Battery Pass
thebatterypass.eu

The Battery Pass Technical Standard Stack

December 15th, 2023
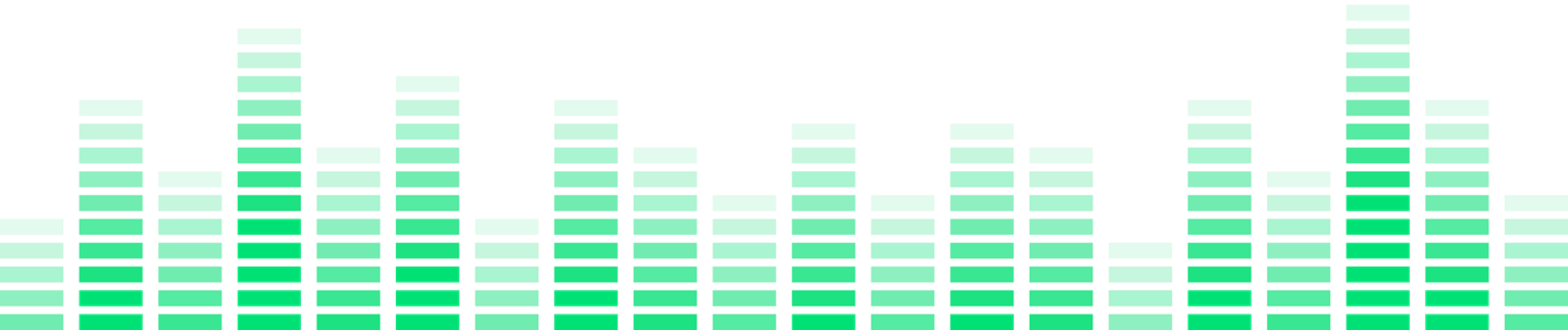
DISCLAIMER

This document (the "Document") is for informational purposes only and is being made available to you by the Battery Pass consortium.

This Document is published by the Battery Pass consortium and contains information that has been or may have been provided by a number of sources. The findings, interpretations and conclusions expressed herein are a result of a collaborative process facilitated and endorsed by the Battery Pass consortium. The Battery Pass consortium partners (the partners as set out on slide 11 of this Document) endorse the overall project approach and findings and the Battery Pass consortium has made efforts to accurately capture stakeholder positions set out by organisations (including supporting partners and further experts), although the results may not necessarily represent the views of all individuals or the organisations they represent. The Battery Pass consortium has not separately verified the information provided from outside sources and cannot take responsibility if any of these statements misrepresent a stakeholder position or if positions evolve over time.

To the extent permitted by law, nothing contained herein shall constitute any representation or warranty and no responsibility or liability is accepted by the Battery Pass consortium as to the accuracy or completeness of any information supplied herein. Recipients of this Document are advised to perform independent verification of information and conduct their own analysis in relation to any of the material set out.
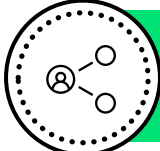
The statements contained herein are made as at the date of the Document. The Battery Pass consortium or any member, employee, counsel, offer, director, representative, agent or affiliate of the Battery Pass consortium does not have any obligation to update or otherwise revise any statements reflecting circumstances arising after the date of this Document.

This Document shall not be treated as tax, regulatory, accounting, legal, investment or any other advice in relation to the recipient of this information and this information should not and cannot be relied upon as such.

If you are in any doubt about the potential purpose to which this communication relates you should consult an authorised person who specialises in advising on business to which it relates.

This document aims to provide a brief overview on the Technical Standard Stack developed by the Battery Pass consortium

Battery Pass

thebatterypass.eu | in | 3

Supported by:

Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag

The Battery Passport

The EU introduces digital product passports (DPP) as part of its broader regulatory ambition towards sustainability with the first being required for batteries from 2027

European Green Deal

Comprehensive plan to make the EU climate-neutral by 2050, safeguard biodiversity, establish a circular economy and eliminate pollution, while boosting the competitiveness of the European industry and ensuring a just transition for the regions and workers affected.

Circular Economy Action Plan

Initiative promoting the sustainable use of resources, especially in resource-intensive sectors with high environmental impact.

Ecodesign for Sustainable Product Regulation	Battery Regulation	End-of-Life Vehicle Regulation
Provisional agreement	*Entered into force*	*Proposal*
• Proposed in Mar 2022, as central part to the Commission's strategy for eco-friendly and circular products • Extends beyond current Ecodesign Directive, which exclusively addresses energy-related products • Aims to promote environmental sustainability across a broader range of products	• Initially proposed in 2020 complementing the Strategic Action Plan for Batteries • Entered into force in Aug 2023 replacing the EU Battery Directive • Provides a legal framework aiming to promote sustainability, circularity, safety and transparency	• Proposed in Jul 2023, as result of the review of the End-of-life Vehicle Directive • Will replace the End-of-life Vehicle Directive as well as the Type-approval Directive • Governs the entire vehicle lifecycle, from design to end-of-life treatment
Introduces **digital product passports** as a general concept	Mandates a **battery passport** for all EV, LMT, and industrial (>2kWh) batteries starting Feb 2027	Mandates a **circularity vehicle passport** starting 7 years after entry into force of the regulation

The regulatory frameworks for the battery passport are the EU Battery Regulation and Ecodesign for Sustainable Products Regulation (ESPR)

● Battery Regulation   ● Ecodesign for Sustainable Products Regulation (ESPR)   ⬚ Standardization process

Trialogue negotiations between European institutions

Regulation entered into force

Battery passport adoption (pilot for DPPs)

Apr-Dec 2022   Aug 2023   *Secondary legislation process*   Feb 2027

Mar 2022   End 2023 (expected)   *Secondary legislation process*   Jun 2027 (expected)

Adoption of Proposal

Regulation enters into force

ESPR adoption

Jul 2023   Dec 2023   Jan 2024   End-2025

24 months

Kick-Off CEN CENELEC SRAHG   "Final" Standardisation Request   JTC24 starts work   Publication of Harmonised Standards (hEN)

SRAHG: Standardization Request – Ad-hoc Group; **JTC:** Joint Technical Committee; **hEN:** harmonised Standard

Battery Pass

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

The purpose of the battery passport is to provide transparency and awareness, enable the shift to a circular economy, and create a level playing field

Purpose of the battery passport

♻	**Enable the shift from linear to circular economies**	• Provide the required "situational awareness" for batteries including, for example a "product-as-a-service" mode, instead of considering a product a consumable only • Keep products within the system to save resources and minimize the amount of actual waste • Leverage data for optimizing circularity processes
🔍	**Provide transparency to impact decisions**	• Enable informed decisions based on comprehensive data being provided digitally • Bridge information gaps in the battery value chain to maximize lifetime value • Leverage new insights from use and fate for design and production
👪	**Create a battery level playing field**	• Build the future battery value chain on multi-stakeholder responsibilities • Move stakeholders to compete on sustainable innovation • Develop business models that operate on value creation, value capture, and value conservation

The Battery Passport is defined in Article 77 of the Battery Regulation and encompasses reporting requirements covering the entire battery life cycle

Not exhaustive

Lifecycle stages

	Sourcing & production	Usage	End of life
Art. 6: Restriction of substances	●───────────►		
Art. 7: Carbon footprint	●───────────►		●────────►
Art. 8: Recycled content	●──►		
Art. 9 and 10: Performance and durability	●──────────────────►		
Art. 11: Removability and replaceability	●───────────►		
Art. 12: Safety parameters	●───────────►		
Art. 13: Labelling and marking	●───────────►		
Art. 14: State of health and exp. lifetime	●──────────────────►		
Art. 48-53: Due diligence policies	●───────────►		
Art. 54 – 76: Mgmt. of waste batteries			●────────►
Art. 77 - 78: Digital Battery Passport	●──────────────────────────────────►		
Art. 85: Green public procurement	●───────────►		

Battery Regulation publication in the Official Journal of the European Commission

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag
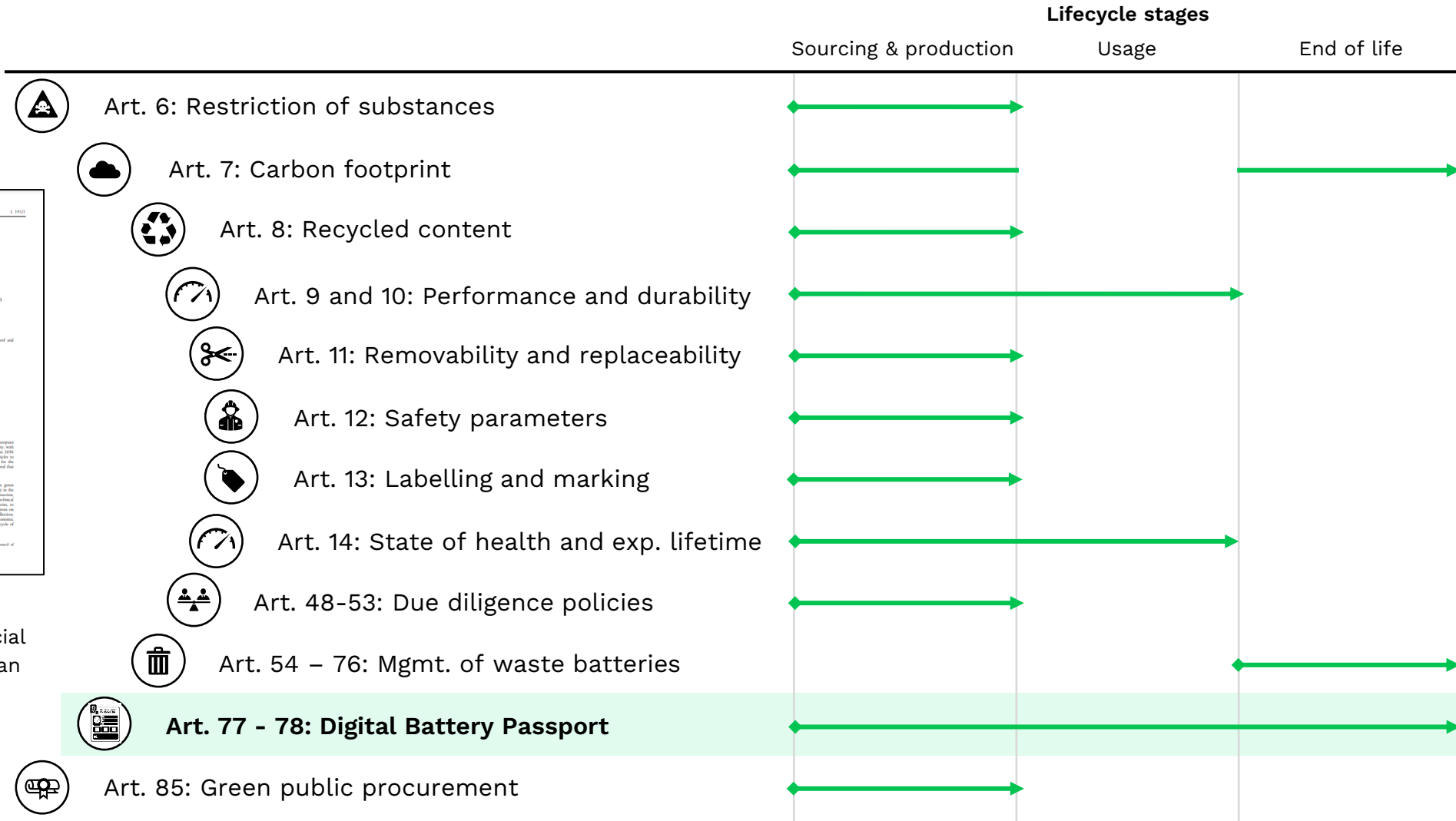
Battery Pass

The scope of information to be made available via the battery passport is extensive with up to 90 data attributes which can be clustered into seven categories

Not exhaustive

Data categories for the battery passport (select data attributes shown below)

Battery Pass

Battery ID: 0101010
Battery passport ID: 1111010
Responsible economic operator

General information

- Manufacturing info (identity, place, date)
- Battery category
- Battery weight
- Battery status

Labels and certifications[1]

- Symbols and labels
- Meaning of labels & symbols
- Declaration of conformity
- Compliance of test results

Carbon footprint

- Carbon footprint (5 metrics)
- Weblink to CF study
- CF performance class

Supply chain due diligence

- Due diligence report

Materials and composition

- Hazardous substances
- Battery chemistry
- Critical raw materials
- Materials used in cathode, anode, electrolyte

Circularity & resource efficiency

- Recycled content shares
- Manuals for removal, disassembly, dismantling
- Component part numbers & spare parts information
- Safety measures/instructions

Performance & durability

- Capacity, energy, power, SoH
- Expected lifetime
- Negative events

1) Labels and symbols are covered in section 5. „Battery materials and composition" in the following. Information on compliance can be found in the main Guidance Document.

The battery passport will be required for EV, LMT and industrial batteries > 2 kWh from February 2027 with the main responsibility lying with the "economic operator"

Specifications for the battery passport

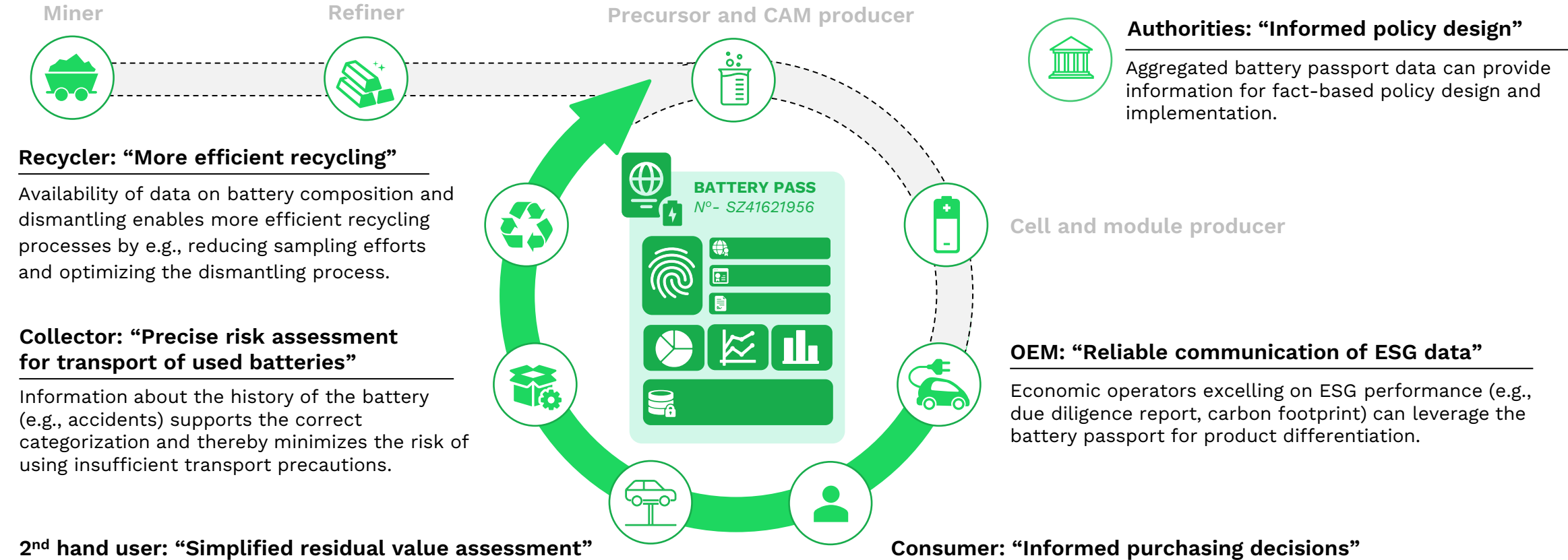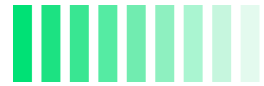|		
⏱	**Timeline**	The battery passport will be required from 18 February 2027
◎	**Scope**	• Batteries in light means of transport (LMT) • Industrial batteries with a capacity greater than 2 kWh • Electric vehicle (EV) batteries
⚖	**Responsibility**	The responsibility lies with the economic operator (or an authorized representative) placing the battery on the market
🔑	**Stakeholder Groups**	1) The "general public" 2) "Notified bodies, market surveillance authorities and the Commission" 3) "Any natural or legal person with a legitimate interest in accessing and processing that information"

Supported by:

Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag

The battery passport will unlock major value along the value chain

Value of the passport:

⬜ Regulatory compliance and potential additional value pending conditions beyond regulatory requirements

🟩 Direct value add along several dimensions (environmental, social and economic)

<u>Select examples</u>

Miner

Refiner

Precursor and CAM producer

Authorities: "Informed policy design"

Aggregated battery passport data can provide information for fact-based policy design and implementation.

Recycler: "More efficient recycling"

Availability of data on battery composition and dismantling enables more efficient recycling processes by e.g., reducing sampling efforts and optimizing the dismantling process.

BATTERY PASS
N°- SZ41621956

Cell and module producer

Collector: "Precise risk assessment for transport of used batteries"

Information about the history of the battery (e.g., accidents) supports the correct categorization and thereby minimizes the risk of using insufficient transport precautions.

OEM: "Reliable communication of ESG data"

Economic operators excelling on ESG performance (e.g., due diligence report, carbon footprint) can leverage the battery passport for product differentiation.

2nd hand user: "Simplified residual value assessment"

Performance and durability data (e.g., remaining capacity) enable downstream businesses and private users to better assess the residual value of the battery to decide between recycling or 2nd life and its specific 2nd life application.

Consumer: "Informed purchasing decisions"

Access to reliable and comparable information about the battery (e.g., carbon footprint) facilitates well-informed purchasing decisions. .

The value of the battery passport is assessed in detail in a distinct work package, the first publication can be expected in Spring 2024.

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

The Battery Pass Consortium

The Battery Pass is a consortium of 11 partners from industry, science, technology and beyond, co-funded by BMWK aiming to provide guidance on the EU battery passport

Key facts on the Battery Pass Consortium

- Evolved from the Circular Economy Initiative Germany (CEID)

- 11 consortium partners from industry, science, technology and beyond

- Co-funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK) with EUR 8.2 mn

- Aiming to advance the implementation of and provide guidance on the EU Battery Passport

- Five work packages including:
  - Project coordination and stakeholder engagement
  - Guidance on content requirements
  - Guidance on technical battery passport system
  - Development of a physical and software demonstrator
  - Value assessment of individual use cases and overall

- 3-year timeframe from April 2022 to April 2025

CONSORTIUM LEAD

SYSTEMIQ

CONSORTIUM PARTNERS

acatech   Audi   BASF We create chemistry   BMW GROUP   Circulor

FIWARE FOUNDATION   Fraunhofer IPK   TWAICE   umicore   VDE RENEWABLES
*under subcontract

Kick-off event of the Battery Pass Consortium in Berlin in April 2022

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

The Battery Pass draws upon a network of associated and supporting partners and guidance of its Advisory Council

The Battery Pass partner network

Associated Partners

GLOBAL BATTERY ALLIANCE | GS1 in Europe | Mercedes-Benz | RWE | SAP

Supporting Partners

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY | ALPHA VENTURI | Battery Associates | BATTERY DAMAGE SERVICE | bat WO man | betteries | CATL | cidetec energy storage | Circular Cars Initiative | DAIMLER TRUCK | DENSO Crafting the Core

DEKRA | DIN | DKE | DMT | energy web | Henkel | Honda R&D Europe (Deutschland) | INOBAT AUTO | JUNGHEINRICH | LG Energy Solution

LiBCycle | Li-Cycle | LogBATT | LRP Autorecycling | MORROW | NIO | northvolt | PEM MOTION | RockTech Lithium | SINE

sonnen | SPHERITY | Stiftung GRS Batterien | StoreDot CHARGING THE EV LIFESTYLE | TÜV VERBAND | We work for tomorrow / UNI GRAZ | volytica diagnostics | wbcsd | zvei electrifying ideas

Advisory Council

EUROPEAN BATTERY ALLIANCE EBA250 | DIN | Federal Ministry for Economic Affairs and Climate Action | Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection | KLiB Kompetenznetzwerk Lithium-Ionen-Batterien | TRANSPORT & ENVIRONMENT | VDE | Wuppertal Institut | zvei electrifying ideas

Supported by:
Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

The Battery Pass supports and collaborates with other major initiatives active in the digital product passport space

CIRPASS — Digital Product Passport

- European Commission "Digital-2021-Trust-01-DIGIPASS" winner
- Kicked off in October 2022 lasting 18 months (March 2024)
- Funding volume: EUR 2 mn
- Partners: 31 organisations
- Objective: build a common understanding of a cross-sectoral DPP
- Focus: Batteries, Textiles, Electronics

Global Battery Alliance

- Leading global voluntary passport initiative
- Objective: enabling transparency and accountability for risks and ESG impacts in EV battery value chains by creating a digital twin of the battery and aggregating data in a battery passport
- 3 early-stage proof of concepts were launched at WEF 2023
- Release of first set of ESG metrics (GHG Rulebook, Child Labour and Human Rights Indices) with additional metrics to follow
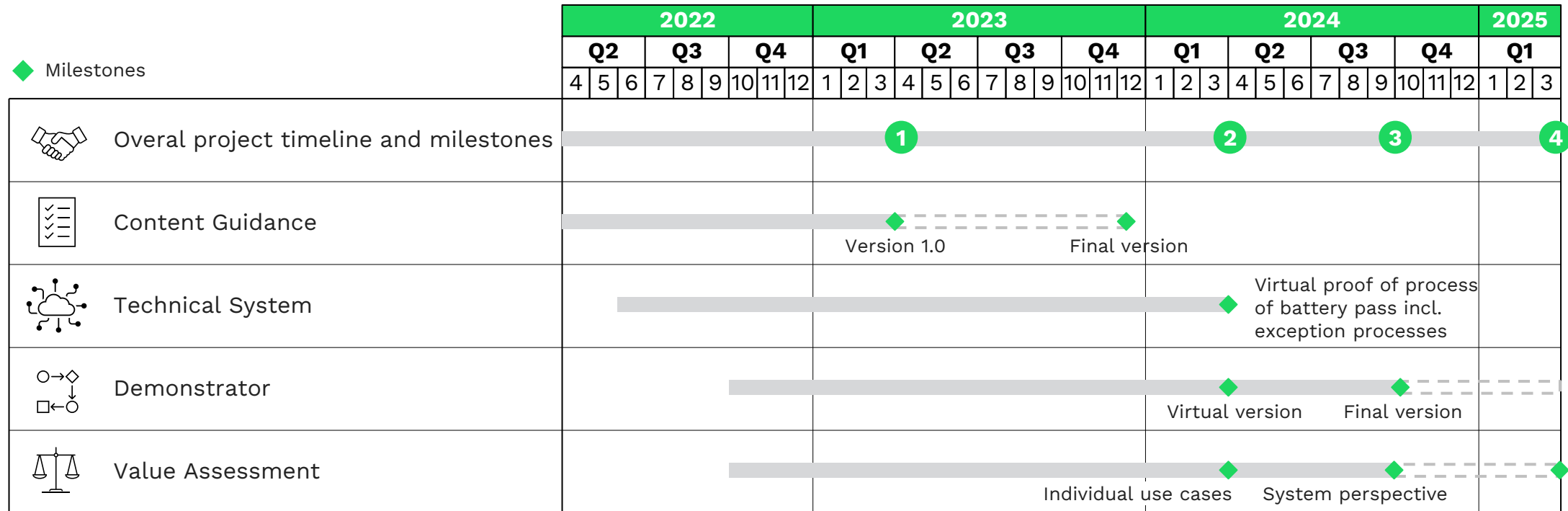
Catena-X — Automotive Network

- Developing a comprehensive data ecosystem with standardized global data exchange for data-driven value chain in the automotive industry
- Based on GAIA-X data space technology to support data sovereignty with distributed data management and sophisticated identity and access management
- Focusing on several use cases including decarbonization and ESG reporting, circularity & battery passport and others

CircuBAT · SAE INTERNATIONAL · bat WO man

NAATBatt INTERNATIONAL · And many more... · zvei electrifying ideas

DIN · CE-RISE · IDTA · DKE

The Battery Pass project runs 3 years: starting with content requirements, the technical system will be analysed, a demonstrator built, and a value assessment conducted

◆ Milestones

	2022			2023												2024												2025		
	Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4		Q1
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

Overal project timeline and milestones — milestones ❶ (Q1 2023), ❷ (Q2 2024), ❸ (Q3 2024), ❹ (Q1 2025)

Content Guidance — Version 1.0, Final version

Technical System — Virtual proof of process of battery pass incl. exception processes

Demonstrator — Virtual version, Final version

Value Assessment — Individual use cases, System perspective, Value model discussed in community

❶ Concept model for data and auditing ❷ Technical system model ❸ Demonstrator in use ❹ Use case model and follow-up for implementation

Battery Pass

thebatterypass.eu

16

The Battery Pass reached its first milestone at Hannover Messe in April 2023 with the handover of its Battery Passport Content Guidance to State Secretary Kellner

Handover of Content Guidance at Hannover Messe

Battery Passport Content Guidance

Comprehensive report
PDF report (200 pages)
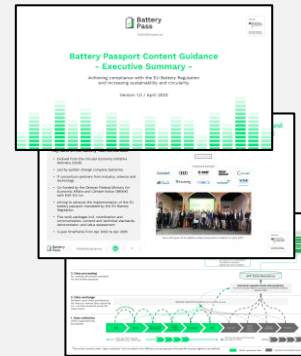
Executive Summary
Slide deck

Data attribute longlist
Excel file

Position Paper to EC
PDF report

Carbon Footprint Documents

Carbon Footprint Rules
PDF report

Carbon Footprint EOL Analysis
PDF report

All documents available on the Battery Pass website

Results of the Content Guidance have been building the foundation for further Battery Pass publications which will soon be released

Technical Guidance

- Objective: provide an overview on how the technical battery passport system could look like and which required technical standards it must support
- Scope: Technical Standard Stack incl. mapping of existing standards as well as key challenges and recommendations

To be released Q1 2024

Demonstrator

- Objective: provide a platform which integrates results on battery passport data and system and verifies technological feasibility of the passport
- Scope: software prototype (TRL 5) covering exemplary real-world data
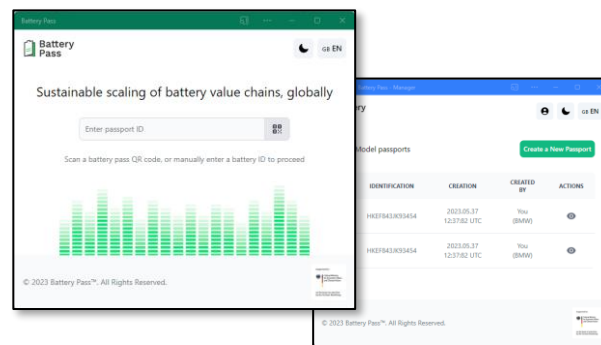
Draft demonstrator to be released Q1 2024

Value Assessment

- Objective: Provide an analytical study to motivate stakeholders to use the battery passport proactively and leverage its full potential.
- Scope: benefit modelling of individual use cases as well as the battery passport overall (incl. a qualitative-conceptual evaluation and exemplary quantification)
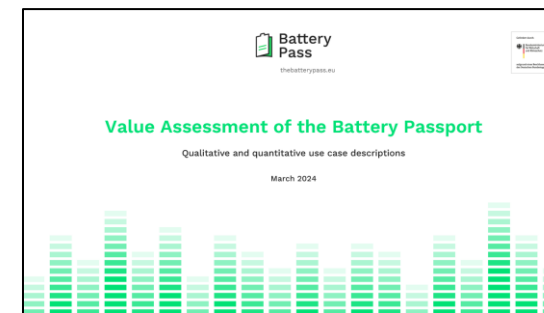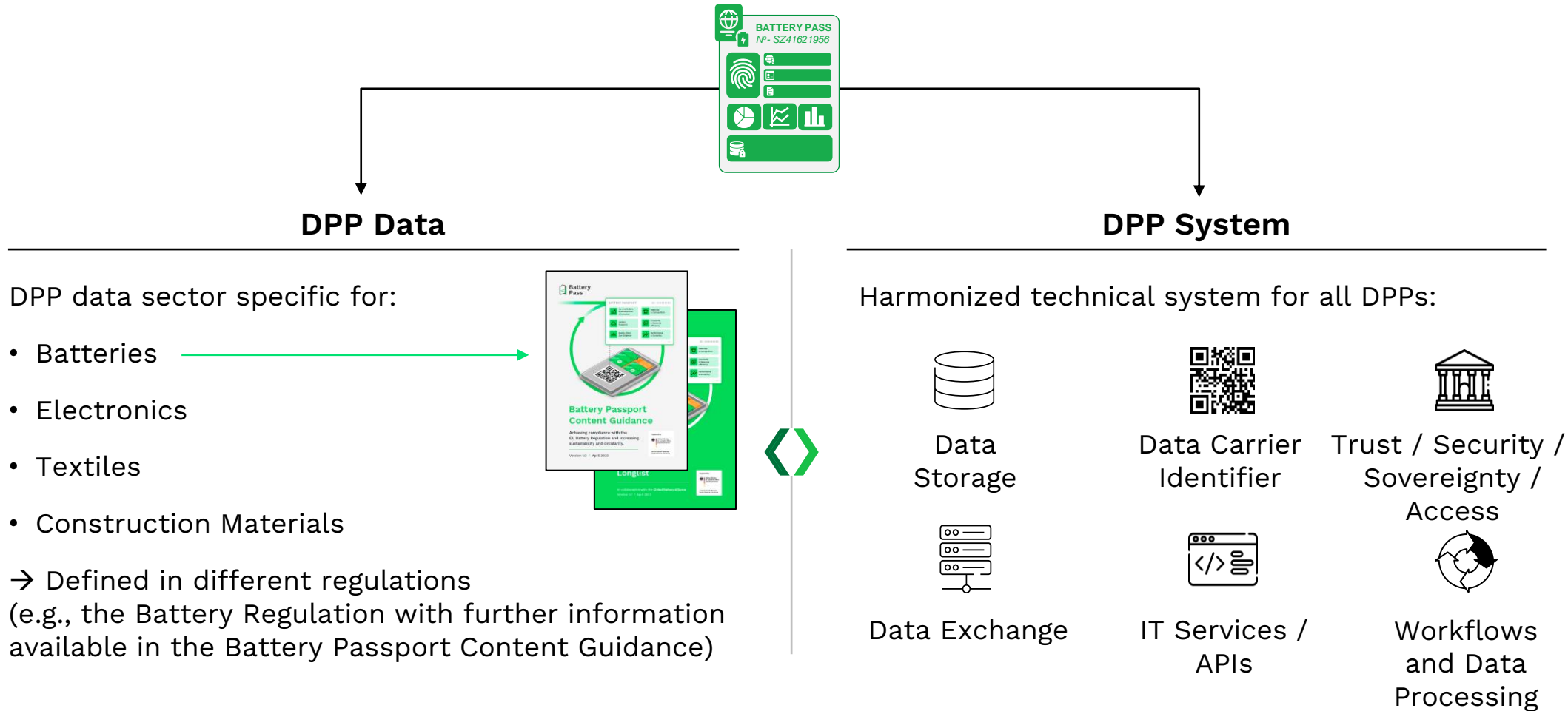

First results to be released Q1 2024

The Digital Battery Passport System

Outlined by the Battery Pass Project

A digital product passport (DPP) consists of data and a system

DPP Data

DPP data sector specific for:

- Batteries
- Electronics
- Textiles
- Construction Materials

→ Defined in different regulations
(e.g., the Battery Regulation with further information available in the Battery Passport Content Guidance)

DPP System

Harmonized technical system for all DPPs:

- Data Storage
- Data Carrier Identifier
- Trust / Security / Sovereignty / Access
- Data Exchange
- IT Services / APIs
- Workflows and Data Processing

A digital product passport (DPP) is a novel concept making available comprehensive lifecycle information of a physical product in digital format

Core elements and functioning of the battery passport system

DPP definition

The European Commission defines a digital product passport (DPP) as:

" *A structured collection of product related data with predefined scope and agreed data ownership and access rights conveyed through a unique identifier.*[1] "

DPP functioning

1) Data is collected within organizations and exchanged between value chain players

2) Data is gathered, processed and transferred for product passport by the economic operator

3) Data is accessed from product passport by pre-defined groups based on respective access rights

3) Data access

Stakeholder Access Groups
- "General public"
- "Notified bodies, market surveillance authorities and the Commission"
- "Any natural or legal person with a legitimate interest"

Data Carrier & Unique Identifier
ID

Passport Registry
By the Commission incl. at least identification data

Web Portal
By the Commission to search for information included in product passports

BATTERY PASS
N°- SZ41621956

2) Data processing

DPP Data repository

Economic operator back-end system(s)
Data is gathered, processed, and transferred

1) Data collection and exchange

Optional supportive systems (e.g., traceability systems)

| Miner | Refiner | Precursor and CAM producer | Cells and modules producer | Pack producer | OEM | User | Re-user Remanu-facturer Repurposer | Collector Dismantler | Recycler |

Static data within upstream organisations ←→ Dynamic and static downstream data

Not specified by regulatory DPP system requirements, but under the responsibility of the economic operators.

1) Galatola, M. Digital Product Passport (DPP). Circular Economy Europe. [Online] [Cited: 20 03 2023.] https://circulareconomy.europa.eu/platform/sites/default/files/michele-galatola-european-commission.pdf

Overview on regulatory references by passport system process steps

Regulatory references (ESPR and Battery Regulation)

1 Data collection and exchange

The **responsibility for collecting and processing** this battery passport **information lies with the economic operator** placing the battery on the market (Battery Regulation, Article 77(4)).

While the regulation requires an **interoperable data exchange network "without vender lock-in"** (Battery Regulation, Article 77(5)) for battery passport data provision, the technology of data collection and processing is not further specified.

2 Data processing

The battery passport should be based on a **decentralized data system**, set up and maintained by economic operators (ESPR (6), Recital 32; Battery Regulation, Recital 126).

Economic operators can authorise other operators to act on their behalf and store the data being accessible via the battery passport (ESPR (6), Article 10(c)).

3 Data access

Product passport registry:

The European Commission will also aggregate and store selected data of the battery passport in the **product passport registry**. This registry, to be set up and maintained by the Commission, should be **accessible to competent national authorities, customs authorities, and the Commission** itself (ESPR (6), Recital 32, Article 12).

The responsibility for uploading the required information to the registry lies with the economic operator placing the product on the market or putting it into service (ESPR, Article 12).

Data carrier:

Access to DPPs shall be provided via a data carrier (ESPR (6), Recital 31), defined as a "linear bar code symbol, a two-dimensional symbol or other automatic identification data capture medium that can be read by a device" (ESPR (6), Article 2(30)).

For the battery passport, this data carrier shall be a QR code (Battery Regulation, Article 77(3)), whereas delegated acts can be adopted by the European Commission to "provide for alternative types of smart labels instead of or in addition to the QR code, in view of technical and scientific progress" (Battery Regulation, Article 13(6, 8)).

Stakeholder groups:

(Article 77(2), Battery Regulation)

- "General public" (Recital 123)
- "Notified bodies, market surveillance authorities and the Commission" (Recital 123)
- Any natural or legal person with a legitimate interest in accessing and processing that information" (Annex XIII (2 and 4))
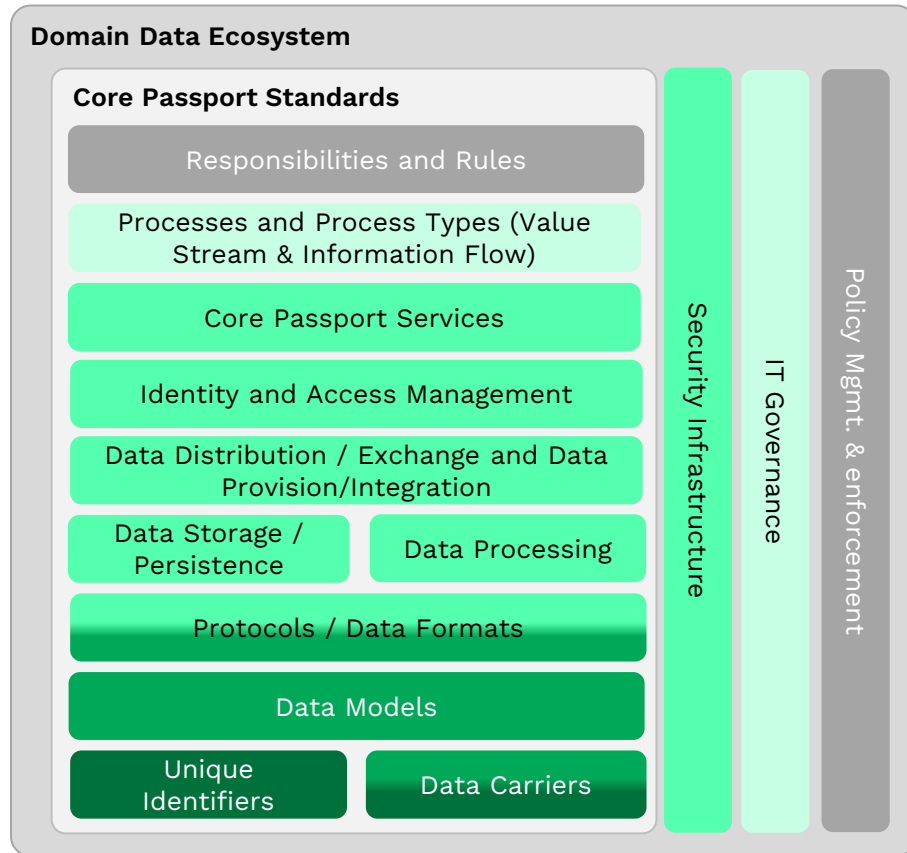
The Battery Pass Technical Standard Stack

Meta structure for implementing an interoperable DPP system

With missing regulatory details, the Battery Pass developed a "Standard Stack", the technical backbone to operate the passport and perform required systems management

The Battery Pass Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types (Value Stream & Information Flow)
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Mgmt. & enforcement

The Technical Standard Stack is representing the minimum required technical standards to be implemented as:

- IT infrastructure

- (Distributed) Software functions

- Management systems

- Governance systems

Via a top-down approach an initial longlist of standards for each element of the Technical Standard Stack has been identified and evaluated afterwards

Standards origin and hierarchy | Select examples

1 Global standards

2 European standards

3 German standards

4 Standard setters

5 Associations
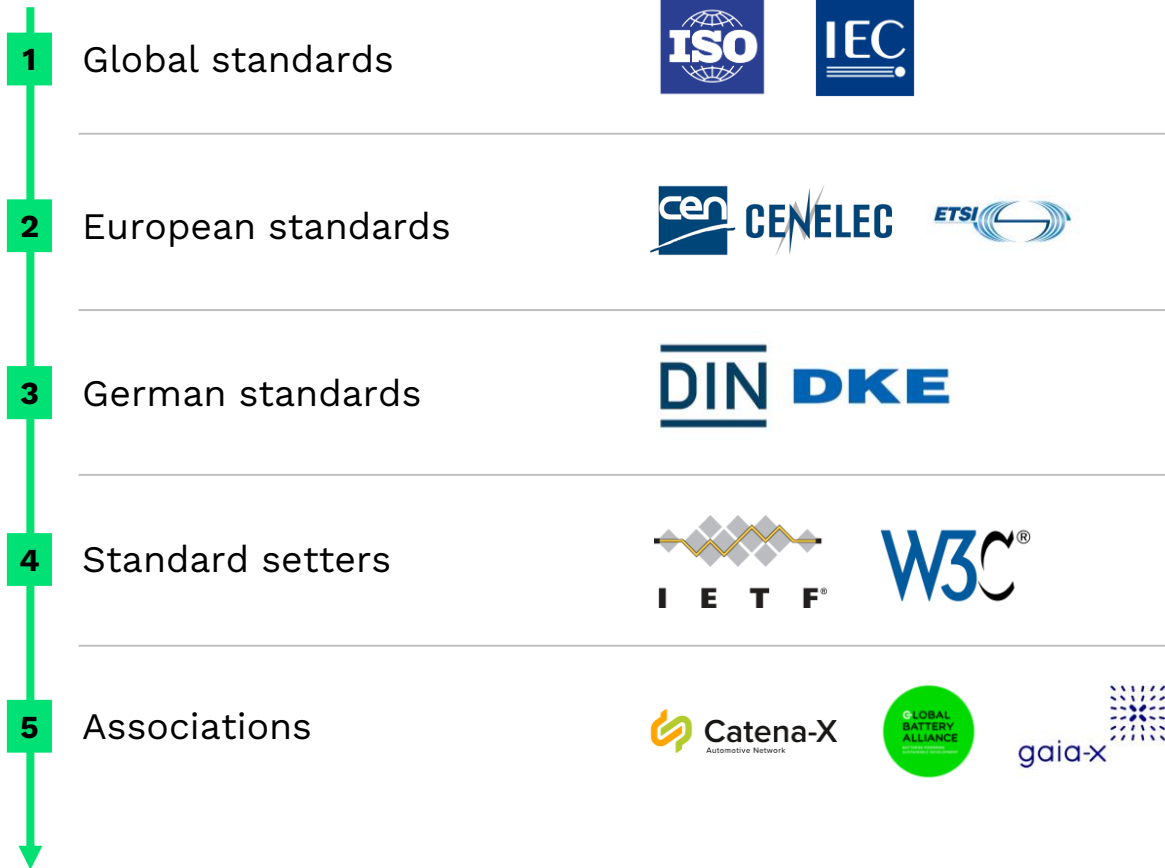
Evaluation criteria

☑ Cross-sector suitability

☑ Open, non-proprietary and independent of specific technical implementation

☑ Co-existence of standards

☑ Consideration of requirements of all stakeholders

→ **Existing mature international standards**
→ **New and innovative approaches**

... according to the standardisation request

Battery Pass

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

The interoperability requirements are numerous – a selection

Common requirements

QR   NFC Tag   Data Matrix   Digital Identification Link

Interoperability 1
Application of different data carriers

NFC

(De-)centralized Product Passport Registry

Unique identifier 1   https://bizx.com/wjwjdhdzejskaow
Unique identifier 2   https://id.dpp.eu/09506000ff13
....

Interoperability 2
Allow different principles of unique identifiers

Stakeholder groups

Common specification

Passport services

Interoperability 3
Routing to different platforms

Identities

Decentralized data

DPP data repository	DPP data repository	DPP data repository	DPP data repository
NGSI-LD	AAS	SQL	GS1 portal

Interoperability 4
Usage of different data management technologies

Supported by:
Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

Why common data models are important for interoperability

One DPP system applicable for different product sectors in the future

Technical Standard Stack

- Data models
- Data distribution / exchange and data provision/ integration
- Protocols / data formats

Regulatory requirements

The product passports should be as uniform as possible across products, industry sectors and relevant EU legislations (standardisation request based on ESPR)

Seamless data exchange between product sector specific DPP

DPP Data

DPP data sector specific for:

- Batteries
- Electronics
- Textiles
- Construction Materials

→ Defined in different regulations (e.g., the Battery Regulation with further information available in the Battery Passport Content Guidance)

DPP System

Harmonized technical system for all DPPs:

- Data Storage
- Data Carrier Identifier
- Trust / Security / Sovereignty / Access
- Data Exchange
- IT Services / APIs
- Workflows and Data Processing

DPP Data Repository — NGSI-LD

DPP Data Repository — AAS

DPP Data Repository — SQL

(Semi-) Automatic sector specific data mapping of DPP system

(Re-) Use existing implementation standards and solutions

Data points are mapped into interoperable semantic models based on RDF

Standardised common meta model based on RDF, defining core data model elements (e.g., entities, properties, data types, physical units, etc.)

Battery Passport
Data Attribute Longlist

In collaboration with the **Global Battery Alliance**
Version 13 / December 2023

Core Language: RDF

Is a → Battery
Bat. ABC12 — Composed of → One Cell
Has a capacity of → 100 mWh
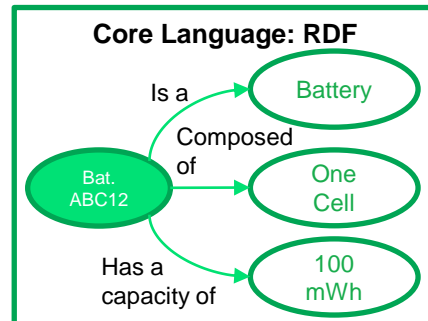
Product-agnostic semantic data models to compose the battery passport data model

General product information	Compliance, labels and certifications	Materials and composition	Carbon footprint
Performance and durability	Circularity and resource efficiency	Supply chain due diligence	
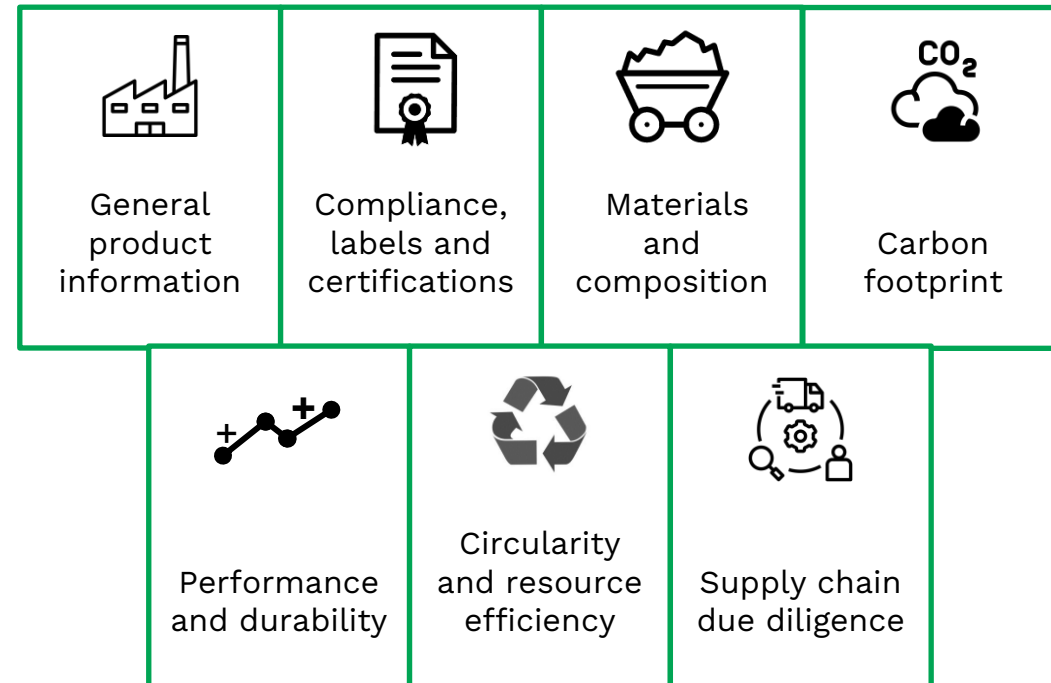
- Extensibility for individual data and updated legislative requirements
- Technology agnostic application in other sectors

Battery Pass

Battery passport data relates to lifecycle stages and product component levels

Technical Standard Stack

Data models

Regulatory requirements

DPP shall help consumers make informed choices by providing access to product information relevant to them (standardisation request based on ESPR)

Two dimensions of granularity have been identified

1 **Lifecycle stages**

- **As-specified:** Technical product characteristics defined during specification phase for model passport prior to concrete technical design

- **As-designed:** Technical product characteristics defined during design phase. Uses averaged ESG metrics based on assumptions, sourced from engineering bill of material (eBOM)

- **As-planned:** Specific production details, including manufacturing processes. Provides more accurate ESG metrics. Information sourced from manufacturing bill of material (mBOM)

- **As-built:** Includes manufacturing conditions, e.g., raw material details. Offers precise ESG metric definition for production stages.

- **As-used (serialized products only):** Individual serial numbers enable tracking of information during product use, incorporating upstream value chain data.

2 **Product component levels**

- Battery pack

- Battery module

- Battery cell

Battery Pass

While the battery passport only relates to the pack level, module and cell data will feed into it

Battery pass granularity matrix

- Battery passport only at pack level

- Model passport for informed purchase decision necessary

- Detailing data in the battery passport down to module item and cell level

- Distinction between cells only necessary if different cell models are used

Lifecycle stages

Component Level	As-specified	As-designed	As-planned	As-built	As-used
	Model	**Model eBoM**	**Model mBoM**	**Batch**	**Item**
Pack	Model passport based on generic technical specification data	Model passport based on design data (eBOM)	Model passport based on production planning data (mBOM)	Batch passport based on manufacturing specific data	Derived from one of the former passports for individual batteries for usage tracking
Module	Data on module item level (no dedicated battery passport but included in the one for the pack)				
Cell	Data on cell model level (no dedicated battery passport but included in the one for the pack)				

BATTERY PASS

eBOM: engineering Bill of Material
mBoM: manufacturing Bill of Material

Battery Pass

thebatterypass.eu

30

The Technical Standard Stack Elements

Technical Standard Stack: Responsibilities and Rules

☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- **Responsibilities and Rules**
- Processes and Process Types (Value Stream and Information Flow)
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement

Description of selected Standard Stack element

In the intricate landscape of a complex IT system like the battery passport system, the concepts of responsibilities and rules emerge as pivotal cornerstones, safeguarding the integrity, security, and efficiency. While this building block doesn't delve into the definition of technical standards, it outlines the specific responsibilities and rules that various stakeholders are entrusted with, particularly in the context of managing lifecycle business cases and addressing incidents.

One prime illustration of the significance of these responsibilities and rules arises when contemplating a change in the economic operator responsible for a battery passport. Such transitions must be executed seamlessly that the continuity of service and data integrity are upheld. Equally paramount is the consideration of bankruptcy scenarios involving companies responsible for data within the battery passport system. In such unfortunate circumstances, it's imperative that the established rules come into play, offering a framework for managing data assets and ensuring that critical information remains accessible and secure.

Technical Standard Stack: Processes and Process Types

☐ Standard Stack element in focus
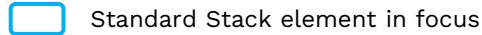
The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- **Processes and Process Types**
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
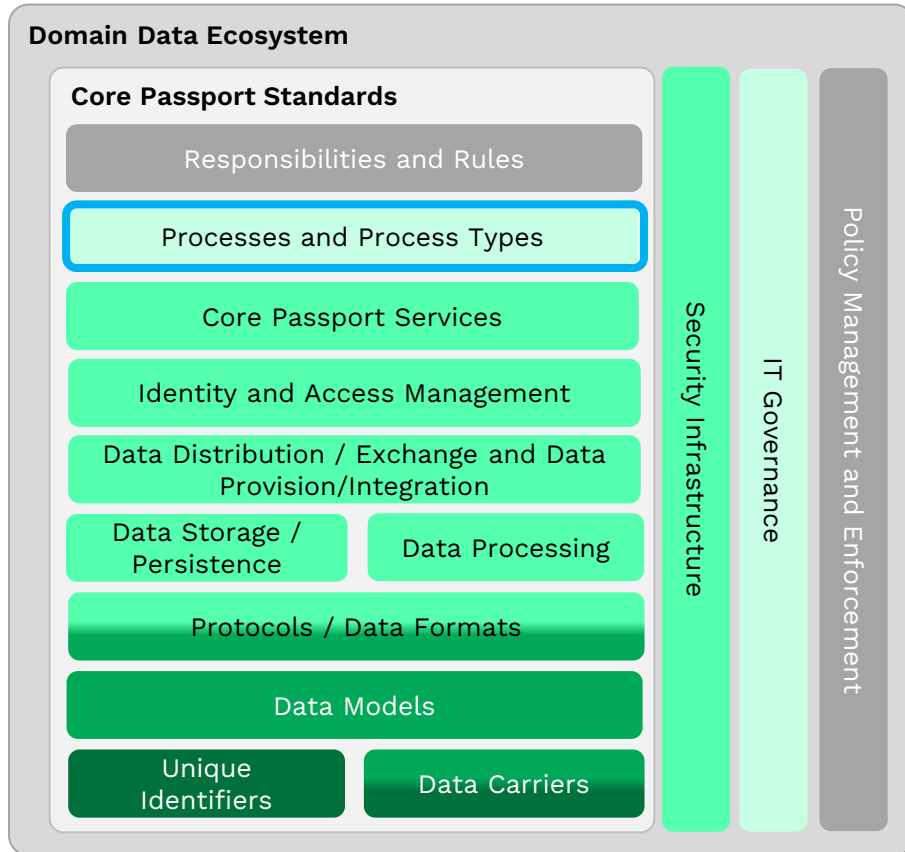
Description of selected Standard Stack element

Typically, processes are separated into **Management, Core Value and Support Processes.** This also applies for the battery passport.

- Management Processes are accreditation, registry, monitoring / measures for organizations, IT-system and eco-system

- The Core Value Processes are the up- and downstream process along the value chain of a battery and its components. Based on the ESPR and Battery Regulation, the battery passport originally does not cover processes from mining to integration. To understand characteristics of these processes, which contribute to the passport, the Battery Pass consortium covers these specifics as well

- Support processes are the operations of technical and organizational resources, required for operating the DPP system

Due to their relevance in the technical battery passport business, the Battery Pass consortium separates **Data and Information Flow** processes along and across the Management, Core Value and Support Processes.

Technical Standard Stack: Core Passport Services

☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

Responsibilities and Rules

Processes and Process Types

Core Passport Services

Identity and Access Management

Data Distribution / Exchange and Data Provision/Integration

Data Storage / Persistence | Data Processing

Protocols / Data Formats

Data Models

Unique Identifiers | Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
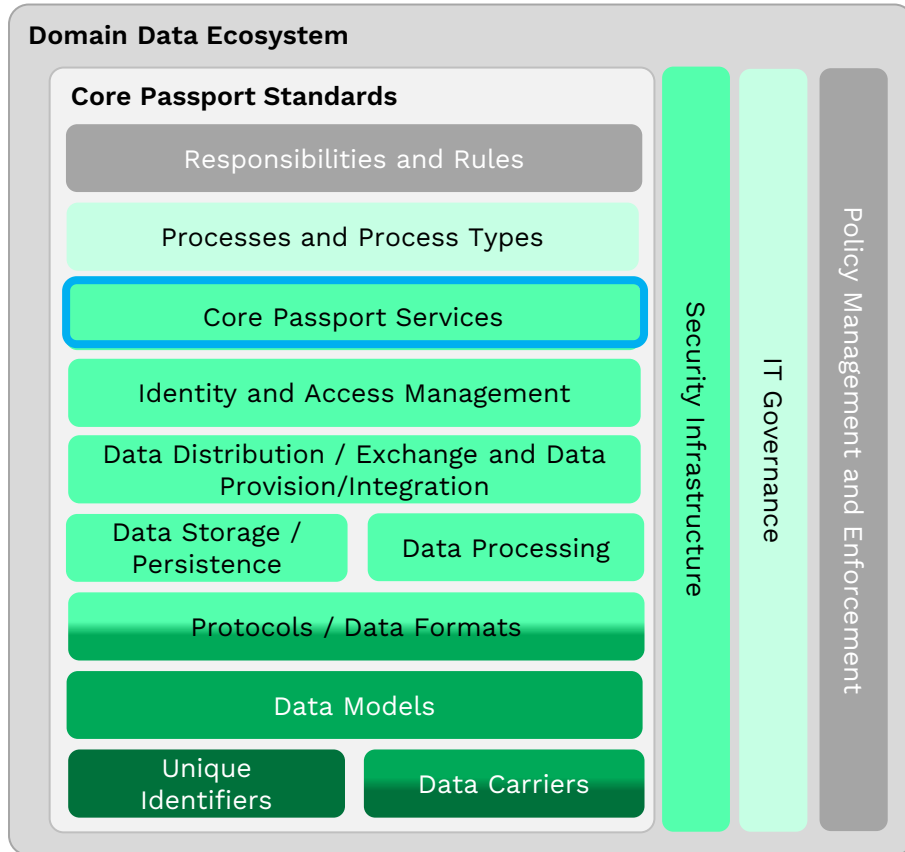
Description of selected Standard Stack element

Central to the functionality of the battery passport system (and all DPP initiatives), are its core services. These integral components provide the bedrock upon which the system operates, offering a range of essential functionalities that are indispensable for its operation. Core services could be, e.g.:

- Basic CRUD API operations (Create, Read, Update, Delete)
- Onboarding services
- Registration services
- Transfer services
- Issuance service
- Archiving service
- View services (e.g. filter)

To specify the functionality and how the core services can be invoked and interacted with, the Battery Pass consortium recommends the use of a Service Definition Language (SDL). An SDL provides a standardized way to define service interfaces, ensuring that services can communicate and interoperate seamlessly, regardless of the technologies used to implement them.

Technical Standard Stack: Identity and Access Management

Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- **Identity and Access Management**
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
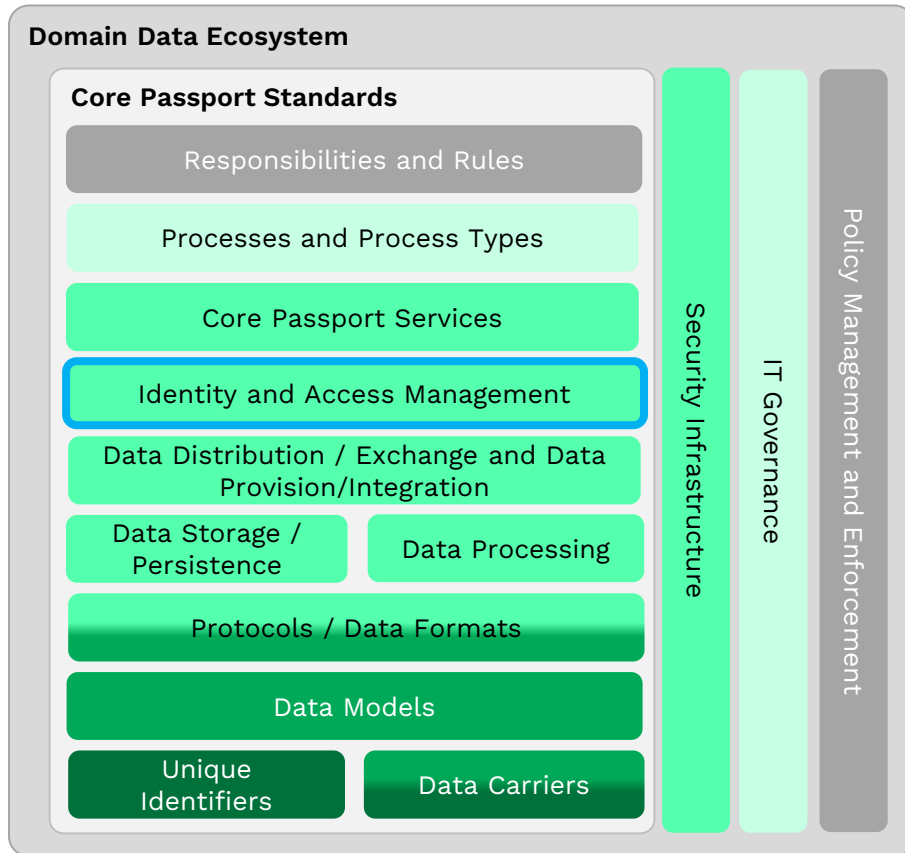
Description of selected Standard Stack element

Identity and access management (IAM or IdAM) is a framework of policies and technologies to ensure that the right users (that are part of the ecosystem connected to or within an enterprise) have the appropriate access to technology resources. To ensure data sovereignty in a global battery passport data space, it is essential to prove the identity and stakeholder roles of any entity within it to enforce access policies to the partially restricted battery passport data attributes.

Technical Standard Stack: Data Distribution / Exchange and Data Provision / Integration

☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- Identity and Access Management
- **Data Distribution / Exchange and Data Provision/Integration**
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
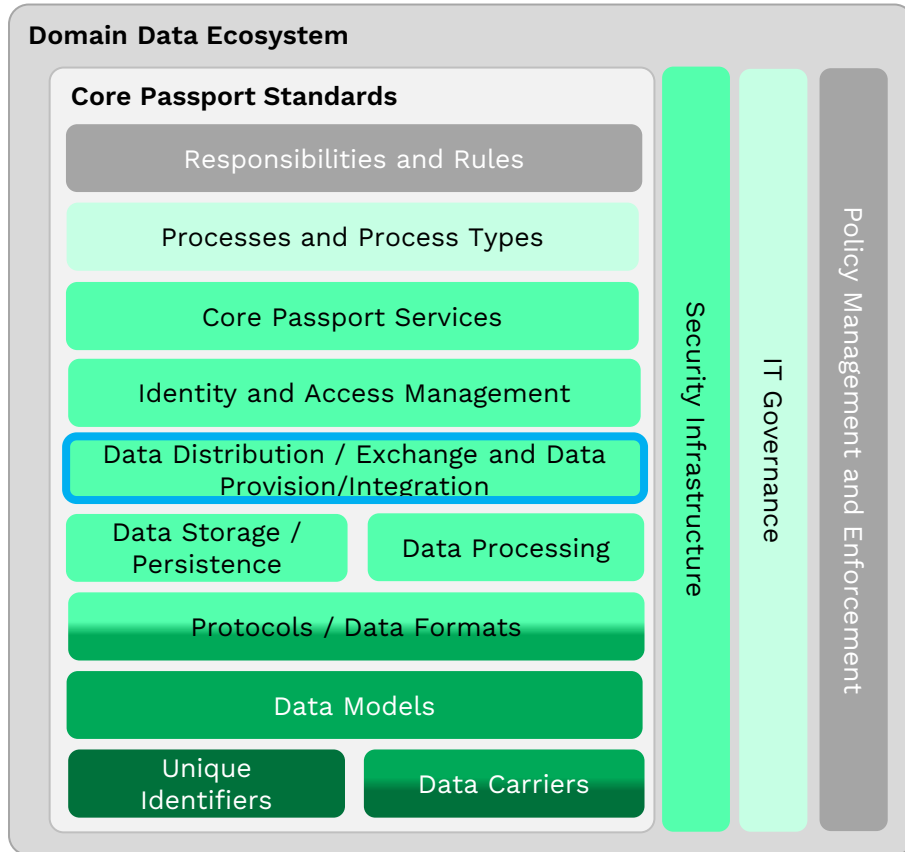
Description of selected Standard Stack element

This element refers to the standard methods and systems used to distribute and exchange data between different parties, such as through APIs or file sharing platforms. In the context of the battery passport, handling the Digital Twin-like data is a complex challenge.

The EU Battery Regulation defines:

"*All information included in the battery passport shall be based on open standards and be in an interoperable format, transferable through an open interoperable data exchange network without vendor lock-in, machine-readable, structured and searchable, in accordance with the essential requirements laid down in Article 78.*" and "*the battery passport shall be fully interoperable with other digital product passports required by Union law concerning eco-design, in relation to the technical, semantic and organisational aspects of end-to-end communi-cation and data transfer*".

Technical Standard Stack: Data Storage / Persistence

☐ Standard Stack element in focus
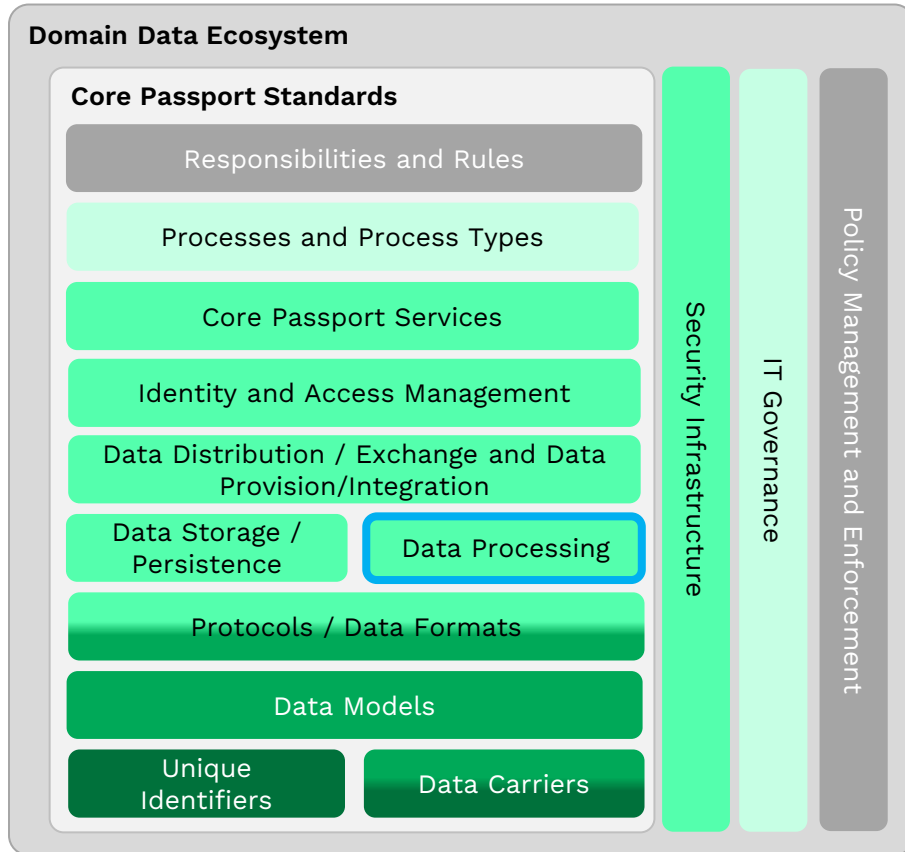
The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- **Data Storage / Persistence** | Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers | Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
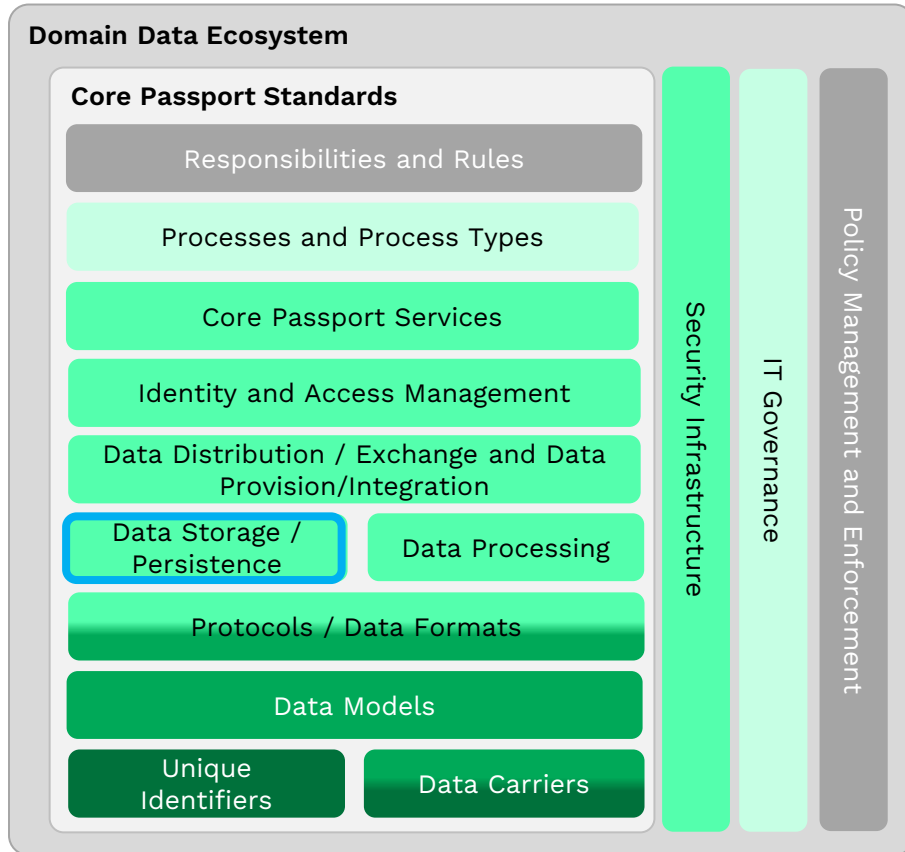
Description of selected Standard Stack element

Data storage and persistence are essential for the battery passport. The choice of storage method depends on factors like data volume, access patterns, performance requirements, and data integrity considerations. Due to the intended distributed management of data, multiple of the above-described methods will be applied. Data storage and persistence refer to the concept of retaining digital information in a way that it can be accessed and retrieved later. This is a crucial aspect of computing and information management, as it allows data to be stored beyond the duration of a single session or use.

Technical Standard Stack: Data Processing

☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

Responsibilities and Rules

Processes and Process Types

Core Passport Services

Identity and Access Management

Data Distribution / Exchange and Data Provision/Integration

Data Storage / Persistence | Data Processing

Protocols / Data Formats

Data Models

Unique Identifiers | Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement

Description of selected Standard Stack element

Data processing refers to the transformation of raw data into meaningful and useful information through a series of operations, computations, and manipulations. It involves collecting, organizing, analysing and converting data into a structured format that can be interpreted and used for various purposes, such as decision-making, reporting, and generating insights.

Data processing can encompass a wide range of activities, including data entry, validation, cleaning, aggregation, calculation, and visualization. The ultimate goal of data processing is to extract valuable insights, patterns, or knowledge from the data to support informed decision-making and improve business processes.

Standards play a significant role in the context of data processing for battery passports. They provide guidelines, specifications, and best practices for collecting, storing, managing, and exchanging data related to batteries throughout their lifecycle. Standards ensure consistency, interoperability, and reliability in data processing.

Technical Standard Stack: Protocols / Data Formats

☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- **Protocols / Data Formats**
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
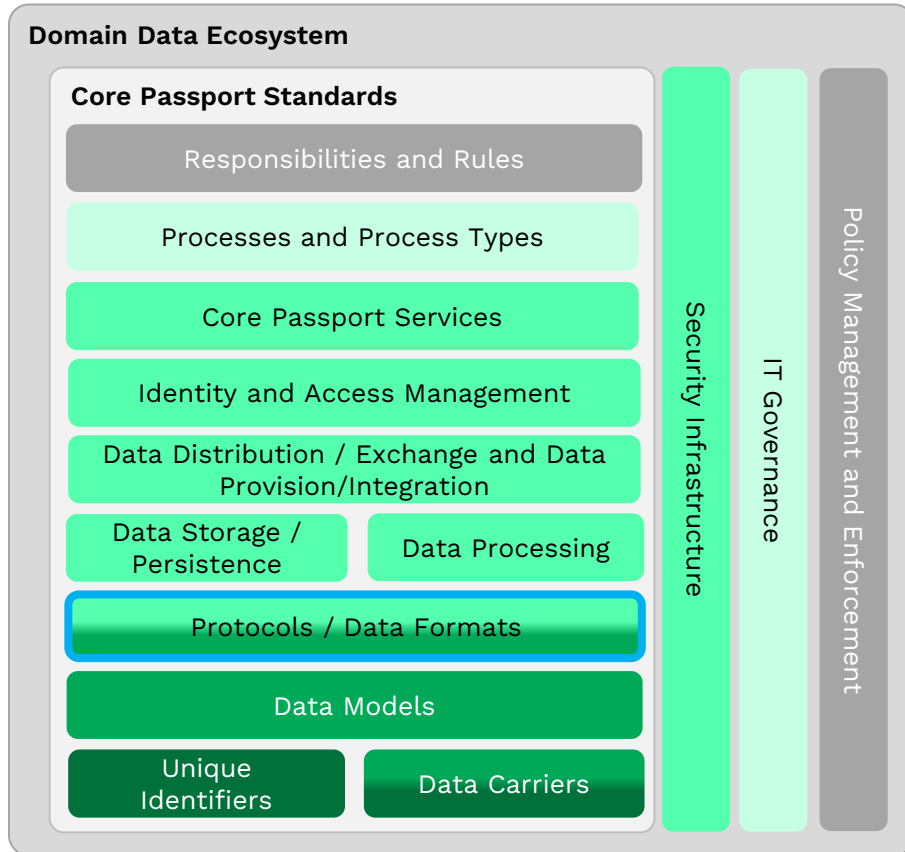
Description of selected Standard Stack element

A protocol in IT defines a set of technical rules that control the exchange of information between different computers or computer networks. Following the major European data space initiatives, the use of the standard combination of HTTPS over TCP/IP should be the protocol standards candidates for the battery passport. A protocol stack that almost any company/developer should be well-experienced in.

A data format typically defines how data is structured, represented and encoded for storage in a computer. Common data formats for the exchange of structured textual information via the internet are XML, JSON and JSON-LD. Non-textual information like PDF documents, images or videos are represented by hyperlinks to external storage locations but not stored within the battery passport directly by following the linked data and semantic web concept.

Technical Standard Stack: Data Models

☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- **Data Models**
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
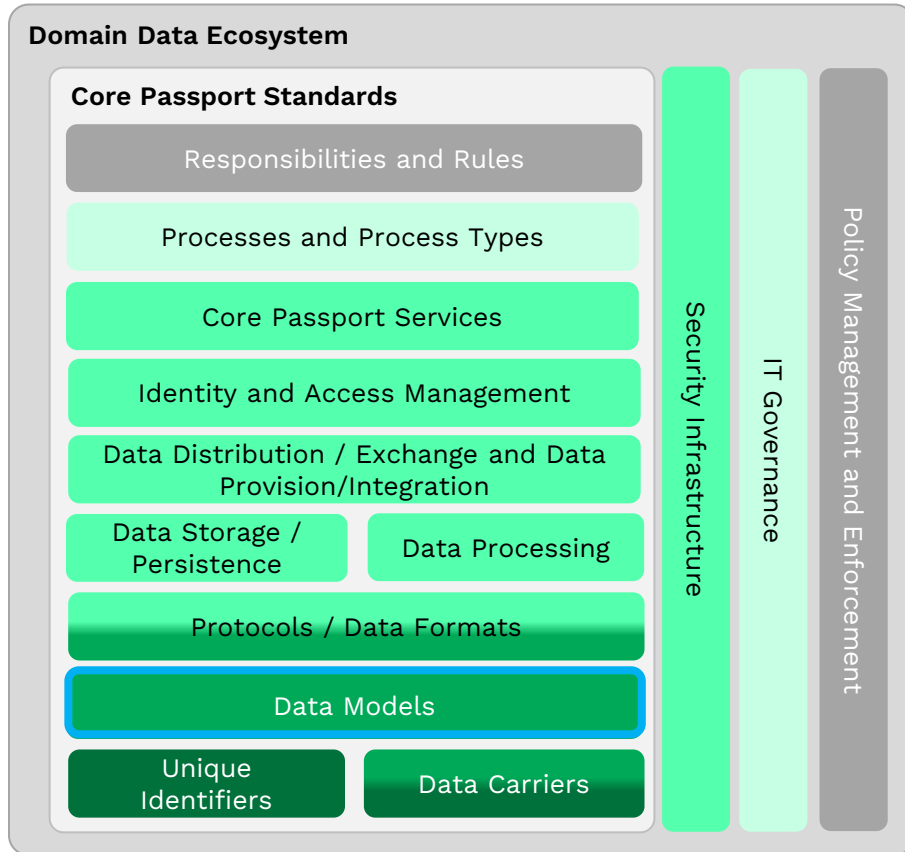
Description of selected Standard Stack element

In an increasingly data-driven world, the effective management and interpretation of information are crucial for informed decision-making and innovative problem-solving. One of the fundamental tools that underpins this process is the data model. A data model serves as a structured representation of data, providing a framework for understanding, organizing, and manipulating information. It is a critical component in fields ranging from computer science and database management to business analysis and scientific research, playing an essential role in transforming raw data into valuable insights. From that perspective it's crucial for the battery passport.

To enable interoperability, a common data model approach is necessary to ensure that data exchange can be performed in a reliable way.

Technical Standard Stack: Unique Identifiers

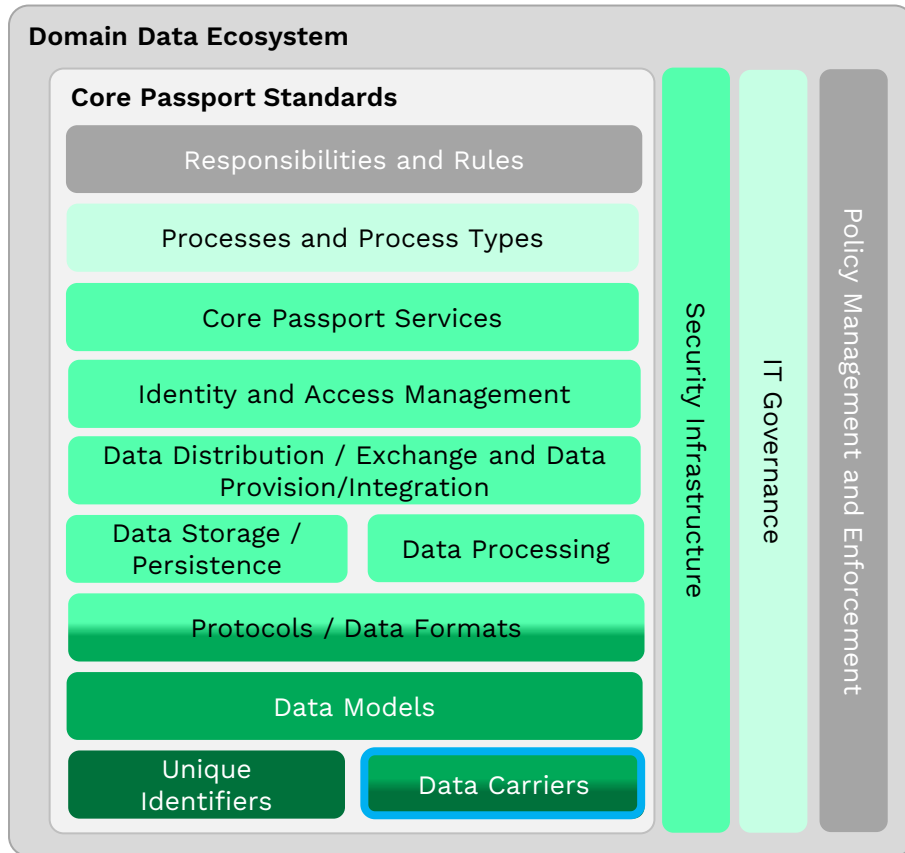☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence | Data Processing
- Protocols / Data Formats
- Data Models
- **Unique Identifiers** | Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
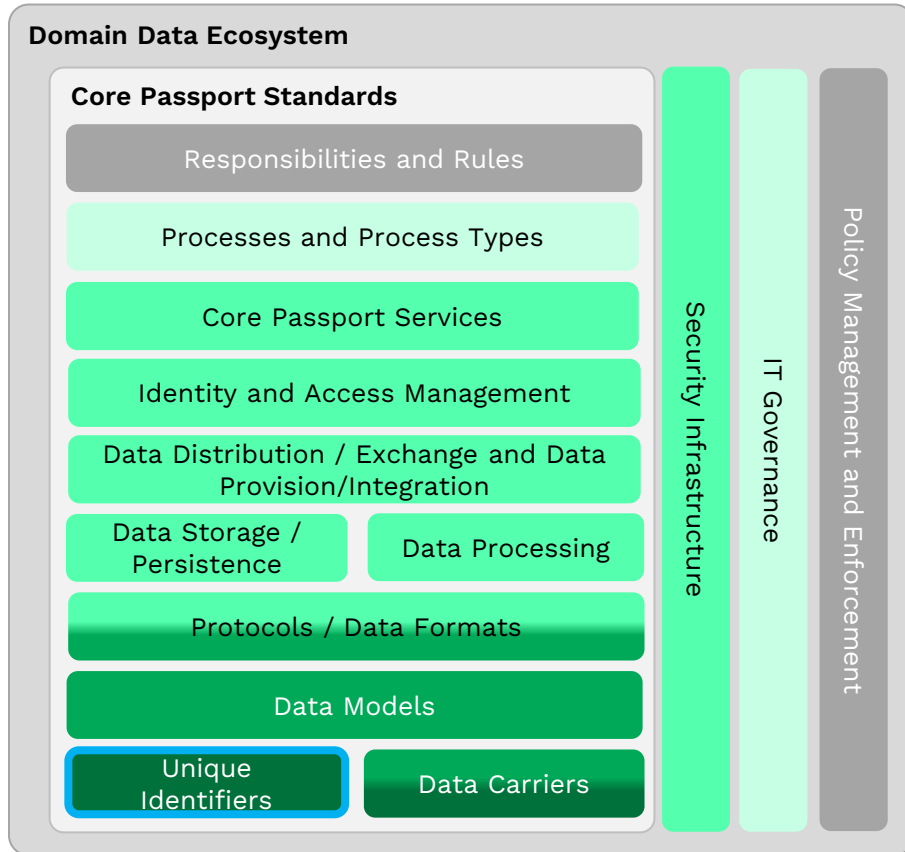
Description of selected Standard Stack element

A crucial element in the realm of battery passports is the utilization of a unique, non-significant string of characters designed to distinguish individual items. This unique identifier assumes a central role, serving as the reference point for the seamless exchange of battery passport data among all relevant stakeholders, encompassing both individual batteries and various battery types. Fundamentally, each battery, without exception, must be assigned its distinct and exclusive identifier. This imperative step ensures that every battery can be identified uniquely within the system, facilitating effective tracking, monitoring, and management. Moreover, the scope of unique identifiers extends beyond batteries themselves. Organizations and individuals involved in the battery ecosystem are also required to possess unique identifiers. This broader application is necessary to maintain clarity and precision in passport information, ensuring that every entity involved is easily distinguishable. In cases where specific equipment is a requisite component of passport information, these too must be assigned unique identifiers. One noteworthy linkage specified by the standard is the serialization of component identifiers to the overall battery identifier. This linkage ensures that all components within a battery system and their corresponding data, regardless of their complexity, can be systematically linked to the overarching identifier.

Technical Standard Stack: Data Carriers

☐ Standard Stack element in focus
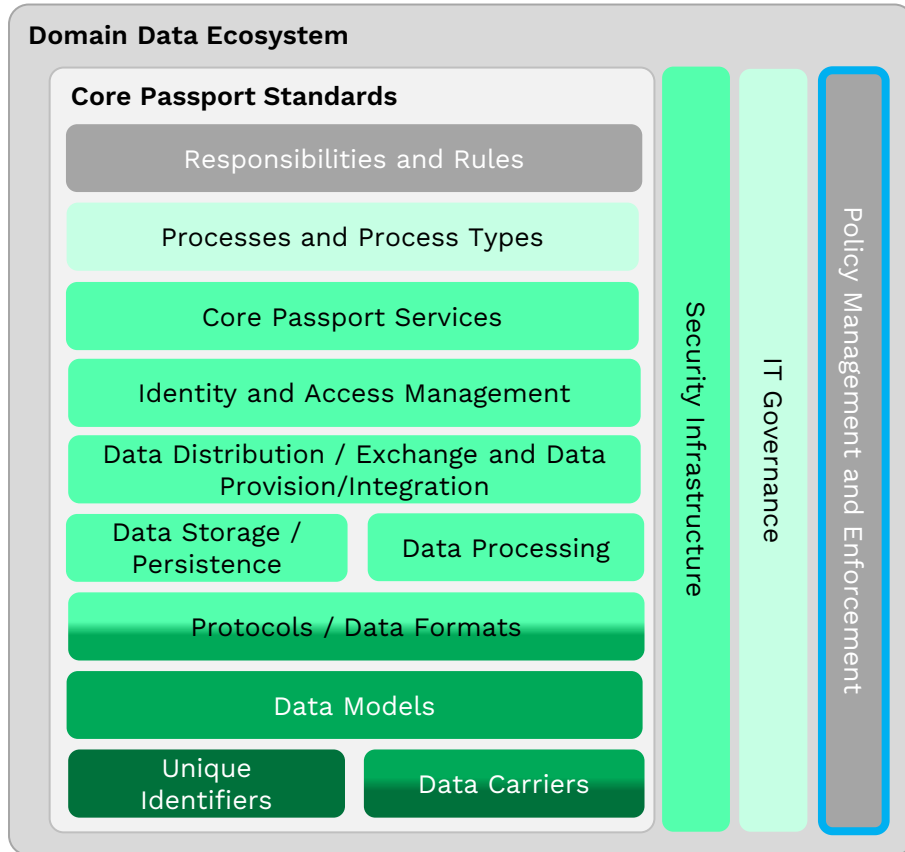
The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement

Description of selected Standard Stack element

A data carrier, in the context of information technology and data management, is a medium or device used to store, transport, or transmit data. Data carriers come in various forms and technologies (e.g., Data Matrix Code, QR Code, NFC Tag, etc.) and serve as containers for digital information. According to the Battery Regulation, the battery passport should be accessible via a data carrier by storing a unique identifier. Both data carrier and unique identifier must follow ISO/IEC 15459 as per regulation (Battery Regulation, Article 77(3)).

Technical Standard Stack: Policy Management and Enforcement

☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement

Description of selected Standard Stack element

Policy management and enforcement refers to the way policies and procedures related to data are managed and enforced. Typically, this includes using specific policy management tools or frameworks, languages or processes to ensure that policies are followed, evaluated in real-time and enforced consistently to user requests for access to protected resources such as a computer application or sensitive database.

Generally, usage policies are defined as part of the terms and conditions established when data resources or services are published or negotiated between providers and consumers. However, the battery passport is not composed of individual data offers, but data that follows the EU Battery Regulation in a mostly standardized way.

Technical Standard Stack: IT Governance

☐ Standard Stack element in focus
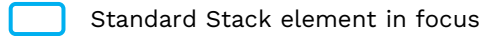
The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

- Responsibilities and Rules
- Processes and Process Types
- Core Passport Services
- Identity and Access Management
- Data Distribution / Exchange and Data Provision/Integration
- Data Storage / Persistence
- Data Processing
- Protocols / Data Formats
- Data Models
- Unique Identifiers
- Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement
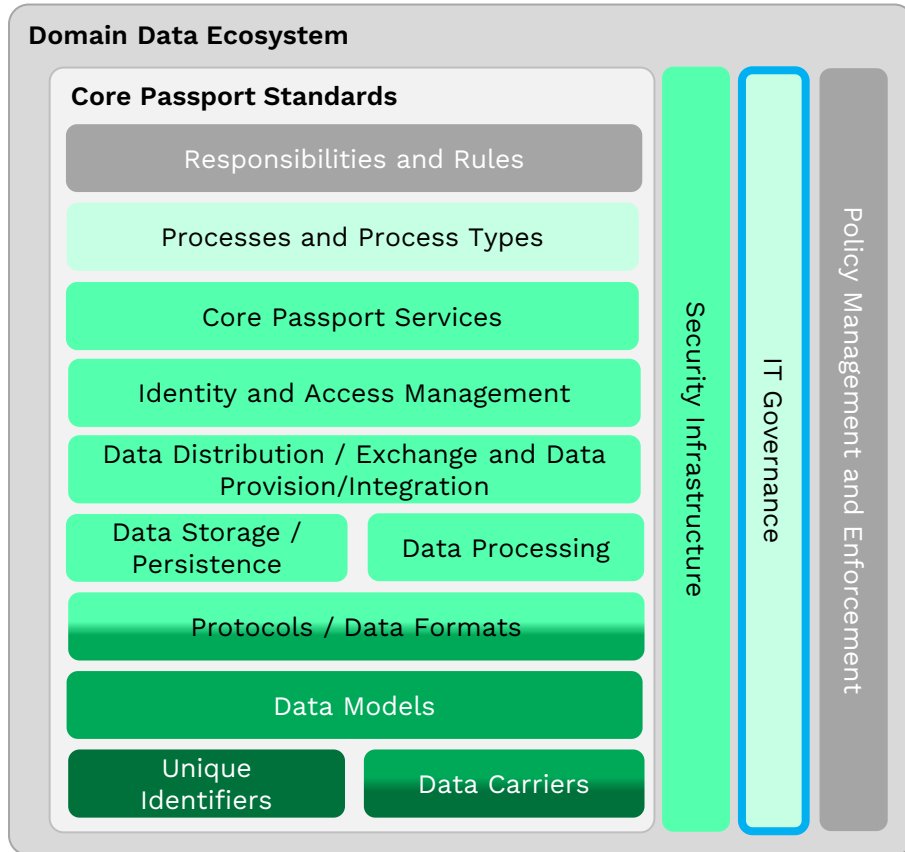
Description of selected Standard Stack element

The IT Governance describes the efficient oversight and management of the technical infrastructure necessary for the functioning of the battery passport system. This module encompasses a set of responsibilities, principles, and processes that ensure the seamless operation of the battery passport system and its associated functions. IT Governance involves a systematic approach to decision-making and control, aiming to align IT strategies with broader objectives. Within the realm of the battery passport system, this governance structure encompasses several key functions that play a pivotal role:
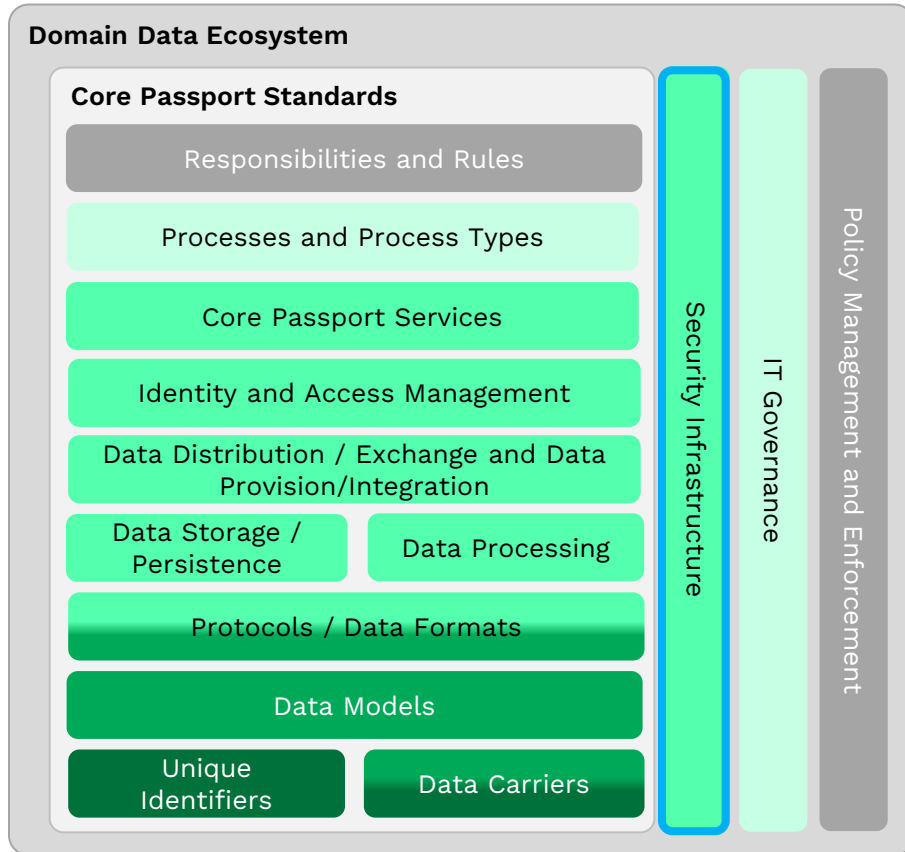
- General Management

- Core IT Service Management

- Technical Management

In addition to these functions, the IT Governance module oversees the accreditation, monitoring, and auditing of eligible partners who operate passport functions within the battery passport system. This includes ensuring that these partners adhere to the established guidelines and standards, maintaining the integrity of the entire value chain processes. In essence, the IT Governance module provides a comprehensive framework to regulate, manage, and optimize the technical elements of the battery passport system.

Technical Standard Stack: Security Infrastructure

☐ Standard Stack element in focus

The Technical Standard Stack

Domain Data Ecosystem

Core Passport Standards

Responsibilities and Rules

Processes and Process Types

Core Passport Services

Identity and Access Management

Data Distribution / Exchange and Data Provision/Integration

Data Storage / Persistence

Data Processing

Protocols / Data Formats

Data Models

Unique Identifiers

Data Carriers

Security Infrastructure

IT Governance

Policy Management and Enforcement

Description of selected Standard Stack element

Cyberattacks are an ongoing threat to security infrastructure, carrying the risk of disrupting operations, getting in the way of customer service and causing damage to a company's reputation. Today, there are diverse reasons for cyberattacks: theft, blackmail, sabotage, terrorism, information warfare, etc.

Security infrastructure refers to the way security is implemented and maintained within a system. It should be an ongoing and active process of security implementation and maintenance to function successfully and reliably.

Security infrastructure typically includes aspects of access control, application security, behavioural analytics, firewalls, virtual private networks, vulnerability management, intrusion detection and prevention, virus protection, security and integrity monitoring, etc. It has become a complex, important and constantly evolving industry as attackers also evolve and their techniques grow more sophisticated.
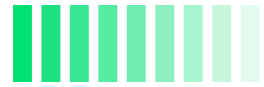
Outlook

After the Battery Pass Technical Guidance report will be released in March 2024, we will conduct several activities at the Fraunhofer booth at Hannover Messe
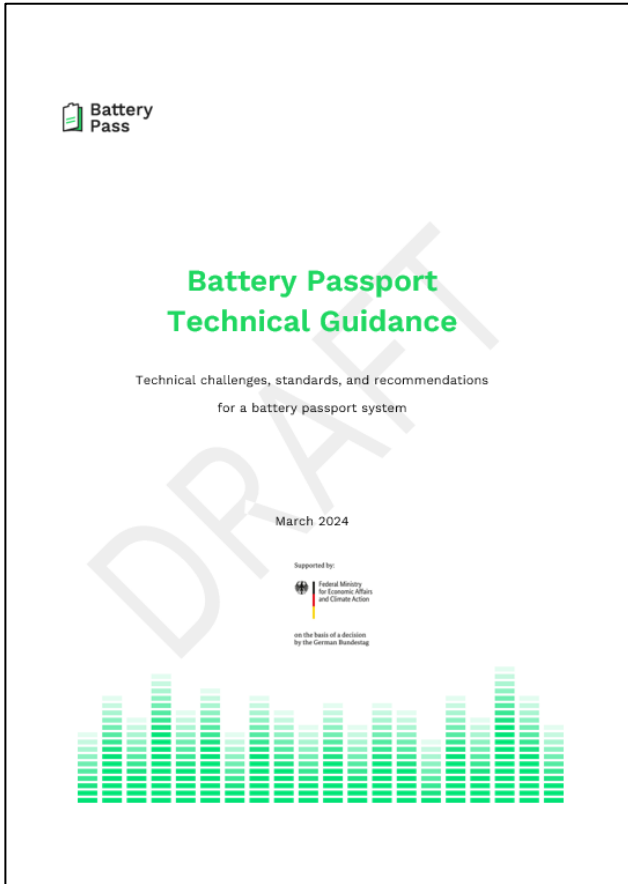
To be released in March 2024

Meet us at Hannover Messe from 22 to 26 April 2024 and learn more about our work on the technical battery passport system and beyond

Fraunhofer booth at Hannover Messe 2023

If you would like to learn more about the "Battery Pass"...

Have a look at our website
Click on the icon to be directed to the respective site

Subscribe to our newsletter
Click on the icon to be directed to the respective site

Follow us on LinkedIn
Click on the icon to be directed to the respective site

Battery Pass

thebatterypass.eu

48

Supported by:

Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag

Thank you

Authors:

Niko D'Agostino, Circulor GmbH
Coenraad van Deventer, Circulor GmbH
Gernot Böge, FIWARE Foundation e.V.
Jason Fox, FIWARE Foundation e.V.
Patrick Gering, Fraunhofer IPK
Sven Jantzen Umicore AG & Co KG
Thomas Knothe, Fraunhofer IPK
Andreas Schlender, Circulor GmbH
Johannes Simböck acatech

Battery Pass

thebatterypass.eu