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Alliance for Batteries Technology, Training and Skills

Alliance for **B**atteries **T**echnology, **T**raining and **S**kills

2019-2023

“BATTERY POWERED TOUR FOR SKILLS - ROMANIA”

Presented by: Marius Tudor (InterTradeCard)

29.05.2024

Co-funded by the
Erasmus+ Programme
of the European Union

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Rationale / Purposes

The European workforce will be disrupted or highly affected by the change brought about by the transfer to electromobility.

There will be a need for new training/ reskilling programmes, adapted to the emerging jobs needs.

The Alliance for Batteries Technology, Training, and Skills (ALBATTS) aims to make a major contribution to green mobility in Europe.

As the European battery value chain is being developed,

- organisations from the demand and supply side of skills/competences are brought together
- to establish a blueprint for preparedness of future skills across Europe.

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OBJECTIVES

Vehicle production, a backbone of European industry, is gearing up for many organisational changes to implement electromobility.

The purpose of this project is to develop a blueprint for education and training for the battery production sector.

& promote cooperation between all stakeholders in the battery and electromobility value-chain,

& & makes the qualifications more transparent

& facilitate the movement of the European workforce across the continent.

what

Indicate the selected technological applications for

a) Stationary and Industrial use of Li-ion and other high-density green energy storage &

b) Mobile applications, as typically in the transport and logistics sector.

why

Across the whole value-chain of the automotive industry, research on new technologies is important, as is identifying new job roles and new needs for learning and upskilling.

how

Develop the best possible applicable models to approach identified industrial and sectoral competence needs: defining and making education setups for new work roles, developing adaptive learning solutions and making use of recognition of prior learning.

to whom

Carry out new trainings to the workforce already working in battery sector, as well as to newcomers to the sector - provide VET trainings not only to the young students, but also the workers from other sectors.

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RESULTS (1)

Short term impact:

- **Analysis of the overall battery sector on its strengths and weaknesses.** Including its interconnections with individual sub-sectors (stationary and other industrial battery applications, mobile battery applications).
- **Involving all levels of stakeholders in the sector, along the value chain** (raw materials and processing, cell components and manufacturing, battery and battery pack manufacturing, recycling and second use).
- **Training preparations based on the needs of the sector** - including skills needs and needs of the methods used for the trainings.
- **Creation of knowledge and skills to start new VET and high degree programs within the sector**, to supply the industry with skilled workforce.
- **Development of knowledge and skills from VET providers' staff**, by working together with companies and universities.

Long term impact:

- The project will allow the **development of new training programmes** for the workforce already working in the battery sector, as well as to newcomers.
- **Integration of new curricula and qualifications in the national frameworks**.
- The **increased** investment in this sector will impact the expected **number of new students**.
- **Improvement of the image, status and attractiveness of VET schools participating.**
- The project will **create a sustainable partnership in this emerging economic sector.**
- Enabling **EU-wide recognition of specific skills/job role achievements** in the sectoral employment market in member countries.
- **Harmonisation of job role/skills definitions in this sector,** on EU level, under umbrella for recognition.

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RESULTS (2)

Skills Cards

The **ALBATTS Skills Cards** describe a number of occupational profiles - and corresponding competencies - within the scope of battery manufacturing, e-mobility and stationary battery storage.

Companies can use the Skills Cards to identify the needed competencies to 1) readjust/improve employee's selection and recruitment; 2) train employees according to the latest sectoral needs; 3) set up their businesses within the battery sector.

Training providers, such as VET providers or universities, will find them useful to 1) create training opportunities; 2) improve existing curricula or training programmes.

National agencies can use the Skills Cards to readjust national education plans, whereas **general public** may use them to know more about the jobs in the batteries sector.

Courses

The ALBATTS Courses (19) are available through the Automotive Skills Alliance (ASA) learning platform (ASA Learning Platform), an association created through the bridging of the projects ALBATTS and DRIVES activities. Examples:

Introduction to the Battery Sector

- Battery Fundamentals
- Types of Batteries
- Future Trends
- Raw Materials, Mining and Refining
- Manufacturing Processes
- Integration Process
- Automotive Battery System Engineer
- Introduction to Safety in Batteries
- Battery Fires
- Batteries Stationary Applications
- Second Life & Recycling of Batteries
- Batteries Operations / Applications

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The partners

20 European partners, from 11 countries, representing both sides - industry and education - and 3 associated partners, that cooperate with the project to advise on the strategic vision.

Steering Board members

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To get involved with the albatts stakeholders group:

Stakeholder registration **here**

Follow us on:

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BATTERY POWERED

TOUR FOR SKILLS

Enabling a prepared education network for the battery ecosystem in Europe

Needed Job Roles and Competences in the Battery Industry

Ing. Marek Spányik, MBA (VSB-TUO)

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What is the European Battery Sector?

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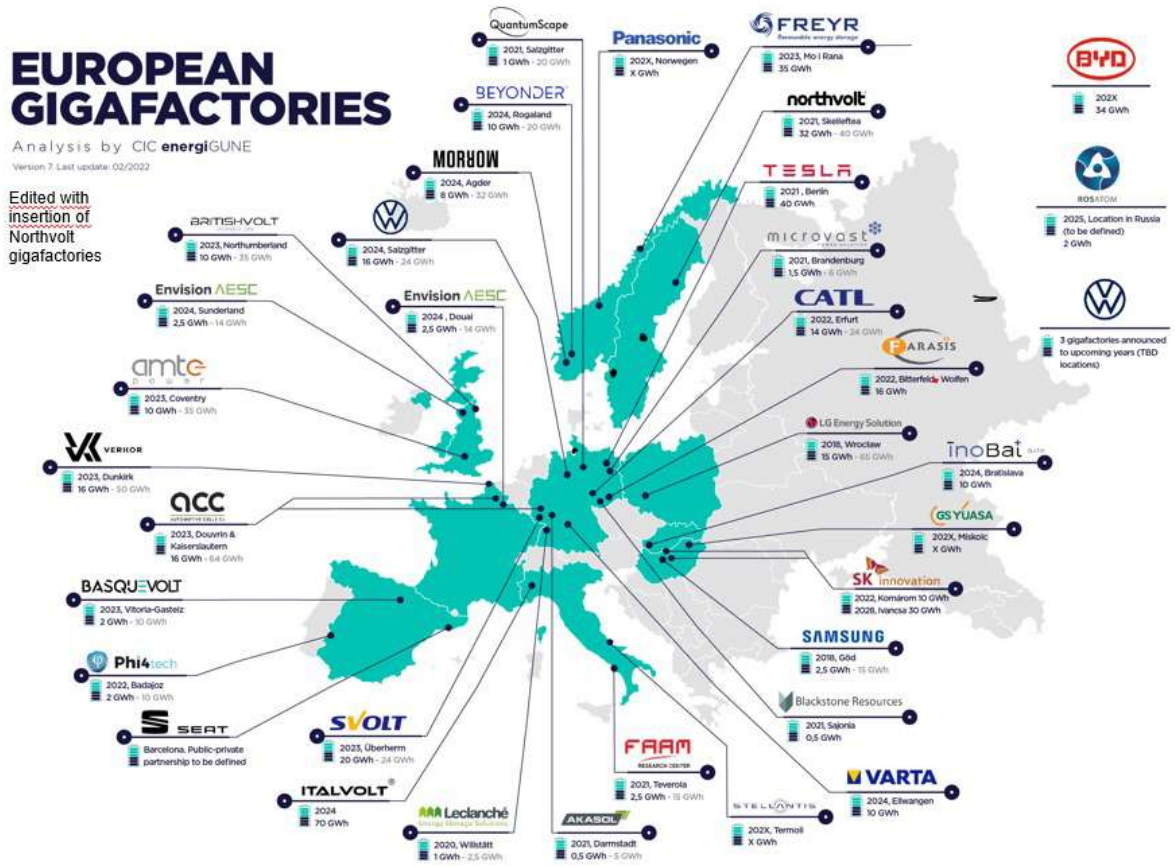
European Battery Sector



- Highly **emerging and rising** sector in Europe
- **Electromobility** is pushing **the European battery sector**

- This needs to be supported by the **workforce with the right skills**
- Change of needed skills/competences or knowledge during the individuals' career – **the change is constant.**

- High demand for workers "The industry estimates that by 2025, this growing ***skills shortage*** could amount to some ***800,000 jobs*** across the entire battery value chain." - EC Vice-President Šefčovič March 12th, 2021

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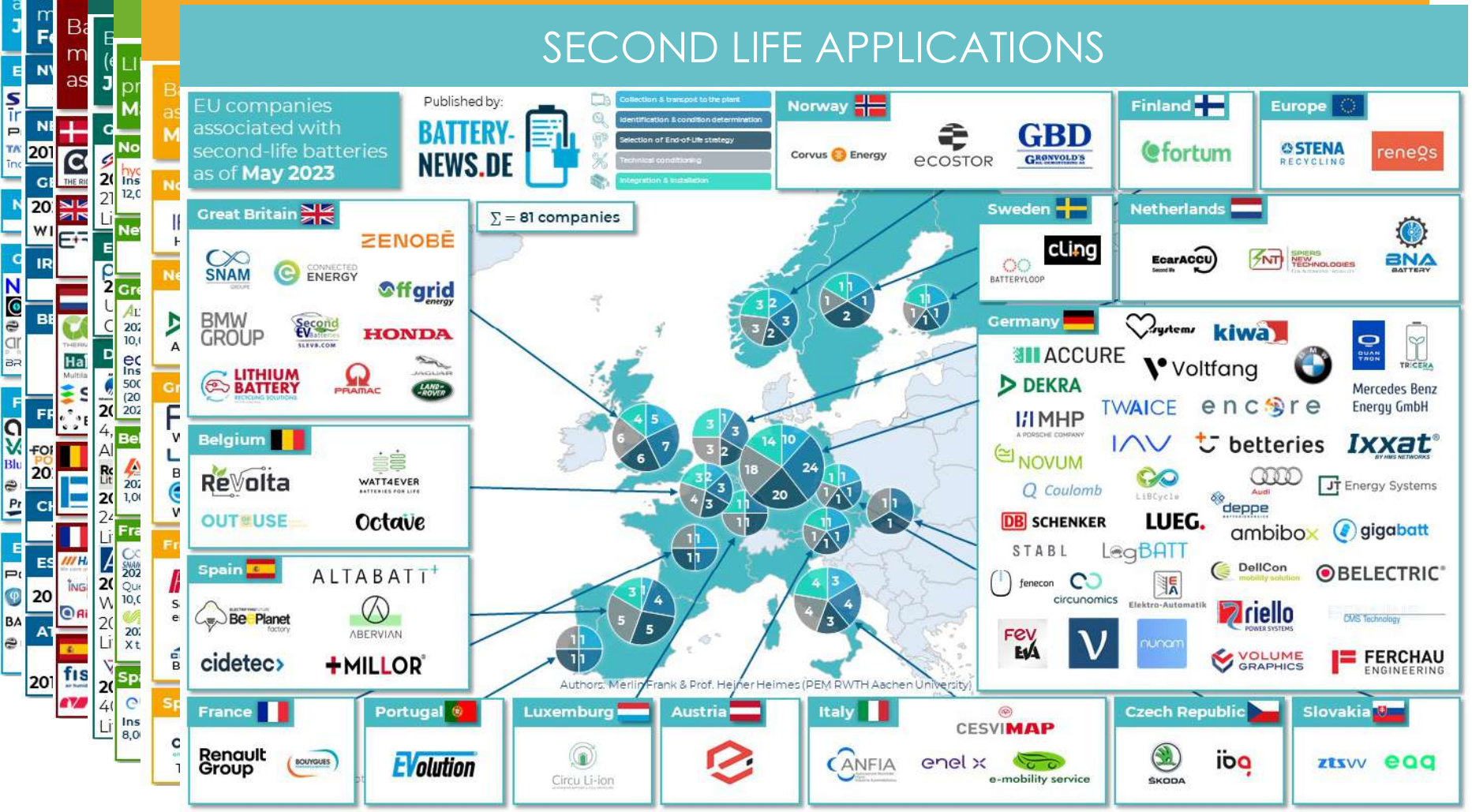
SECOND LIFE APPLICATIONS



Source:
Battery Atlas Europe

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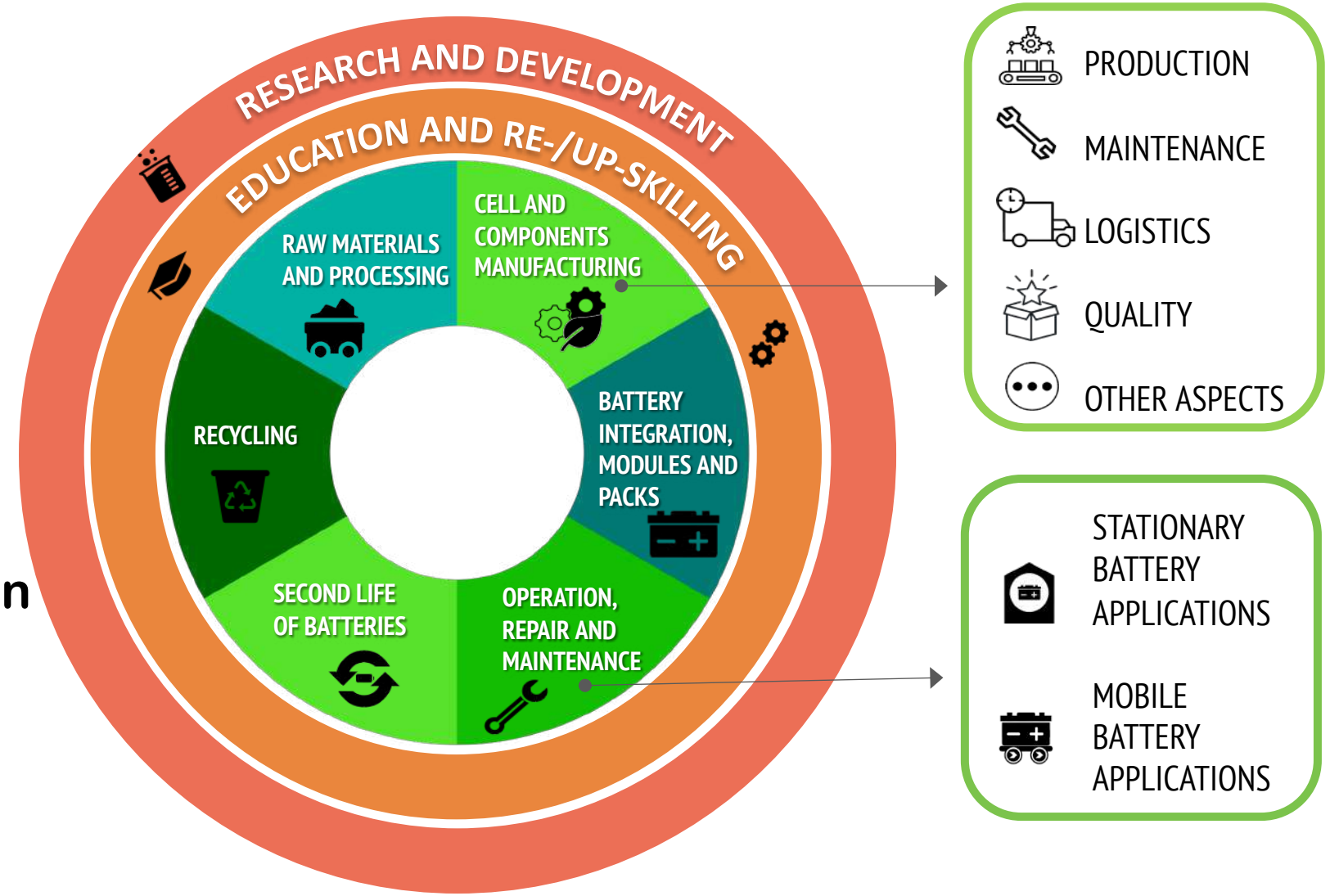
Battery Value Chain

- There is a **lack of information** on needed **skills and job roles**
- We need **more collaboration**
- **Needed skills impact on each phase of the production cycle**



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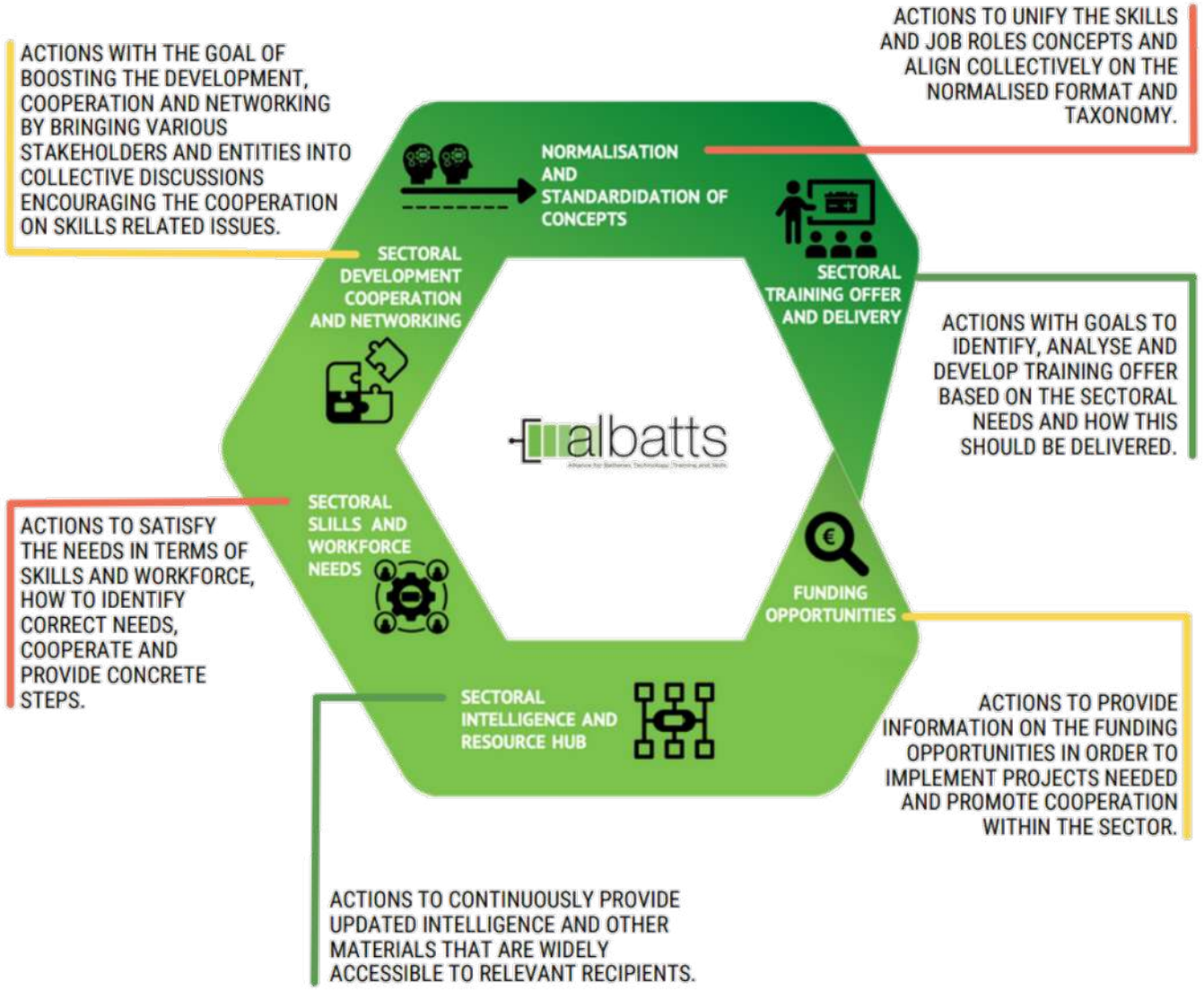
Skills Agenda and Strategy

- The overall assessment is supported by a strategy
- The whole value chain and **all levels of education** need to be addressed
- Competences can be **sector specific** and **cross-sectoral**



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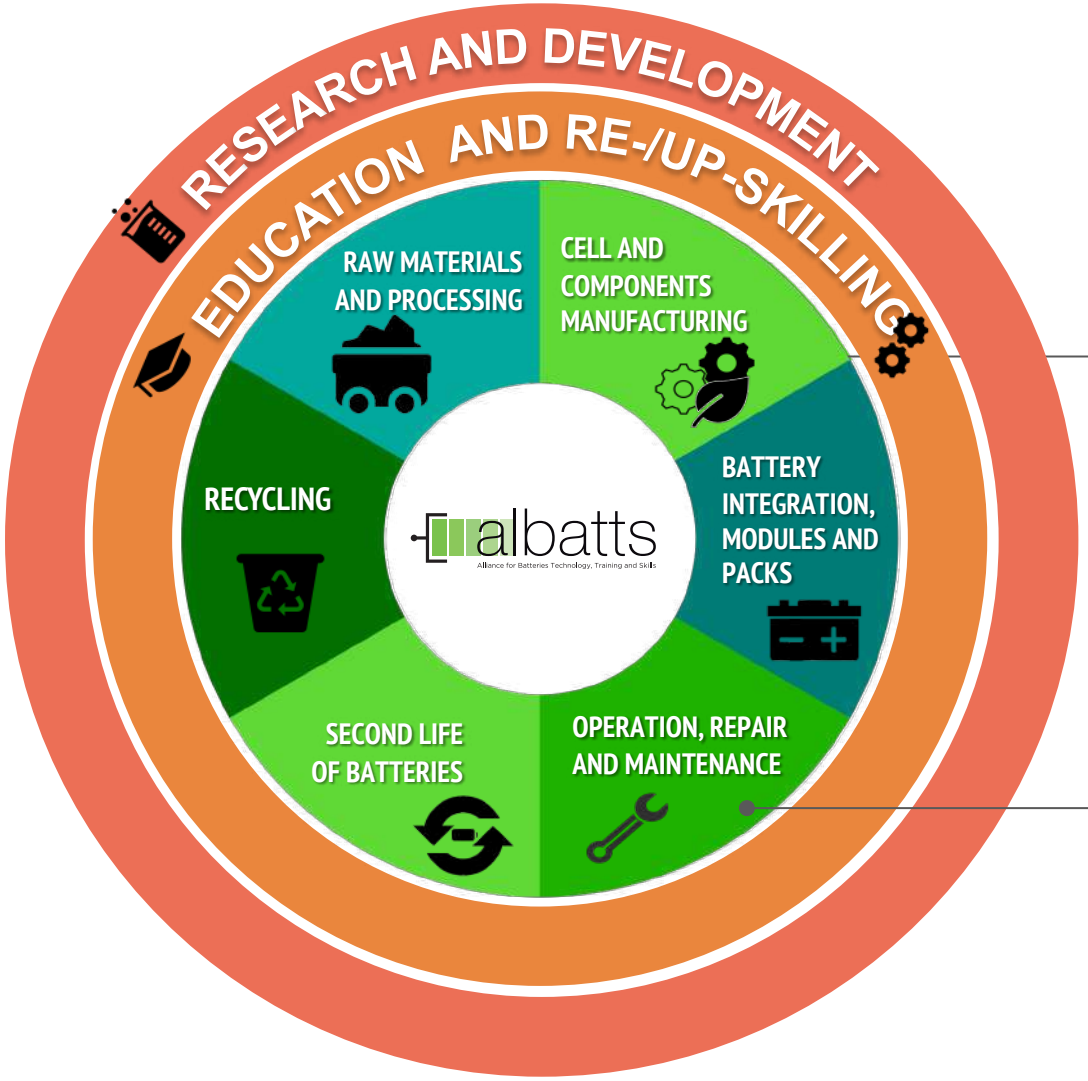
Glance on Needed Skills

CELLS PRODUCTION & CELLS MAINTENANCE



- PRODUCTION
- MAINTENANCE
- LOGISTICS
- QUALITY
- OTHER ASPECTS

- STATIONARY BATTERY APPLICATIONS
- MOBILE BATTERY APPLICATIONS

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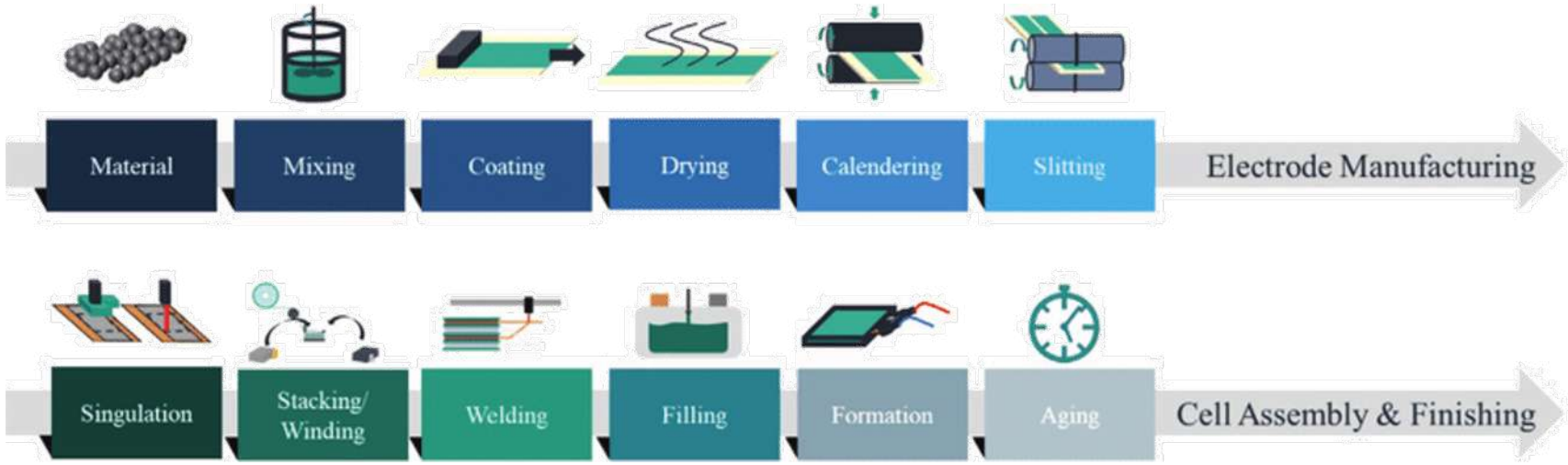
Cell Production

- Understanding in fields **electrochemistry, electronics, mechanical engineering, process engineering, manufacturing technology, automation** and **digitalization in manufacturing** (data analytics, maintenance and product process optimisation)
- In general, to speak and understand foreign languages, mainly English in working environment



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Cell Production and Maintenance – Specific Needs

→ What Industry Demands

PRODUCTION

- Apart from the general battery-related education, strengthening the skills and competencies to ensure understanding of setting up the production, preparing the related structures, commissioning the machines, chemical, and mechanical assembly, automation experience, and mechanical understanding of the automated systems combined with understanding the related software and calibration.
- Strengthening general IT and data analysis skills to cover future needs.
- Battery skills (also mentioned in the context of Production)
- "Dry and clean room" maintenance (including room contamination measurement)
- Predictive and preventive maintenance
- Diagnostics

WHITE-COLLAR SPECIFIC NEEDS

- Increasing competencies in **production and material engineering, production planning, production management, shift management, process engineering, cell design, machine learning and optimisation, modelling and simulation;**
- Strengthening the focus on **large-scale manufacturing,** understanding of **chemical processes** and **quality, risk and safety management;**
- **Battery industry-related knowledge skills:** battery material, battery chemistry, battery fluids, battery components, battery testing, defective products removal

BLUE-COLLAR SPECIFIC NEEDS

- "Upstream" production - increasing knowledge to understand the **risks, envision the safety issues**, and how **chemicals** behave;
- "Downstream" production - increase **machine understanding, 5S skills**, and the ability to **troubleshoot**;
- Overall production system understanding;
- Knowledge/skills: **material handling, Clean/Dry Room Procedure/Validation, Inspect Quality of Product / Sampling, material pressing, electrode process, fine mechanics, HMI (Human Machine Interface)**

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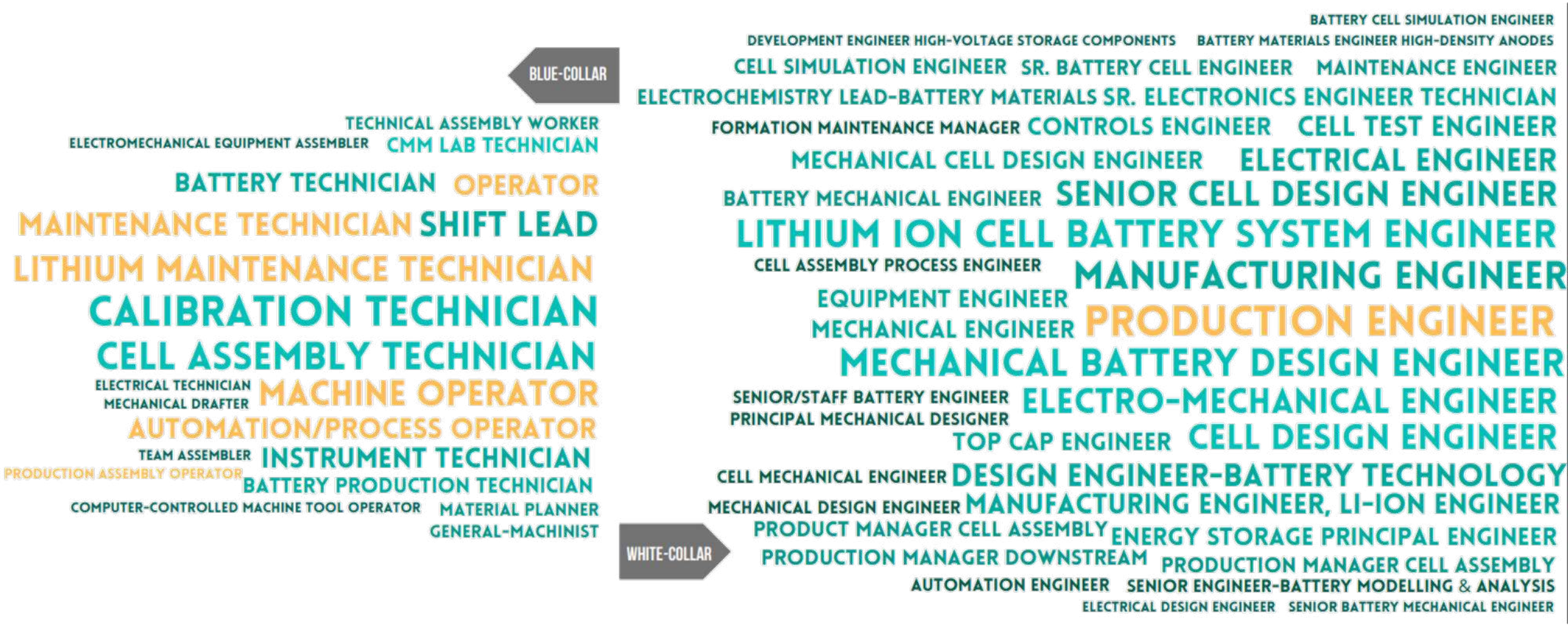
Production and Maintenance

→ What Industry Demands



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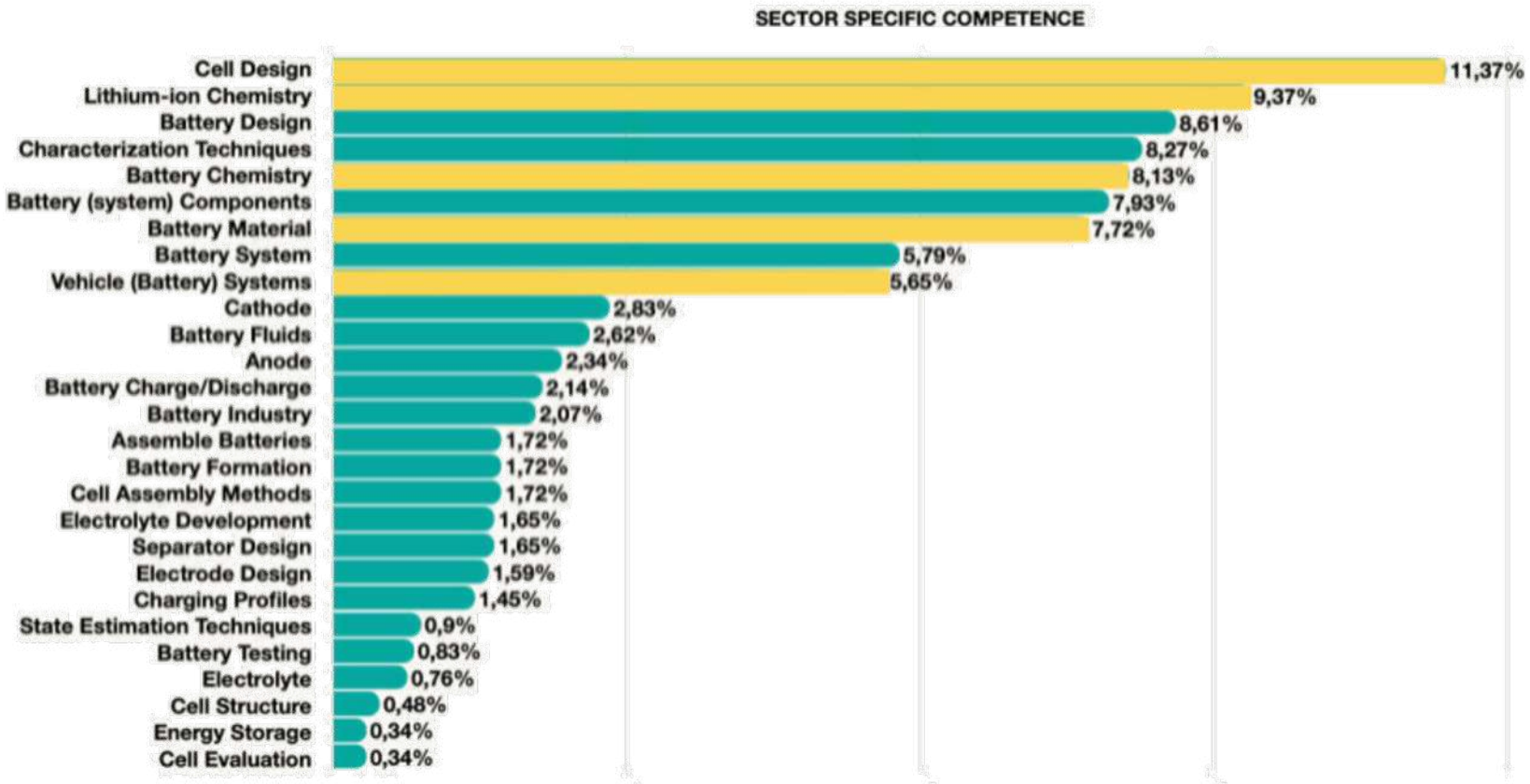
Production and Maintenance– Skills and Competence

→ What Industry Demands



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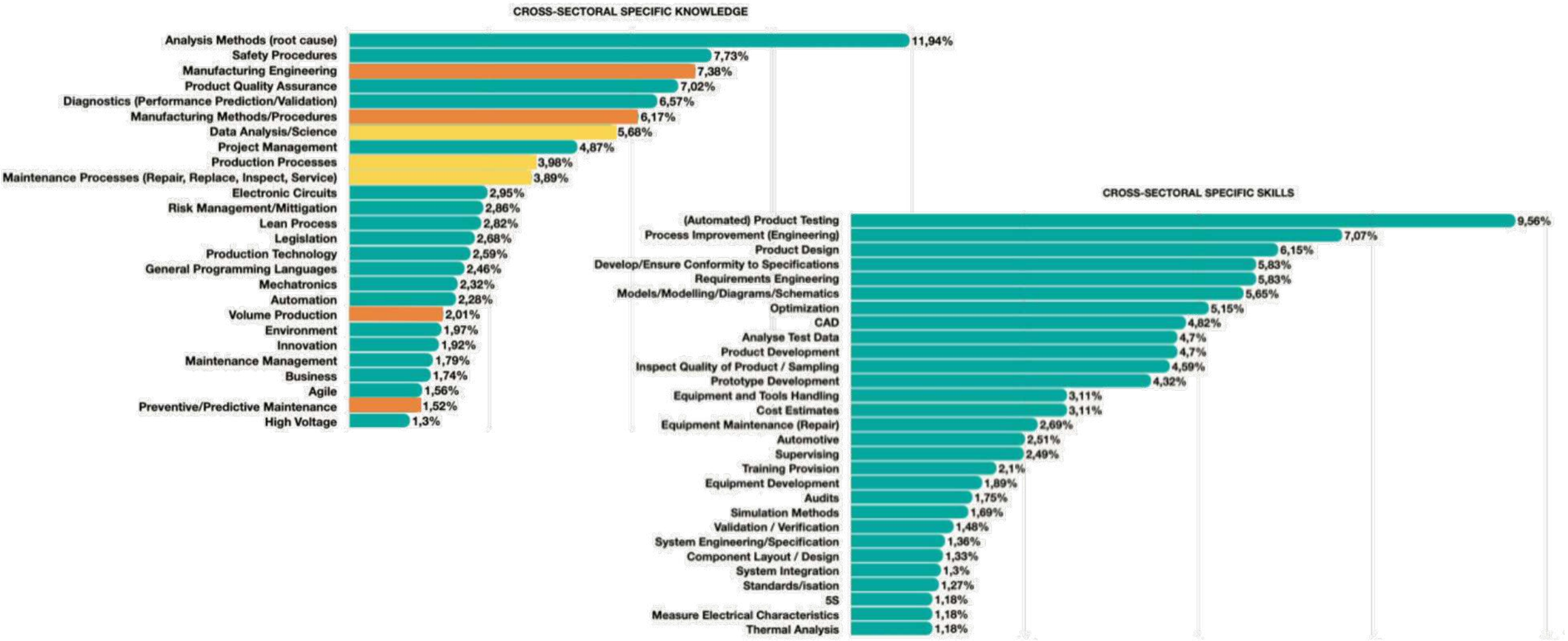
Production and Maintenance– Skills and Competence

→ What Industry Demands



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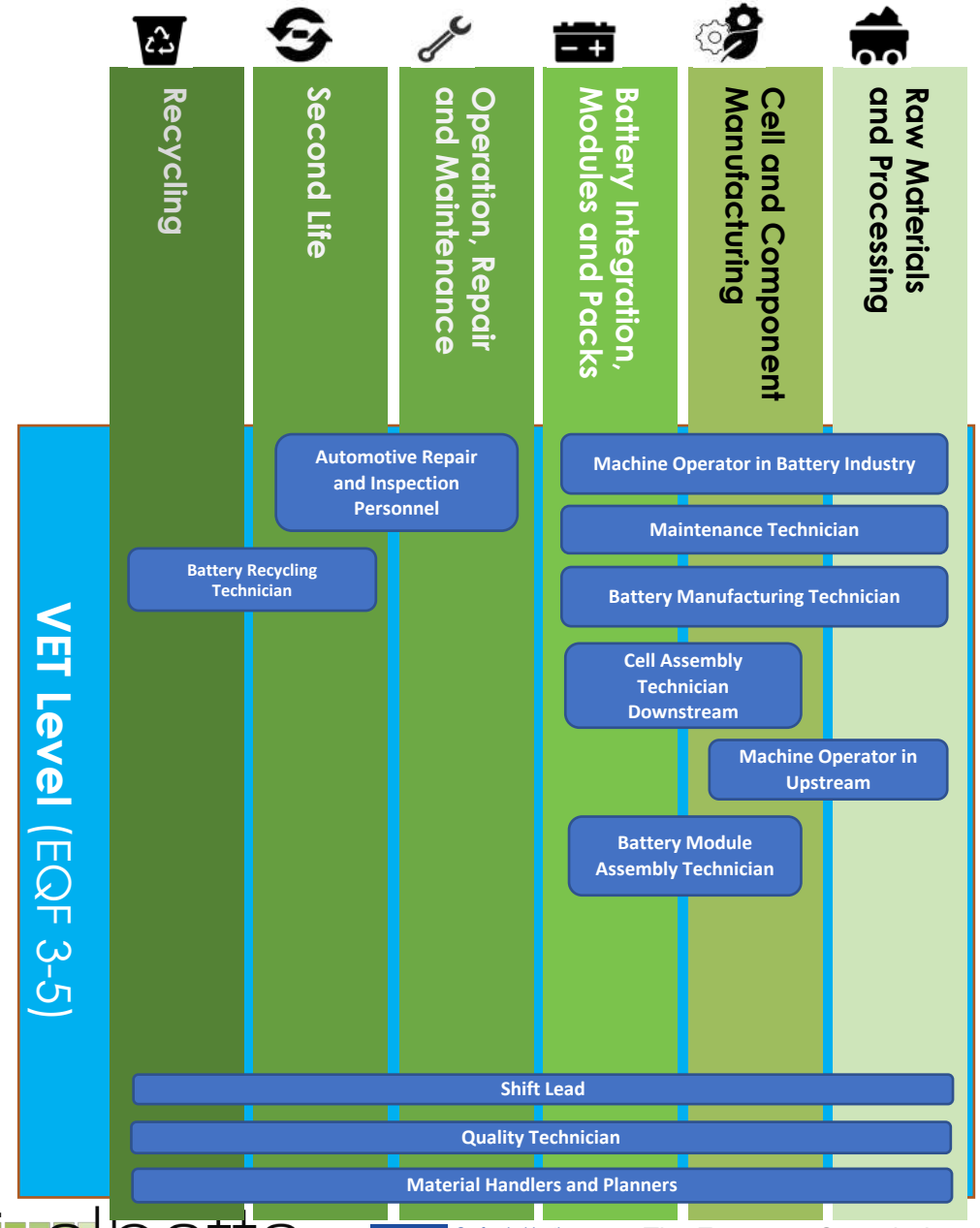
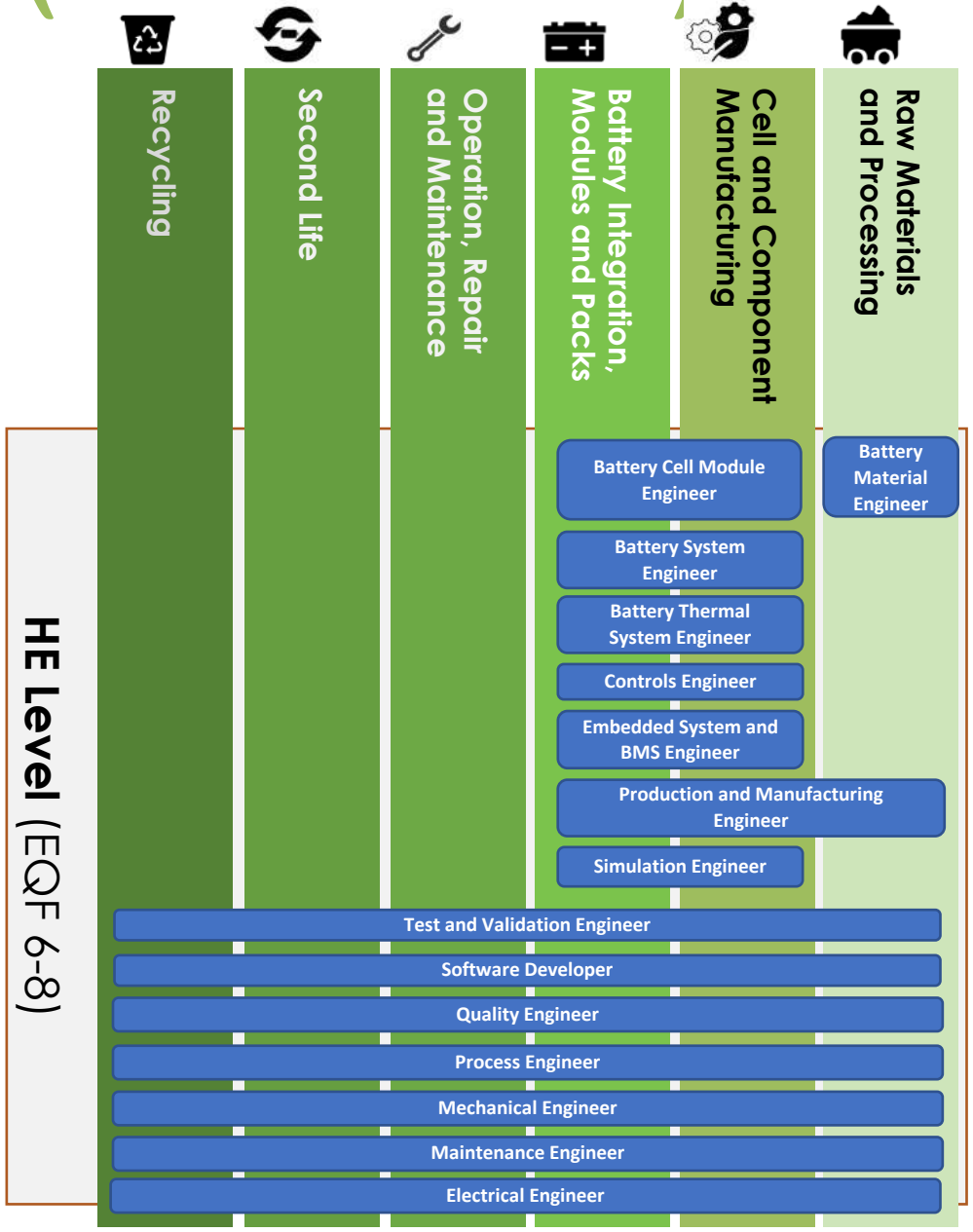
Defined Job Roles (Skills Cards)





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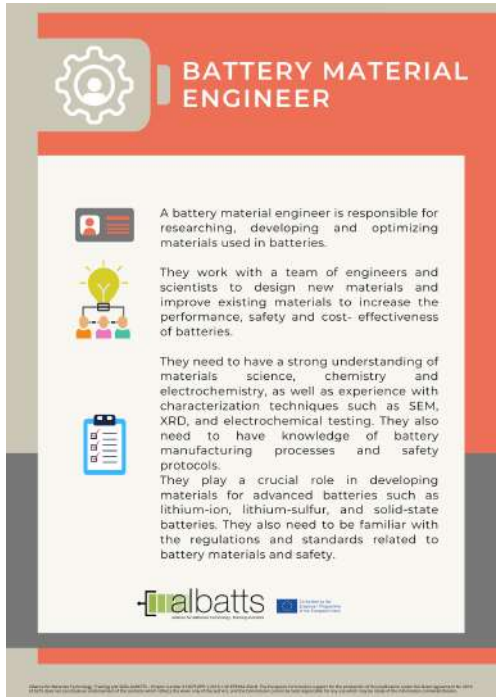
Skills Cards

26 job skills cards produced
(15 on HE level and 11 on VET level)



Summaries of Skills Cards (available in our website)

Each card has short description of the job role and
-Cross-sectoral specific competences
-Sector specific competences (has a big importance)
-General transversal competences
-Academic competences

ALBATTS SKILLS CARDS

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Recognition

Discussion on Skills Cards with multiple stakeholders and projects

- KOMBiH based analysis of needed skills and jobs in the Germany
- Updated VET curriculum in Czech Republic – Battery Manufacturing Technician
- Core competence analysis – helped to shape national curriculum module in Finland
- Update of national curriculum in Portugal
- Update of ESCO – European Skills, Competences, and Occupations
  - 4 new occupations, 8 new competence concepts, and 15 alternative concepts
- Issued Micro-credential under the Automotive Skills Alliance

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Reports

Intelligence in Mobile Battery Applications

R&D and technological perspectives for the battery sector

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Sectoral Intelligence

Intelligence in Battery Manufacturing and Battery Technology

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Stationary & Industrial Applications

Intelligence in Stationary and Industrial Battery Applications

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Education and Training

State-of-art of job roles and education in the batteries' sector

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Examples of reports released

REPORTS' HIGHLIGHTS

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BATTERY POWERED

TOUR FOR SKILLS

Enabling a prepared education network for the battery ecosystem in Europe

Education and Training development for the battery value chain within ALBATTS

João Alves, ATEC

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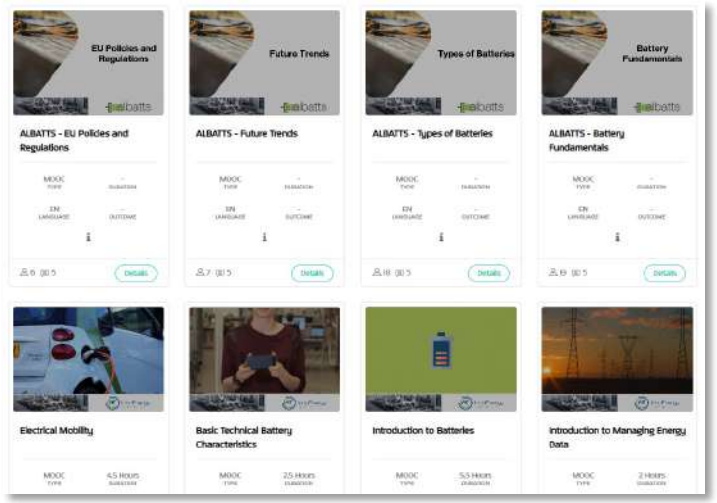
ALBATTS Tackles Two Main Questions

Learning Platform



2 **HOW CAN WE ADDRESS CURRENT CHALLENGES?**

EDUCATION & TRAINING

- **FOCUSING ON** Vocational Education and Training (**VET**) & Higher Education (**HE**) **AIMED AT initial training and re-skilling and up-skilling of workforce**

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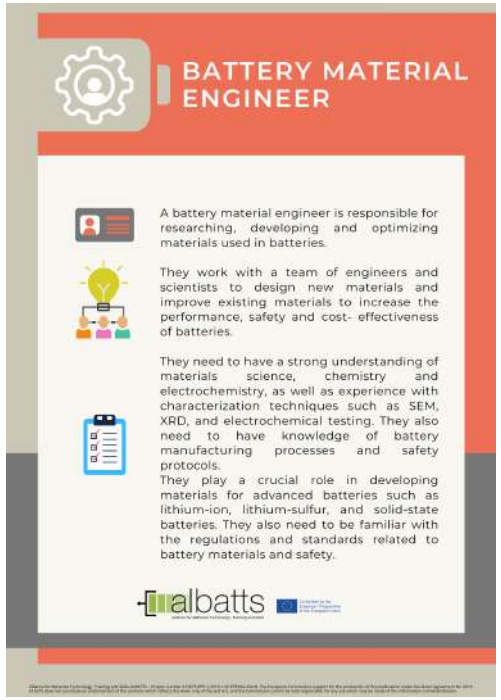

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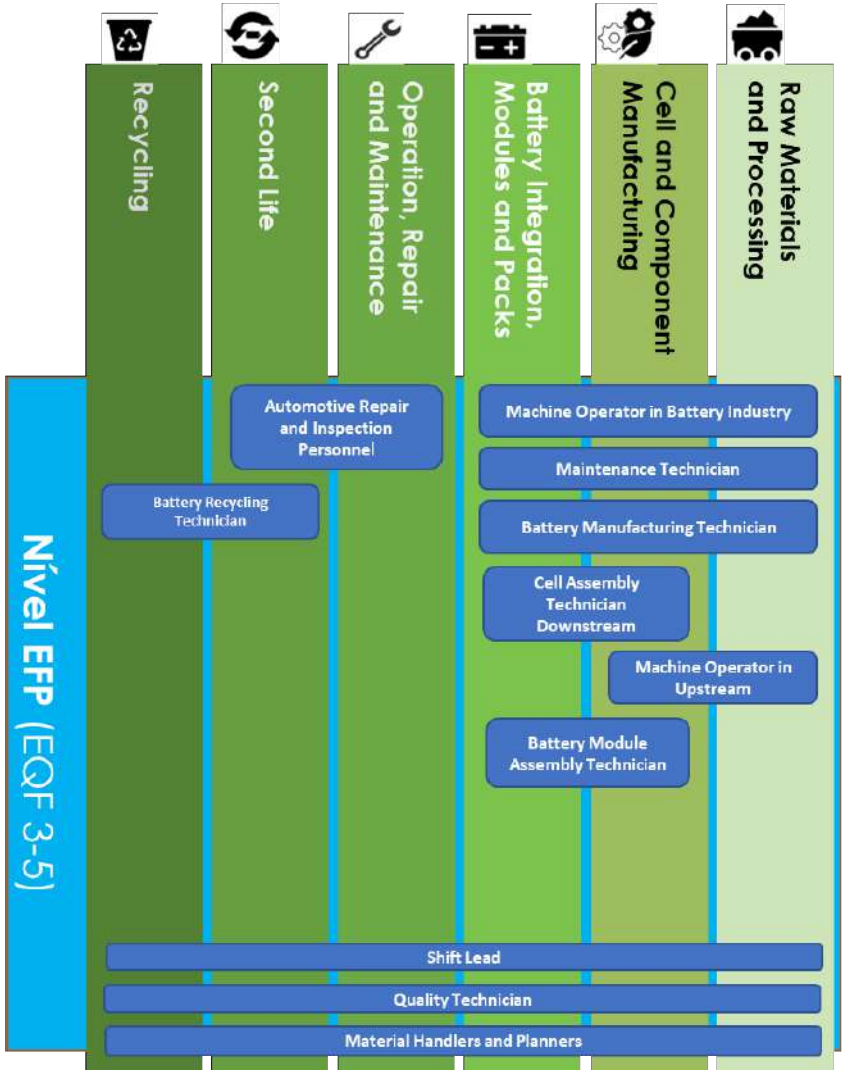
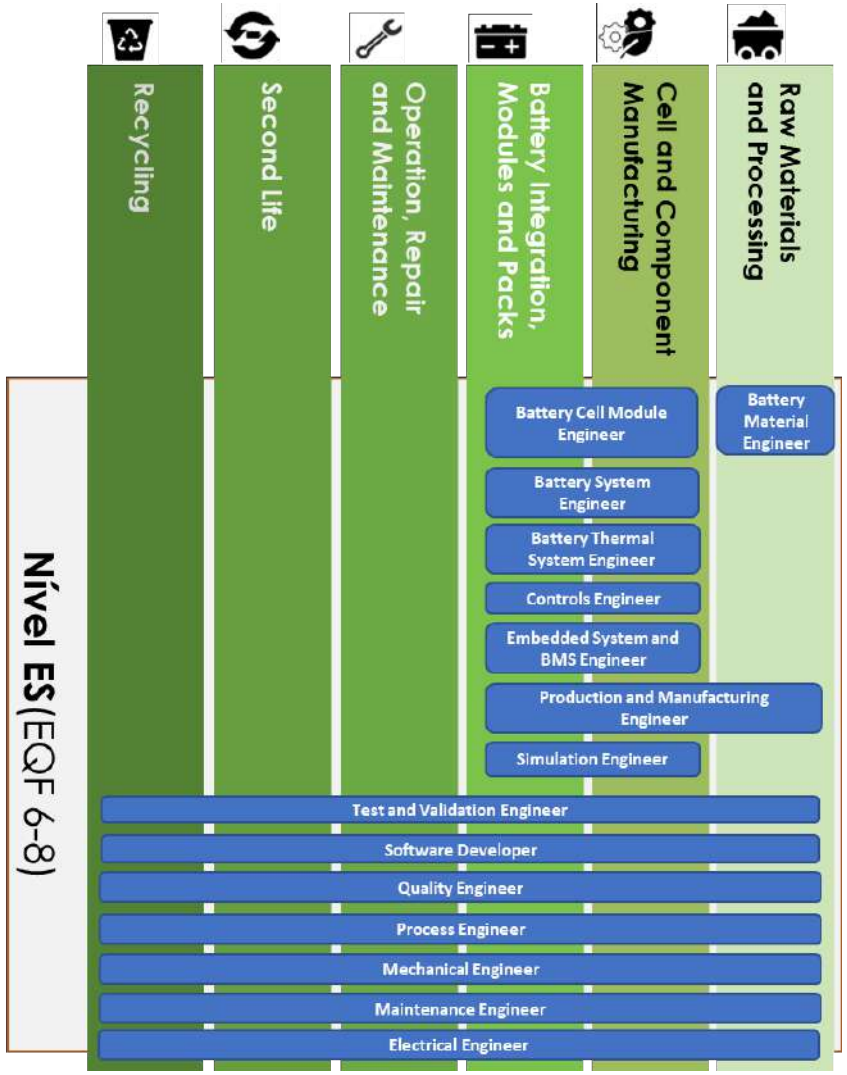
ALBATTS SKILLS CARDS

Skills Cards





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Education & Training Framework

Pillar 2
Innovative and flexible learning

- Inclusive training methods
- Training methods adapted to initial and up/re-skilling
- Work-based learning
- ICT based on open educational resources
- Adaptive learning solutions
- Joint educational programs, including transnational learning

Pillar 1
Curricula for all levels

- 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

- Continuous train the trainer programs for sectoral skills update
- Digital skills development programs
- Language skills (VET)
- Companies' tutors development programs (Dual system)
- Mobility programs for teachers/trainers in companies
- Expert and discussion international forums

Pillar 3
Competent trainers and tutors

- Reference to other frameworks
- Micro-credentials / Digital badge
- Adapted to national and regional frameworks
- Validate and recognition of Competence
- Training recognition
- Sectoral Skills Strategy Alignment
- European Vocational Core Profiles

Pillar 4
EU wide recognition

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Courses

11 Courses already available

Examples of available courses

Available through the Automotive Skills Alliance (ASA), an association created through the bridging of the projects ALBATTS and DRIVES activities and to sustain project results

ALBATTS COURSES

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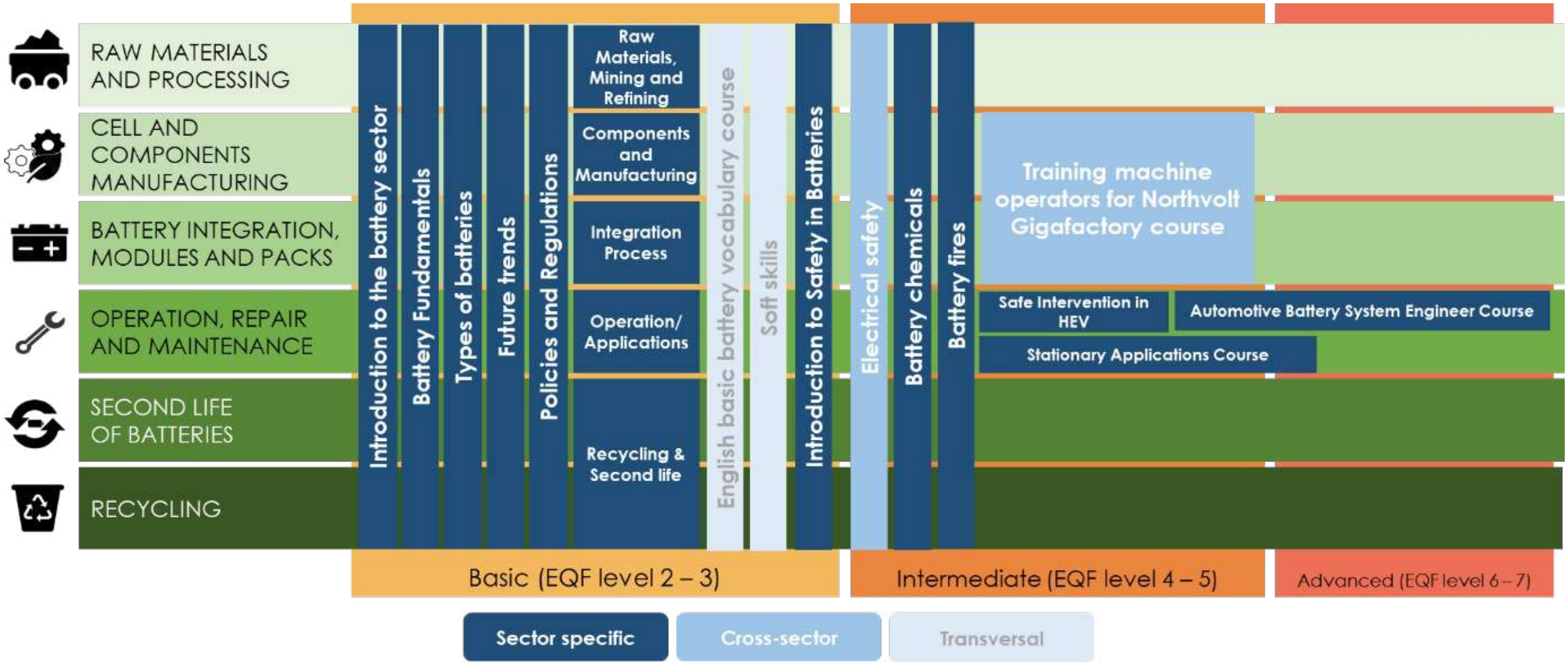
ALBATTS courses



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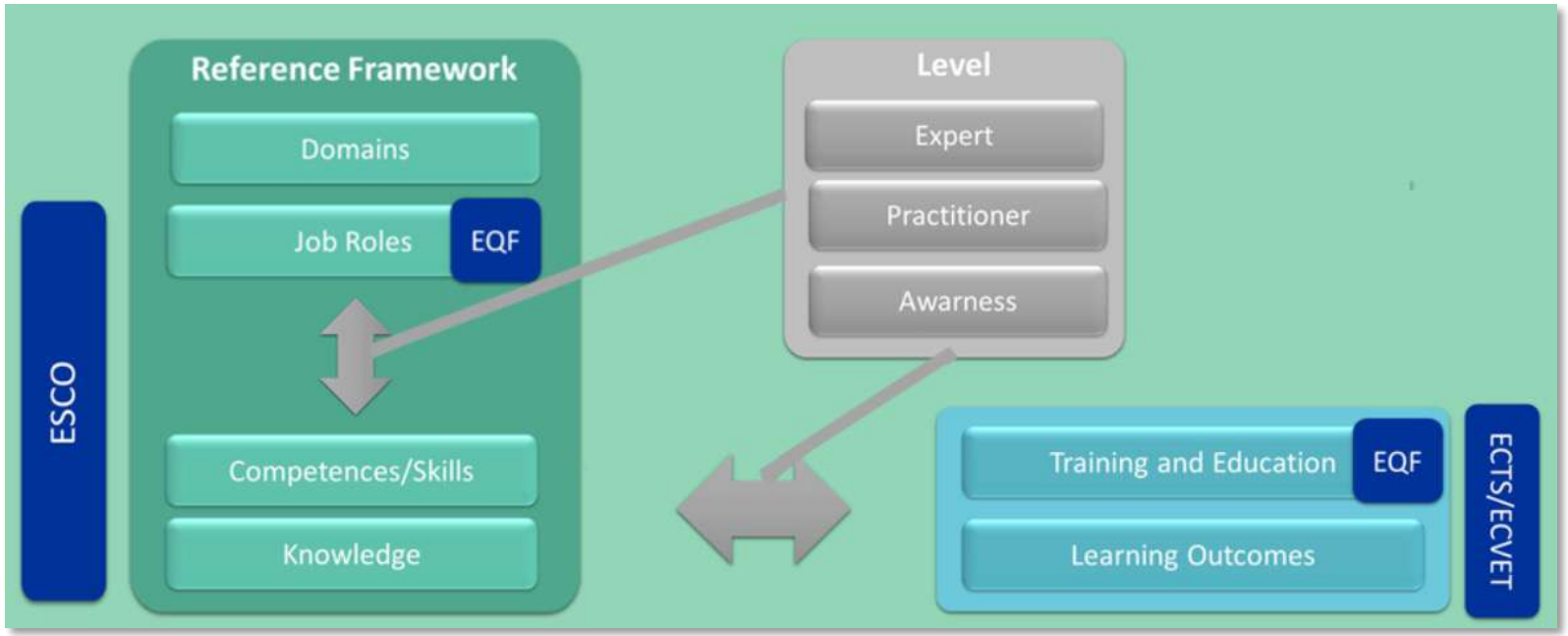
Learning Platform

Skills Hub

- Database for **training courses**
- Definition and **recognition of job roles** and skills/competence concepts using micro-badges.



Learning Platform

learn.skills-framework.eu

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Training for VET Teachers

COLLABORATION

BEST PRACTICES & FUNDRAISING

Support of Knowledge Sharing

About BaTT Forum

- **The Batteries Teachers & Trainers Forum (BaTT Forum) is an initiative launched by ALBATTS**
- **Upskilling and sharing of the best practices among VET teachers to support Batteries education and training (especially EQF 3-5)**

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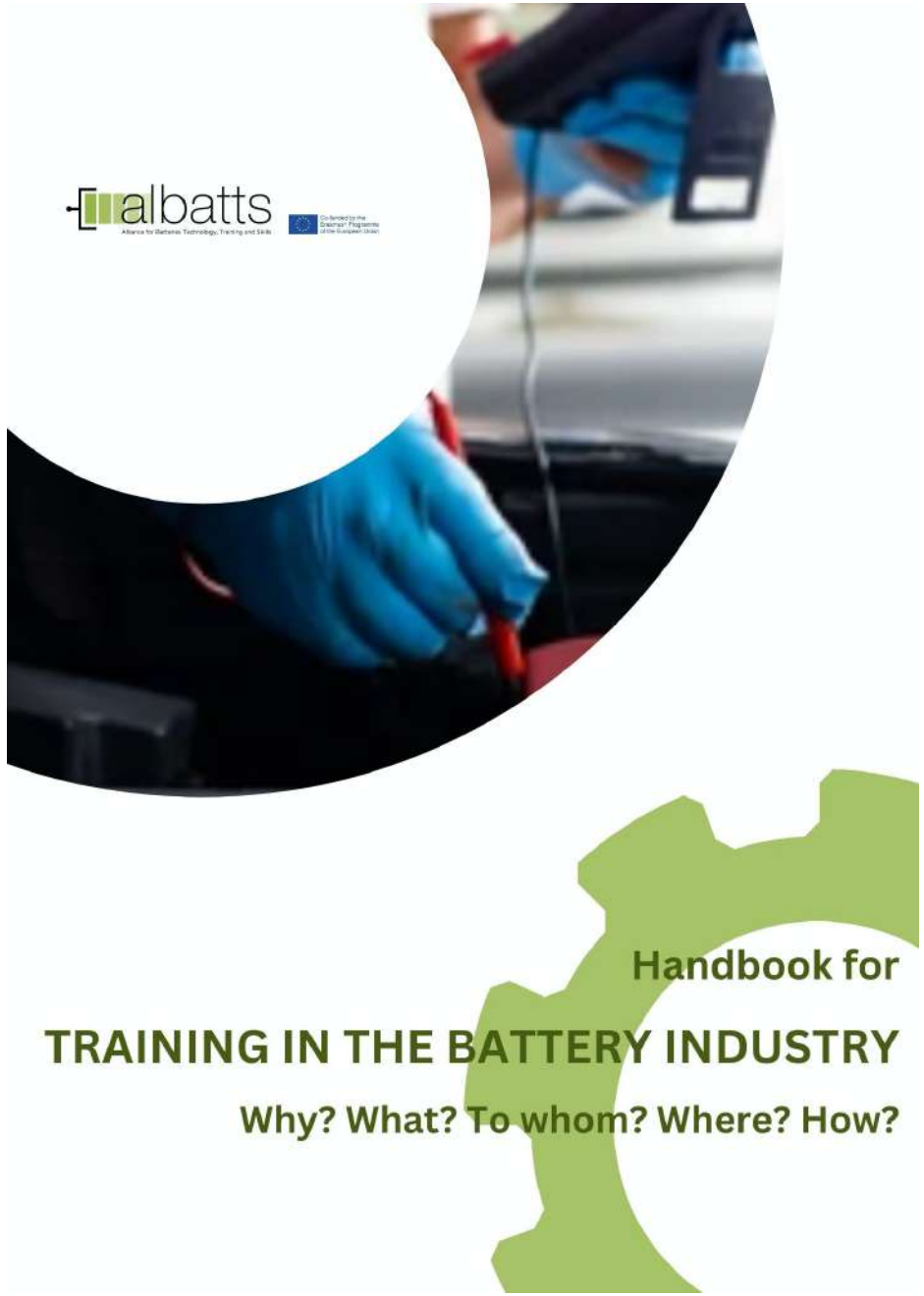

Will be published in March 2024

Will be found on Albatts homepage https://www.project-albatts.eu/en/home

Target group: VET schools, teachers, companies

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Recommendations

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Battery Training Courses & Skills Collaborations

- Need for urgent and continuous training courses offer and update & Need for active and sustainable collaborations, e.g.: **New Eba Academy – InnoEnergy Skills Institute**

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EUROPEAN BATTERY ALLIANCE | EBA250

Learning Platform

Skills Framework

AUTOMOTIVE SKILLS ALLIANCE

PACT FOR SKILLS Leader

An initiative of the European Commission

BEPA
Batteries European Partnership Association

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UNIVERSITATEA NAȚIONALĂ DE ȘTIINȚĂ ȘI TEHNOLOGIE POLITEHNICA BUCUREȘTI

FACULTATEA DE TRANSPORTURI

SOLUȚII CONSTRUCTIVE ACTUALE ȘI VIITOARE ALE SURSELOR DE ENERGIE CE ECHIPEAZĂ AUTOVEHICULELE ELECTRICE

Webinar: „Stabilirea unei rețele de educație privind industria de baterii în Europa”
„ALBATTS: BATTERY POWERED TOUR FOR SKILLS”

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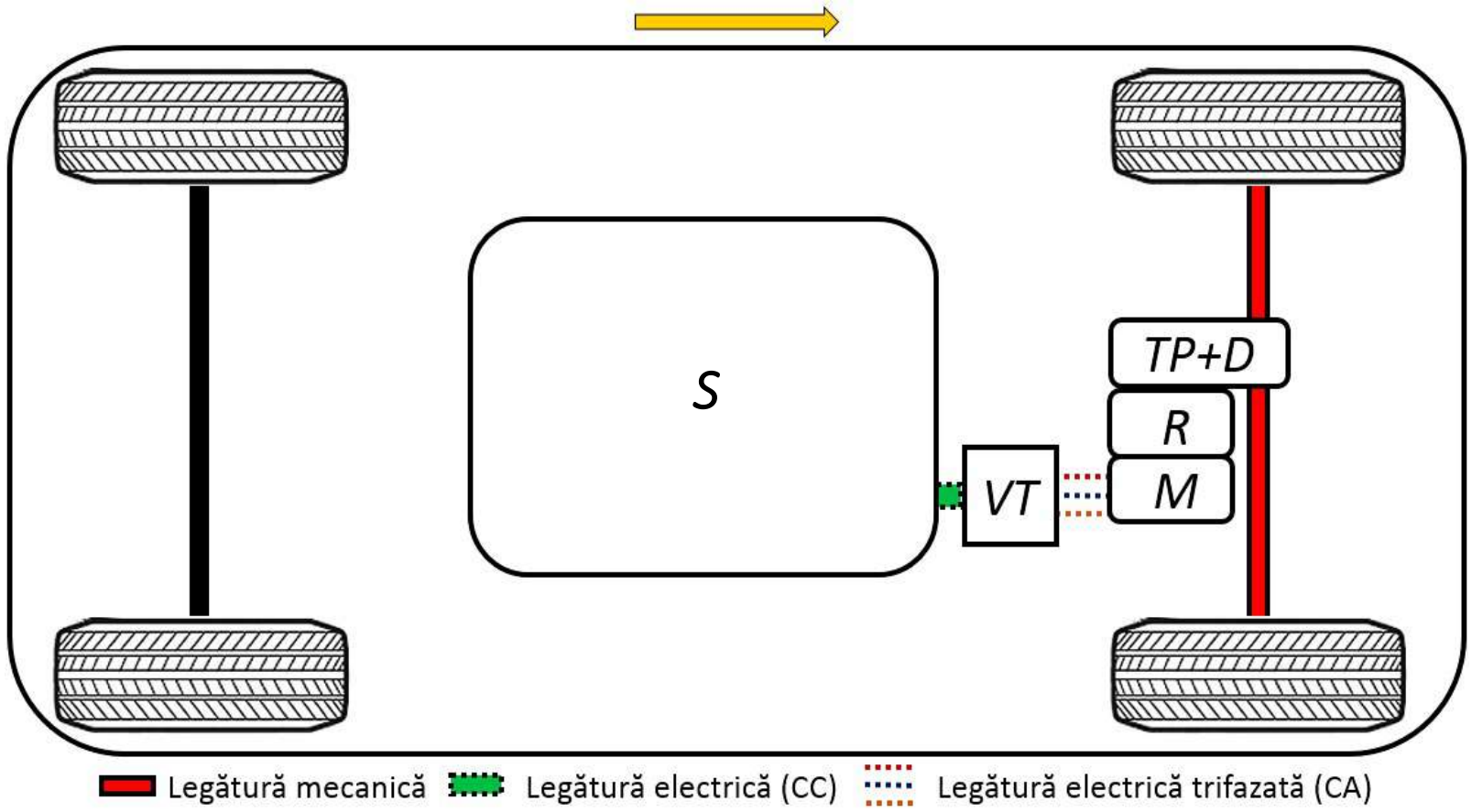
Autor:
*as.drd.ing. Alexandru-Adrian **ANCUȚA***

Cuprins

Schema generală de principiu a unui autovehicul electric

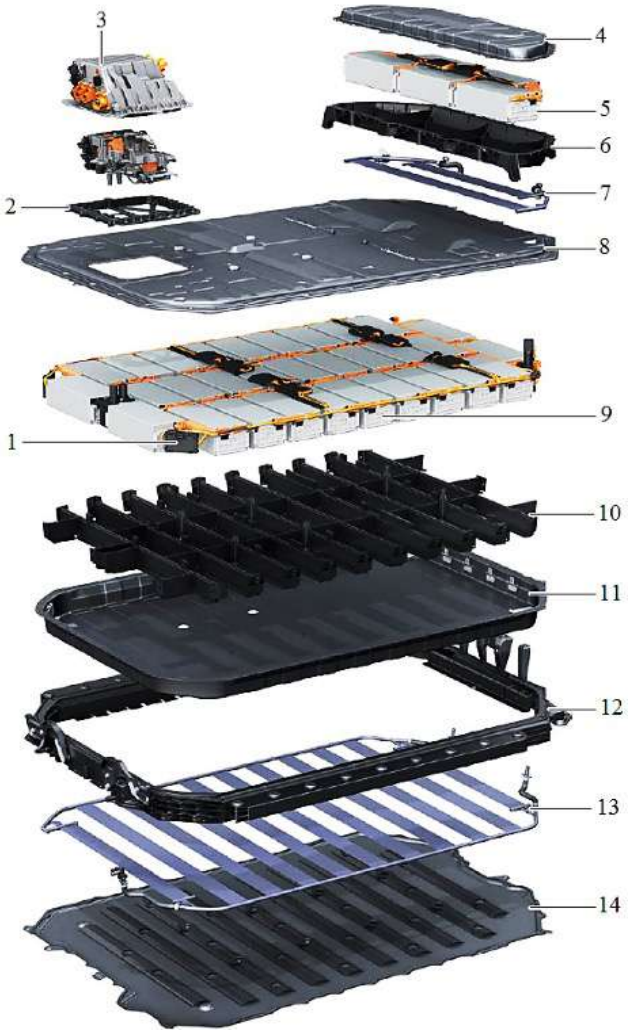


S – Sursă; VT – Variator de turație; M – Motor electric; R – Reductor; TP+D – Transmisie principală + Diferențial.

Surse de energie actuale

- ❑ Baterii electrochimice
  - ***a)*** ***Pb*** (ex. bateria de 12 V)
  - ***b)*** ***Ni*** (ex. NiCd și NiMH – Toyota)
  - ***c)*** ***Na*** (ex. bateriile Na_2S_x și ZEBRA Zero Emissions Battery Research Association)
  - ***d)*** ***Li*** (ex. tehnologiile litiu-ion și litiu polimer)
- ❑ Supercondensatoare
- ❑ Pile de combustibil

Bateriile cu litiu – construcție



Construcția unei baterii litiu-ion

1 – Sistemul de control al bateriei (BMS);

2 – Garnitură metalică;

3 – Modul de borne și contacte de înaltă tensiune;

4 – Capacul carcasei;

5 – Modul de celule;

6 – Carcasă inferioară;

7 – Garnitură metalică;

8 – Capac;

9 – Modul de celule

(12 celule/modul);

10 – Structura de susținere și compartimentare a modulelor;

11 – Suport pentru 10;

12 – Cadru de susținere;

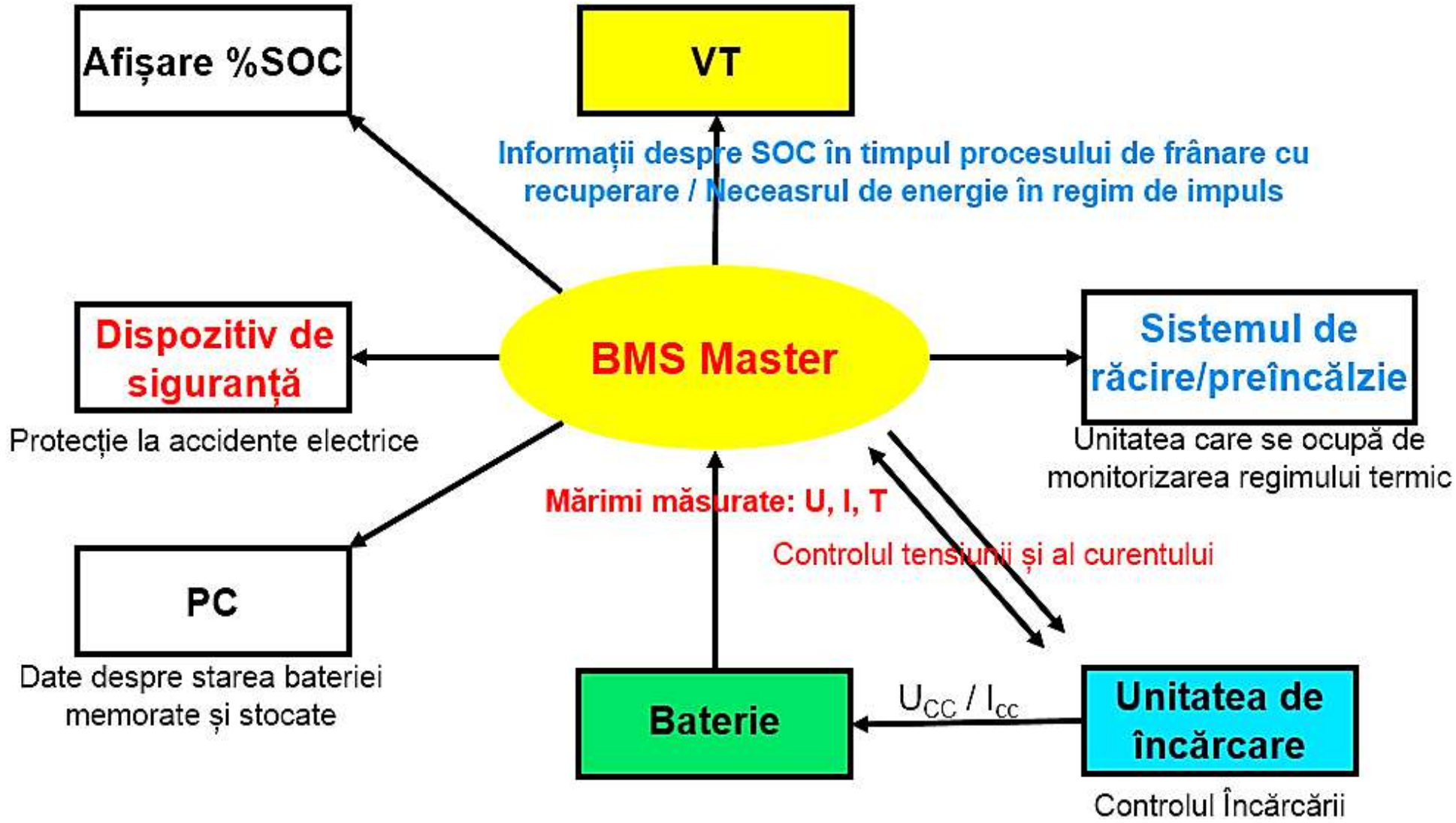
13 – Sistemul de răcire;

14 – Protecție inferioară.

Clasificarea celulelor cu litiu

- *Celulă cilindrică*
- *Celulă prismatică*
- *Celulă tip „plic”*

Bateriile cu litiu – sistemul de control (Battery Management System)



Bateriile cu litiu

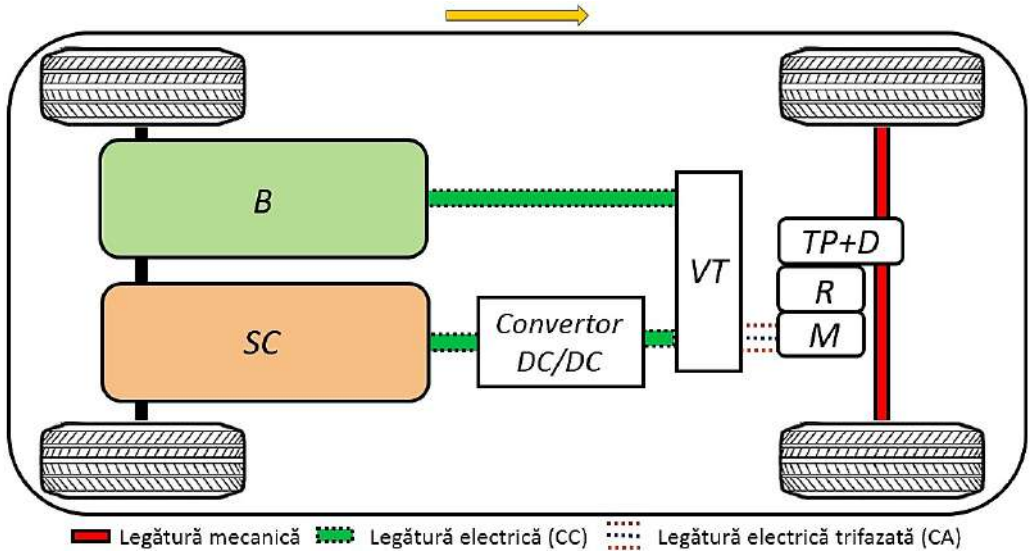
Clasificarea principalelor tipuri de celule cu litiu

Denumire	Abreviere	Tensiune	Aplicație
Litiu Oxid de Cobalt	LCO ($LiCoO_2$)	3,6 V (nominală) și 3...4,2 V (domeniul de funcționare)	Telefoane mobile, Camere, Laptop-uri
Litiu Fosfat de Fier	LFP ($LiFePO_4$)	3,2...3,3 V (nominală) și 2,5...3,65 V (domeniul de funcționare)	Unelte electronice, Aparate medicale, Vehicule electrice
Litiu-ion Mangan	LMO (MnO_2)	3,7/3,8 V și 3...4,2 V (domeniul de funcționare)	Unelte electronice, Aparate medicale, Vehicule electrice
Litiu Nichel-Cobalt-Oxid de Aluminiu	NCA ($LiNiCoAlO_2$)	3,6 V (nominală) și 3...4,2 V (domeniul de funcționare)	Rețele de stocare, Vehicule electrice
Litiu Nichel-Mangan-Oxid de Cobalt	NMC ($LiNiMnCoO_2$)	3,6...3,7 V (nominală) și 3...4,2 V (domeniul de funcționare)	Unelte electronice, Aparate medicale, Vehicule electrice
Litiu-Titan	LTO ($Li_4Ti_5O_{12}$)	2,4 V (nominală) și 1,8...2,85 V (domeniul de funcționare)	Rețele de stocare, Vehicule electrice

Comparație a principalilor parametrii de interes ce caracterizează tipurile de baterii prezentate

Tipul bateriei	***Energie specifică [Wh/kg]***	***Tensiunea nominală a unei celule [V]***	***Durata de viață [cicluri]***	***Temperatura de funcționare [°C]***	***Timp de reîncărcare [ore]***	***Preț [dolar/kWh]***
Pb	35 – 50	2	500...1000	Mediul ambiant	8 ore (90% într-o oră)	120...150
Ni	50 – 90	1,2	> 1200	Mediul ambiant	O oră (60% din capacitate în 20 min)	200...400
Na	90 – 240	~2 V	800...1200	300...350	8	230...450
Li	90 – 130	3 – 4,2	> 1000	-30...60	2-3	~100

❑ Supercondensatoare (SUPERCAP)

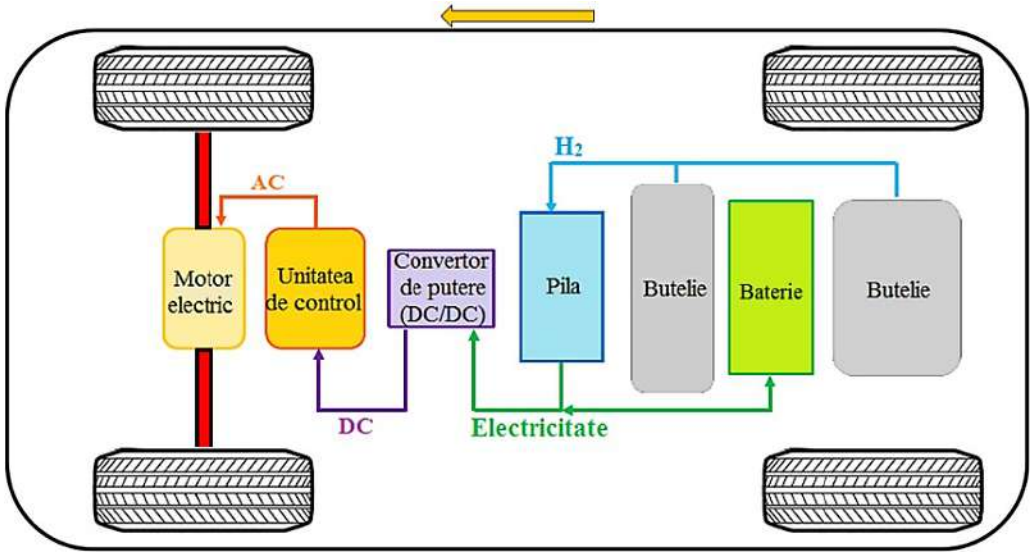


Schema de principiu a unui autovehicul echipat cu baterie de supercondensatoare

Studiul comparativ între supercondensatoare și bateriile litiu-ion

Parametru	*Supercondensator*	*Baterie litiu-ion*
Timp de încărcare	1 – 10 secunde	10 – 60 minute
Cicluri de funcționare	> 50000	> 1000
Tensiunea unei celule	2,3 – 2,75 V	3.5 – 3.7 V
Energie specifică	5 Wh/kg	100 – 200 Wh/kg
Putere specifică	> 10000 W/kg	1000 – 3000 W/kg
Preț	20 $/Wh	0,5 – 1 $/Wh
Durată de viață	10 – 15 ani	5 – 10 ani
Temperatură de încărcare	-40 – 65°C	0 – 45°C
Temperatură de descărcare	-40 – 65°C	-20 – 60°C

❑ Pile de combustie (FUEL CELL)



Schema de principiu a unui autovehicul electric echipat cu pilă de combustie

2015

Construcția autovehiculului Toyota Mirai:

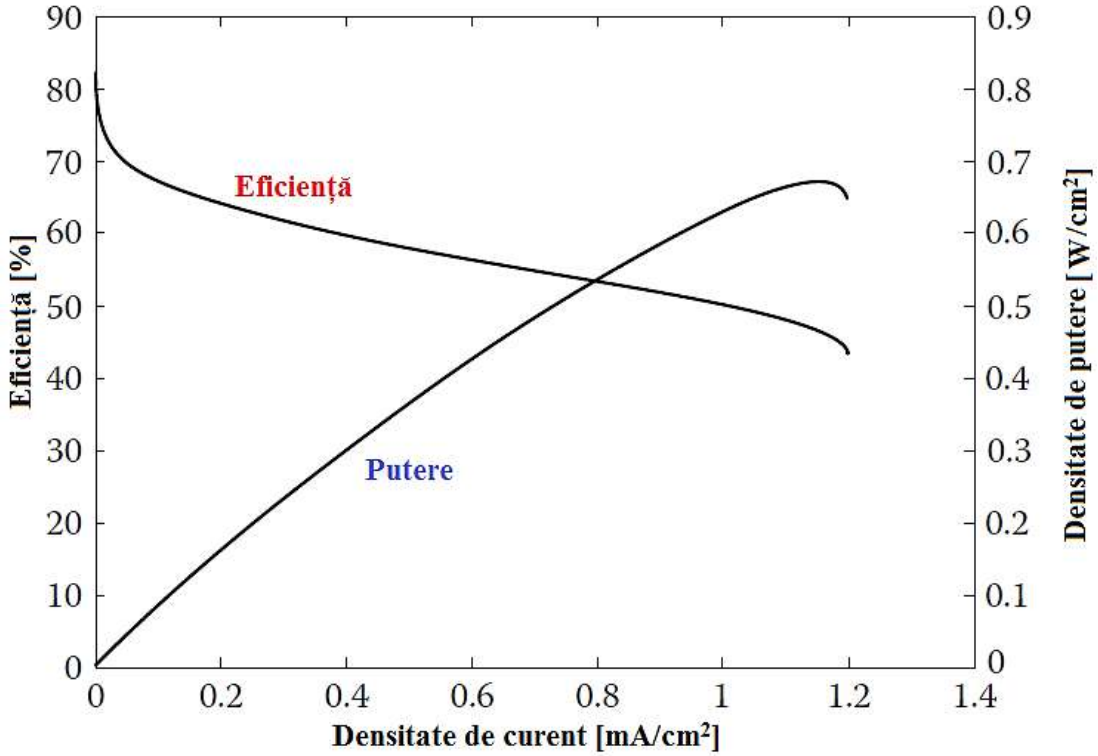
1 - Baterie NiMH; 2 – Butelie de H_2; 3 – Pila de combustibil; 4 – Motor electric; 5 – Unitate de control.

❑ Pile de combustie (FUEL CELL) - clasificare

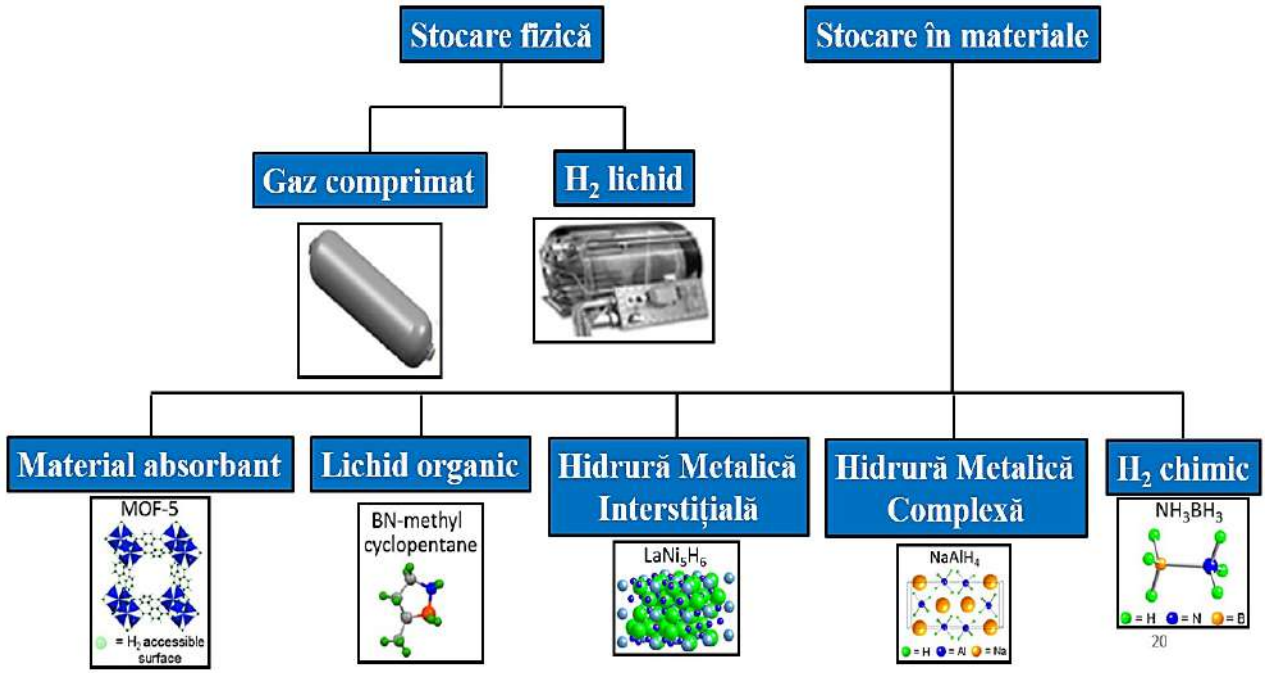
- Pilă de combustibil cu membrană electrolitică polimerică (***PEMFC – Polymer Electrolyte Membrane Fuel Cells***)
- Pilă de combustibil cu metanol (***DMFC – Direct Methanol Fuel Cells***)
- Pilă de combustibil alcalină (***AFC – Alkaline Fuel Cells***)
- Pilă de combustibil cu acid fosforic (***PAFC – Phosphoric Acid Fuel Cells***)
- Pilă de combustibil pe bază de carbon topit (***MCFC – Molten Carbonate Fuel Cells***)
- Pilă de combustibil cu oxid solid (***SOFC – Solid Oxide Fuel Cells***)

Tipul Pilei	*Ionii mobili*	*Electrolit*	*Temperatură de lucru [°C]*	*Eficiență*	*Combustibil*	*Aplicații*
PEMFC	H^+	Polimer	60...100	>70%	H_2	Vehicule și aplicații mobile de putere mică și medie
DMFC	H^+	Polimer	50...130	60%	CH_3OH	Sisteme electronice și portabile (laptop, smartphone, etc)
AFC	OH^-	KOH	80...230	60...87%	H_2	Programe spațiale
PAFC	H^+	H_3PO_4	Peste 150	cca. 40%	H_2	Sisteme ce utilizează puteri în jurul valorii de 200 kW
MCFC	CO_3^{2-}	Carbon topit	500...800	65%	H_2; CH_4; CO	Aplicații cu puteri de ordinul kW până la MW
SOFC	O^{2-}	Oxid solid	500...1200	60...80%	H_2; CH_4; CO	Aplicații staționare cu puteri de la 2kW la MW

- Pile de combustie (FUEL CELL) – performanțe și metode de stocare



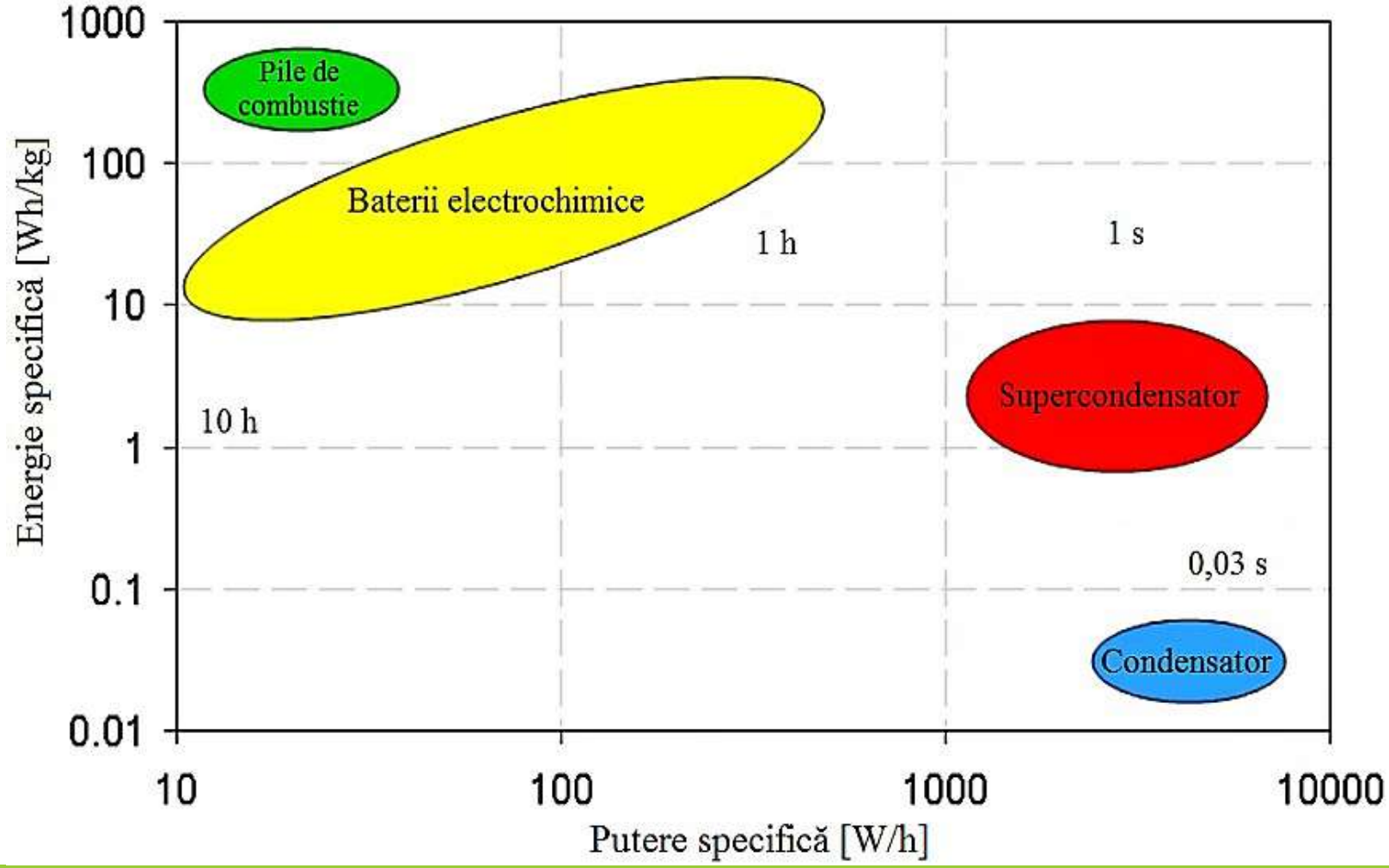
Dependența dintre eficiența pilei de combustibil și densitatea de putere



Metode de stocare a H_2

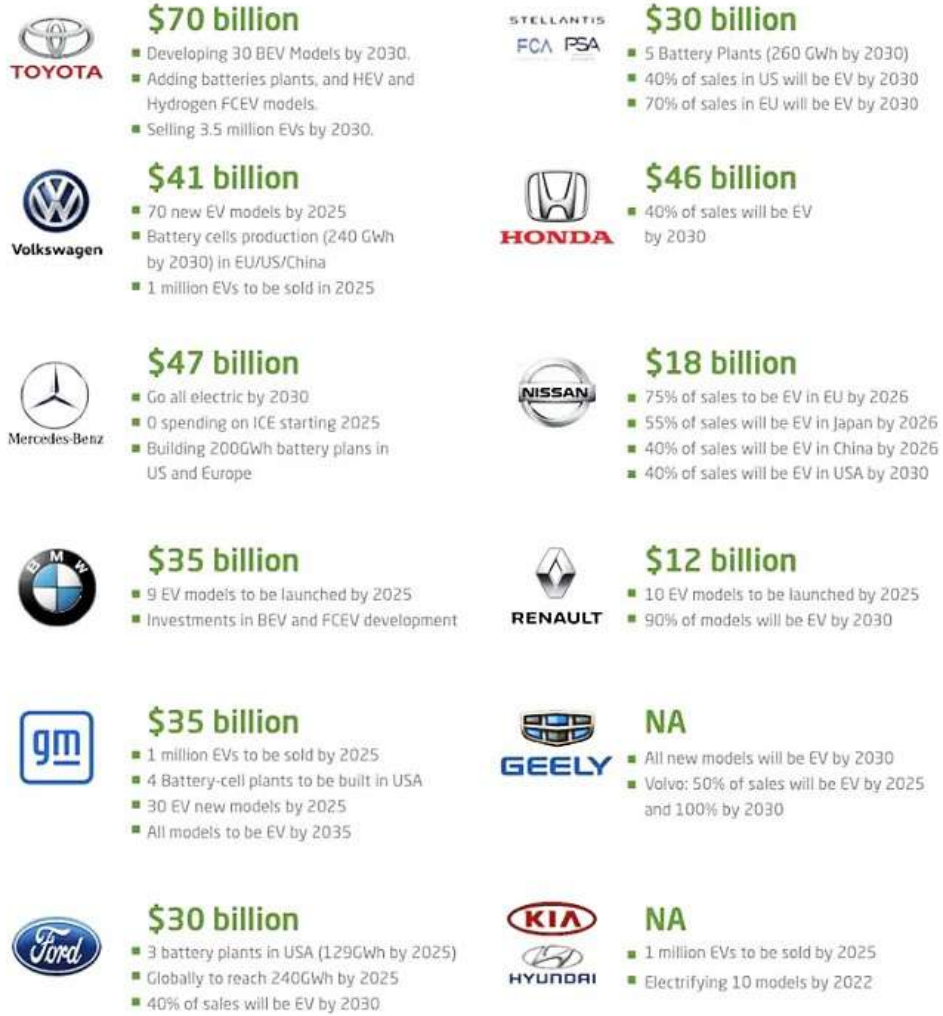
Surse de energie actuale

- Comparație între diferitele surse de energie în funcție de energia specifică și de puterea specifică



Surse de energie actuale

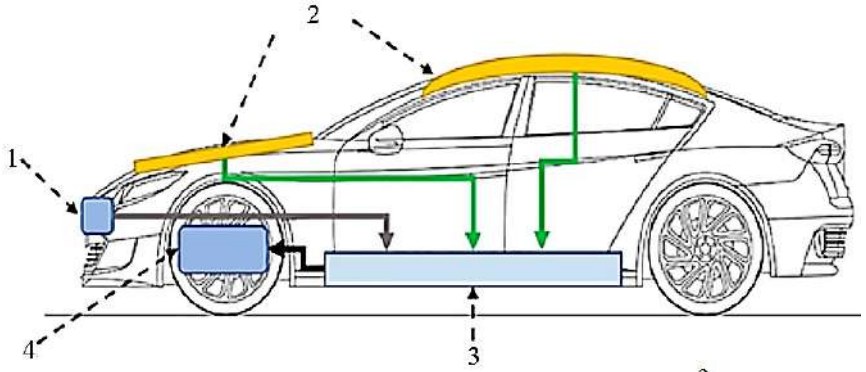
Producători de celule cu litiu – clasificare în funcție de tipul construcției



Bugete alocate de producători – actuale și viitoare

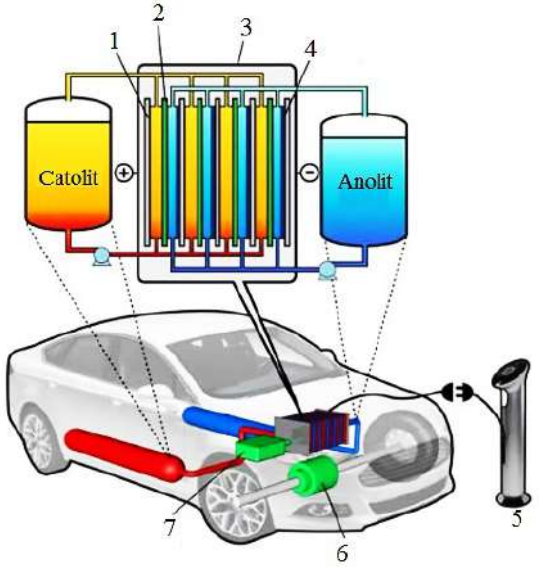
Surse de energie viitoare

❑Celulele fotovoltaice



Structura unui autovehicul electric echipat cu celule fotovoltaice:
1 – Port de încărcare;
2 – Celule fotovoltaice integrate;
3 – Baterie de tracțiune;
4 – Motorul electric.

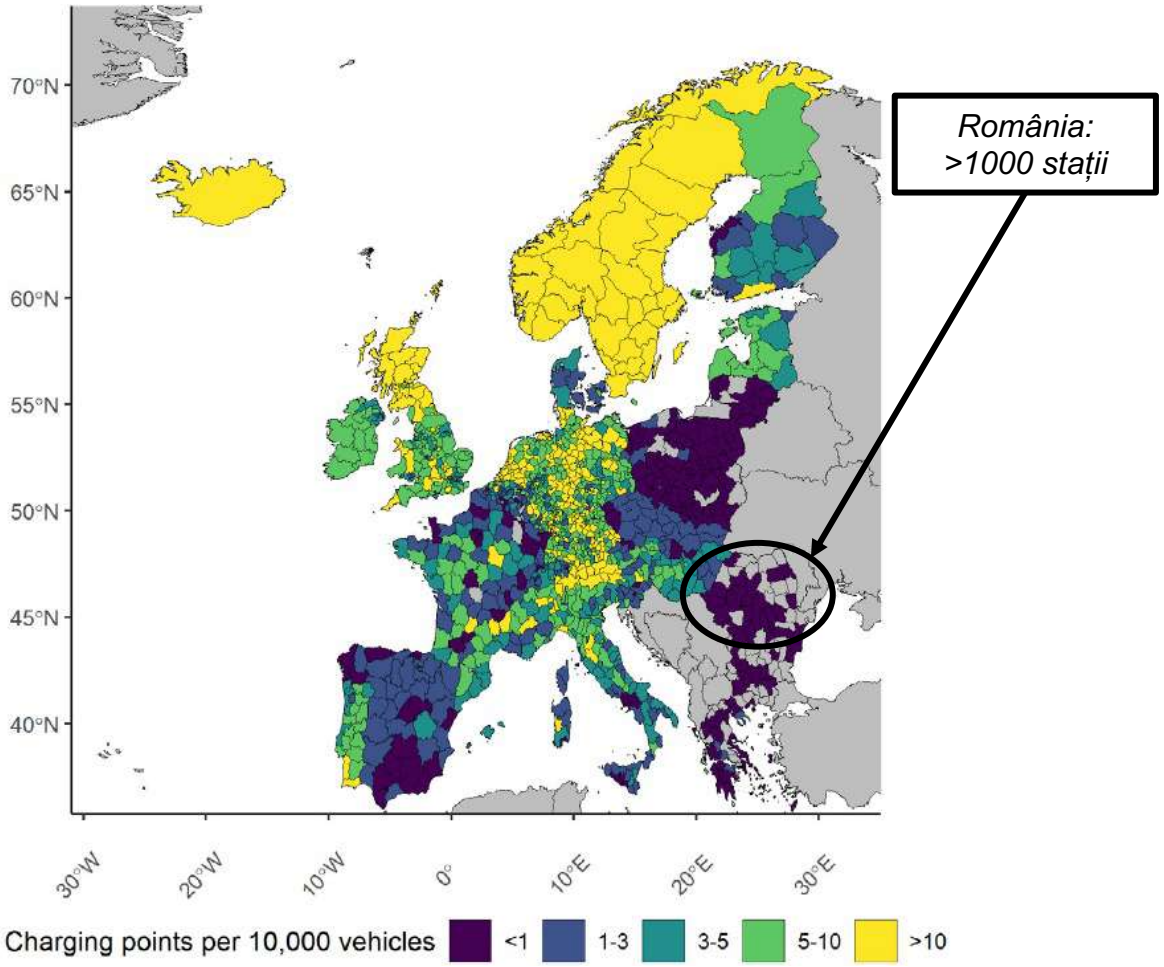
❑Salt-water battery



Structura unui autovehicul electric echipat cu baterii cu apă sărată:
1 – Electrod;
2 – Membrană cu schimb de ioni;
3 – Pachet/Incintă; 4 – Depozit de material metalic;
5 – Stație de încărcare;
6 – Motor electric;
7 – Variator de turație/Unitate de control.

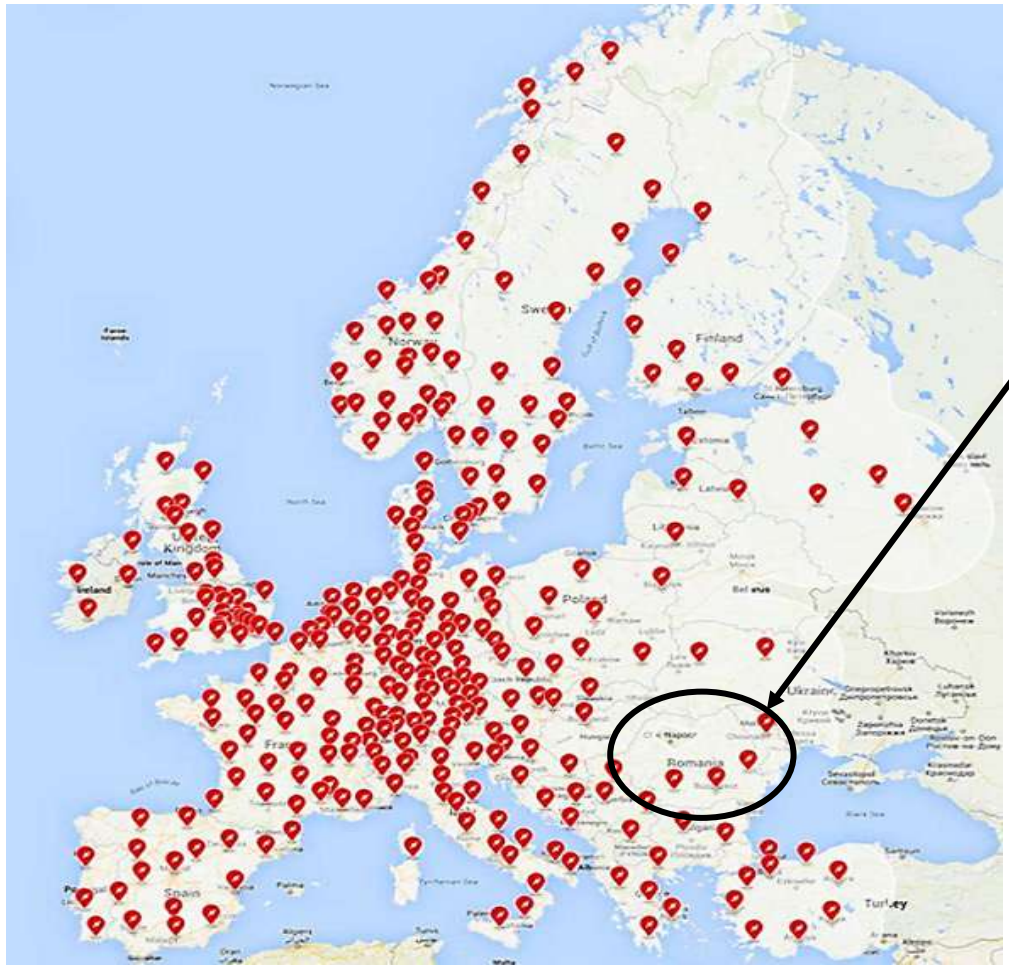
❑Minireactorul nuclear – pentru alimentarea autocamioanelor electrice

Stadiul actual privind la infrastructura de încărcare



Harta Europei ce semnifică numărul de stații de încărcare în raport cu un număr de 10000 autovehicule.

România: >1000 stații



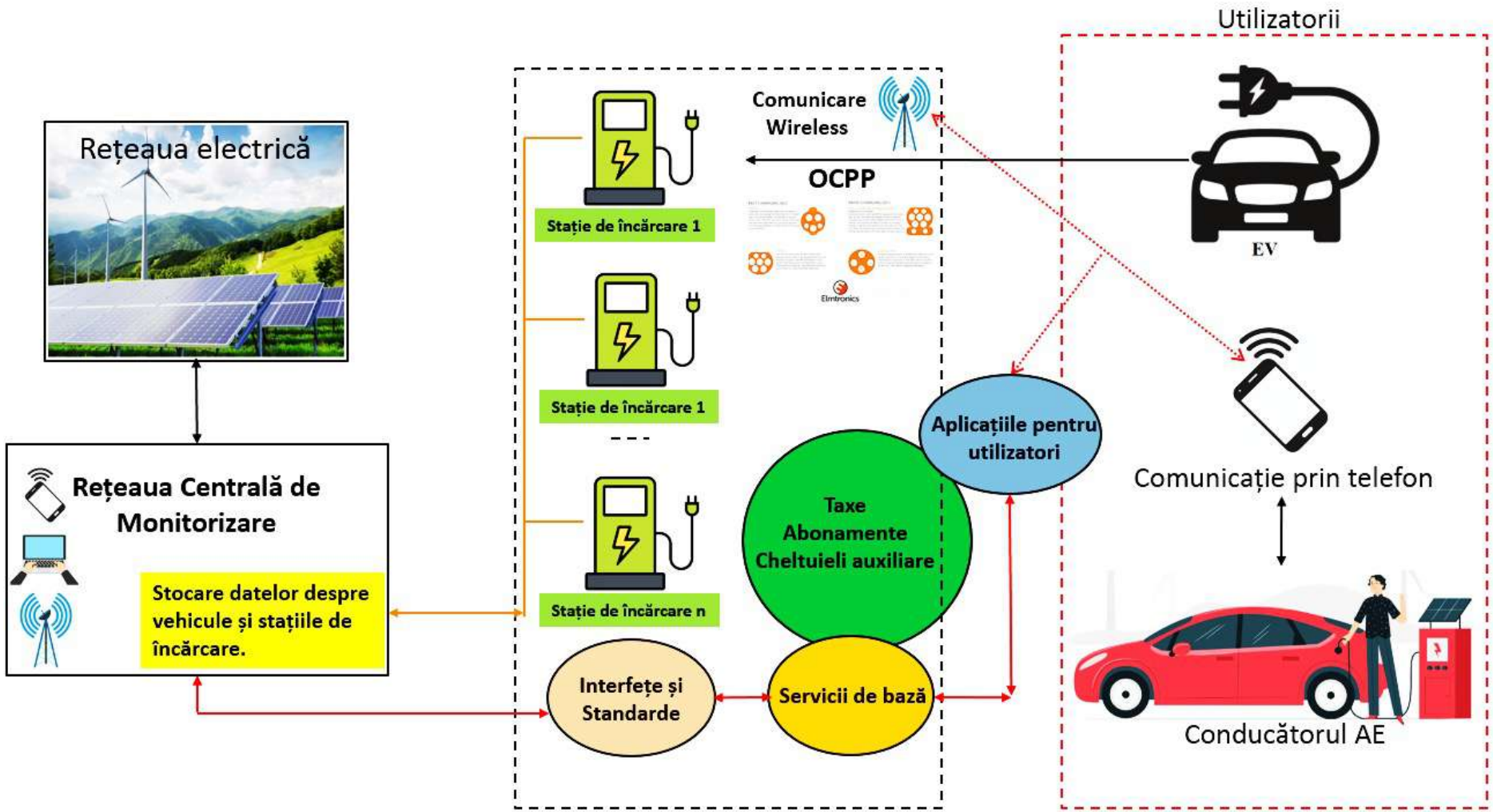
Harta Europei privind stațiile „Supercharger”.

România: 6/8 stații

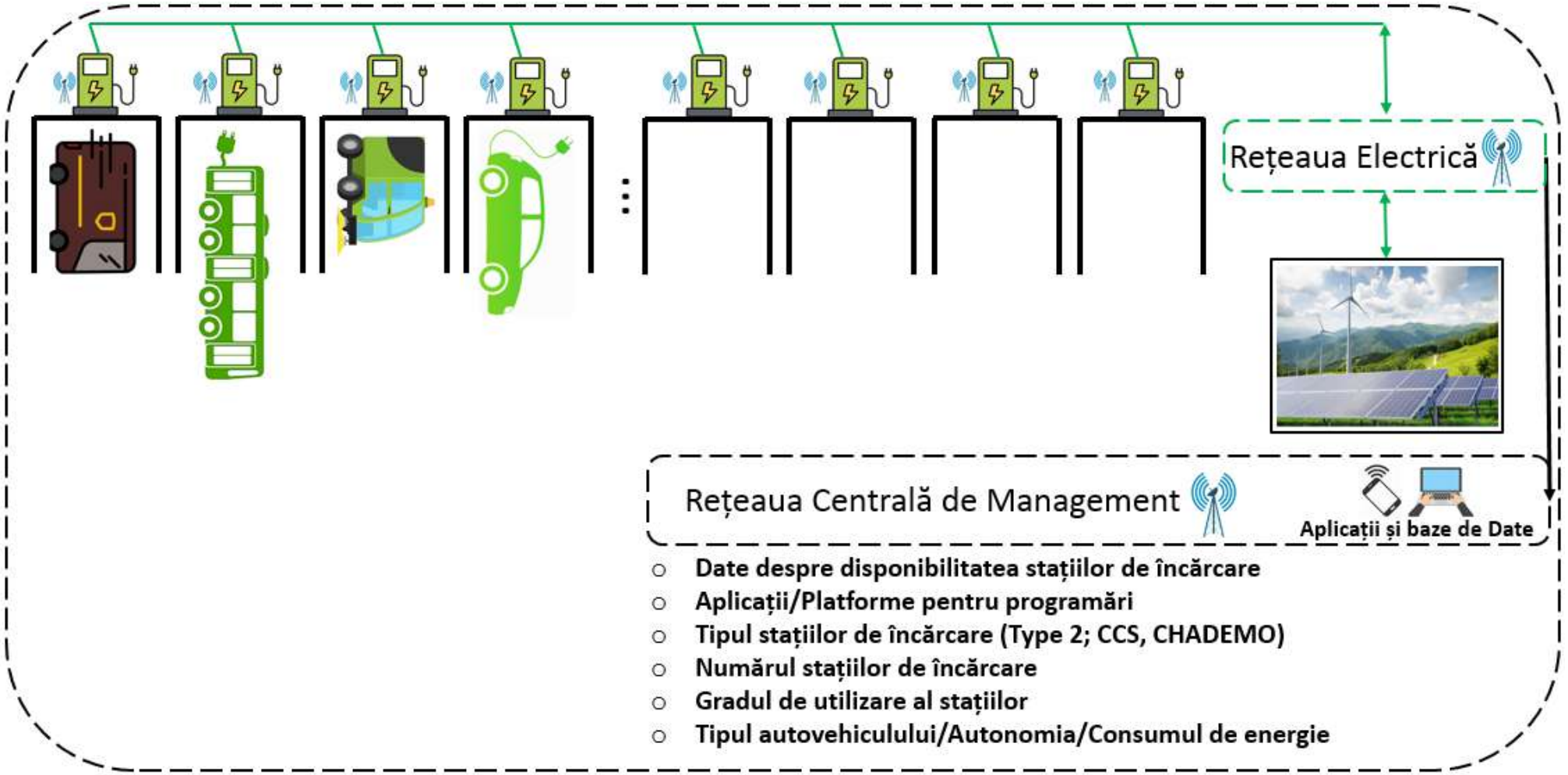
Stadiul actual privind la infrastructura de încărcare

Conceptul „Charging Service”

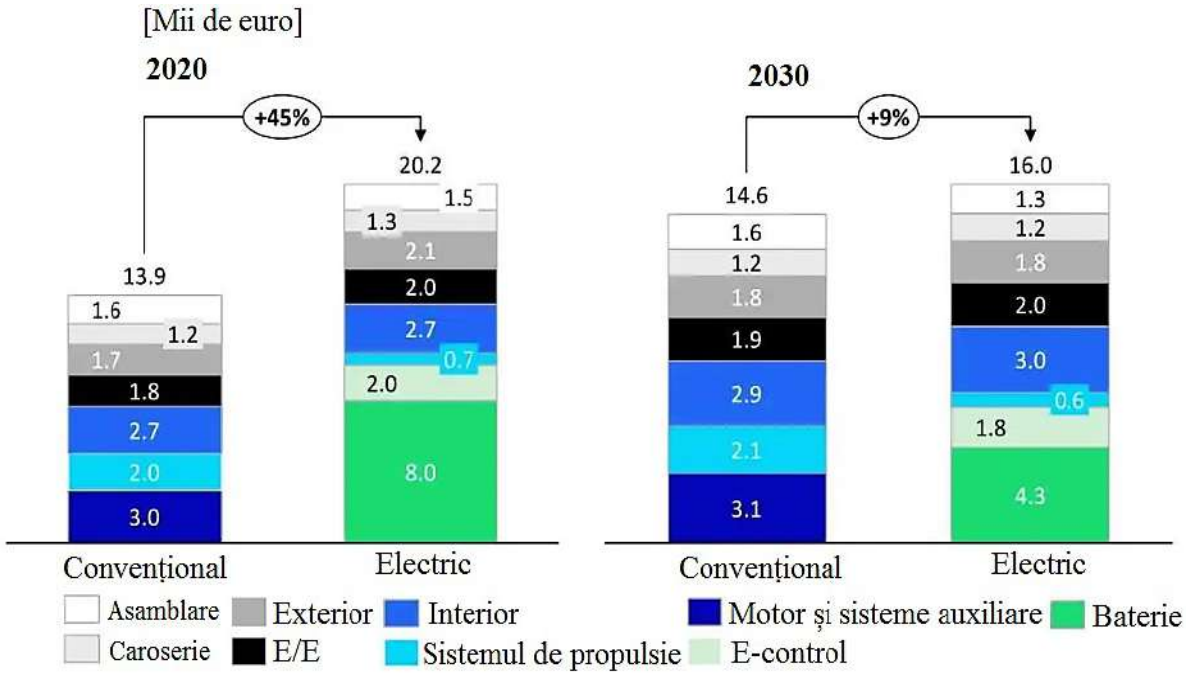
Reprezintă o rețea inteligentă ce perimte încărcarea tuturor vehiculelor electrice, care au nevoie de acest servicu în exploatare, indiferent de categoria din care fac parte și de sectorul de utilizare.



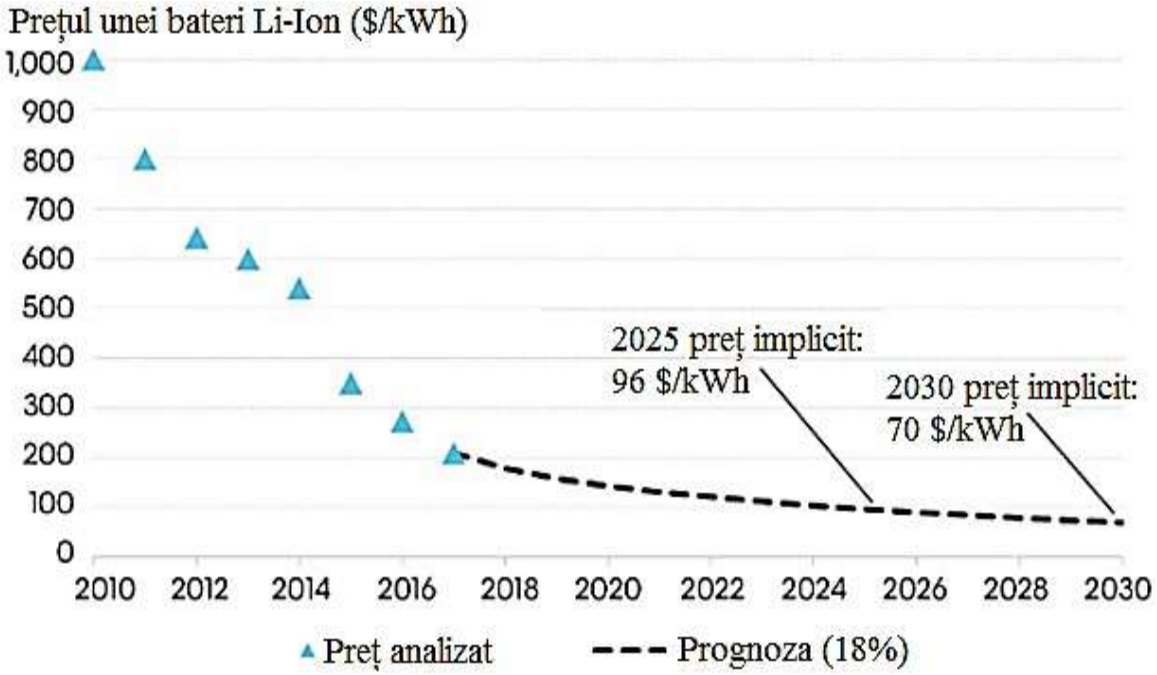
Conceptul „Charging Service" – arhitectura unei rețele inteligente de reîncărcare



Costuri – de producție/de achiziție



Comparație privind costul de producție al celor două tipuri de autovehciule



Stadiul actual și prognoza privind prețul per kWh al bateriilor Li-Ion

- *Care este viitorul autovehiculului electric?*
- *Va fi 2035 anul apogeului în ceea ce privește numărul de autovehicule electrice?*
- *Infrastructura de reîncărcare va mai fi o problemă?*
- *Timpul de reîncărcare va mai fi o problemă?*
- *Care va fi sursa de energie care va domina în viitor?*

Vă mulțumesc pentru atenție!