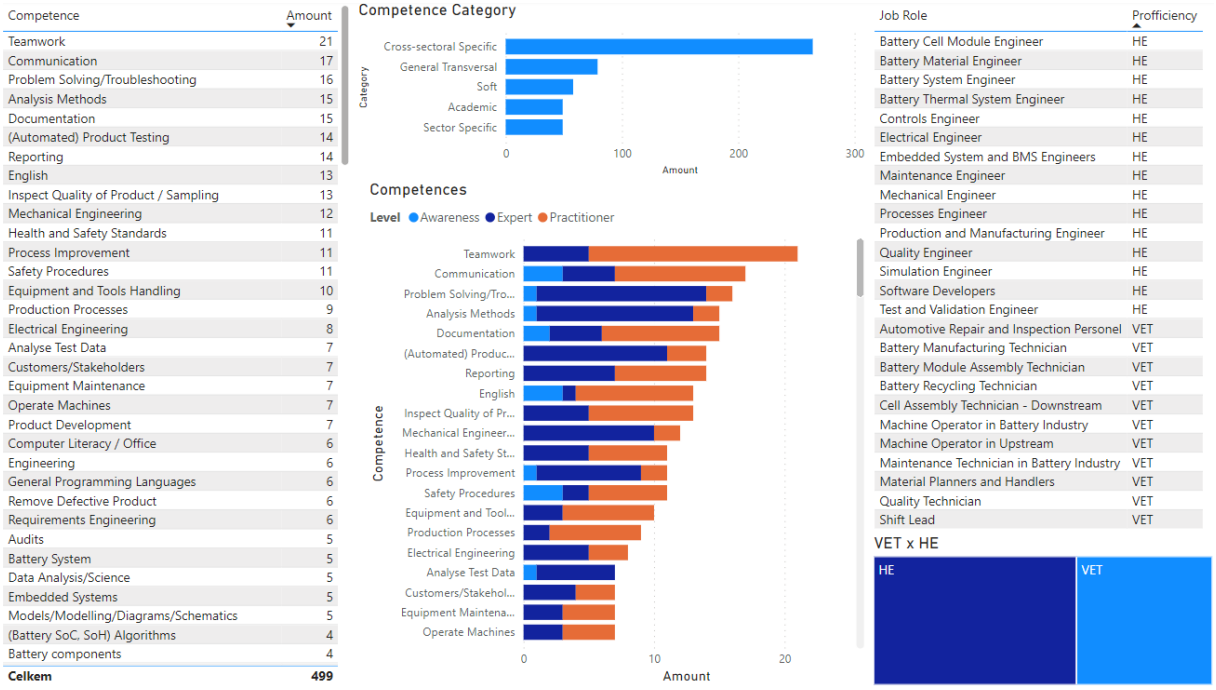

Figure 6 dashboard with analyzed ALBATTS skills cards

The job roles were then mapped against the value chain (Figure 7) highlighting the wide spreading of the identified job roles along the value chain and the need to develop training and education programs that could cover the full value chain, in addition to the identified competences.

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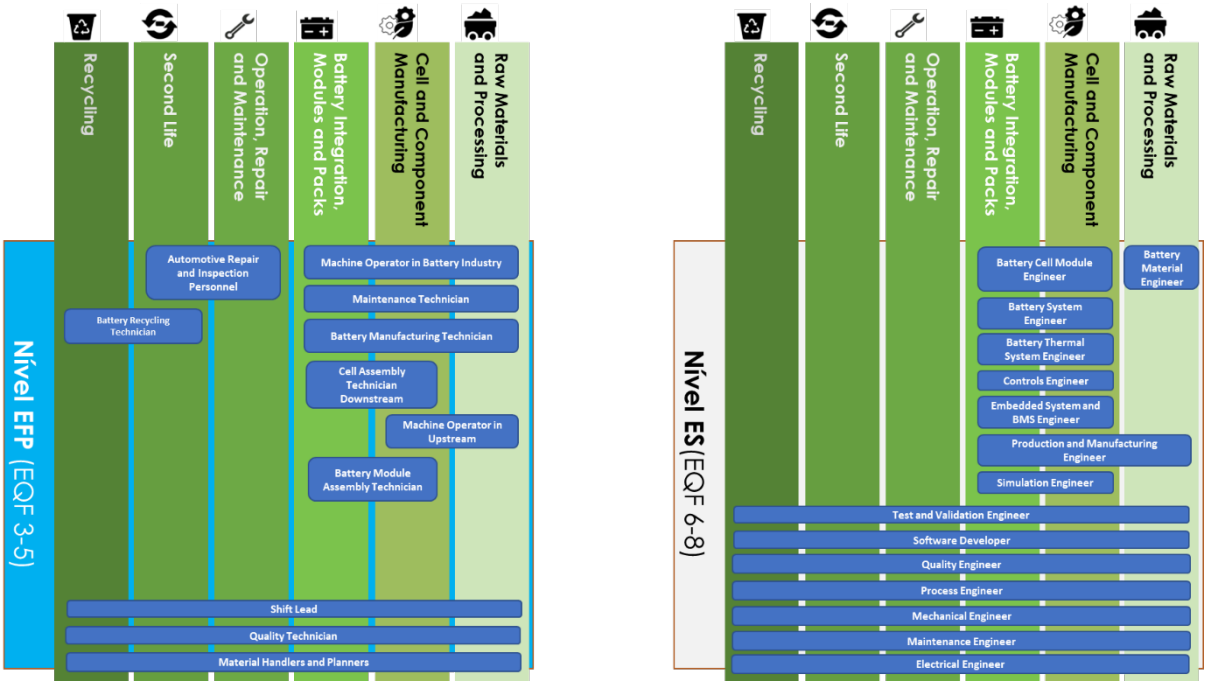

Figure 7 – Distribution of the ALBATTS skill cards through out the battery value chain

Based on the skill cards analysis and partners' capacity a set of training curricula was identified to be described as learning outcomes (see Chapter 3) and then to produce training courses/units that could be of use to the industry and training providers (see Deliverable 6.5).

2.3 GAP ANALYSIS MODEL AND SOLUTIONS FOR TRANSFER/ BRIDGING FROM ONE SECTOR TO ANOTHER

In education and training, conducting a **gap analysis** is crucial for identifying discrepancies between desired skills or competencies and the current state of knowledge or performance. During the ALBATTS project, the following models and solutions were used to conduct gap analysis and guarantee coherence between needs and the training offer:

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Competency Mapping: Competency mapping involves identifying and documenting the skills, knowledge, and behaviors required for successful performance in a particular role or field. A competence matrix (see Figure 5) was developed, allowing the comparison of current competencies with desired competencies by educators and trainers, identifying skill gaps and developing targeted interventions to address them.

Job Task Analysis: Job task analysis involves breaking down a job or role into its component tasks and identifying the knowledge, skills, and abilities required to perform each task effectively. ALBATTS developed skill cards which were analyzed by the project educators and trainers to identify gaps in skills or knowledge that may impede job performance, and develop training interventions.

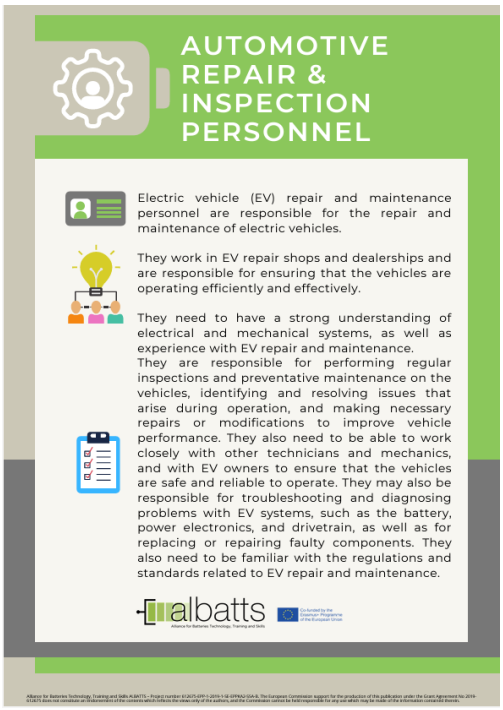

Figure 8 – Example of a skill card summary from the ALBATTS project

By utilizing these models and solutions, educators and trainers can effectively identify gaps in knowledge, skills, and performance and develop targeted strategies to bridge those gaps and improve learning outcomes.

Robust gap analysis models can sustain reliable job roles and skills needs definitions for a specific sector, allowing comparability and the implementation of other models and solutions aimed at **transferring or bridging skills and competencies from one sector to another**. ALBATTS curricula design and education and training solutions were developed to facilitate the recognition of skills and competencies, thus the transference between sectors:

Competency-Based Education (CBE): This approach focuses on the demonstration of specific skills or competencies rather than traditional seat-time-based learning. In CBE, learners progress based on their mastery of skills, allowing them to transfer skills across different sectors more effectively.

Prior Learning Assessment and Recognition (PLAR): PLAR is a process used to evaluate and recognize an individual's skills and knowledge acquired through work experience, formal education, or other means. By assessing prior learning, individuals can receive credit or recognition for skills that are

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relevant to a different sector. ALBATTS curricula were developed using learning outcomes, clearly stating what a learner should be able to do after a training program is finalized (see Chapter 3).

Flexible Credentialing: Offering flexible credentialing options, such as micro-credentials, allows individuals to acquire and demonstrate specific skills relevant to multiple sectors. These credentials can be earned incrementally and tailored to the needs of different industries, facilitating skill transferability. ALBATTS curricula were designed following the defined learning outcomes, and the training units and modules are supplemented with **digital badges**, which are synergistic with the **ASA Skills Hub** where badges can be issued per learning outcome on different levels (see Deliverable 6.3).

Other solutions and models can also be used to facilitate transferring or bridging skills and competencies from one sector to another, such as:

Skills Mapping and Gap Analysis: Conducting a thorough analysis of the skills required in one sector compared to another can identify transferable skills and highlight areas where additional training or upskilling may be needed. By mapping skills across sectors, individuals can better understand how their existing competencies align with the requirements of a different industry.

Cross-Sector Collaboration and Partnerships: Collaborative efforts between different industries or sectors can facilitate the transfer of skills and competencies. Initiatives such as industry-academic partnerships, joint training programs, and cross-sector mentorship opportunities can help individuals bridge the gap between sectors.

Apprenticeship Programs: Apprenticeship programs provide hands-on training combined with classroom instruction, allowing individuals to learn and develop skills directly applicable to a specific industry or sector. These programs often include a structured pathway for transferring skills from one sector to another.

These models and solutions emphasize the importance of recognizing and leveraging transferable skills and competencies to facilitate career mobility and support lifelong learning in an evolving workforce landscape.

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2.4 ANALYSIS OF REQUIREMENTS

In this section, we analyze the requirements of the ALBATTS Education and Training Framework and the working structure for the development of the ALBATTS training curricula.

2.4.1 ALBATTS Framework

ALBATTS education approach identifies four central pillars that constitute the guiding principles of the ALBATTS education and training framework for the battery sector. This report focuses on Pillar 1 – Curricula for all levels and addressing the following requirements, as highlighted in Figure 6:

- EQF levels 3 to 8
- Learning outcomes approach
- Modular approach (training units) based on micro-learning
- Reference of transversal skills (key competences, soft skills, STEM disciplines, digital skills adapted to different public), cross-sectoral, sector specific and occupation specific skills

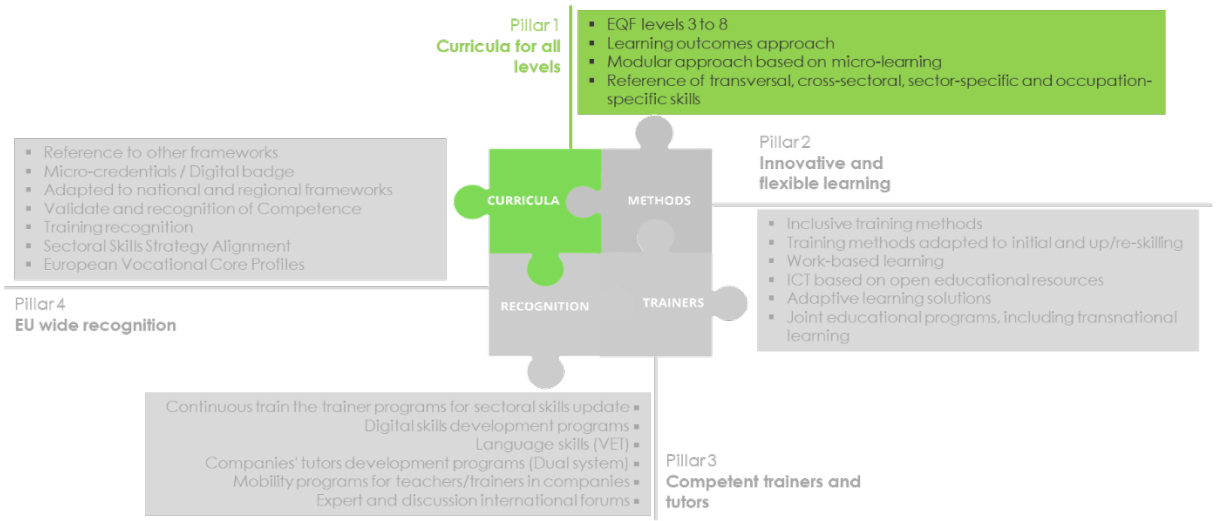

Figure 9 Work package 6 Training and Education structure

Although the framework states curricula from levels 3 to 8, as the main findings from the Sectoral Intelligence suggest, at an operational level ALBATTS project focused mainly on Basic and Intermediate levels (equivalent to EQF levels 3 to 5), according to the skills hub definition used.

2.4.2 Structure and formats

The chosen approach to come from Job Roles and skills identified by the labor market to Units of Competence and Learning Outcomes for the definition of education and training modules is based on the functional analysis, as represented in Figure 7 and more in-depth described in Deliverable 6.2 - Preparatory development of the education and training framework and choice of tools.

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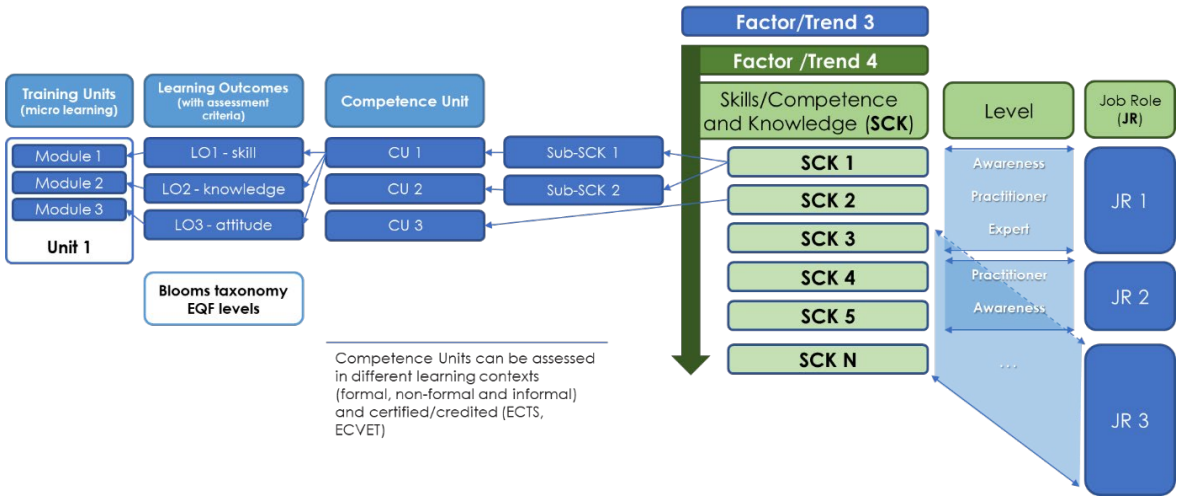

Figure 10 Cascading process for the definition of Competence Units, Learning Outcomes and Training Units/Modules

For the operationalization of this process, the team created two supporting documents, which allowed, easily and understandably, the transfer of information from the Skill Cards, to the definition of the training units/modules. In Figure 11 is the template used to the definition of the Competence Units (Achievements/Functions/Topic), and the associated Learning Outcomes with corresponding Assessment Criteria.

Competence Unit name:

EQF level:	ISCO level:	raw materials	components	modules & pack	integration	operation, r, m	second life	recycling

Department:	Production Maintenance	Logistics	quality	purchasing	HR	Finance	Sales	RnD	Construction	Intellectual, Legal	Recycling	Environment	IT, Digital

Job roles/skills associated:

Code	Achievements/ Functions / Topic	Learning Outcomes (Knowledge, Skills, Competences)	Competence requirements/assessment criteria	Badge (Y/N)
XXX01	Asdfdsfsadfsd sdfsdfasdfsd	**Knowledge:** 1.1 xdfre	1.1.1 sdfsdfd 1.1.2 sadfasf	
		Knowledge: 1.2 adsdafsf	1.2.1 fgsdfg	
		Skills: 1.3 adsdfdsf	1.3.1 asdfs 1.3.2 sdfgdgd 1.3.3 dfgdfsgsd	
		Competence: 1.4 dsfsdfsd	1.4.1 gdfgfd	

Figure 11 Template used for the definition of the Competence Unit (Achievements/Functions/Topic) and the Learning Outcomes with corresponding Assessment Criteria

Finally, the content was defined per Learning Outcome, allowing a modular approach (training units) based on micro-learning and was used as the main intput for the development of training material and activities, under Task 6.5.

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3 Training *curricula* for the Battery sector

ALBATTS training curricula are mapped against three different descriptors:

1 – the value chain steps

2 – the level (Basic, Intermediate and Advanced)

3 – If it is sector-specific, cross-sector, or transversal

Additionally, they are divided into small modules, using the micro-credential approach, where each corresponds to a specific learning outcome, making it more flexible, and easy and faster to update each course content.

The picture below shows the different *curricula* that were created by the ALBATTS partnership and are available for the community as training material as described in more detail in Deliverable 6.5.

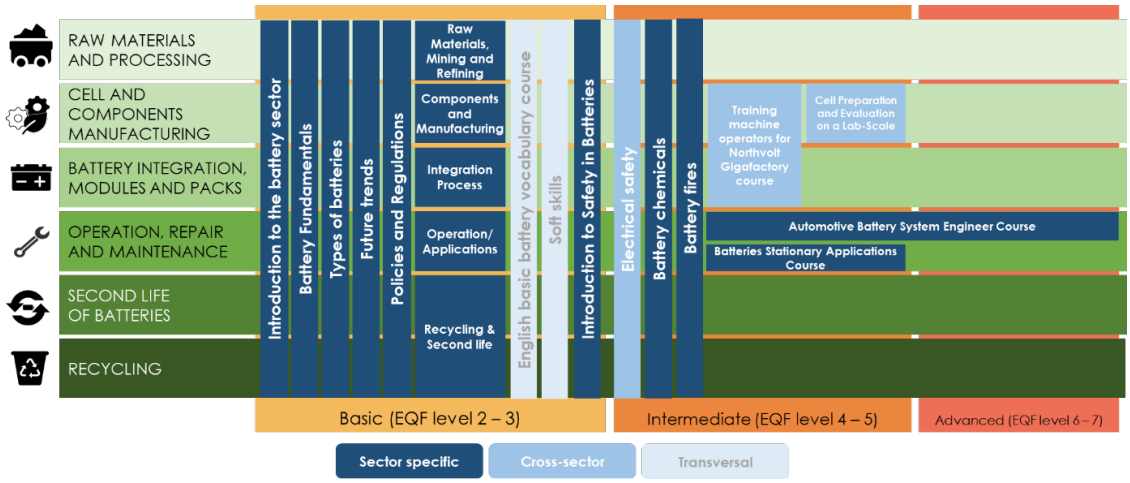

Figure 12 Curricula developed under the ALBATTS project

3.1 COMPETENCE UNITS AND LEARNING OUTCOMES

The following competence units and learning outcomes were created by ALBATTS partners:

Table 1 – List of ALBATTS competence units and learning outcomes

Number	Achievements/ Functions / Topic	Learning Outcomes	EQF level
AL01-01	Introduction to the battery sector	1.1 Describe the history of batteries 1.2 Explain the entire value chain of the battery 1.3 Describe the battery market and its players 1.4 Identify some applications of batteries 1.5 Describe the impacts of the battery industry on the environment and people	2 – 3
AL01-02	Battery Fundamentals	2.1 Explain the electro-chemical principles of batteries 2.2 Describe how a battery works 2.3 Describe the battery characteristics and concepts	2 – 3

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Number	Achievements/ Functions / Topic	Learning Outcomes	EQF level
AL01-03	Types of batteries	3.1 Compare the different geometries of batteries available 3.2 Compare primary and secondary batteries 3.3 Describe the different types of chemistries of batteries 3.4 Select the right chemistry for different applications of batteries	2 – 3
AL01-04	Future trends	4.1 Compare the trends in battery technology 4.2 Describe the future trends in the battery manufacturing 4.3 Describe the future trends in the battery recycling sector	2 – 3
AL01-05	Policies and Regulations	5.1 Describe the most relevant international and EU agreements influencing the development of the battery industry in EU 5.2 Describe the EU policies regarding batteries 5.3 Identify the main requirements from the EU regulations regarding batteries	2 – 3
AL01-06	Raw Materials, Mining and Refining	6.1 Describe the materials used in Li-ion batteries, and their mining and refining properties 6.2 Describe the types of materials used for electrolytes and separators in Li-ion batteries 6.3. Describe other materials used in cell and battery pack production (mainly metals and plastics)	2 – 3
AL01-07	Manufacturing Processes	7.1 Describe lithium-ion battery manufacturing production 7.2 Describe the battery electrodes production processes 7.3 Compare the different battery cell production processes	2 – 3
AL01-08	Integration Process	8.1 Explain the generic integration process 8.2 Describe the assembly of battery modules 8.3 Describe the integration of battery modules with the Battery Management System 8.4 Describe the system integration process	2 – 3
AL01-09	Operation/Applications	9.1 Demonstrate the correct operation of batteries in in portable consumer electronics 9.2 Describe the batteries used in mobile applications 9.3 Explain the stationary battery applications 9.4 Describe the environmental aspect of Battery Applications	2 – 3
AL01-10	Recycling & Second life	10.1 Explain the importance of battery recycling 10.2 Compare the different recycling processes 10.3 Recognize the environmental impacts of different types of battery recycling processes	2 – 3

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Number	Achievements/ Functions / Topic	Learning Outcomes	EQF level
		10.4 Discuss the reasons for battery second life use	
AL02-01	Battery English – Terms and Concepts	1.1 Recognize fundamental terms and concepts related to the battery sector. 1.2 Define fundamental terms and concepts related to the battery sector. 1.3 Appropriately use fundamental terms and concepts related to the battery sector.	2 – 3
AL02-02	Battery English – Safety of Batteries	2.1 Identify key safety vocabulary associated with handling and maintaining batteries. 2.2 Communicate safety measures and emergency responses clearly and effectively in English.	2 – 3
AL02-03	Battery English – Quality	3.1 Understand vocabulary and concepts related to quality control and assurance in the battery production process. 3.2 Describe quality issues in English.	2 – 3
AL02-04	Battery English – Tools and equipment for electricians	4.1 Recognize vocabulary related to tools and equipment used by electricians in the battery sector. 4.2 Recognize the tools needed in work.	2 – 3
AL02-05	Battery English – Tools and equipment for process operators	5.1 Use English vocabulary relevant to process operators in battery manufacturing. 5.2 Explain parts of processes involved in battery production and handling.	2 – 3
AL02-06	Battery English – Tools and Equipment for Automation and Robotics	6.1 Utilize terminology related to robotics and automation in the battery industry. 6.2 Describe automated systems used in battery assembly and testing.	2 – 3
AL02-07	Battery English – Tools and Equipment for Maintenance	7.1 Use vocabulary in the maintenance of battery manufacturing equipment. 7.2 Understand maintenance-related issues.	2 – 3
AL02-08	Battery English – Tools and Equipment for Logistics	8.1 Use key terminology related to logistics in the battery sector. 8.2 Describe supply chain processes specific to the transportation and storage of batteries.	2 – 3
AL03	Soft skills for the battery industry	1.1 Recognize the importance of soft skills in teaching 1.2 Apply effective communication, leadership, and collaboration techniques to develop practical strategies for integrating soft skills into classroom instruction and student interactions. 1.3 Create an action plan to integrate soft skills into teaching practice.	2 – 3
AL04-01	Introduction to safety in batteries	1.1 Recognize the Risks and Dangers associated with the batteries 1.2 Explain the risks and dangers associated with each step of the battery value chain	2 - 3

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Number	Achievements/ Functions / Topic	Learning Outcomes	EQF level
AL04-02	Electrical safety	2.1 Explain the importance of electrical safety when working with batteries 2.2 Describe the safety measures associated with electrical safety when working with batteries	4 – 5
AL04-03	Battery chemicals	3.1 Identify the hazards related to the common chemicals in lithium-ion batteries 3.2 Describe the EU policies regarding safety of batteries	4 – 5
AL04-04	Battery fires	4.1 Recognize the importance of fire safety when working with batteries 4.2 Explain the thermal runaway phenomenon 4.3 Discuss battery fire safety strategies	4 – 5
AL06-01	Introduction to battery concepts in automotive	1.1 Know about the History of the battery in automotive. 1.2 Know about the battery supply chain in automotive. 1.3 Know some applications of batteries in automotive architectures. 1.4 Know the principles of an electric battery and battery cells in cars. 1.5 Know about the battery market and its players in general. 1.6 Know the impact of the battery industry.	4 – 5
AL06-02	Battery Systems Engineering	2.1 Know the functions of a Battery Management System (BMS). 2.2 Know the components, specifics and requirements for a BMS. 2.3 Know the hardware functions of a BMS. 2.4 Know the software functions of a BMS. 2.5 Know the main functions of a high-voltage relay. 2.6 Know about the control strategy of a power electronic which realizes a high voltage relay. 2.7 Knows how a HARA is performed. 2.8 Know about ASIL and target FIT and target Diagnostic Coverage. 2.9 Know what an FMEA/FMEDA is. 2.10 Know how a TARA (Threat and Risk Analysis) is performed according to ISO 21434. 2.11 Know how to use a TARA for a battery system.	6 – 7
AL06-03	Battery Homologation	3.1 Know about automotive homologation process basics. 3.2 Know about specific norms to be applied to qualify and release a battery system in automotive.	6 – 7
AL07	Battery Energy Storage	1.1 Explain what a BES is 1.2 Describe the technology associated with BES	4 - 5

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Number	Achievements/ Functions / Topic	Learning Outcomes	EQF level
		1.3 Recognize the need for service and maintenance of BES 1.4 Explain different BES solutions/applications 1.5 Recognize future developments of BES 1.6 Understand the safety risks related to BES	
AL08	Cell Preparation and Evaluation on a Lab-Scale	1.1 Describe the principles and mechanisms of wet synthesis techniques used on a lab scale to produce the electrode materials 1.2 Identify the principles and application of various methods for characterizing the electrode materials 1.3 Describe different types of batteries produced on a lab scale 1.4 Test various electrochemical techniques for batteries obtained at laboratory scale	4 - 5

3.2 MAP OF THE SKILL CARDS TO DEVELOPED CURRICULA

The ALBATTS courses available through the Automotive Skills Alliance (ASA) learning platform, are integrated with its skills hub, allowing the mapping of the learning outcomes from each of the training units/modules with the skills, competencies and associated job roles. These are also synchronized with ESCO (section 1), the European Skills, Competencies and Occupations.

According to the skills hub, the ALBATTS courses can be mapped with the following skills, competencies and job roles:

Table 2 – Skills, competencies and job roles covered by ALBATTS training units and modules

Number	Training unit/module	Skills and Competencies	Job roles
AL01-01	Introduction to the battery sector	Battery fluids knowledge | Awareness Level Battery Material knowledge | Awareness Level Anode knowledge | Awareness Level Cathode knowledge | Awareness Level Separator Design knowledge | Awareness Level	**ALBATTS Roles:** Battery Manufacturing Technician - 3%
AL01-02	Battery Fundamentals	Electrochemistry knowledge | Awareness Level	**ALBATTS Roles:**

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Number	Training unit/module	Skills and Competencies	Job roles
		Battery chemistry knowledge | Awareness Level Batteries knowledge | Awareness Level Battery components knowledge | Awareness Level	Battery Material Engineer - 4% Simulation Engineer - 6% Battery Manufacturing Technician - 3% Battery Recycling Technician - 9%Machine Operator in Upstream - 10%
AL01-03	Types of batteries	Batteries knowledge | Awareness Level Battery chemistry knowledge | Awareness Level Battery Formation skill/competence | Awareness Level	**ALBATTS Roles:** Battery Manufacturing Technician - 3% Battery Recycling Technician - 5% Machine Operator in Upstream - 5%
AL01-04	Future trends	Battery Outlook knowledge | Awareness Level	**Other:** Advanced Powertrain Engineer - 5%
AL01-05	Policies and Regulations	Regulation Compliance knowledge | Awareness Level Legislation knowledge | Awareness Level	
AL01-06	Raw Materials, Mining and Refining	Battery fluids knowledge | Awareness Level Battery Material knowledge | Awareness Level Anode knowledge | Awareness Level Cathode knowledge | Awareness Level Separator Design knowledge | Awareness Level	**ALBATTS Roles:** Battery Manufacturing Technician - 3%
AL01-07	Components and Manufacturing	Battery components knowledge | Awareness Level Production processes knowledge | Awareness Level Production Technology knowledge | Awareness Level	**ALBATTS Roles:** Battery Material Engineer - 4% Battery Recycling Technician - 5% Machine Operator in Upstream - 5%

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Number	Training unit/module	Skills and Competencies	Job roles
			Other: Connected Vehicle – Technician - 10%
AL01-08	Integration Process	Battery Management Systems knowledge | Awareness Level Battery Systems knowledge | Awareness Level Embedded systems knowledge | Awareness Level System Integration knowledge | Awareness Level	**ALBATTS Roles:** Battery Cell Module Engineer - 3% Battery Manufacturing Technician - 3% **Other:** e-Powertrain Engineer - 5%
AL01-09	Operation/Applications	Automotive Applications of Batteries skill/competence | Awareness Level Consumer electronics knowledge | Practitioner Level Stationary Applications of Batteries skill/competence | Awareness Level Environment knowledge | Awareness Level	
AL01-10	Recycling & Second life	Battery recycling knowledge | Awareness Level Environment knowledge | Awareness Level Waste Legislative knowledge | Awareness Level Second life of batteries knowledge | Awareness Level	
AL02-01	Battery English – Terms and Concepts	English - Battery Sector knowledge | Practitioner Level English knowledge | Awareness Level	**ALBATTS roles:** Battery Manufacturing Technician - 3% Battery Recycling Technician - 5% Machine Operator in Battery Industry - 6% Machine Operator in Upstream - 5%

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Number	Training unit/module	Skills and Competencies	Job roles
AL02-02	Battery English – Safety of Batteries	English knowledge | Awareness Level English – Handling and Maintaining Batteries knowledge | Awareness Level English – Safety Measures Communication knowledge | Awareness Level	**ALBATTS roles:** Battery Manufacturing Technician - 3% Battery Recycling Technician - 5% Machine Operator in Battery Industry - 6% Machine Operator in Upstream - 5%
AL02-03	Battery English – Quality	English knowledge | Awareness Level English – QA in Battery Production knowledge | Awareness Level English – Quality Issues knowledge | Awareness Level	**ALBATTS roles:** Battery Manufacturing Technician - 3% Battery Recycling Technician - 5% Machine Operator in Battery Industry - 6% Machine Operator in Upstream - 5%
AL02-04	Battery English – Tools and equipment for electricians	English knowledge | Awareness Level English – Equipment for Electricians knowledge | Awareness Level	**ALBATTS roles:** Battery Manufacturing Technician - 3% Battery Recycling Technician - 5% Machine Operator in Battery Industry - 6% Machine Operator in Upstream - 5%
AL03	Soft skills for the battery industry	Communication knowledge | Practitioner Level Leadership principles knowledge | Practitioner Level Teamwork principles knowledge | Practitioner Level Soft Skills in Teaching skill/competence | Awareness Level	Training Detail - Skills Hub (skills-framework.eu) – see here for the roles.

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Number	Training unit/module	Skills and Competencies	Job roles
AL04-01	Introduction to safety in batteries	Battery Risks and Dangers knowledge | Awareness Level Battery Safety knowledge | Awareness Level	
AL04-02	Electrical safety	Electrical safety regulations knowledge | Awareness Level Safety engineering knowledge | Awareness Level	**ALBATTS Roles:** Battery Recycling Technician - 5% Machine Operator in Battery Industry - 6% Machine Operator in Upstream - 5%
AL04-04	Battery fires	Battery Safety knowledge | Awareness Level Thermal Runaway knowledge | Awareness Level Fire prevention procedures knowledge | Awareness Level	
AL06	Battery Systems Engineering	Batteries knowledge | Awareness Level Battery Management Systems knowledge | Practitioner Level Homologation knowledge | Practitioner Level Functional Safety knowledge | Practitioner Level Battery Market knowledge | Awareness Level High Voltage Relays skill/competence | Awareness Level Cybersecurity skill/competence | Awareness Level Testing of electrically propelled road vehicles skill/competence | Awareness Level	**Other roles:** e-Powertrain Engineer - 16% Functional Safety Manager - 25% Functional Safety Manager - Strategy Level - 25% Automotive Mechatronics Developer - 2% Automotive Mechatronics Expert - 4%
AL07	Battery Energy Storage	Battery Systems knowledge | Awareness Level	**ALBATTS roles:**

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Number	Training unit/module	Skills and Competencies	Job roles
		Stationary Applications of Batteries skill/competence | Awareness Level Energy Storage knowledge | Awareness Level Maintenance and repair knowledge | Awareness Level	Battery Cell Module Engineer - 3% Battery Manufacturing Technician - 3% **Other roles:** e-Powertrain Engineer - 5%
AL08	Cell Preparation and Evaluation on a Lab-Scale	Electrode Design knowledge | Awareness Level Characterization Techniques skill/competence | Awareness Level Batteries knowledge | Awareness Level Electrochemistry knowledge | Practitioner Level Battery testers knowledge | Practitioner Level	**ALBATTS roles:** Simulation Engineer - 6% Battery Manufacturing Technician - 3% Quality Technician - 7%

ALBATTS curricula cover a wide range of skills and competencies from many job roles of the entire battery value chain, with a focus on the lower levels of proficiency, where the most needed workforce will occur. However, it is also clear that a gap still exists in the necessary intermediate practical skills, which might only be covered with the implementation of curricula oriented to practice, such as Apprentices programs, post-secondary programs and/or through practical training developed in specialized training environments, such as the ones available in VUX adult education centre in Sweden and explained in detail in the deliverable 6.7.

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4 Recommendations for further developments

All relevant stakeholders should cooperate in developing educational programs aligned with current and emerging skills requirements across all European Qualifications Framework (EQF) levels. This includes Initial Vocational Education and Training (IVET) at EQF levels 3-4, Continuous Vocational Education and Training (CVET) at EQF level 5, Bachelor-level education at EQF level 6, Master's-level education at EQF level 7, and PhD-level education at EQF level 8. Strong cooperation between different educational levels is essential in developing training content and learning environments.

Rather than creating specific qualifications solely for the battery industry, the focus should be in developing modules covering different job roles and tasks, allowing individuals to transition between jobs and acquire new skills as demand evolves. They should be flexible enough to integrate into training programs and qualifications, supporting up-skilling and re-skilling.

It is adviseble to adopt a learning outcomes approach when developing learning modules, clearly stating what learners are expected to know, understand, or be able to do after the learning experience, encompassing knowledge, skills, and competencies, and the use of digital badges (micro-credentials) to acknowledge and validate acquired skills and competencies.

A modular approach or microlearning for training is recomended, where courses are divided into small, manageable units encompassing a broad set of skills. While specialized skills are needed for specific jobs, transversal (transferable) skills are crucial for all workers. These include English language proficiency, teamwork, cross-cultural understanding, communication, and problem-solving. Cross-sectoral skills, such as equipment handling, documentation, operating machines, digital skills, and equipment maintenance, are also essential. Sector-specific skills include knowledge of health and safety standards, battery industry processes, and raw materials. Occupation-specific skills are required for particular jobs, such as operating machines, equipment maintenance, troubleshooting, and product inspection.

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5 Conclusions and further developments

ALBATTS project conducted a comprehensive analysis of job roles and skills within the battery sector, collecting job advertisements to create a Competence matrix that maps job roles to the steps of the battery value chain. This mapping identified core competencies and highlighted the need for training programs spanning the entire value chain. To address skill gaps, the project employed competency mapping and job task analysis, developing skill cards to guide training interventions. The curricula were designed with learning outcomes to facilitate effective training and the transfer of skills across sectors. The developed training curricula are strategically structured around three key descriptors: value chain steps, proficiency levels (Basic, Intermediate, and Advanced), and sector relevance (sector-specific, cross-sector, or transversal). The modular micro-credential approach enhances flexibility, allowing quick updates and targeted learning outcomes. Developed competence units cover a broad spectrum, from fundamental battery concepts and future trends to safety, manufacturing processes, and specialized topics like battery recycling and energy storage. These units are integrated into the Automotive Skills Alliance (ASA) learning platform, aligned with the European Skills, Competencies, and Occupations (ESCO) framework, ensuring relevance to job roles across the battery value chain.

Despite extensive coverage, a gap remains in intermediate practical skills, highlighting the need for practice-oriented curricula such as apprenticeship programs and specialized training environments. This structured, adaptable approach aims to meet the evolving skill needs of the battery sector, addressing both immediate and long-term workforce demands.

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List of Appendixes

APPENDIX 1 – Example of syllabus

APPRNDIX 2 – Example of content unit development

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ALBATTS Units Structure

Competence Unit name: Batteries Basics - Integration Process

Version: v2 Date: 05.01.2024

EQF level:
3

raw materials	components	modules & pack	integration	operation, r, m	second life	recycling
x	x	x	x	x	x	x

Department:

Production Maintenance	Logistics	quality	purchasing	HR	Finance	Sales	RnD	Construction	Intellectual, Legal	Recycling	Environment	IT, Digital
x	x	x	x	x	x	x	x	x	x	x	x	x

Job roles/skills associated: All job roles in the batteries value chain

Code	Achievements/ Functions / Topic	Learning Outcomes (Knowledge, Skills, Competences)	Competence requirements/assessment criteria	Badge (Y/N)
AL01-08	Integration Process	Knowledge: 8.1 Explain the generic integration process	8.1.1 Define the term integration 8.1.1 Describe the generic integration process levels	Y
		Knowledge: 8.2 Describe the assembly of battery modules	8.1.1 Identify the components of a battery module 8.1.2 Describe the assembly of battery modules 8.2.1 Compare prismatic and punch cells integration process	Y
		Knowledge: 8.3 Describe the integration of battery modules with the Battery Management System	8.3.1 Describe the integration of battery modules with the Battery Management System 8.3.2 Identify the tasks of BMS Integration 8.3.3 Describe BMS functions 8.3.4 Identify the testing aspects of battery integration	Y
		Knowledge: 8.4 Describe the system integration process	8.4.1 define system integration 8.4.2 Describe the integration of BMS and systems 8.4.3 Describe the electric vehicle system integration components	Y

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Alliance for Batteries Technology, Training and Skills

2019-2023

ALBATTS Content Unit

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Batteries Basics

AL01-06 EU Policies and Regulations

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Introduction

The present document is the teacher's/trainers guide of content of the EU Policies and Regulations training unit. Here you can find the structure and information related to the content of the unit and the activities and evaluation proposals according to the following learning outcomes:

- **Knowledge:** Describe the most relevant international and EU agreements influencing the development of the battery industry in EU
- **Knowledge:** Describe the EU policies regarding batteries
- **Knowledge:** Identify the main requirements from the EU regulations regarding batteries

In this unit, you will first learn about the main UN agreements adopted by the EU and an overview of the EU Green Deal and how it is affecting the legal requirements related to batteries, including the Battery Passport, and how it contributes for a sustainable battery industry and its integration into the circular economy.

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1 LO AL01-06.1 Describe the most relevant international and EU agreements influencing the development of the battery industry in EU

1.1 INTRODUCTION TO THE INTERNATIONAL AND EU AGREEMENTS

In recent years, politicians have become aware that we cannot continue our way of life as we have done in the past decades. Therefore, **many different agreements and action plans have been made in relation to the environment and a more sustainable way of life**.

The **United Nations Agenda 2030** sets **17 Sustainable Development Goals** (SDGs), to help reduce negative impacts on various areas of our planet and to eliminate grievances, which link to the UN Framework Convention on Climate Change (UNFCCC) and the **Paris Agreement**, about climate action. Both are the ground for the action against climate change, specifically at European level, forming the roadmap to a better world and the global framework for international cooperation on sustainable development and its **economic**, **social**, **environmental** and **governance** dimensions.

External content

Check the UN website to learn more about Climate Action:

https://www.un.org/en/climatechange

At the EU level, the European Commission developed the **Green Deal**, which is a growth strategy. An integral part of this strategy is to implement the United Nation's 2030 Agenda and the Paris Agreement, ensuring, among others, a **Circular Economy Action Plan** and a **Strategic Action Plan on Batteries**, to significantly contribute to reaching to a carbon neutral economy by 2050, as envisaged by the European Commission`s vision, paving the way to the EU battery specific regulations.

The next picture schematizes the relation between the international and EU policies influencing the battery sector:

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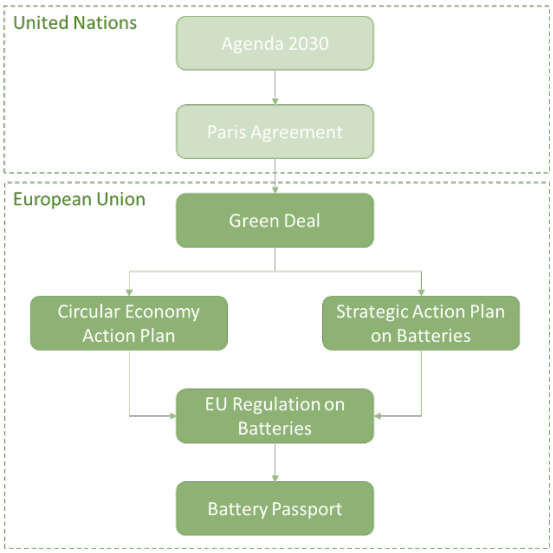

Figure 1 – International and EU Policies and Regulations on batteries

1.2 UN AGENDA 2030

To ensure that **sustainable action** is implemented and adhered to around the globe, it has become clear that globally applicable agreements and regulations are needed. Therefore, the United Nations adopted in 2015 the **2030 Agenda**, which includes **17 Sustainable Development Goals** (SDGs), to help reduce negative impacts on various areas of our planet and to eliminate grievances.

The 2030 Agenda, entitled "**Transforming our world: the 2030 Agenda for Sustainable Development**", is a plan to promote **sustainable peace and prosperity and protect our planet**. Since 2016, all member states of the United Nations have been working on translating the goals of this agenda into national measures and thus fighting poverty and inequalities. An important aspect of this is to **leave no one behind,** i.e. to also support less developed countries to develop and implement sustainable measures.

The 2030 Agenda contains **17** goals, the so-called **Sustainable Development Goals**, which are to be **achieved by 2030**, related not only to the **ecological** sphere, but also to the **social and economic** areas, which is why these 17 goals take into account our environment as well as people and the economy.

Important

The 17 Sustainable Development Goals were introduced to make global development socially, ecologically and economically sustainable.

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The introduction of these sustainability goals is intended to achieve the following, among other things:

- Respect for human rights
- Supporting disadvantaged population groups
- Protecting our environment
- Economic growth

The specific goals that have been defined are the following:

Figure 2 – The 17 Sustainable Development Goals

Since 2017, the new European Consensus on Development has aligned all development activities of the EU institutions and of the EU Member States with the 2030 Agenda.

External content

Check the video to learn more about the 17 SDG:

https://www.youtube.com/watch?v=M-iJM02m_Hg

1.3 PARIS AGREEMENT

In 1994, countries all over the world signed the United Nations Framework Convention on Climate Change (UNFCCC). By signing the convention, **countries recognised the problems of global climate change and committed themselves to action**.

The UNFCCC aims to **stabilise greenhouse gas concentrations** so that the climate system is not dangerously disrupted. All member states should contribute to this goal within their capacities.

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Every year, the **Conference of the Parties (COP)** is held, where the Parties of the UNFCCC meet and discuss how the climate goals can best be achieved. These conferences have laid the foundations for further agreements on climate protection, including the Kyoto Protocol and the **Paris Agreement**.

Kyoto Protocol

As part of the third Conference of the Parties of the UNFCCC, the so-called Kyoto Protocol was drawn up and subsequently adopted in the Japanese city of Kyoto. The goal behind this agreement was for **industrialised countries to reduce their greenhouse gas emissions by 5.2% by 2012 compared to 1990 levels**, with the eventual decision to extend it to 2020. Binding targets were set in the Kyoto Protocol, and if **individual countries failed** to meet their commitments, they were subject to **sanctions**. Because of this, and with the help of burden sharing and emissions trading, member countries managed to formally reduce their emissions by an average of 20% by 2012, which was well above the target.

Check the following videos to learn more about the Kyoto Protocol:

https://www.youtube.com/watch?v=DFhuNKNDrLg

The **Paris Agreement** should help to ensure that the climate protection agreement between different countries worldwide is maintained after 2020 and that negative impacts on the climate and our planet are minimised or prevented. This agreement came into force in 2016 and has so far been signed by 194 countries. Within the EU, it has been signed by all member states, with related targets and measures to reduce emissions being determined and coordinated at the EU level.

The Paris Agreement is intended to serve as a bridge between our current way of life and the goal of climate neutrality by the end of this century. The main contents of this agreement are:

- **Reduction of emissions**: In the long term, the global average temperature should rise by well below 2°C compared to pre-industrial levels, the target would be a maximum of 1.5°C, thus significantly reducing the risks of climate change. The peak of global emissions is also to be reached as soon as possible so that a balance can be achieved between emissions and emission reductions.
- **Transparency and global stocktaking**: The governments have agreed to meet every 5 years to evaluate their progress. An important aspect is transparency in the implementation of the measures and the fulfilment of their obligations, which is why they are reported on publicly.

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- **Adaptation**: The aim is to support the society in dealing with the impacts of climate change accordingly, with increased international assistance being offered to developing countries in particular.
- **Losses and damage**: Damage caused by negative environmental impacts should be minimised or averted through early warning systems, emergency programmes, etc.
- **Role of cities, regions and local authorities**: They are encouraged to strengthen their action to combat climate change, with regional and international cooperation playing an important role. It also aims to strengthen their resilience to the negative impacts of climate change.

To ensure that measures to reduce emissions are always followed up, member states must **submit an up-to-date climate action plan every 5 years**.

External content

Check the following video for an overview of the objectives and contents of the Paris Agreement:

https://youtu.be/WiGD0OgK2ug

1.4 THE GREEN DEAL

The EU's **Green Deal** is a growth strategy and an integral part of this Commission's strategy to implement the United Nation's **2030 Agenda** and the **Paris Agreement**.

The EU's Green Deal aims at transforming the EU into a modern, resource-efficient and competitive economy, ensuring:

- no net emissions of greenhouse gases by 2050;
- economic growth decoupled from resource use;
- no person and no place left behind;
- includes the strategic action plan on batteries;
- includes the new circular economy action plan;
- includes the new industrial strategy for Europe;
- includes the sustainable and smart mobility strategy.

Thus, the overarching aim of the European Green Deal is to reach net-zero greenhouse gas emissions within the EU and deliver a **pollution-free environment by 2050**. Advances in transport, agriculture systems and ecosystems and biodiversity are all required, as well as

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efforts to further develop a **circular economy** that ensures products can be reused and recycled. From 2021 to 2027, 35% of the EU's research funding will be dedicated to developing climate-friendly technologies.

Figure 3 – The Europen Green Deal (adapted from euinasean.eu)

External content

Check the following videos to learn more about the Green Deal:

https://audiovisual.ec.europa.eu/en/video/I-199819?&lg=EN

https://audiovisual.ec.europa.eu/en/video/I-206619?&lg=INT

As part of the European Green Deal, the EU committed to become the **first climate-neutral continent** globally and to **reduce net greenhouse gas emissions by at least 55% by 2030**, compared to 1990 levels, which requires changes in many domains. With this purpose, the Commission adopted a set of proposals to make the EU's climate, energy and transport legislation under the so-called '**Fit for 55 package**' in order to align current laws with the 2030 and 2050 ambitions.

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External content

Learn more about the "Fit for 55 package" at https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

1.5 EVALUATION

1.5.1 Assessment criteria

6.1.1 List the main international and EU agreements affecting the battery industry and its applications.

6.1.2 Identify the UN Agenda 2030 main goal.

6.1.3 Identify the Paris Agreement main goals.

6.1.4 Identify the Green Deal main goals.

1.5.2 Questions

Chapter 1.1 Introduction to the international and EU agreements:

Link the Policy/Regulation on the left with the corresponding organization:

Policy/Regulation	Organization
Agenda 2030 x	United Nations (UN) x
Paris Agreement x	European Union (EU) y
Green Deal y	
Circular Economy Action Plan y	
Strategic Action Plan on Batteries y	
EU Regulation on Batteries y	
Battery Passport y	

Chapter 1.2 UN AGENDA 2030:

The 2030 Agenda is a plan to:

- Promote sustainable peace and prosperity and protect our planet x
- Eliminate racism
- Promote democracy

The Sustainable Development Goals are to be achieved by 2030 T or ~~F~~

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The Sustainable Development Goals are related not only to the ecological sphere, but also to the social and economic areas.

Chapter 1.3 Paris Agreement:

The Paris Agreement should help to ensure that the climate protection agreement between different countries worldwide is maintained after:

- 2020 x
- 2023
- 2030

The Paris Agreement has been signed by all EU member states T or ~~F~~

The main contents of this agreement are:

- Reduction of emissions
- Transparency and global stocktaking
- Adaptation
- Losses and damage
- Role of cities, regions and local authorities
- All the above x

Chapter 1.4 The Green Deal:

The EU's Green Deal is an integral part of this Commission's strategy to implement the United Nation's 2030 Agenda and the Paris Agreement. T or ~~F~~

The overarching aim of the European Green Deal is to reach net-zero greenhouse gas emissions within the EU T or ~~F~~

The EU committed to reduce net greenhouse gas emissions by at least 55% by 2030 T or ~~F~~

The Commission adopted a set of proposals to align current EU's legislation on climate, energy and transport with the 2030 and 2050 ambitions called 'Fit for 55 package'.

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2 LO AL01-06.2 Describe the EU policies regarding batteries

2.1 INTRODUCTION TO EU POLICIES REGARDING BATTERIES

Climate change and environmental degradation are an existential threat to Europe and the world. The most significant aspect regarding the European Union is that by 2050, close to 100% of the energy needed will have to be carbon neutral given the objectives envisaged by the European Commission`s vision from November 2018.

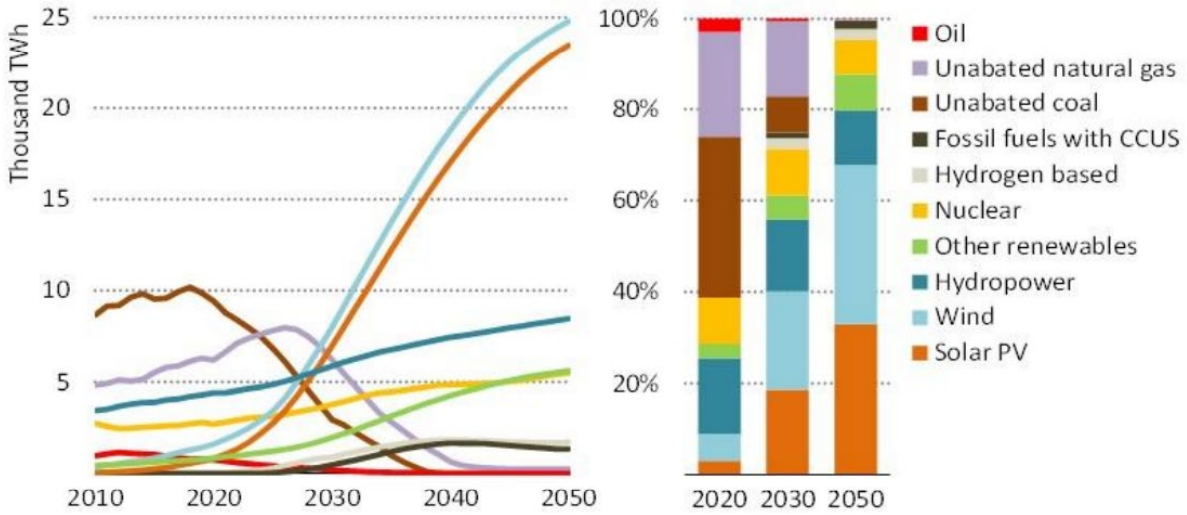

Figure 4 – Global electricity generation by source

This projection will be confirmed only if massive investments in **carbon-neutral energy sources** such as solar, wind and hydropower are achieved, as well as EU and national policies heavily incentivize the purchase and use of **electric vehicles** in the following years.

As a result of the changes required for the mobility and energy sectors, the demand for **battery** capacity in Europe would amount to 400 – 1 000 GWh by 2030.

However, not all the batteries are properly collected and recycled at the end of their life, which increases the risk of releasing hazardous substances and constitutes a waste of resources. Many of the components of these batteries and accumulators can be recycled, avoiding the release of hazardous substances to the environment and, in addition, providing valuable materials to important products and production processes in Europe.

Thus, only **batteries that are more sustainable** throughout their life cycle can significantly contribute to the zero pollution ambition set in the **European Green Deal**. Therefore, under its Green Deal initiative, the European Commission proposes to modernise EU legislation on

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batteries, to promote competitive sustainability and because they are necessary for green transport, clean energy and to achieve climate neutrality by 2050.

Definition

Sustainable batteries are: produced with the lowest possible environmental impact, using materials that have been obtained in full respect of social and ecological standards, long lasting and safe and that can be repaired or reused and repurposed.

In: *European Commission (2020), Sustainable batteries in their full life-cycle. A step forward towards circular economy and climate neutrality.*

2.2 CIRCULAR ECONOMY ACTION PLAN

It is becoming increasingly clear that linear modes of production and consumption are unsustainable.

On the contrairy, the foundation of environmental protection and the **sustainability** regulations are the principles of the **circular economy** (Figure 5). This means that a product or a packaging item should be designed with responsible raw material sourcing, reusability, and recyclability in mind and, once the product leaves the factory, it must be taken care of by a series of stakeholders, including the producer, as the main actor, to avoid the unsound disposal and ensure the proper recycling of the biggest possible share thereof.

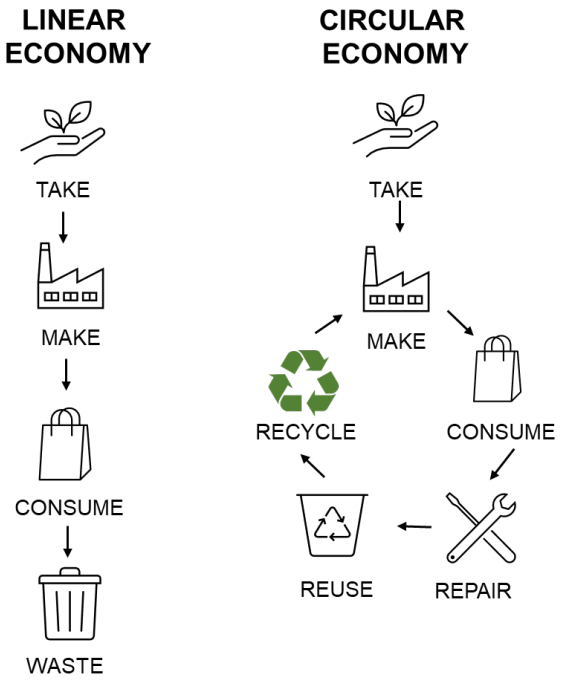

Figure 5 – Linear vs Circular Economy

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External content

In the following video the concept of the circular economy and its benefits are explained in more detail:

https://www.youtube.com/watch?v=9yPnfDVd6Fc&t=71s

As a result, in December 2019, the European Commission published its communication on the European Green Deal highlighting the aim of **mobilizing industry for a clean and circular economy**, in which **growth is decoupled from resource use**, which would minimize both environmental and social problems. It is acknowledged that the Circular Economy can reduce import dependencies and supply chain risks, at the same time as it is an important pillar in reducing the demand for (energy-intensive) raw materials and the related carbon emissions in the context of the climate goals set out by the 2015 Paris Agreement.

In March 2020, the European Commission published a new **Circular Economy Action Plan (CEAP)**, one of the main building blocks of the European Green Deal. This plan focuses on **consumer empowerment**, **waste reduction** and **sustainable product** policy. The latter aims to make products last longer through repair and re-use as well as by increasing the proportion of secondary materials in these products, ensuring that the resources used are kept in the EU economy for as long as possible.

In this plan, **sectors and products with high resource demand, associated environmental impacts and high Circular Economy potentials**, such as electronics and ICT, **batteries** and vehicles, packaging, plastics, textiles, construction and buildings, as well as food **are prioritized**.

The Circular Economy Action Plan presents measures to:

- **Make sustainable products the norm in the EU**.

  Legislation on Sustainable Product Policy, to ensure that products placed on the EU market are designed to last longer, are easier to reuse, repair and recycle, and incorporate as much as possible recycled material instead of primary raw material. Single-use will be restricted, premature obsolescence tackled and the destruction of unsold durable goods banned.

- **Empower consumers**.

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Consumers will have access to reliable information on issues such as the reparability and durability of products to help them make environmentally sustainable choices. Consumers will benefit from a true 'Right to Repair'.

- **Focus on the sectors that use the most resources and where the potential for circularity is high**.

  The Commission will launch concrete actions on:

  - ✓ electronics and ICT – a 'Circular Electronics Initiative' to have longer product lifetimes, and improve the collection and treatment of waste
  - ✓ **batteries and vehicles** – new regulatory framework for batteries for enhancing the sustainability and boosting the circular potential of batteries
  - ✓ packaging – new mandatory requirements on what is allowed on the EU market, including the reduction of (over)packaging
  - ✓ plastics – new mandatory requirements for recycled content and special attention on microplastics as well as biobased and biodegradable plastics
  - ✓ textiles – a new EU Strategy for Textiles to strengthen competitiveness and innovation in the sector and boost the EU market for textile reuse
  - ✓ construction and buildings – a comprehensive Strategy for a Sustainably Built Environment promoting circularity principles for buildings
  - ✓ food – new legislative initiative on reuse to substitute single-use packaging, tableware and cutlery by reusable products in food services

- **Ensure less waste**.

  The focus will be on avoiding waste altogether and transforming it into high-quality secondary resources that benefit from a well-functioning market for secondary raw materials. The Commission will explore setting an EU-wide, harmonised model for the separate collection of waste and labelling. The Action Plan also puts forward a series of actions to minimise EU exports of waste and tackle illegal shipments.

2.3 STRATEGIC ACTION PLAN FOR BATTERIES

As an integral part of the Green Deal, the Commission is putting forward a comprehensive **Strategic Action Plan for batteries**, with concrete measures to contribute to creating an **innovative**, **sustainable** and **competitive battery "ecosystem" in Europe**. Through this action

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plan, the Commission is not only promoting a cross-border and integrated European approach but also putting a major focus on **sustainable batteries manufacturing throughout the value chain**, starting with the extraction and processing of (primary and secondary) raw materials, the design and manufacturing phase of battery cells and battery packs, and their use, second use, recycling and disposal in a **circular economy context**. Such an approach will promote the production and use of high performing batteries and set sustainability benchmarks throughout the EU value chain.

Batteries Value Chain

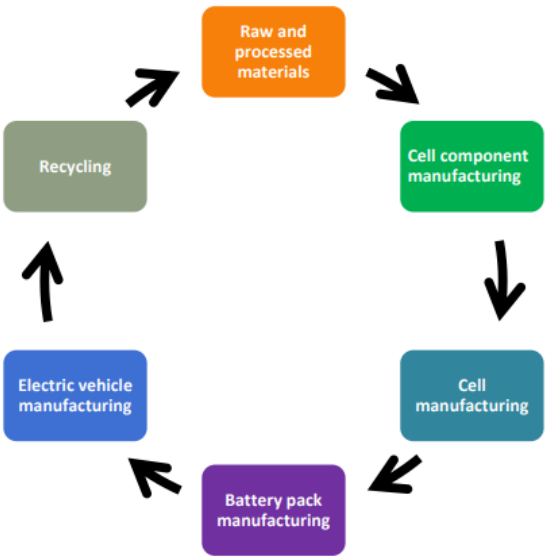

Figure 6 – sustainable batteries value chain, as set by the Strategic Action Plan for batteries

The action plan combines targeted measures at EU level including in raw materials, research and innovation, financing/investment, standardisation/regulatory, trade and skills development, in order to make Europe the global leader in sustainable battery production and use, in the context of the circular economy. More specifically it aims to:

- **secure access to raw materials** from resource-rich countries outside the EU, facilitate access to European sources of raw materials, as well as accessing secondary raw materials through recycling in a circular economy of batteries;
- **support European battery cells manufacturing at scale and a full competitive value chain in Europe**: bringing key industry players and national authorities together; working in partnership with Member States and the European Investment Bank to

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support innovative and integrated manufacturing projects at scale, with an important cross-border and sustainability dimension;

- **strengthen industrial leadership through stepped-up EU research and innovation** support to advanced (e.g. Lithium-ion) and disruptive (e.g. solid state) technologies;
- **develop and strengthen a highly skilled workforce in all parts of the battery value chain** in order to close the skills gap through actions at EU and Member State level providing adequate training, re-skilling and upskilling, and making Europe an attractive location for world class experts in batteries development and production;
- **support the sustainability of EU battery cell manufacturing industry with the lowest environmental footprint possible**. This objective should be notably implemented through setting out requirements for safe and sustainable batteries production in Europe;
- **ensure consistency with the EU broader regulatory and enabling framework** (Clean Energy Strategy and Mobility Packages, trade policy, etc.).

The identified actions have the potential to generate a short-to-medium term impact in particular on EU cells manufacturing as well as help to bring about longer-term structural change that will contribute to the creation of a battery ecosystem in the EU covering the entire battery value chain and preparing the ground for the next generation of batteries technologies.

With this action plan, the Commission wants to put **Europe** on a firm path towards **leadership** in a key industry for the future, **supporting jobs and growth in a circular economy**, whilst ensuring clean mobility and an improved environment and quality of life for EU citizens.

Remember

The Strategic Action Plan for Batteries:

- secure access to raw materials
- support European battery cells manufacturing at scale and a full competitive value chain in Europe
- strengthen industrial leadership through stepped-up EU research and innovation
- develop and strengthen a highly skilled workforce in all parts of the battery value chain
- support the sustainability of EU battery cell manufacturing industry with the lowest environmental footprint possible
- ensure consistency with the EU broader regulatory and enabling framework

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2.4 EVALUATION

2.4.1 Assessment criteria

6.2.1 Recognize the characteristics of sustainable batteries

6.2.2 Recognize the importance of sustainable batteries

6.2.3 Describe the steps of a circular economy in the battery sector

6.2.4 Identify the Circular Economy Action Plan main goals.

6.2.5 Identify the Strategic Action Plan for Batteries main goals.

2.4.2 Questions

Chapter 2.1 Introduction to EU policies regarding batteries

Sustainable batteries are:

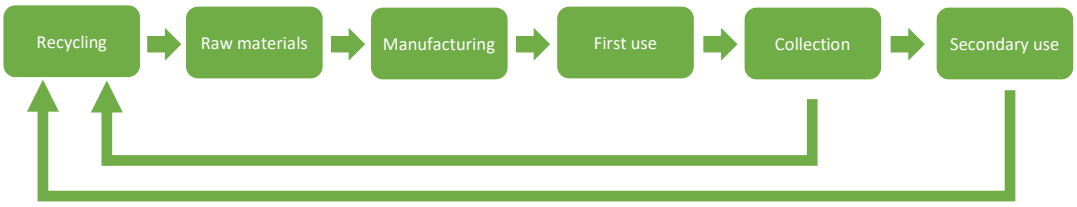
- produced with the lowest possible environmental impact.
- produced using materials that have been obtained in full respect of social and ecological standards.
- produced using materials that are long lasting and safe.
- Produced using materials that can be repaired or reused and repurposed.
- All the above x

Only batteries that are more sustainable throughout their life cycle can significantly contribute to the zero-pollution ambition set by the EU T or ~~F~~

Chapter 2.2 Circular Economy Action Plan

Batteries and vehicles are one of the sectors prioritized by the Circular Economy Action Plan (CEAP), according to its high resource demand, associated environmental impacts and high Circular Economy potentials. T or ~~F~~

Fill in the gaps related to the steps of a circular economy in the battery sector, as proposed by the EC:



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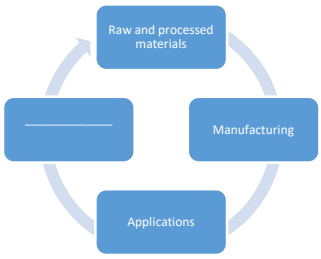
Chapter 2.3 Strategic Action Plan for Batteries

The Strategic Action Plan for batteries is putting a major focus on sustainable batteries manufacturing in a circular economy context. T or ~~F~~

Fill in the gap:



Recycling and 2nd use

The Strategic Action Plan for batteries aims to (select the correct ones):

- Secure access to raw materials x
- Support a full competitive value chain in Europe x
- Develop and strengthen a highly skilled workforce in the battery value chain x
- Support the sustainability of EU battery cell manufacturing industry with the lowest environmental footprint possible x
- Establish requirements on sustainability (carbon footprint, recycling content)
- Establish requirements for collecting, treating and recycling of waste batteries

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3 LO AL01-06.2 Identify the main requirements from the EU regulations regarding batteries

3.1 INTRODUCTION ON EU REGULATIONS REGARDING BATTERIES

The larger environmental impacts of batteries occur in early stages of their life cycle, namely extraction of materials and manufacturing processes. Thus, higher material efficiency of the battery value chains will lead to reduced extractive activities and overall reduction of the environmental impact.

However, much remains to be done as regards lithium-ion batteries used in electric cars, energy storage systems and industrial activities, where only 10% of lithium contained in batteries is recycled.

The proposal for a Regulation concerning batteries and waste batteries from December 2020 is an integral part of the EU's Green Deal and establishes various requirements on sustainability (carbon footprint, recycling content etc.). These include information about performance, durability, safety, labelling, supply chain due diligence and other information for allowing the placing on the market or putting into service of batteries. In addition, there are also requirements for the collection, treatment, and recycling of waste batteries, in order to guarantee a true circular economy for batteries, and an electronic record, the so-called “battery passport”.

3.2 EU BATTERIES REGULATION

Batteries are a key technology in the transition to climate neutrality, and to a more circular economy. They are essential for sustainable mobility and contribute to the zero pollution ambition.

To ensure that the expected massive deployment of batteries does not hamper the efforts in the green transition, the EU takes resolute action for the sustainable production, deployment and waste management of all batteries placed on the EU market.

The proposal for a Regulation concerning batteries and waste batteries from December 2020 is an integral part of the EU's Green Deal and establishes various requirements at the different stages of the battery life cycle.

A first requirement is related to enhance collection rates of waste batteries, contributing in this critical step to close the loop for the materials contained in batteries.

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As a second step, these batteries have to be recycled. The obligation to ensure that all collected waste batteries are properly recycled, the cornerstone of the current system, is maintained.

The Commission proposes also to increase the targets for the efficiency of recycling processes, as well as to establish a specific target for lithium-based batteries.

Likewise, the Commission proposes to introduce substantial changes in the provisions dealing with material recovery. Compulsory, quantified targets for cobalt, copper, nickel, lead and lithium are proposed for their recovery processes.

In the last step, those recovered materials should be made available for the battery industry. The Commission is proposing that the new batteries placed on the market contain minimum levels of recycled content, contributing to closing the material loops. Last, but not least, the proposal establishes a clear framework for the repurposing of industrial and electric-vehicle batteries for a second life (e.g. facilitating that the used electric vehicle battery can still be used for stationary energy storage).

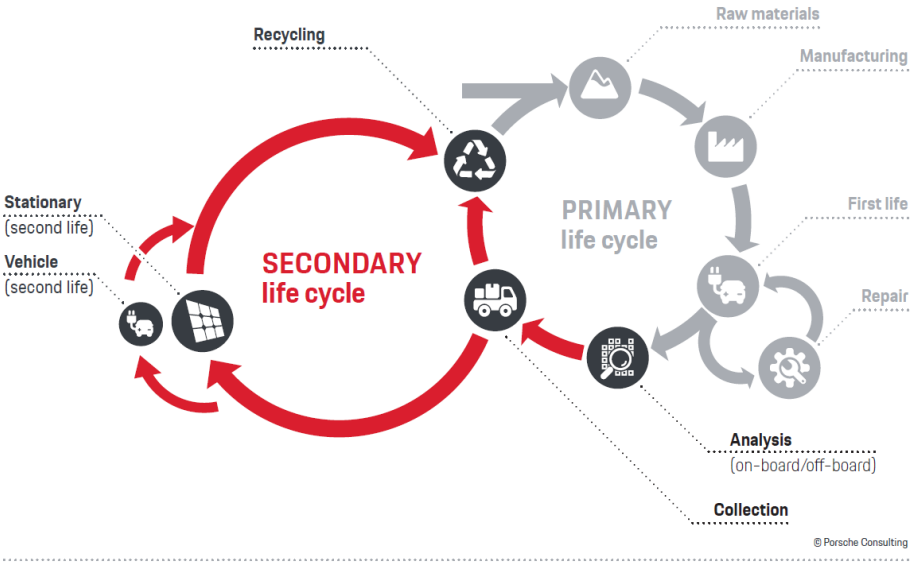

Figure 1. The stages of the battery life cycle

Figure 7 –Circular economy of batteries

To guarantee transparency in the process, for industrial and electric vehicle batteries, it's also introduced an electronic record, the so-called "battery passport".

Figure 8 represents the timeline of the implementation of EU Batteries and Waste Directive, from its first version in 2006 to the new version proposal in 2020.

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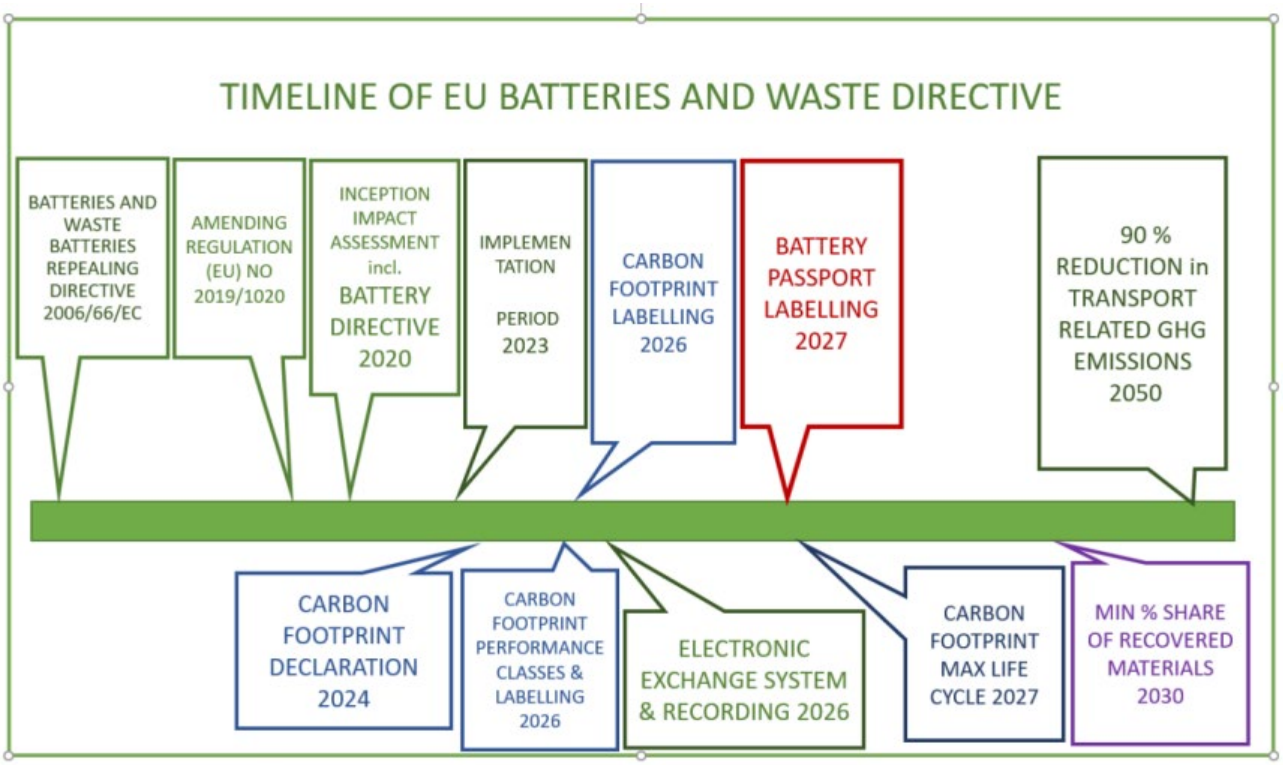

Figure 8 – Timeline of EU Batteries and Waste Directive

In detail, the new EU Battery regulation addresses:

- **Sustainable, circular, high-performing and safe batteries along their entire life cycle**

  Batteries that are produced with the lowest possible environmental impact, using materials obtained in full respect of human rights as well as social and ecological standards. Batteries have to be long-lasting and safe, and at the end of their life, they should be repurposed, remanufactured or recycled, feeding valuable materials back into the economy.

- **Competitive sustainability in Europe**

  Mandatory requirements for all batteries (i.e. industrial, automotive, electric vehicle and portable) placed on the EU market. Requirements such as use of responsibly sourced materials with restricted use of hazardous substances, minimum content of recycled materials, carbon footprint, performance and durability and labelling, as well as meeting collection and recycling targets.

- **Legal certainty**

  To help unlock large-scale investments and boost the production capacity for innovative and sustainable batteries in Europe and beyond to respond to the fast-growing market.

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- **Minimising environmental impact of batteries**

  From 1 July 2024, only rechargeable industrial and electric vehicles batteries for which a carbon footprint declaration has been established, can be placed on the market.

  Establish new requirements and targets on the content of recycled materials and collection, treatment and recycling of batteries at the end-of-life part.

  The current figure of 45% collection rate of portable batteries should rise to 65 % in 2025 and 70% in 2030 so that the materials of batteries we use at home are not lost for the economy. Other batteries – industrial, automotive or electric vehicle ones – have to be collected in full. All collected batteries have to be recycled and high levels of recovery have to be achieved, in particular of valuable materials such as cobalt, lithium, nickel and lead.

- **Repurposing of batteries from electric vehicles**

  Defines a framework so that **batteries from electric vehicles** can have a second life, for example as stationary energy storage systems, or integration into electricity grids as energy resources.

- **Battery Passport**

  The use of new IT technologies will be key for safe data sharing, increasing transparency of the battery market and the traceability of large batteries throughout their life cycle. It will enable manufacturers to develop innovative products and services as part of the twin green and digital transition.

Remember

The Batteries Regulation aims to:

- **Harmonise product requirements** for batteries
- **Minimise environmental impact** of batteries
- **"Close the loop"** by encouraging reuse and improving batteries collection and recycling
- **Provide legal certainty** to unlock investments and boost the production capacity for sustainable batteries in Europe and beyond

This will be achieved by:

- Sustainability and safety requirements for batteries
- Performance and durability requirements
- Labelling and information requirements e.g. on hazardous materials
- End-of-life management – increased separate collection, recycling and materials recovery

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3.3 BATTERY PASSPORT

Besides power electric stuff, batteries also help determine their performance, service life, charging speed and costs. However, a battery journey along the value chain is much longer, starting with the extraction of raw materials and extends into the second life of each battery or recycling sources.

The production of a rechargeable battery poses significant social and environmental risks, from mineral extraction (child labor, unsafe working conditions, indigenous rights), to production processes (C02 footprint, water use, biodiversity loss, pollution) and significantly impact the overall sustainability of the end product.

The **Battery Passport** is a digital representation of a battery that **conveys information** about all applicable **Environmental, Social, Governance and lifecycle requirements** based on a comprehensive definition of a sustainable battery.

The Battery Passport is an integral part of the new Batteries Directive proposal to ensure the sustainability and competitiveness of the EU battery value chain. A battery passport would support data sharing on dimensions such as materials chemistry, origin or the state of health of batteries. It could provide a powerful means to identify and track batteries throughout the lifecycle and support the establishment of life extension and end-of-life-treatment systems. The process started in 2006 when the batteries and waste directive entered into force. The Battery Passport will become active in 2027 and will enable the following outcomes:

- Provide transparency in practices and impact of the battery along the value chain to all relevant stakeholders in the battery value chain
- Create a framework for benchmarking batteries along criteria by identifying those that are best and worst in class and providing minimum acceptable standards for a sustainable and responsible battery
- Validate and track progress on the pathway to sustainable, responsible and resource-efficient batteries.

External content

Watch the following video to know more about Battery Passport:

https://youtu.be/-9xHRXSAN9I

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3.4 EVALUATION

3.4.1 Assessment criteria

6.1.1 Identify the targets set by the new Batteries Regulation.

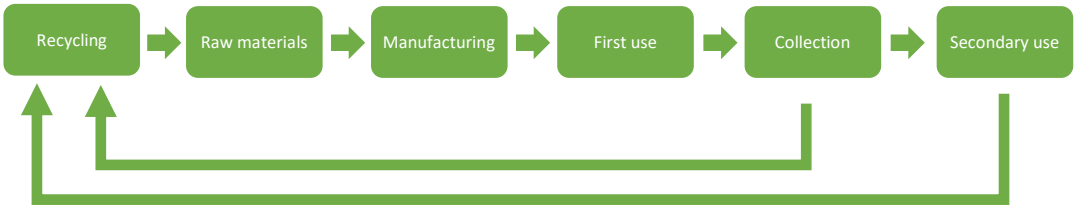
6.1.2 Identify the requirements set by the Batteries Regulation.

6.1.3 Describe the main functions of the Battery Passport as proposed by the EC.

3.4.2 Questions

Chapter 3.1 Introduction on EU regulations regarding batteries

Fill in the gaps related to the steps of a circular economy in the battery sector, as proposed by the EC:



Chapter 3.2 EU BATTERIES REGULATION

Select the correct option(s):

The new Batteries Regulation sets targets on:

- the batteries' production for the EU
- the content of recycled materials x
- the collection, treatment and recycling of batteries at the end-of-life part x
- all the above

The new Batteries Regulation aims to minimise <u>environmental impact</u> of batteries and for a <u>circular</u> economy of the battery industry.

The new Batteries Regulation establishes various requirements on sustainability T or ~~F~~

The new Batteries Regulation introduces an electronic record for industrial and electric vehicle batteries T or ~~F~~

The new Batteries Regulation introduces an electronic record for industrial and electric vehicle batteries called "battery ID" ~~T~~ or F

Chapter 3.3 BATTERY PASSPORT

The Battery Passport is a digital representation of a battery T or ~~F~~

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The battery passport would support data such as materials chemistry, origin or the state of health of batteries T or F

The Battery Passport will enable the provision of transparency in practices and impact of the battery along the value chain to all relevant stakeholders in the battery value chain T or F

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