

Deliverable D1.5

Data Management Plan Final version



Feasible Recovery of critical raw materials through a new circular Ecosystem for a Li-Ion Battery cross-value chain in Europe

WP 1 - Project Management

D1.5 - Data Management Plan (final version)

Due date of deliverable
31/08/2026

Actual submission date:
31/08/2026

Organisation name of lead contractor for this deliverable: CARTIF

Dissemination Level

SEN	Sensitive	
PU	Public	X

Project Acronym
FREE4LiB

Project Start Date
01-09-2022

Duration
48 months

Grant Agreement No.
101069890

Project End Date
31-08-2026



Funded by
the European Union

Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them. This project has received funding from Horizon Europe research and innovation programme under Grant Agreement No. 101069890

[@FREE4LiB](#)
[in FREE4LiB](#)
[freeforlib.com](#)

Disclaimer

©2026 FREE4LiB Consortium Partners. All rights reserved.

FREE4LiB is an EU-funded project that has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement no. 101069890. The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Union. The European Commission is not responsible for any use that may be made of the information contained therein.

While this publication has been prepared by the consortium partners of the project, the authors provide no warranty with regards to the content and shall not be liable for any direct, incidental or consequential damages that may result from the use of the information or the data contained therein.

The present document includes data management procedures that are applicable to all running projects coordinated by CARTIF as mandated and recommended by CARTIF R&D Programmes Department, and then those have been adapted specifically to FREE4LiB project whenever applicable. Thus, the high level of similarity that may be found with similar deliverables prepared by CARTIF in other Horizon Europe projects.

Versions

DATE	VERSION	AUTHOR	COMMENT
27/07/2026	1	CARTIF	First draft of the document
04/08/2026	2	CARTIF	Reviewed version shared with Work Package Leaders
31/08/2026	3	CARTIF	Final document



Content

Disclaimer.....	3
Versions.....	3
Abbreviations and acronyms	5
Executive Summary	6
Introduction	7
Contributions of Partners.....	8
Relation to other activities in the project	9
Data Summary	11
Purpose of data collection	11
Data collection and creation	12
Description of datasets.....	12
FAIR Data.....	27
Making data findable, including provisions for metadata.....	27
Making data accessible.....	28
Making data interoperable	28
Making data reusable	29
Other research outputs	31
Allocation of resources	32
Data Security	32
Introduction	32
Cloud Battery recycling and data-driven modelling platform	34
Battery Passport deployment.....	35
Ethics	37
Conclusions	38

Abbreviations and acronyms

ACRONYMS	DESCRIPTION
API	Application programming interface
CA	Consortium Agreement
CC	Creative Common
D&C	Dissemination and Communication
DMP	Data Management Plan
DOI	Digital Object Identifier
EOL	End-of-Life
FAIR	Findable, Accessible, Interoperable and Re-usable
GA	Grant Agreement
GDPR	General Data Protection Regulation
HAZOP	Hazard and Operability
LIBs	Lithium-Ion Batteries
WP	Work Package



Executive Summary

FREE4LiB is a €9,3 million-euro European Union funded Horizon Europe project to shift the circularity of material flows and its use of secondary raw materials in new batteries produced in Europe. The project develop at TRL 5-6 technologies to achieve 6 new sustainable and efficient processes to recycle end-of-life (EOL) Lithium-Ion Batteries (LIBs) and 3 processes aiming at metals and polymers re-using and electrode synthesis on the same value chain for re-manufacturing greener batteries. We worked on this together with 22 project partners from 2022 to 2026.

The chosen approach to achieve the objectives of the project was based on the deployment of two digital platforms: a Battery Passport Platform and a Cloud Battery Recycling Platform. These platforms enable battery value-chain stakeholders to consult and exchange information related to EOL LIBs and support decision-making.. The vision is to set up a platform environment, where manufacturers, repairers and recyclers, or other organisations want to exchange information. Linked both digitally and physically via tags on life cycle traceability.

This deliverable document (D1.5) sets up the final version of the Data Management Plan, updating the original D1.4 (original data management) through a comprehensive revision of its sections.



Introduction

The present document D1.5 “Data management plan” provides the final overview of the data management in the FREE4LiB project, considering the data collected, generated and/or used in the different WPs as mentioned in Task 1.3 (called Knowledge and data management). As the final update of the DMP, it reflects the transition from the data initially expected in D1.4 to the research data and other research outputs actually generated and managed throughout the project.

The main scope of this Data Management Plan is to provide useful insights about the storage, access, sharing, and reproducibility of the data generated by the project. The aim of this deliverable is to describe the mechanisms applied to handle research data during the project and the arrangements relevant to their access, preservation and management after its end. This deliverable provides information about how data was created or collected, stored and backed up, who owns it and who is responsible for the different data. The document offers a description of the datasets organized by WP, offering information about the partners involved, the related task and how the consortium handled the data. It also considers other research outputs relevant to data management and reuse, including guidelines and the digital platforms developed within FREE4LiB.

In particular, data management evolved together with the technical development of the project. FREE4LiB generated experimental and process data supporting the development and validation of recycling technologies and physics-based and data-driven models, while the Battery Passport activities developed a data model and a digital platform supporting information exchange and traceability across the battery lifecycle. These developments are reflected in the corresponding technical deliverables and are considered in the FAIR, Other research outputs and Data Security sections of this final DMP.

A Data management plan (DMP) is the key element of good data management. A DMP describes the data management life cycle for the data to be collected, processed and/or generated. The DMP presented in this document follows the FAIR principles, being FAIR an acronym referring to the principle that research data and, where applicable, other research outputs should be Findable, Accessible, Interoperable, and Reusable. Besides, other issues such as ethical aspects or data security have been considered in this text. The project ensured that the applicable ethical requirements were addressed throughout its implementation, including management aspects mandatory under Horizon Europe. For data security, aspects related to confidentiality, integrity and availability of data are explained. The project in order to avoid unforeseen ethical concerns limited the use of personal data, adopting specific measures



to protect this kind of data regulated by the General Data Protection Regulation (GDPR).

Data management plans in Horizon Europe projects must be living documents; hence this document (as D1.5) has been reviewed at the end of the project (month 48), updating the information initially provided at month 6 in D1.4 and taking into account relevant developments reported in subsequent technical deliverables and periodic reporting. Accordingly, D1.5 provides the final consolidation of the project approach to FAIR data, other research outputs, data security, ethical aspects and post-project preservation.

First of all, it must be clarified two terms deeply related: research data and dataset.

- Research data means any kind of information that has been collected, observed, generated or created to validate original research findings.
- Dataset is a collection of related sets of information that is composed of separate elements but can be manipulated as a unit by a computer.

The adequate compliance with the standards sets by the framework programme Horizon Europe allows different stakeholders interested in lithium-ion batteries and their recycling could be able to enhance their knowledge in that field. The use of different widespread repositories such as Zenodo¹ enable that the datasets supports the long-term findability, accessibility and reuse of research results that can be made openly available.

Contributions of Partners

CARTIF leads this deliverable with the contribution of the WP leaders (Table 1)

Table 1. Contributions of Partners.

PARTNER SHORT NAME	CONTRIBUTIONS
1 – CARTIF	Leading partner and WP1 leader
12 - FBK	WP2 leader
7 - CSIC	WP3 leader
9 - Fraunhofer	WP4 leader
21 - UNIGRAZ	WP5 leader

¹ Zenodo repository. Available at: <https://zenodo.org/>



Relation to other activities in the project

The data management plan is the reference document for dataset definition and implementation in all the research activities of the project. This section contains the dataset description per task or deliverable.

The following table (Table 2) describes the main relationship of this deliverable to other activities (tasks and deliverables) developed within FREE4LIB project and that should be considered along with this document for further understanding of its content.

Table 2. Relation to other activities in the project.

DELIVERABLE No.	RELATION
D1.1	Project Management guidelines
D1.4	Data Management Plan (first version) (T1.3)
D1.6	Ethics requirements (T1.4)
D2.3	Electrochemical test results from EOL and BOL LIBs (T2.2)
D2.4	Material characterisation results (T2.2)
D2.5	Cloud Battery recycling platform (T2.4)
D2.6	
D2.8	Battery Passport platform (T2.5)
D2.9	
D2.10	
D3.8	Lab results and methodology for the scale-up of the technologies
D5.1	LCA, SLCA, Circularity Assessment and Design for sustainability Guidelines
D5.2	
D5.3	
D5.4	Battery Passport platform and concept (T2.5 and T5.4)
D5.6	HAZOP results from recycling technologies (T5.5)

D6.1	FREE4LIB Communication, Dissemination and Exploitation Plan
D6.2	
D6.3	
D6.4	FREE4LIB website and social media accounts
D6.9	FREE4LIB Exploitation, IPR and business models
D6.10	



Data Summary

This section addresses issues related to the data collection and creation, such as the purpose, type and format of the gathered data, origin and usefulness of the collections.

The procedure for detailing the data summary consisted of a question-answer procedure for each dataset identified at this stage. At the moment of the submission of this deliverable, the DMP is comprised of the datasets that were generated or used within each of the WP.

Purpose of data collection

FREE4LIB provided access to the facts and knowledge gleaned from the project's activities over the four-year period, to enable the project's stakeholder groups, researchers and the public in general, to find and re-use its data, and to find and feed both FREE4LIB's platforms related with battery recycling and battery passports.

The project's activities developed a TRL 5-6 technologies to achieve 6 new sustainable and efficient processes to recycle EOL LIBs delivering very innovative recycling solutions to reach highly efficient materials recovery improving the supply of secondary resources at the EU level, but also to generate knowledge, methodologies and guidelines through fostering the battery value chain transformation through collaborations, discussions, evaluations and eco-design and development of technologies. The data from these activities were collected at knowledge exchange events, via online workshops, seminars, interviews and clustering events with other projects and stakeholders related to the entire battery value chain.

FREE4LIB encouraged all to contribute their knowledge openly, to use and share the project's learning outcomes, and created or improved the development of an open innovation ecosystem where concrete actions were deployed in order to implement effective policy recommendations. Thus, a key aspect of FREE4LIB project is the co-creation value for achieving understanding and effective engagement among citizens, stakeholders and policymakers in order to maximize the impact on (1) strengthening European raw material independence (2) increasing the circularity of battery material flow and (3) using secondary raw materials in new batteries.



Data collection and creation

FRE4LiB partners collected, generated and created data from its project activities across five broad categories of data for evaluation:

1. Data for evaluation
2. Research data and metadata
3. Manuscripts
4. Dissemination and communication (D&C) material
5. Exploitation material

Data types may take the form of lists (of organizations, events, activities, etc.), reports, papers, interviews, showcases, guidelines, expert and organizational contact details, field notes, videos, audio recordings and presentations. Video and presentation D&C material were made accessible online via the FREE4LiB website (<https://freeforlib.eu/>) and disseminated through the project's media channels (LinkedIn and X), EC-associated activities, press, conference presentations, demonstrations and other means, using open publishing means and standards.

In the following, we describe the types of data and the formats used. A list of the data collected and created during the project is provided below and any additional information will be explained in the following sections.

Description of datasets

All the documents are expected to be preserved for at least 2 years after the final payment once the project ended in case a review has been carried out by the European Commission (as mentioned in Datasheet Point 6 of the GA). The only exception to this general preservation rule could be those datasets containing personal data must be destroyed after the end of the project (having been previously anonymised if needed).



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMA T	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
WP1	Created	Administrative, legal and financial data for coordination of the project: feedback for the deliverables, mailing list and other related data	Project management data	Document (Excel, word, pdf)	Consortium	Sensitive	Common repository of the project and in partners servers	No
WP1	Created	Documentation relating to the establishment and operation of the FREE4LIB Advisory Board	External expert advisory and project governance data	Data / Document (Excel, word)	Consortium	Sensitive	Common repository of the project	Partly. Project records non-personal data (retained), personal details deleted or anonymised if not required
WP1	Created	Ethics documentation generated in relation to the project	Ethics compliance data	Data / Document	Consortium	Sensitive	Common repository	Partly. Project records non-

WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
				(Excel, word, pdf)			of the project	personal data (retained), personal details deleted or anonymised if not required
WP2	Created	Material characterisations results. All the data and results generated with the materials characterisation techniques taken during the project within WP2, WP3 and WP4. During lab and pilot tests.	Process data and reports	Data / Document (Excel, word,raw, pdf)	Consortium	Sensitive	Common repository of the project and in partners servers	No
WP2	Created	Electrochemical results. All the data and results generated with	Process data and reports	Data / Document	Consortium	Sensitive	Common repository of the	No



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
		the electrochemical techniques and performances taken during the project within WP2, WP3 and WP4. During lab and pilot tests.		(Excel, word,raw, pdf)			project and in partners servers	
WP2	Created	Analysis of State of Health assessment methodologies for 2nd life battery. Criteria Data about testing methodology	Data for evaluation	Document (word)	Watt4Ever	Public	Common repository of the project and in partners servers	No
WP2	Created	SoH evaluation tool for modules or micro mobility batteries. Data about modules performance and testing protocols	Research data	Document (Pdf, excel)	Watt4Ever, IREC-CERCA	Sensitive	Common repository of the project and in partners servers	No
WP2	Created and collected	Cells and batteries modules information. All the information	Experimental data /	Document (Excel, html, .png,	ERION, RECYCLIA,	Public	Common repository of the	No

WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMA T	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
		regarding cells and batteries analysed used within the project. It has been used for public deliverables	process data and reports	.jpeg, word, pdf)	AC, Fraunhofer		project and in partners servers	
WP2	Created and collected	Detailed data on batteries origin	Process data and reports	Document (Excel, html, .png, .jpeg, word, pdf)	ERION, RECYCLIA	Sensitive	Common repository of the project and in partners servers	No
WP2	Collected	Data on packaging, collection and logistics. All the data related with collection and logistics of batteries	Research data	Document (Excel, html, .png, .jpeg, word, pdf)	ERION, RECYCLIA, ITL	Public	Common repository of the project and in partners servers	No
WP2	Created	Modelling tools for recycling processes	Research data	Software (Exe)	FBK	Sensitive	Common repository of the project and	No

WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
							in partners servers	
WP2	Created	Validated cells models	Research data	Software (exe mainly)	FBK	Public	Common repository of the project and in partners servers	No
WP2	Collected	Battery Passport. All data are necessary for the creation of the passport.	Data used in the platform	Metadata (json)	Consortium	Public / Sensitive	Blockchain	No
WP2	Collected	Battery Passport. All initial parameter data are necessary for the creation of the passport.	Research data	Document (Excel)	Consortium	Public / Sensitive	Common repository of the project and in partners servers	No
WP2	Created	Assembly manuals for 2nd life batteries.	Research data	Document (Pdf)	AVL	Sensitive	Common repository of the project and	No



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
		Detailed assembly manual for workers					in partners servers	
WP3	Created	Evaluation and information on ceramic pigment processing and novel materials using precursors	Data for evaluation	Document (Excel, word, pdf, raw)	TORRECID	Sensitive	Common repository of the project and in partners servers	No
WP3	Created	Electrode optimization conditions, coating processing conditions, material granulation conditions	Data for evaluation	Document (Excel, word, pdf)	IREC-CERCA	Sensitive	Common repository of the project and in partners servers	No
WP3	Created	Development, testing and validation of recycling processes at lab-scale	Data for evaluation / Research data	Document (Word, pdf)	Consortium	Sensitive	Common repository of the project and in partners servers	No

WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
WP3	Created	Development, testing and validation of materials re-use technologies at lab-scale	Data for evaluation / Research data	Document (Excel, word, pdf)	Consortium	Sensitive	Common repository of the project	No
WP3	Created	Laboratory results and methodology to scale-up technologies. Results regarding the technologies scale-up methodology for WP4	Data for evaluation	Document (Word, pdf)	Consortium	Public	Common repository of the project and in partners servers	No
WP3	Created	Dismantling process description, analysis and technical feasibility of its robotization	Process data and reports	Document (Pdf)	Consortium	Public	Common repository of the project and in partners servers	No
WP4	Created	Synthesis conditions on active materials upscaled	Data for evaluation	Document (Excel, word, pdf)	TORRECID	Sensitive	Common repository of the project and	No



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
							in partners servers	
WP4	Created	Reprocessing of plastic materials recovered from EOL LIBs. Data relate to machine parameters and material properties confidential for the consortium	Data for evaluation	Document (Word, pdf, excel)	Consortium	Sensitive	Common repository of the project	No
WP4	Created	Assembling of pouch cells from optimized recycled, commercial, and recycled + commercial battery components.	Data for evaluation	Document (Word, pdf, excel)	Consortium	Public	Common repository of the project and in partners servers	No
WP4	Created	Upscaling of the FSP processes to pilot scale. Information implying the selection of best cathode composition and	Data for evaluation	Document (Word, pdf)	LUREDERRA	Public	Common repository of the project and in partners servers	No



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMA T	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
		optimisation and adjustment of precursor mixture and operation parameters.						
WP4	Created	FREE4LIB battery pack design and documentation for manufacturing, assembly and disposal phases	Data for evaluation	Document (STEP-file for data exchange of 3D objects of battery pack design, and Word or pdf)	Consortium	Sensitive	Common repository of the project and in partners servers	No
WP4	Created	Black mass Recycling Pilot plant test results	Data from pilot plant	Document (Word, pdf, excel)	Consortium	Sensitive	Common repository of the project and in partners servers	No

WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
WP4	Created	Metal Recycling Pilot plant test results	Data from pilot plant	Document (Word, pdf, excel)	Consortium	Sensitive	Common repository of the project and in partners servers	No
WP4	Created	Processes parameter of pre-treatment	Data from pilot plant	Document (Word, pdf, excel)	Consortium	Sensitive	Common repository of the project and in partners servers	No
WP4	Created	Learned practices on the integration and validation of the robotized dismantling tasks	Process data and reports	Document (Pdf)	Consortium	Public	Common repository of the project and in partners servers	No
WP4	Created	Upscaling of metal recycling of Al and Cu by centrifugal	Process data and reports	Document (Pdf)	EURECAT	Sensitive	Common repository of the project and	No



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
		atomisation to produce metal powders					in partners servers	
WP4	Created	Upscaling of extrusion profiles of aluminium alloys developed during the project, using remanufactured battery packs.	Process data and reports	Document (Pdf)	EURECAT	Sensitive	Common repository of the project and in partners servers	No
WP5	Created	Life cycle inventories data	Data to conduct the environmental life cycle assessment following a life cycle perspective	Document (Excel)	Consortium and data provider	Sensitive	Common repository of the project and in partners servers	No
WP5	Created	Environmental impact analysis report related data	Data for evaluation	Document (Word, pdf)	Consortium	Sensitive	Common repository of the project and in partners servers	No



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
WP5	Created	Data for report on techno- economical aspects	Data for evaluation	Document (Word, pdf)	Consortium	Sensitive	Common repository of the project and in partners servers	No
WP5	Created	Data for Social analysis report. Great variety of data, some confidential, some shared with consortium, some public	Data for evaluation	Document (Word, pdf)	Consortium	Public	Common repository of the project and in partners servers	No
WP5	Created	Design for recycling guidelines. Deliverable for members of the consortium, communication public	Data for evaluation	Document (Word, pdf)	Consortium	Public	Common repository of the project and in partners servers	No
WP5	Created	Meeting recordings and interviews	Data for evaluation	Documents and media (Word, MS	Consortium	Sensitive	Common repository of the	Partly. Project records non-



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMA T	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
			and contact tracing	teams chat protocol and video format)			project and in partners servers	personal data (retained), personal details deleted or anonymised if not required
WP5	Created	Report for HAZOP study	HAZOP report of recycling technologies	Document (Word, pdf)	Consortium	Sensitive	Common repository of the project and in partners servers	No
WP6	Created and collected	Stakeholder contact data. Information on the major stakeholder groups. The contact information that is collected includes the name, institutional	D&C data and exploitation activities	Document (Excel)	Consortium	Sensitive	Common repository of the project	Partly. Project records non- personal data (retained), personal details



WP	COLLECTED /CREATED	DESCRIPTION OF DATA	CATEGORY	TYPE/FORMAT	OWNER	PRIVACY LEVEL	STORAGE	DESTROYED AT THE END OF THE PROJECT?
		affiliation, position, email address.						deleted or anonymised if not required
WP1 to WP6	Created	Public material available about the project (technical deliverables, D&C info...)	Technical activities and D&C data	Document (pdf)	Consortium	Public	FREE4LIB website, CORDIS and/or Zenodo, as applicable	No



FAIR Data

This section of the DMP describes the compliance of FREE4LIB with the FAIR principles. FAIR is an acronym that summarizes the main features that research data and, where applicable, other research outputs must comply with: the data and outputs must be **Findable**, **Accessible**, **Interoperable** and **Reusable**.

Not all datasets containing research data have been made available to every consortium partner, or openly accessible to the public. Nevertheless, the FAIR principles have been applied as far as possible, and each limitation has been identified and justified, in accordance with the principle “as open as possible, as closed as necessary”.

These principles precede implementation choices and do not necessarily, suggest any specific technology, standard, or implementation solution. The final objective of a DMP is leading to knowledge discovery and innovation, and to subsequent data and knowledge integration and reuse.

Making data findable, including provisions for metadata

In order to comply with these FAIR principles some instruments are being implemented for allowing the data can be properly searched. The inclusion of metadata (that summarizes basic information about data) is a useful mechanism to make the data more Findable because it allows identifying, describing and organizing data in a manner that allows humans or processes to search and find this data in an optimal way.

As mentioned in Section 1.2.4 of the Grant Agreement (GA) each dataset created in FREE4LIB was assigned a unique name, using the convention “[data name] (FREE4LIB dataset, v[ZZ])”. Scientific publications and other material publicly shared use a persistent and unique identifier: the Digital Object Identifier (DOI). Each dataset or other research output deposited for long-term preservation or sharing received an appropriate persistent identifier, such as a DOI. Its metadata included, as applicable, the title, creator and right holder, version and date, description, keywords, access status, applicable licence, related deliverable, publication or Key Exploitable Result, Grant Agreement No. 101069890 and the FREE4LIB project DOI 10.3030/101069890.

The use of keywords is another mechanism that could help the findability of the data. Keywords are usually required by scientific journals, so partners are encouraged to use this mechanism adding the most pertinent words according to the research done. In the case keyword frameworks are not required, the



partners are encouraged to use relevant words in the abstract or introduction section as a way to facilitate that the research data could be findable.

The final dataset and research-output register included the persistent links already available through CORDIS, the FREE4LIB Reports & Results page and trusted repositories. Repository records were linked, where applicable, to the corresponding publication, public deliverable or project result. As an implemented example, the dataset “Revalorisation of aluminium scrap from electric car battery packs by production of raw powder for additive manufacturing” is available in Zenodo under DOI 10.5281/zenodo.15222692.

Making data accessible

The consortium partners are aware of the key principle related to DMP called “as open as possible, as closed as necessary”. It is important to note that some of the datasets used in the WP cannot be shared outside the consortium. Much of the data generated during the project has been used for internal management and communication only at the consortium level. That data remained confidential (only accessed by the owner or shared at the consortium level for internal implementation of the project). The restrictions regarding sharing the information were based on issues such as protection of the intellectual property rights (trade secrets, patent pending to be granted ...), personal data (GDPR restrictions) or security reasons (might jeopardise the results of the project).

Selected public research data and other digital outputs have been deposited in [Zenodo](#). The information contained in this trustworthy repository must be also considered with the [CORDIS](#) and the FREE4LIB Reports & Results [website](#) were also used as complementary discovery and linking points rather than as the sole long-term preservation location.

For the sake of allowing Accessibility, the metadata of the datasets must normally be available and obtainable, even in case the data are not completely open unless the disclosure of the metadata would itself compromise personal data, confidentiality, security, intellectual property protection or another legitimate interest.

Making data interoperable

To maximize data interoperability and facilitate the data uptake and re-combinations with different datasets from different origins, the information was, where technically feasible, provided in open or widely used exchange formats, for example CSV or TSV for tabular data, JSON or XML for structured



and platform data, and PDF/A or another appropriate preservation format for documents. Native and raw formats were retained where they are needed to validate, interpret or reproduce the results.

Complementary data documentation can be also provided to explain details on units of measurement and key vocabulary. Whenever possible the use of standard data and metadata vocabularies can be used, to maximize data interoperability.

For the Battery Passport outputs, the data model, user requirements, roles and access rights described in D5.4, together with the integrations implemented through D2.8 and D2.9, were used as the project-specific reference for documenting the structure and exchange of platform information.

The consortium follows the defined terms established by the Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regulations (EU) 1290/2013 and (EU) 1291/2013. Where no suitable standard or controlled vocabulary exists, the partner responsible for the dataset or output documented the project-specific terms and any relevant mappings, while CARTIF coordinated consistency across the final DMP.

Making data reusable

The data generated within the project is made reusable through the creation of documentation that helps others interpret and analyse it. As mentioned in Section 1.2.4 of the GA the consortium has established four access levels, each one depending on the sensitivity of the information and the applicable legitimate restrictions of information contained in the dataset:

- Open access: everyone has permission; the dataset does not include any personal information unless given informed consent.
- Access limited to registered users: Only authenticated users holding the relevant role or permission may access the dataset. Registration or authentication is an access-control mechanism and does not determine whether the information is personal or non-personal; that classification was assessed separately.
- Restricted access: Permission is granted to users upon request and the main characteristic dataset contains sensitive data (i.e. information that could be considered protected by intellectual property rights).
- Embargo: the permission is available to users after a certain period of time and the characteristic is that the dataset contains data that could for instance ensure the competitiveness of a product.



Partners of the project must indicate unambiguously the kind of license applications for the data and their related metadata. The Creative Commons (CC) licenses² are the standards to be used. For openly shared datasets and documentation, standard licences such as CC BY 4.0 or CC 0 1.0 were used, as appropriate. Software and source code were subject to an appropriate software licence, taking account of ownership, third-party components and the project exploitation strategy. Where software is not made available, the restriction and the applicable access conditions were recorded. Metadata was made available under CC0 or an equivalent instrument wherever possible.

The selected licence or access conditions were displayed together with the corresponding repository record so that potential users can determine unambiguously how the dataset or output may be accessed and reused.

² Creative Commons. Available at: <https://creativecommons.org/licenses>



Other research outputs

Complementary to the management of research data described above, the partners are aware that Horizon Europe as a novelty to the previous Framework Programme it must be considered adequate management of the research outputs that have been generated or made available for re-use purposes. This kind of output can be either digital (e.g. software, workflows, protocols, models, etc.) The FAIR principles described in the previous section were also considered for other research outputs, where applicable to their nature and potential for access and reuse.

FREE4LIB research outputs include models, methodologies, guidelines, protocols, software-related outputs and digital platforms (see Section 1.2.4 of the GA). In particular, the project generated and validated physics-based and data-driven models for cells and recycling processes, methodologies supporting the scale-up of recycling technologies, State-of-Health assessment approaches, the Battery Passport data model and the successive versions of the Battery Passport Platform. Other relevant outputs include design and technical documentation supporting recycling, materials reuse and battery manufacturing and assembly activities. The research outputs were shared or made accessible whenever appropriate through a suitable trusted repository such as Zenodo, an appropriate software repository or another repository appropriate for the type of output, and were linked to the relevant CORDIS or project result. Physical research outputs were documented with sufficient information on their nature, owner, location or custodian, access conditions and preservation status.

Particular attention was paid to the Battery Passport Platform, the Cloud Battery Recycling/data-driven modelling platform and the models, software, protocols and documentation supporting them. CORDIS already identifies the Battery Passport Platform versions I and II as specific project results and separately identifies the validation of physics-based and data-driven models for cells and recycling processes. D5.4 further provides the data model, user requirements, roles and access rights underpinning the Battery Passport concept. These arrangements were aligned with the final exploitation and IPR activities described in the exploitation deliverables (D6.9 and D6.10).



Allocation of resources

CARTIF coordinated the overall implementation and update of the DMP and acted as responsible for its consolidation and quality assurance at project level. Each partner remained individually responsible for implementing the DMP requirements applicable to the data, research outputs, systems and activities under its responsibility, aligned with the Consortium Agreement (CA) provisions m.

As the management of the data following this DMP is aligned with the commitments of our project, the cost for making data FAIR would be assumed by the corresponding budget inside the project for each partner involved as allowed in article 6 of the GA. The cost incurred by the partners has to be eligible and comply with the GA rules (article 17 and Annex V). The community profile created in Zenodo will be available for free beyond the end of the project.

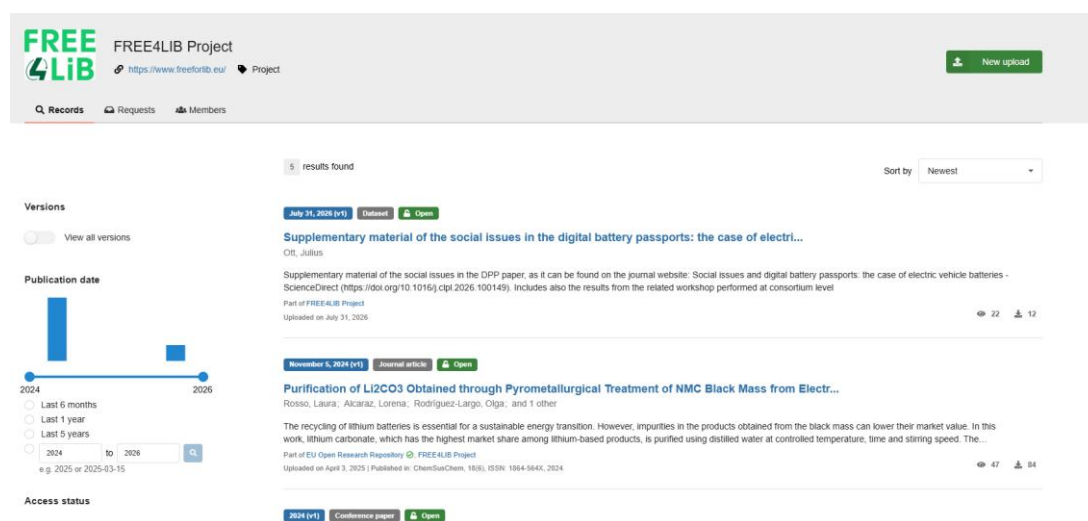


Figure 1: Zenodo profile

Any other post-project hosting, maintenance, preservation or security costs relating to platforms, software, models or repositories were identified by the relevant owner or host and were recorded as a continuing commitment where the responsible entity and the necessary resources have been confirmed.

Data Security

Introduction

Data security focuses on ensuring the confidentiality, integrity and availability of data when it is being stored, transmitted or used. Appropriate technical and

organisational measures are applied according to the nature, sensitivity, access conditions and risks associated with each dataset, information system and other research output. These measures cover, as applicable, access control, authentication, secure transmission, encryption, logging, backup and recovery, incident handling, retention and secure deletion.

The partners stored and managed their data in the project's common repository held in Nextcloud (managed by CARTIF) and also in their private servers and data-storage systems. Moreover, as the preferred application for online meetings, FREE4LIB uses its own dedicated Microsoft Teams workspace (managed by CARTIF) for the exchange and online working documents. Nextcloud and Microsoft Teams are project collaboration environments; datasets and other outputs selected for long-term public access or preservation are deposited in an appropriate trusted repository.

In the case of Nextcloud, each member of the research team accesses the common repository using individual credentials. Credentials must not be shared between users. Access is limited to personnel directly involved in the relevant project activities and is granted according to the applicable access level and the need to perform the corresponding project tasks.

Special provisions apply to the management of sensitive or confidential data during and, where applicable, after the project. The research data was publicly shared unless there are justified reasons for keeping datasets confidential. The main reasons for considering confidential sensitive information contained in datasets are the existence of intellectual property rights titles/trade secrets (because the data could confer a competitive advantage to the owners) or personal data collected compliant with the data protection regulation (GDPR). The non-sensitive information (and the related metadata) can be publicly shared in certified repositories such as Zenodo, accepting the internal procedures for long-term preservation and curation.

Each partner is responsible for establishing and implement security measures according to the type of data and systems under its responsibility. Article 32 of the GDPR deals with the security of processing, and requires controllers and processors, as applicable, to implement a level of security appropriate to the relevant risks. One of the security measures that can be adopted is mentioned in Section 4.4 of the Consortium Agreement: conclude a separate agreement (including but not limited to data processing, data sharing and/or joint controller agreement) before any data processing or data sharing takes place. In any case, each partner remains responsible for implementing the security measures applicable to the systems and processing operations under its control, including the surveillance of third parties (e.g. affiliated entities or external actors) also involved in FREE4LIB project.



The role of each beneficiary as controller, joint controller or processor is determined according to the specific processing activity and the actual allocation of purposes and responsibilities. Irrespective of that role, each beneficiary remains responsible for complying with the obligations applicable to the processing activities and systems under its responsibility.

Where personal data are processed, data minimisation, access restriction and, where appropriate, pseudonymisation or anonymisation will be applied.

- Anonymisation will only be claimed where the data subject is no longer identifiable by means reasonably likely to be used. Properly anonymised data fall outside the scope of the GDPR, whereas pseudonymised data remain personal data and must continue to be protected accordingly. Direct identifiers and any information permitting re-identification will be kept separately and subject to restricted access. Personal data will be reused or shared only where this is compatible with the stated purpose and supported by an appropriate legal basis. Only effectively anonymised or suitably aggregated information will be made publicly available. These measures apply in particular to meeting recordings and interviews, stakeholder contact data, platform user accounts and access logs.
- Pseudonymization means according to article 4.5 of the GDPR the processing of personal data in such a manner that the personal data can no longer be attributed to a specific data subject without the use of additional information, provided that such additional information is kept separately and is subject to technical and organizational measures to ensure that the personal data are not attributed to an identified or identifiable natural person. Pseudonymized data still fall within the scope of the GDPR because it is possible to re-identify the data subject. Recital 26 of the GDPR covered this differentiation between both kinds of security measures, anonymization is the best option to avoid all personal data implications. Only data that are irreversibly anonymized to the degree that it is impossible to identify individuals can be shared publicly. The data can be shared in an aggregated way being the basis for carrying out the work (statistics, submission of deliverables...).

Cloud Battery recycling and data-driven modelling platform

A specific mention is made of the Cloud Battery Recycling/data-driven modelling platform developed within FREE4LIB. The platform supports the hosting and processing of technical information and models relating to active-material characterisation, batteries and recycling processes. The final DMP records the architecture and security controls actually implemented, as confirmed by EURECAT as the responsible technical partner.



Some remarks are provided regarding data security:

- The platform is primarily intended for technical and non-personal research data. Nevertheless, user-account information, authentication data, access logs and other operational metadata may constitute personal data, while uploaded technical information may be confidential or commercially sensitive. The applicable data classification, access restrictions and security measures are therefore assessed according to the actual data concerned.
- Access to stored data is provided through individual user accounts and role-based permissions using authentication protocol actually implemented and confirmed by EURECAT.
- Direct access to the servers is limited only to the system administrators and is behind EURECAT's secure virtual private networks. No direct public access to the servers is given to any user.

Also, some clarification could be made for the data recovery and storage:

- All the data collected in the platform was stored in the CEPH storage of the Red Hat OpenStack⁴ platform hosted by EURECAT (the main responsible partner) in their private cloud.
- The server data disk was backed up monthly.
- All the data was captured in a Structured Query Language server and all the raw files and reports uploaded was stored on the hard disk.
- A replication server was set up to insure Realtime data is replicated into another server.
- The raw files and reports data files Stored in the hard disk drives was backed up once every week.

Battery Passport deployment

A battery passport platform has been deployed as one of the main results of the work performed in WP2 -task 2.4 & 2.5- & WP5 -task 5.4-. The Battery Passport Platform is intended to store and make available comprehensive information about lithium-ion batteries, including their composition, state of health, lifecycle data and repair instructions. This information is intended to be accessible to different stakeholders, including manufacturers, recyclers and regulatory bodies, in order to support decision-making and improve the sustainability of the battery value chain. Each Battery Passport is intended to operate as a digital twin of its physical battery enabled by the digital Battery Passport platform, which offers a global solution for securely sharing information and data.

⁴ Red Hat® Ceph® Storage. Available at: <https://www.redhat.com/en/technologies/storage/ceph>

The data model developed in D5.4 facilitates the flow of information between the different stakeholders in the battery value chain and includes data points such as battery chemistry, dimensions and manufacturer details. The Battery Passport is also intended to support Design for Recycling by providing information on battery composition and disassembly instructions and to contribute to the optimisation of recycling processes. The final platform uses a hybrid blockchain–MongoDB architecture, smart contracts and role-based access controls to support traceability throughout the battery lifecycle. D5.4 defines the data model, user requirements, roles and access rights, while D2.8 to D2.10 provided the deployment and integration of the platform. Personal data should not be written to the blockchain. Where platform user accounts, authentication information or access logs involve personal data, such information is handled off-chain under appropriate access, retention and deletion controls. The final version of the Battery Passport Platform is documented in D2.10, which is due at the same project milestone as this final DMP.



Ethics

No additional ethical concerns have been identified since the submission of the D1.6 Ethics requirements at month 3. The final review of the DMP has nevertheless taken into account the evolution of the project activities, including stakeholder engagement, social assessment and the development of the digital platforms. The CA remained applicable throughout the project, providing the contractual framework for confidentiality or allocating responsibilities concerning data sharing. Each processing activity involving personal data remained subject to the applicable GDPR requirements and legal basis.

Most scientific and technical datasets generated by FREE4LIB do not contain personal data. Nevertheless, certain project activities involve the processing of personal data, particularly D&C activities such as stakeholder contact, event registration, interviews, meeting recordings or platform user accounts. Such processing is managed by the beneficiary or beneficiaries responsible for the activity in accordance with the GDPR and other contractual arrangement (e.g. CA). This was particularly relevant to WP5 activities involving stakeholder engagement and the development of the Battery Passport concept. D5.4 used workshops and interviews to identify data needs, user requirements and stakeholder perspectives.

Most of the scientific and technical information generated concerns non-personal data associated with batteries, materials, recycling processes, environmental assessment and technological development. However, for the processing of personal data the GDPR applies. For non-personal data, the project followed the applicable EU framework on the free flow of non-personal data (Regulation 2018/1807 on the free flow of non-personal data in the EU⁵). Where stakeholder contributions (e.g. interviews or questionnaires) were used to support project analyses and deliverables, the management of the underlying personal information was distinguished from the scientific or aggregated results derived from those activities. Public D&C activities focused on aggregated or effectively anonymised information, consistently with the data-protection measures described in the section Data Security.

⁵ Regulation (EU) 2018/1807 of the European Parliament and of the Council of 14 November 2018 on a framework for the free flow of non-personal data in the European Union (Text with EEA relevance). Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018R1807>



Conclusions

This document constitutes the final version of the DMP of the project, offering a description of the datasets generated, collected and managed within the framework of this EU-funded project regarding the EOL of LIBs. It also provides information regarding how these datasets and, where applicable, other research outputs comply with all the FAIR principles. A list of the identified datasets has been provided with selected research data and other outputs made available externally in trustworthy repositories such as Zenodo following standards such as the DOI and applying appropriate licences, including the CC BY 4.0 license to allow their identification, access and reuse, fully aligned with our D&C strategy and GA/CA provisions. The use of persistent identifiers, appropriate metadata, open or widely used formats and clearly defined access conditions supports the long-term findability and reusability of the project results. Additional details have been included in this D1.5 about the preservation conditions beyond the end of FREE4LIB and the reproducibility of the results.

Most scientific and technical datasets generated by FREE4LIB are non-personal data. Nevertheless, certain project activities involved the processing of personal data, including stakeholder contact management, interviews, questionnaires, meeting recordings and, where applicable, platform user information. The GDPR therefore applies to those specific processing activities, while effectively anonymised data and non-personal scientific and technical data fall outside its scope. The potential public dissemination of the datasets that have been collected/generated inside the project was assessed on a case-by-case basis, following the principle “as open as possible, as closed as necessary”. Access was restricted where justified by intellectual property rights, confidentiality, personal data protection, security considerations or other legitimate interests.

Each partner remained responsible for implementing the technical and organisational security measures applicable to the data, systems and processing operations under its responsibility. The security measures adopted to protect the data have been explained, with particular focus on the Cloud Battery Recycling Platform and the Battery Passport Platform. Beyond research data, FREE4LIB generated other relevant research outputs, including models, software, protocols, guidelines and digital platforms. These outputs have been considered under the same FAIR-oriented approach.

No additional ethical or legal issues beyond those addressed in this DMP and in D1.6 have been identified as preventing the appropriate sharing via D&C activities or through the effective exploitation of project results. Each beneficiary remained responsible for complying with the ethical requirements



applicable to the activities carried out under its responsibility, while the coordinator provided support to the whole consortium and ensured consistency across the project.

The final DMP also addresses the continuity of data and digital research outputs beyond the end of the project. Publicly reusable results are intended to remain accessible through appropriate repositories and project result channels. This final version of the DMP consolidates the datasets and other research outputs actually generated during the project and records their final access, licensing, preservation and deletion arrangements, and identifies the responsibilities applicable after the end of the action. It therefore represents the final reference for the management, protection, accessibility and preservation of FREE4LiB research data and other research outputs, complementing the technical, exploitation and IPR deliverables produced during the project.

