GOLD AWARD WINNER
BELGIAN BUSINESS AWARDS FOR THE ENVIRONMENT 2021-2022

Watt4Ever

Watt4Ever: transforming end-of-life EV batteries to assets for the energy transition

ALBATTS Webinar 27/01/2023

WATT4EVER
BATTERIES FOR LIFE

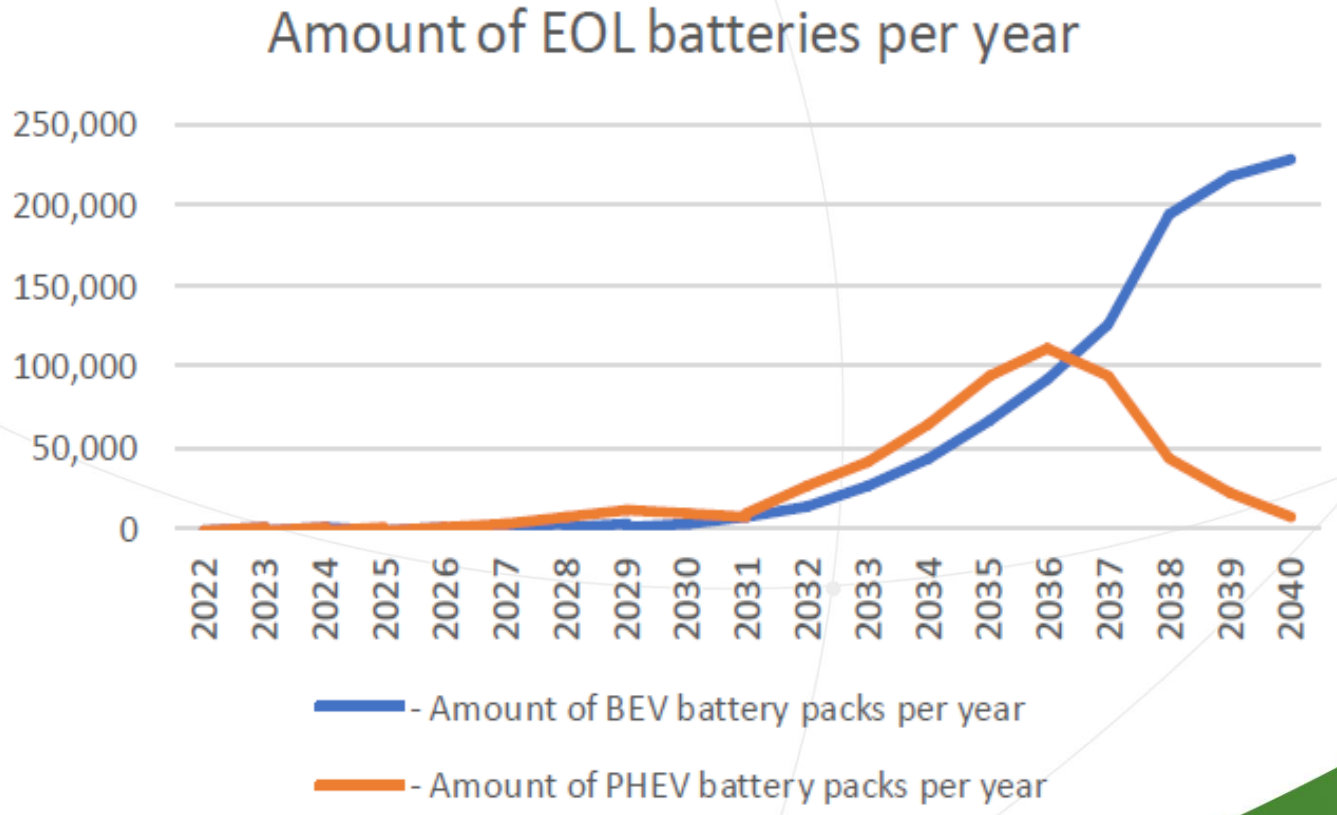
Massive influx of EV batteries: what to do?

A challenge…

Need for services to ensure sustainable & circular end-of-life chain (remanufacture/reuse/recycle)

…and an opportunity

Need for affordable stationary batteries in industrial buildings for backup, renewable energy, grid services, etc.



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BATTERIES FOR LIFE

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BATTERIES FOR LIFE

A battery pioneer dedicated to circular economy

Sustainable, affordable, and tailor-made BESS solutions, from Belgium, for circular economy driven entities.

SL batteries built from used EV batteries

Repair/
Reman/ Refurbish

Engineering, Monitoring, Optimization services

Watt4Ever Facilities

- **HQ: Brussels, BE**
- **Factory: Limburg, BE** (presently)
- Storing
- Testing
- Dismantling
- Assembly line for new batteries

✓ Storage of batteries

✓ Trained HV technicians

✓ Minimum waste approach

Final products: battery modules, battery packs & battery systems

Modules in all types & sizes

LG Chem 6S2P

Pouch cell 24V module with 2.86kWh capacity with internal BMS

1st life: Porsche Taycan

Samsung SDI 12S1P

Prismatic cell 48V module with 2.07 kWh capacity.

1st life: Ford Kuga PHEV

Samsung SDI 16S1P

Prismatic cell 48V module with 1.55 kWh capacity.

1st life: BMW PHEV

CATL 26S

Prismatic cell 94V module with 17.94 KWh capacity.

1st life: MB EQC

Panasonic 12S1P

Prismatic cell 48V module with 1.55 KWh capacity.

1st life: Audi PHEV

Safety

- Cells and modules are tested under IEC 62619 and IEC 62485-2 international safety protocols
- Electric safety design of our systems audited by Vinçotte for electric safety conformity
- Incoming and finished batteries undergo testing and control under a strict quality control procedure
- Storage is done according to national environmental norms

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Environmental gains from second-life batteries

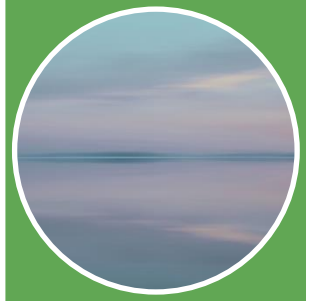
For a typical battery of 100kWh, society avoids:

11tCO_2 of grey emissions[1]

100tCO_2 of emissions by offsetting renewable energy over 10 years[2]

1t of hazardous waste

Extraction of 555kg of Cobalt[1]

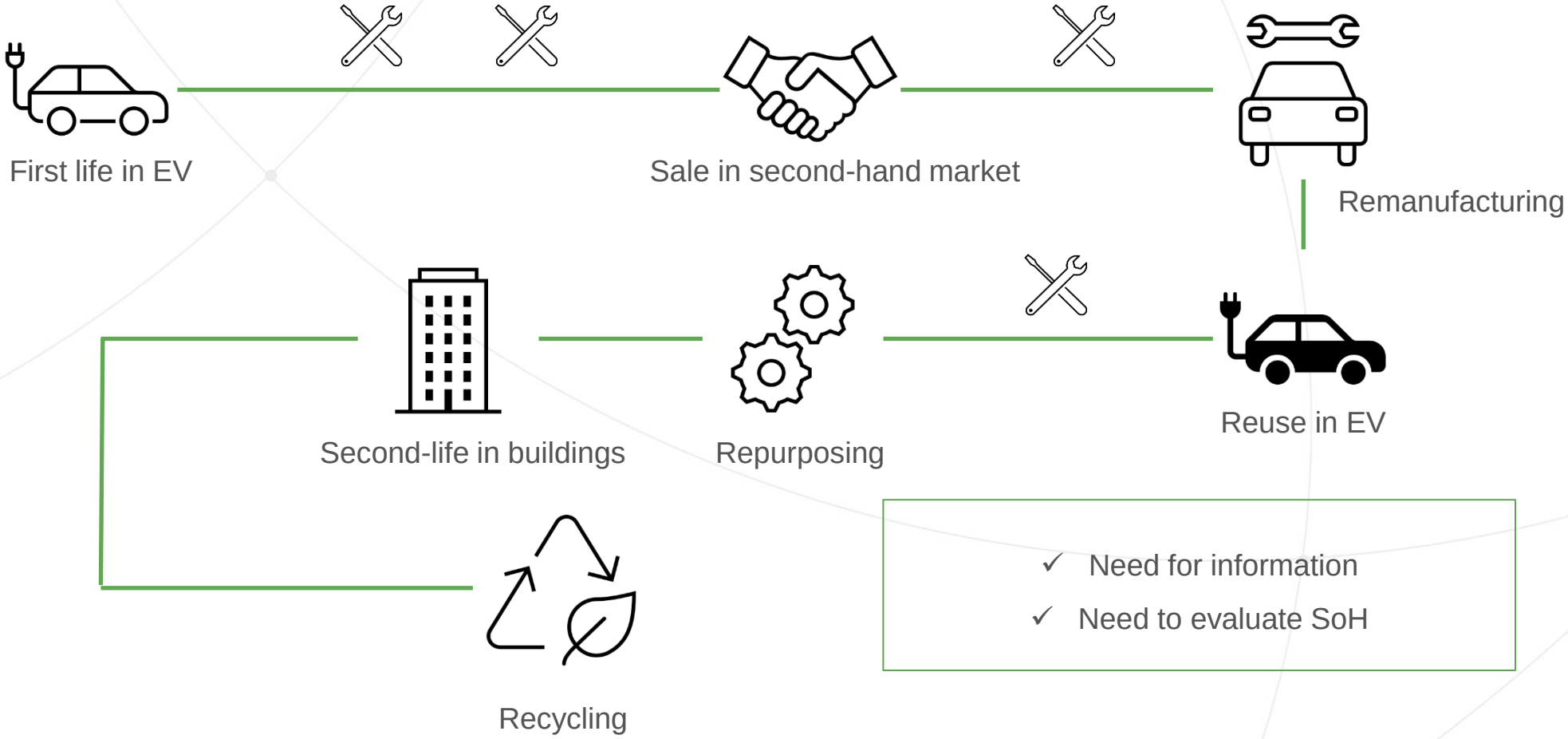


Impact on water reserves[3]

Incl. avoided grey emissions and expected life-cycle emissions over 10 years versus no battery scenario

Source 1: EU Eco-design study for batteries for NMC 111 chemistry
Source 2: EU Joint Research Centre, Sibelga
Source 3: Coolproducts

Extended life cycle of a battery



- ✓ Need for information
- ✓ Need to evaluate SoH

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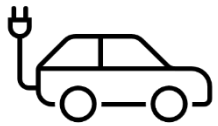
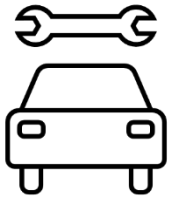
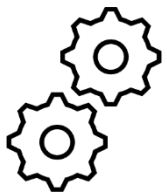
What are necessary skills to maximize battery life?







Stage	Tasks	Skillset categories	Specific training
First life in EV	Battery diagnostics & repair	Blue-collar	HEV 4, battery pack dismantling, training in SoH testing tools
Sale in second-hand market	SoH estimation	Blue-collar	Training in SoH testing tools
Remanufacturing	Dismantling, SoH estimation, new system design, new system assembly	Blue-collar & white-collar	HEV 4, battery pack dismantling, battery pack assembly, safety & performance standards
Repurposing	Dismantling, SoH estimation, new system design, new system assembly	Blue-collar & white-collar	HEV 4, battery pack assembly

Different types of blue-collar trainings

- Besides standard academic trainings, a series of other industry trainings are required for blue-collar personnel.

Battery skills	Logistics	Safety	New battery assembly
• Training on battery dismantling & repair (regulated?) • OEM-specific training	• Safety for transport trainings (IATA certification, UN38.3) • Handling of forklifts & other field equipment • …	• HEV4 • Design for safety industry trainings	• Trainings in norms & standards (IEC standards, UL standards) • Trainings on power electronics

Need to scale-up training offer!

- Battery dismantling & reuse

- HEV 4, various

- Various white-collar & blue-collar trainings

- UL standards

- Safety for air transport

- **Very limited availability!!!**
- **Example: 4-5 months waiting time for HEV4 training**

White-collar education on batteries

- Very good offer for post-graduate curricula in batteries, mostly at PhD level.
- However, battery courses still largely eluding undergraduate curricula

Shout-out to Belgian academia & industry for very advanced offer in post-graduate education, PhD and post-doc programs!

VUB mobi MOBILITY, LOGISTICS & AUTOMOTIVE TECHNOLOGY RESEARCH CENTRE

KU LEUVEN

vito Energy Ville

flux50 ENERGISING THE FUTURE

Still painfully missing: trainings on norms & standards (IEC, UL, UN38.3, national standards etc.)

Not to forget: significant need for research to progress!!!

Worst case scenario: SoH evaluation through characterization/ageing tests, dismantling

€ € €

€

Best case scenario: Retrieval of information from BMS, direct reuse

Significant need to progress in several areas:

- New SoH estimation methods
- Automated dismantling
- New-gen BMS's & EMS's
- Design for recycling & reuse

Great expectations from academia & research funding!

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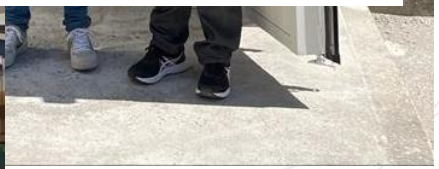
We’re hiring! Want to join us?



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Interested? Contact us to know more!

Contact

info@watt4ever.be

WATT4EVER BV - SRL

Woluwedal 46 b.13 Blvd de la Woluwe

BE-1200 Brussel / Bruxelles

www.watt4ever.be

Importance of standards in recycling batteries in the context of an European circular economy

Iuliana CHILEA

General Director ASRO

Content

Standardization System

Standards & Regulations

The importance of Standardization

Current status and initiatives

Recommendations

Who we are

- private organization association of members
- of public interest
- non-governmental & non-political

recognized as the

National Standardization Body:

- *National Standardization Law 163/2015*
- *EU Regulation 1025/2012*

- manage the national standardization activity in Romania (160 Technical Committees)
- disseminate information about standardization
- sale standards

Member of:

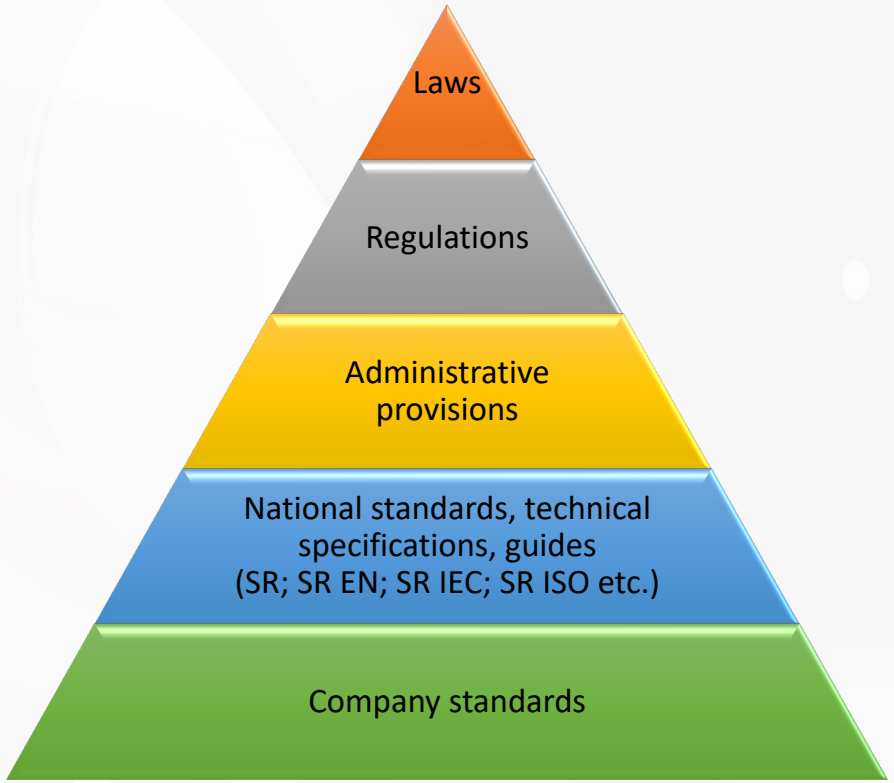
- International Electrotechnical Commission – since 1927
- International Organization for Standardization – since 1950
- European Committee for Standardization – since 2006
- European Committee for Electrotechnical Standardization – since 2006
- European Telecommunications Standards Institute – NSO Member

The European Standardization System

National Standardization Body in Romania

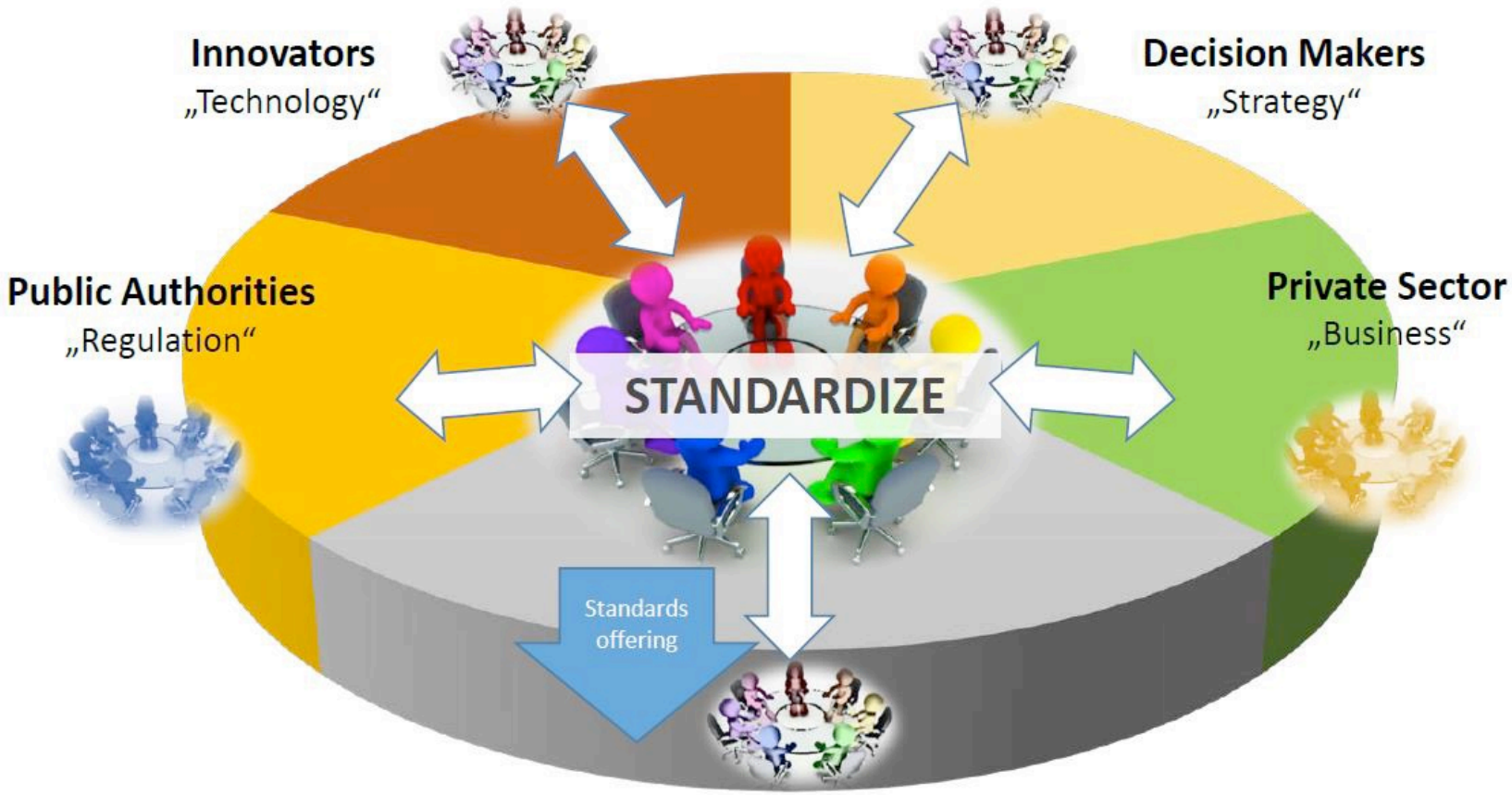
Standards and regulations

- Hierarchy of regulatory documents



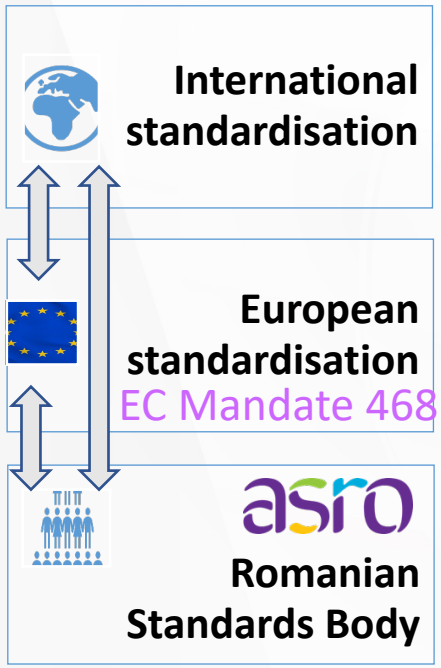
- Using of **standards in all domains**
- Ensuring the implementation of technical regulations;
- Industry - all industrial sectors;
- Design, research and construction;
- Product certification;
- Management systems;
- Public services – healthcare, education, public safety, etc.
- Public procurement and as basis for contract negotiation, etc.

Importance of standardisation



:EN-CENELEC 2021

Standardisation in automotive industry



International standardisation

European standardisation
EC Mandate 468

Romanian Standards Body

Automotive engineering	Electric road vehicles	Charging infrastructure	Charging interface for wired charging
ISO/TC 22 **Road vehicles**	IEC/TC 69 **Electric vehicles** ISO/TC 22/SC 32 ISO/TC 22/SC 37	IEC/TC 64	IEC/TC 23
CEN/TC 301	CLC/TC 69X	CLC/TC 64	CLC/TC 23
ASRO/CT 78 • Manufacturing; • Vehicle to grid communication interface: **SR EN ISO 15118** series	ASRO/CT 333 • Safety requirements related to the electric vehicles and charging stations: **SR EN 61851** series	ASRO/CT 136 • The electrical installations in buildings and metering system interface: **SR HD 60364-7-722**	ASRO/CT 11 • Charging connectors: **SR EN 62196** series • Charging cables: **SR EN 62752**

Standardisation activities concerning the charging of electric vehicles

- **CEN, CENELEC and ETSI develop standards for the electric vehicles and charging infrastructure** - Mandate M/468 concerning charging of electric vehicles and M/579 concerning performance, safety and sustainability requirements for batteries

- **CEN-CENELEC eMobility Coordination Group** was created as a result of the need to coordinate the activities carried out by the involved technical committees by M/468

- **CEN-CENELEC eMobility Coordination Group coordinates** its work program with:
  - CEN-CENELEC-ETSI Smart Grid Coordination Group - M/490
  - CEN-CENELEC-ETSI Smart Metering Coordination Group - M/441
  - CEN-CENELEC Smart and Sustainable Cities and Communities

Standardization for a Circular Economy

ISO/TC 323 Circular economy

Scope: Standardization in the field of Circular Economy to develop frameworks, guidance, supporting tools and requirements for the implementation of activities of all involved organizations, to maximize the contribution to Sustainable Development.

Excluded: Aspects of Circular Economy already covered by existing committees.

Secretariat: AFNOR , France

SUSTAINABLE DEVELOPMENT GOALS

This committee contributes with 4 standards to the following Sustainable Development Goals:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Standardization for a Circular Economy

6 ISO standards under development under the direct responsibility of ISO/TC 323 - Circular economy

ISO/CD 59004 –
Circular Economy – Terminology, Principles and Guidance for Implementation

ISO/CD 59010
Circular Economy — Guidance on the transition of business models and value networks

ISO/CD 59020
Circular Economy — Measuring and assessing Circularity

ISO/WD 59040
Circular Economy — Product Circularity Data Sheet

ISO/CD TR 59031
Circular economy – Performance-based approach – Analysis of cases studies

ISO/CD TR 59032.2
Circular economy - Review of business model implementation

Standardization for a Circular Economy

CEN/CLC/JTC 10 – Material efficiency aspects for products in scope of Ecodesign legislation

Scope: Material efficiency aspects for products in scope of the Ecodesign Directive 2009/125/EC and its future revisions.
Producing generic and horizontal CEN-CENELEC publications covering aspects such as assessment methods, design rules, dematerialization, digitalization and transfer of information on a variety of material efficiency topics, in particular (but not limited to):
-Extending product lifetime
- Ability to reuse components or recycle materials from products at End-of-Life
- Use of reused components and/or recycled materials in products.
* Includes coverage of the European Commission defined list of Critical Raw Materials (CRM).

Secretariat: NEC (CENELEC)

Standardization for a Circular Economy

CEN/CLC/JTC 10 – Material efficiency aspects for products in scope of Ecodesign legislation

EN 45552:2020 General method for the assessment of the durability of energy-related products

EN 45553:2020 General method for the assessment of the ability to remanufacture energy-related products

EN 45554:2020 General methods for the assessment of the ability to repair, reuse and upgrade energy-related products

EN 45555:2019 General methods for assessing the recyclability and recoverability of energy-related products

EN 45556:2019 General method for assessing the proportion of reused components in energy-related products

EN 45557:2020 General method for assessing the proportion of recycled material content in energy-related products

EN 45558:2019 General method to declare the use of critical raw materials in energy-related products

EN 45559:2019 Methods for providing information relating to material efficiency aspects of energy-related products

CLC/TR 45550:2020 Definitions related to material efficiency

prEN 45560 Method to achieve circular designs of products (Under Drafting)

Other relevant technical committees

ISO/TC 298 Rare earth

Scope: Standardization in the field of rare earth mining, concentration, extraction, separation and conversion to useful rare earth compounds/materials (including oxides, salts, metals, master alloys, etc.) which are key inputs to manufacturing and further production process in a safe and environmentally sustainable manner.

Secretariat: SAC – China

SUSTAINABLE DEVELOPMENT GOALS

This committee contributes with 8 standards to the following Sustainable Development Goals:

Recommendations

- All stakeholders obtain benefits by the involvement in standardization work carried out within technical committees;
- National Regulators should maintain close collaboration with Standardization Technical Committees according to their competence domains, having in view that the standards shall be prepared to be used as technical basis for regulations;
- Participation in the standards development process of all national representatives of the industry, regulators, equipment manufacturers, professional associations, consumers, universities, etc. in the European and international technical committees.
- Close collaboration between all representatives of automotive industry, manufacturers of Electric Vehicles batteries and the waste recycling industry (electronic and electrotechnical equipment, including EV batteries) as well as regulators in order to contribute, within the international and European technical committees (e.g. ISO TC 298, IEC TC 111, CLC/TC 111), to the development process of suitable standards for recycling of vehicles, their batteries and the other electronic components in order to meet the environmental and health requirements provided by relevant European policies.

Q & A

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ROSTANDARD

JAN 2023

circunomics

@ ALBATTS

Safe recycling and secondary use of EV batteries: Required Skills and Competencies from a AI-driven Company perspective

JENNY GAEKEL - HUMAN RESOURCES BUSINESS PARTNER - CIRCUNOMICS.COM

Pitch

URBAN BATTERY MINING

120 GWh
USED BATTERIES IN 2030

Gigantic & Overlooked Market Opportunity
Electric vehicles (EV) are coming — by the millions. But what will happen to the batteries after use in the car? Used battery volumes will grow faster than newly produced batteries in 2030 (40x vs. 10x). 120 GWh (= 2 million EV battery packs) of used electric vehicle batteries could be re-used for energy storage in 2030 in Europe. Still, there is currently no infrastructure to make this happen in reality.

AI-Driven
ANALYTICS AND MARKETPLACE

Unique Technology & Offering
Circunomics' AI-powered battery marketplace allows OEMs access to a quality-checked service network that collects, remanufactures, and recycles used batteries at scale. Circunomics analytics are best-in-class in simulating the performance of second-life batteries. Our unfair advantage is access to battery cells, second-life data, and in-depth recycling know-how.

13 FTE
9 NATIONS, ELITE UNIVERSITIES

Experienced Team, Investors & Advisory Board
Leadership team that developed intelligent platform solutions, digital services for tier 1 automotive OEMs, and analytics tools for battery producers. Investors with NASDAQ IPOs and advisory board with DAX C-level managers.

€ 1.4m
PROJECTED REVENUE 2023

Commercialization
Currently, 50 MW is on the platform, and an additional 50 MW supply is incoming. MoUs with ESS Manufacturers and multiple Recyclers, starting pilots with several OEMs. Together with Shell, we signed a Co-Sales agreement to tackle the enormous Automotive OEM and energy sector.

Pitch

Memberships & Associations

Catena-X Automotive Network

VDA Verband der Automobilindustrie

BEPA Batteries European Partnership Association

VDE

GLOBAL BATTERY ALLIANCE
BATTERIES POWERING SUSTAINABLE DEVELOPMENT

DIN

What makes a battery truly sustainable?

The battery is responsible for 50% of the cost of an electric vehicle or energy storage and almost 70% of its lifecycle carbon emissions. The most powerful lever to reduce the carbon footprint and increase the profitability of a battery is a second life/use.

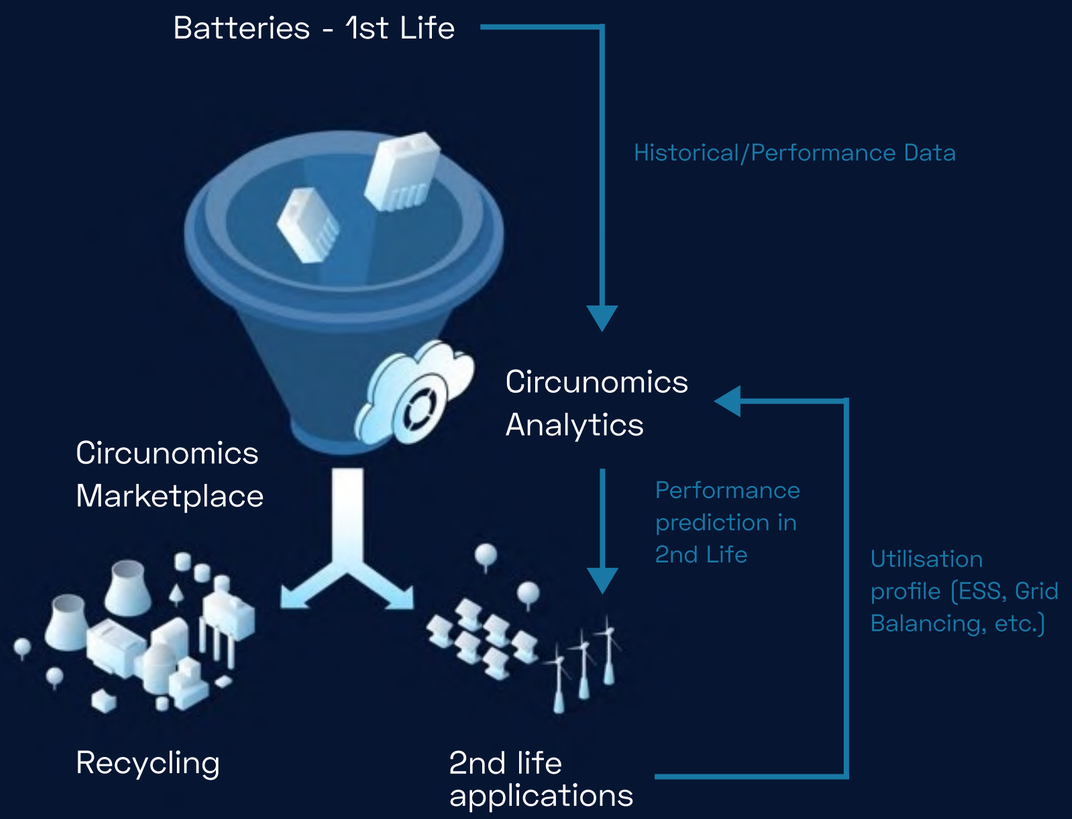
The world needs circular batteries.

To make this a reality, OEMs and energy companies need a partner to manage millions of used batteries. They have no partner to transport, test, dismantle, remanufacture, and recycle tens of thousands of used batteries.

This is what Circunomics is changing.

How Circunomics can help generating maximum value from batteries

Circunomics is based on two main components. Circular Analytics (1st life analytics & 2nd life simulations) and a marketplace for trading batteries into a second life. Deciding whether a battery is suitable for second life can be complex, especially for large volumes, and buyers want to know how well these batteries will perform in their application. Circunomics helps battery owners (OEMs) and buyers take those decisions at scale.



Essential Competencies for AI Deployment

1

Ability to Learn

AI deployment requires continuous monitoring and modification, so one of the critical competencies for our team members is the ability to learn. AI engineers and data scientists may require as much training as their models because the AI field is rapidly evolving, with new algorithms appearing frequently.

2

Relevant Technical Knowledge

One primary requirement for the AI engineer or data scientist is solid technical knowledge. Technical members of our deployment team need to be familiar with neural networks, deep learning, algorithm development, software development, programming, data science, statistics, and other AI fundamentals.

3

Understanding of Security and Data Privacy

Team members also need to consider whether data privacy issues are involved, as this may affect the design and implementation of the AI model. That's because several applications for artificial intelligence involve sensitive assets or data.

And with the overarching competencies and skills already mentioned, the most important thing is!

Do Know Exactly What You're Looking For

DATA SCIENTIST

- Uses data to build algorithms or machine learning models, that answer business questions or address business needs

MACHINE LEARNING ARCHITECT

- Maintains resources needed to ensure a scalable and flexible environment for machine learning model pipelines
- Also introduces new technologies when appropriate that improve machine learning model performance in production

DATA LEADER / MANAGER

- Ensures work being done aligns with business goals and that, teams have the necessary tools and resources to build the best solutions

DATA ENGINEER

- Responsible for developing and maintaining analytics structures and data pipelines, including discovering new sources of data and recommending ways to improve data accuracy and quality

ANALYST

- Generate baseline insights for a specific team or line of business and collaborate with data scientists to build larger business-impacting solutions

What challenges do we face as a facilitator (SaaS Provider) of secondary use and safe recycling of EV Batteries?

As a Battery Engineer

- Lab testing, design, and supervision of data quality
- Fast, cheap, and accurate SoH, SoC estimation from the field, historical, and lab data
- Anomaly detection and batteries security

As a Data Scientist

- Developing AI and physics-based models
- Capturing non-linearities (especially when SoC is near the extrema 0% or 100%, the effect of temperature, high C-rates, aging phenomena...
- Optimizing the parameters, model validation, and testing.

As an Analyst

- Analyzing, Cleaning, exploring and get insight from data and design impactful KPIs

What challenges do we face as a facilitator (SaaS Provider) of secondary use and safe recycling of EV Batteries?

As a Data Engineer/Architect

- Design resilient and scalable architecture and infrastructure
- Developing Data Pipelines
- Cybersecurity and data privacy

As a Software Engineer (different roles with different competencies)

- Frontend-Development (Development of User Interfaces)
- Backend-Development (Development of server-side applications and API's)
- Software-Architects (Provide experienced leadership and technical direction, Own the entire software development lifecycle - problem definition, design, development)
- DevOps (Infrastructure as Code, CI&CD, Monitoring and Tracking Performance of the whole Infrastructure)

As a Human Resources Business Partner

- Strategic Leader
- International Mindset
- Qualified Talent Scouting
- Transparent, Trustworthy and Direct Communication

Thank you

www.circunomics.com
Phone +49 (0)160 9289233
E-Mail jenny.gaekel@circunomics.com

Pitch

Skills and Competencies for Battery Recycling and Battery Handling

27.1.2023

Johannes Rößner

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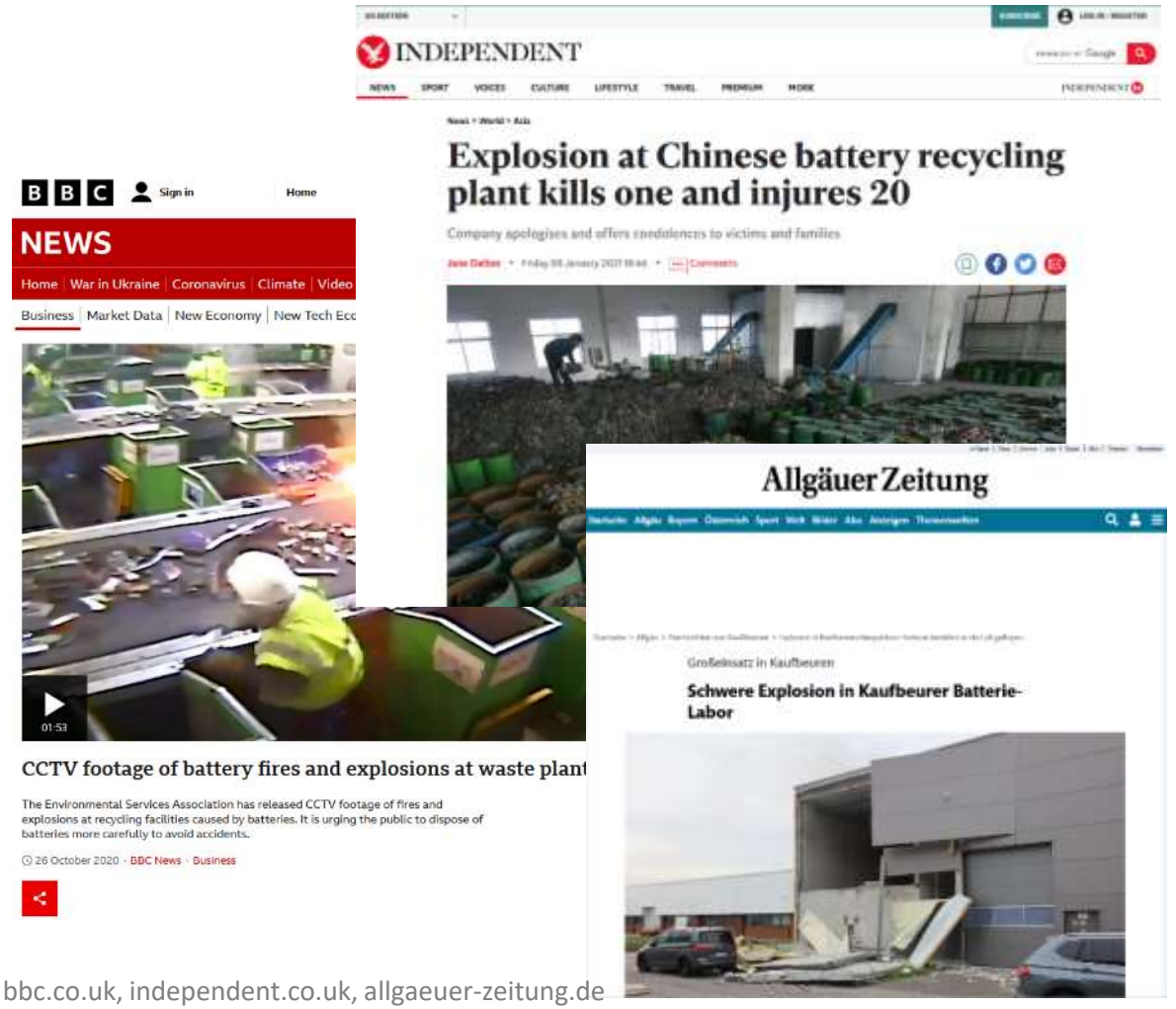
Importance of safety in battery handling

- Safe battery handling is a key point for successful operation
- Risks exist towards:
  - People
  - Machines
  - Environment
- Risk of event until batteries are drained of energy



Source: bbc.co.uk, independent.co.uk, allgaeuer-zeitung.de

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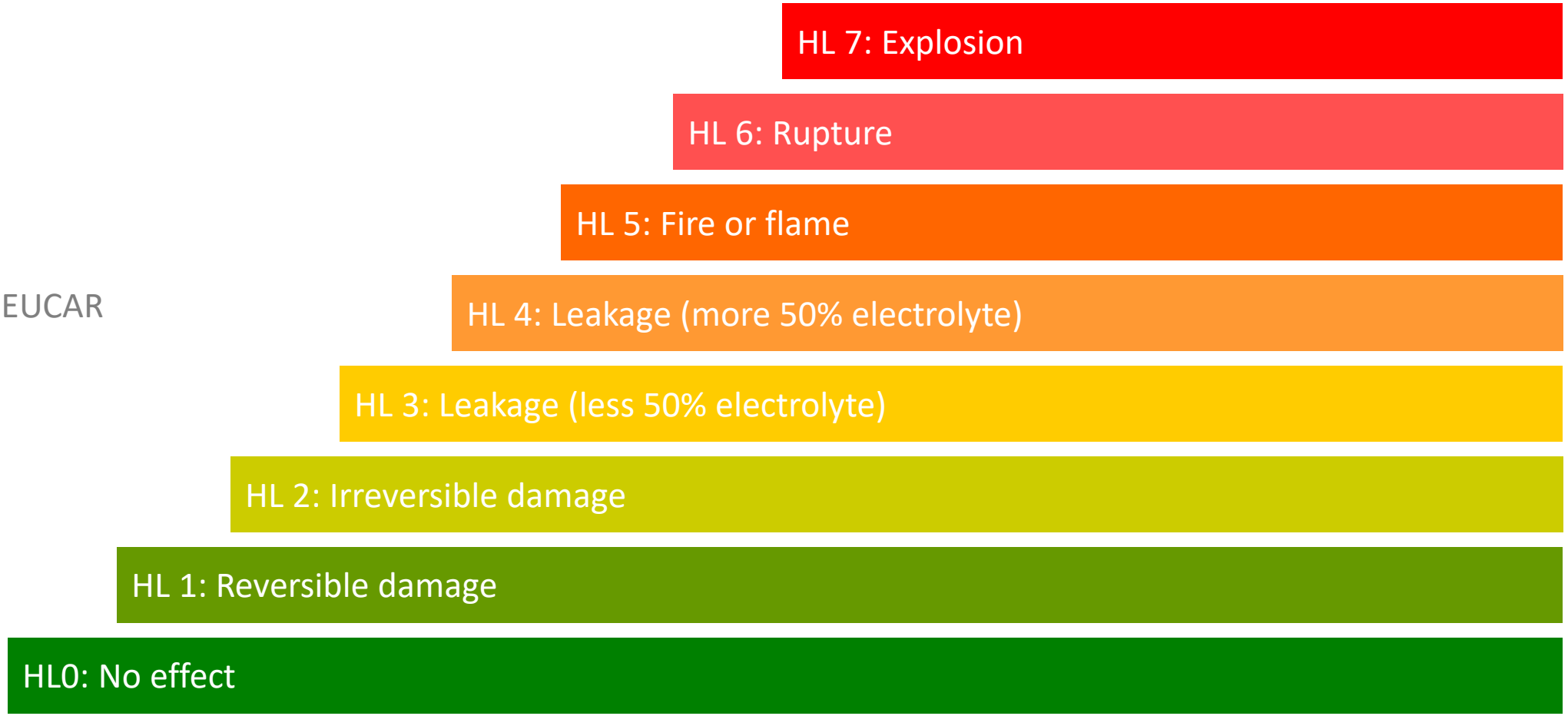
What can happen: Hazard levels

According to EUCAR



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What can lead to such a reaction

- False treatment: outside of the operation conditions
  - Too hot
  - Too cold
  - Too high voltage
  - Too low voltage
  - Too high charge current
  - Too high discharge current
  - Too humid&dirty environment

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Battery Safety
The recycling view

- Behavior of old batteries is not fully clear
- Batteries that go to recycling:
  - Towards end of life = poor SOH
  - Damaged
  - Sometimes undefined state / no means to analyze the status
- Typical handling can trigger event:
  Vibration & shock // Drop // Short circuit // Leakage
- High Voltage carries risk of electrocution in case of wrong handling
- As long as cell/pack contains energy, there is a risk
- Only after complete discharge can the battery be expected to be safe

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Skills & Competency
HV training and the actual doing

- Training for dealing with high voltage is baseline for meeting working safety regulations
- HV trainings are focused on government mandated requirements, based on electrical installations
- Work with batteries is only partly considered
- Specific challenges of recycling work is not considered

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Example: Training on battery disassembly

- Recycling company receives old battery packs
- Challenge: disassembly of live battery packs to enable discharging of modules
- 2 day training developed:
  - Sensibilization of dangers arising from batteries
  - Practical training of battery pack disassembly
  - Interactive group-work on batteries

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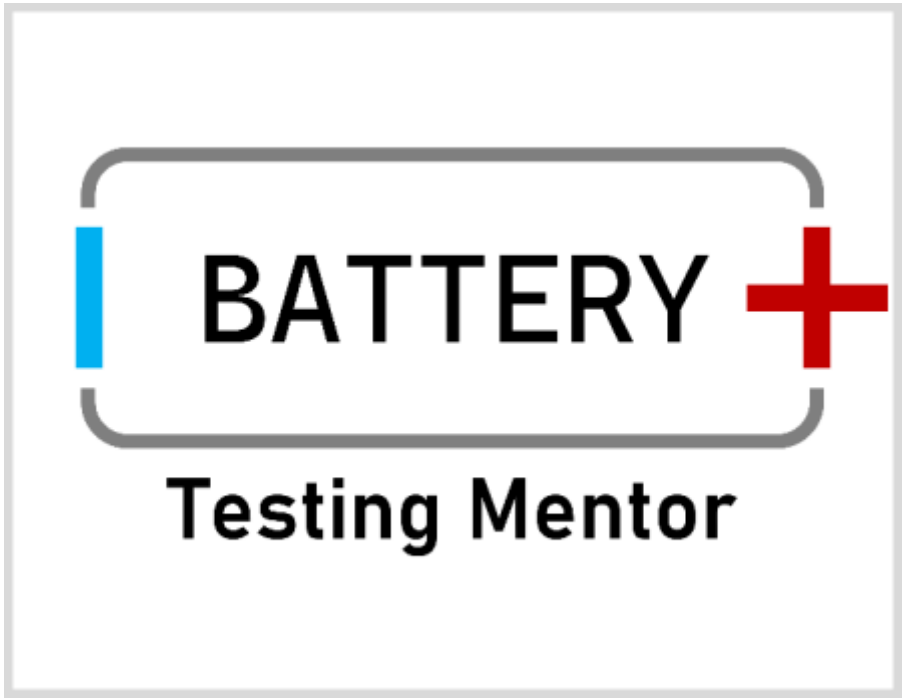
A new battery podcast

- A podcast focusing on advice for battery test labs, but also for companies handling batteries
- Subscribe to emails with the key takeaways for handling batteries
- Actionable, short and to the point!

www.bt-advisor.com/btm



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Get in contact!

BT Advisor UG (haftungsbeschränkt)
Johannes Roessner
+49 163 632 52 70
j.roessner@bt-advisor.com
www.linkedin.com/in/johannes-roessner

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