EMPOWER

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Project Title:

Eco-operated, Modular, highly efficient, and flexible multi-POWERtrain for long-haul heavy-duty vehicles

Acronym: EMPOWER

Grant Agreement No.: 101096028

Topic: **Modular multi-powertrain zero-emission systems for HDV (BEV and FCEV) for efficient and economic operation (2ZERO)**

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History of Changes

Date	Action
D9.2	Initial version of Data Management Plan
D9.3	Update of “Types and formats of research data to be generated and used in EMPOWER” Update of “Reuse of existing data” Update of “Expected size of data” Added chapter “Standards and Regulations” Update of “Data utility” Update of “Allocation of resources”

Publishable Executive Summary

In the recent years, there is a strong incentive from the European Commission (EC) towards the implementation of open access to scientific publications and research data derived from the European Union (EU) funded research projects. This is reflected in efforts to standardise procedures to achieve Findable, Accessible, Interoperable ad Reusable (FAIR) research data. The goal behind this incentive is to maximise the impact of EU-funded research projects and accelerate discovery through the interaction of the data produced in several research projects.

This Deliverable D9.3 First Revision of Data Management Plan (DMP) is an update to Deliverable D9.2 Data Measurement Plan and aims at proposing a general approach to handle the research data during and after the end of the EMPOWER project, providing guidelines to specify which data will be collected, processed and/or generated, to what extent this data will be publicly available, and how data will be curated and preserved (including after the end of the project). The document also addresses several aspects on how to make the data produced in the EMPOWER project as FAIR as possible, following the indications provided by the EC. This deliverable does not include any deviation from the objectives and timings planned in the Grant Agreement of the project.

This First Revision of Data Management Plan will again be revised in Month 36 as Deliverable D9.4 Second Revision of Data Management Plan.

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Abbreviations and Nomenclature

Table 1: List of Abbreviations and Nomenclature

Symbol or Shortname	Description
DMP	Data Management Plan
BEV	Battery Electric Vehicle
CAD	Computer Aided Design
FCEV	Fuel Cell Electric Vehicle
GDPR	General Data Protection Regulation
HVAC	Heating, Ventilation, and Air Conditioning System
HVI	Human-Vehicle Interface
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
TCO	Total Cost of Operation
ZE-HDV	Zero-Emission Heavy-Duty Vehicles

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1 Introduction

The present document is the first revision of the EMPOWER data management plan (DMP) which will be again revised in the upcoming Deliverable D9.4 (Second revision of data management plan – M36). At the end of the project all information about data management will be summarised in D9.5 (Final version of data management plan – M48). The present DMP is an indicative plan as to what kind of data the project beneficiaries expect to generate during the project, and how these data will be managed. This DMP follows the provided standard DMP template [1].

Section 2 provides some information about the data used, gathered, and shared in EMPOWER whereas section 3 provides an overview about the use of FAIR data. Section 4 highlights all other aspects of data handling.

The objective of EMPOWER is to deliver two modular and flexible Zero-Emission Heavy-Duty Vehicles (ZE HDVs) of Vehicle Energy Consumption Calculation Tool (VECTO) group 9 with a Gross Vehicle Weight of at least 40 tons. One of the trucks will be a Fuel Cell Electric Vehicle suitable for long-haul operation conditions with a maximum unrefuelled range of 750 km. The second one, being a Battery Electric Vehicle, will be designed for regional distribution mission profiles with a maximum unrecharged driving range of 400 km.

During the project, data will be generated for designing the ZE HDVs and their auxiliary components, for sharing information and for assessing and evaluating the success of the overall project objectives. The purpose of the data collection/generation can be subdivided into the following points:

- **Modelling the vehicles:** The creation of a digital twin model is the core of the EMPOWER project and will help to assess the impact of the developed solutions.
- **Development of components and systems:** EMPOWER will elaborate efficient solutions for 12 technology bricks covering the entire vehicle architecture, propulsion- and braking systems, energy storage, energy- and thermal management, fleet management, charging infrastructure, and Human-Vehicle-Interface.
- **Measurements:** This comprises the proof and validation of the planned EMPOWER KPIs for both demonstrator vehicles in two stages – on the testing ground and during real-world operation.
- **LCA and TCO assessment:** A Life Cycle Assessment and a Total Cost of Operation Assessment will provide essential information about the environmental and economic impacts.

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2 Data Summary

2.1 Data types and formats

A wide range of data types and formats are expected to be generated in the project. While these cannot be listed in advance, some general remarks can be made. The data types will vary according to the source application in which they are generated. Generally, the consortium will endeavour to utilise common data formats. In some cases, particular laboratory equipment or software may output data in proprietary formats, but where sharing of these data with other partners is necessary, a conversion to or a summary in common formats may be possible. Table 2 gives an overview about the project work packages. Table 3 gives a summary of the expected types of research data expected to be generated in the project whereas Table 4 summarises the non-research data.

Table 2: List of work packages in EMPOWER

WP	Name
1	Platform identification, technical specification of modular HDV, and digital-twin
2	Integrated e-axle and fuel cell system
3	Modular energy storages (battery and hydrogen tank)
4	Modular and flexible vehicle architecture
5	Innovative HVI, V2G communication, fleet management, and infrastructure
6	Integration of components into vehicle demonstrators
7	Demonstration of FCEV and BEV use cases
8	Dissemination, communication, and exploitation
9	Project management

Table 3: Types and formats of research data to be generated and used in EMPOWER

WP	Type of Data	Data Format
1	Technical specifications, Simulation models and results, LCA and TCO assessment	Lists and tables (e.g., *.xlsx, .docx), simulation models (e.g., *.mo, .m), results (e.g., *.mat, .xlsx), reports (*.pdf, *.pptx)
2	CAD Data, system specifications, measurement results	CAD Data (e.g., *.stl, *.stp), specifications (e.g., *.pdf, *.xlsx, *.docx), measurement data (e.g., *.mat, *.xlsx)
3	CAD Data, system specifications, measurement results	CAD Data (e.g., *.stl, *.stp), specifications (e.g., *.pdf, *.xlsx, *.docx), measurement data (e.g., *.mat, *.xlsx)
4	CAD Data, system specifications, measurement results	CAD Data (e.g., *.stl, *.stp), specifications (e.g., *.pdf, *.xlsx, *.docx, *.pptx), measurement data (e.g., *.mat, *.xlsx)
5	system specifications, measurement results	Specifications (e.g., *.pdf, *.xlsx, *.docx), measurement data (e.g., *.mat, *.xlsx)
6	CAD Data, system specifications, measurement results	CAD Data (e.g., *.stl, *.stp), specifications (e.g., *.pdf, *.xlsx, *.docx), measurement data (e.g., *.mat, *.xlsx)
7	measurement results	measurement data (e.g., *.mat, *.xlsx)

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Table 4: Types and formats of non-research data to be generated and used in EMPOWER

WP	Type of Data	Data Format
8	Website traffic; audience engagement statistics from social media; photos and/or videos of project participants	Exports from LinkedIn analytics (probably *.xlsx and/or *.pdf)
9	Project management data (e.g. financial, resources)	Financial tables (*.xlsx), reports and deliverables (*.docx, *.pdf)

2.2 Reuse of existing data

It is recommended to use existing resources for research to enlarge and diversify the underlying database for developments made in this project. This means that the data was either obtained by a partner outside of the EMPOWER project or by external sources/parties and introduced into the EMPOWER during the project implementation. This data includes for example:

- Vehicle data will be gathered from different IVECO departments. IVECO will share internal data related to vehicle systems, performances (overall vehicle performances and systems' performances), production techniques, etc., especially for the purpose of performing the LCA and TCO analysis. Some IVECO sensible data will not be shared and used/reused for this project due to intellectual knowledge protection.
- Existing measurement data and generically parameterized models of the HVAC system and the powertrain. These will be used to set up a workflow before the actual measurement data of this project will be available. In this way, the development of the energy and thermal management strategies can be sped up. The measurement data is necessary to parametrize the simulation models, which will then be used to generate data e.g. develop and validate the energy and thermal management strategies.

2.3 Origin of data

Most of the data in the project will be generated in-project. The re-used data will come from external and open sources databases as well as from internal databases from the project partners. Databases provided will be assessed beforehand for their suitability by the respective partner. Only technically and legally suitable data from external databases is used in the project.

2.4 Expected Size of Data

At this state of the project, the expected size of the data is still not fully known. Nevertheless, a first estimation based on previous projects and the experience of the project partners can be given.

Table 5: Expected type and size of generated data in EMPOWER.

Type of Data	Size of Data
Controller Parameters	1 MB
Data Sheets and Components Specification Data	1 MB up to 1 GB
Simulation Models, Results Data	Up to 1 GB
Software Code	Up to 1 GB

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CAD Data of HVAC system	1 GB up to 10 GB
Measurement Results (depending on final measurement setup and use cases)	10 GB up to 100 GB

2.5 Standards and Regulations

A lot of different data is used, generated, stored and shared in this project. Different standards and regulations exist dealing with the quality of these data and the handling during sharing between project partners and with external parties. The data itself and the handling is compliant to the following standards and regulations:

- Company specific internal policies
- Grant Agreement (GA)
- Consortium Agreement (CA)
- General Data Protection Regulation (GDPR)
- ISO 9001

2.6 Data utility

The data generated in EMPOWER will be useful for the project (consortium), for other research projects in a similar field and for companies that want to develop products or systems of a similar nature. EMPOWER is committed to promoting Open Science but maintains a balance between opening science and protecting confidential information and intellectual property rights, which are an essential part of the innovation cycle. This balance is crucial for efficient collaboration, respecting the legitimate interests of all stakeholders, and for the effective and viable exploitation of knowledge and technologies.

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3 FAIR data

The research data generated by the EMPOWER project should be 'FAIR'; findable, accessible, interoperable, and re-usable. The acronym and principles were defined in a March 2016 paper in the journal Scientific Data by a consortium of scientists and organisations [2].

Table 6: Overview over the FAIR principle

F Findable	The first step in (re)using data is to find them. Metadata and data should be easy to find for both humans and computers. Machine-readable metadata are essential for automatic discovery of datasets and services.
A Accessible	Once the user finds the required data, she/he/they need to know how they can be accessed, possibly including authentication and authorisation.
I Interoperable	The data usually need to be integrated with other data. In addition, the data need to interoperate with applications or workflows for analysis, storage, and processing.
R Reusable	The ultimate goal of FAIR is to optimise the reuse of data. To achieve this, metadata and data should be well-described so that they can be replicated and/or combined in different settings.

3.1 Making data findable, including provisions for metadata

3.1.1 Persistent identifiers

Unless any project beneficiary applies persistent identifiers for their own use, no persistent data identifiers are envisaged for the purposes of information sharing between consortium partners in the EMPOWER project. However, any datasets made available as open data will use the possibilities for persistent identifiers as provided by the host platform (e.g., Zenodo).

3.1.2 Naming conventions

To manage the created number of documents, common rules for file names need to be followed. File names need to comply with the following rule which is also described in D9.1 Project handbook:

- **EMPOWER**_*Index_DocName_Date_Version_Partner.ext*

with the following meanings:

- Index — Number of WP or deliverable — e.g. WP1 or D1.4
- DocName — Short name suitable for content identification — e.g. KickOff
- Date — Date of document creation — e.g. 2023-05-22
- Version — Version number — e.g. V1.1
- Partner — Acronym of document responsible partner — e.g. AIT
- ext — File extension — e.g. pptx

3.1.3 Metadata

Metadata for describing the data that is collected and generated by the EMPOWER project is needed for facilitating open access to the data, e.g. when searching or accessing data. There are many different meta-data standards for many different types of data, and it may not be possible to find one that fits all purposes. Therefore, a pragmatic and feasible approach is to agree on a common and minimal catalogue metadata schema for those datasets that are published in public catalogues and data repositories and to use data-type specific schema extensions, if necessary. Following initial metadata and classifiers have been identified currently:

- **Scope:** For what purpose was data created / collected?

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- **Date of dataset generation:** When was the data generated?
- **(Laboratory) conditions:** What where the relevant conditions like temperature, humidity, etc.?
- **Parameter settings:** Which settings were set while generating the data?
- **Name and version of the software used:** Which software and version were used?
- **Data type:** Does the dataset contain raw data or processed data or both?
- **Variable names:** Variable names / parameters are explained or self-explanatory (i.e. defined in the vocabulary of the research field).
- **Data version:** The version of the archived and / or re-used data is clearly specified and documented.

Once data will be generated, the list of metadata will possibly be adapted in further versions of the Data Management Plan.

3.2 Making data accessible

3.2.1 Availability of data

Data are subject to a case-per-case evaluation to determine whether they should be made openly available to protect industrially/commercially sensitive information. Only selected data will be shared after internal consultation and approval in the consortium.

3.2.2 Accessibility of data

The MS SharePoint repository set up by AIT enables partners to share and access the relevant data for the different project activities and tasks. Public deliverables as well as open access publications will be uploaded on the EMPOWER website (https://www.projectempower.eu/). Publications and public data will be available on open access data repositories such as OpenAIRE (https://www.openaire.eu/) and/or Zenodo (https://zenodo.org/).

3.2.3 Access management

For open data, no tracking of people accessing the data is planned from the EMPOWER consortium side.

Access to the EMPOWER project SharePoint is provided individually for each user of the project team secured by username (email) and password. The repository applies a strict policy in granting and revoking access to data and logging the user identity while accessing, downloading, and uploading, including version control. This enables to restore the availability and access to the data in timely manner if an incident were to occur.

3.2.4 Personal or sensitive data

No personal or sensitive research data is planned to be generated or shared in EMPOWER. For non-research personal data, project partners are requested to fill out a consent form regarding the use of photo or video material featuring still or animated images of individuals – in conformity with data protection regulation.

3.2.5 Expiry date for open data

Once approved for publication as open data, the consortium does not envisage an expiry date.

3.2.6 Additional tools

Any data generated in EMPOWER is expected to be readable with generally available tools (word processors, PDF and image viewers, spreadsheet software) or open-source tools available.

3.3 Making data interoperable

Community-based standards like ISO standards, established software, hardware and computer code will be used. Documents will be written in English and will be using established standard terminologies/ontologies. Nevertheless, variables and value names will be constructed following general data processing conventions

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common to the research subject. List of value names and their properties will be provided in a separate list. Examples of these information to be managed within the project will be e.g. units of variables, list of variables with the name and label of each variable as well as its values and value labels, frequency distribution of each variable, information on the classifications used and meanings of abbreviations used.

While knowing that not all the research datasets that is being collected and that will be generated during the project's duration are public, many datasets will be kept confidential and therefore will not be available for access or inter-operability. Moreover, files such as simulation models cannot be used by other partners that do not have the software license.

Nevertheless, some of the data that will be publicly available and put in open access repositories like Zenodo can be interoperable. JSON (JavaScript Object Notation) scheme is used by Zenodo for metadata. Research data can be exported into different file types which will be defined once it is known, which data will be available.

3.4 Increase data re-use

Ownership of datasets will belong to project consortium after the project completion. Creative Commons licence CC BY-SA or CC BY will be used for any open datasets unless there are compelling reasons to select a more restricted type of CC-licence. Creative commons licences will by default also include a disclaimer of liability for the re-use of opened data. The availability of data is summarised in Table 7.

Table 7: Data availability

Data	Type	Availability
Underlying data published in scientific journals	Public	Available after publication
Underlying data published in scientific journals	Confidential	Not available for publication because of privacy concerns
Data from public deliverables	Public	Available after approval of EC
Other data	Public	Available after consent of all project partners at the end of the project at latest
Other data	Confidential	Not available for publication.

No definite period or time limit is planned for access or re-use of the data. However, the opened data will be deposited in a repository that guarantees data integrity on the bit level. At this point no continuous data curation policy to guarantee full long-term digital preservation of datasets is planned.

Justification for possible case-specific embargo for published data will be decided by project consortium. Embargo will be sought primarily in connection with any potential patent application based on project results.

For all public open data, it will remain reusable via Zenodo for at least 20 years. As stated by the Zenodo Repository "Items will be retained for the lifetime of the repository. This is currently the lifetime of the host laboratory CERN, which currently has an experimental programme defined for the next 20 years at least.".

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4 Allocation of resources

The activities related to the data generation and collection are part of the person months (and therefore Direct personnel costs) quantified in the Grant Agreement for each partner.

Costs corresponding to the open access provision of research publications and research data have been included as “Other goods and services” in the budget.

The cost related to long-term preservation (and protection, if necessary) of the generated data is still not fully quantified, as it is still not clear which data can be made openly available. However, following the infographic in [3] about Research Data Management, depending on the size of data to be stored, the length of preservation and the security levels costs in the range between 0 EUR and approx. 1,000 EUR arise.

The first step for total cost quantification is to get an overview of all the data produced within the project. The potential value associated with the long-term preservation of data and the costs, including how data will be kept beyond the project, how long and how the costs will be met, will be further discussed by the consortium.

The Project Coordinator (AIT) will be responsible for developing and updating the DMP throughout the whole duration of the project, as well as for providing guidelines to the EMPOWER partners to comply with the DMP. Each partner will be responsible for quality assurance of their generated data and metadata.

5 Data Security

Data security follows the policies and procedures of each project beneficiary, particularly those who create or own the data. In principle, it is assumed that data security corresponding to the state of the art is given. For open data, the consortium relies on the host repository's data security safeguards.

Open data, if any, will be stored in a trusted repository (probably zenodo.org).

6 Ethical Aspects

An ethics screening was done at the project proposal stage and in the grant agreement preparation of the project. No noteworthy ethics issues were identified.

Informed consent for personal data where it regards photos or videos is handled through the consent form as part of WP8. For preservation of these data, where project beneficiaries are the data controllers, these are handled in conformity with the data protection statement (as referenced in the consent form).

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7 Conclusions

This Deliverable D9.3 is the revision and update of the Initial Data Management Plan (D9.2) submitted in M6. It has disclosed the plans for data management according to best available information at project month M6 following a structured DMP template, enhanced with information gathered in the period from M6 to M18.

While beneficiaries are encouraged to look for ways to share data with the research community, they are under no obligation to disclose data if this goes against their interests.

A further update of this DMP will be published at project month M36 as D9.4 Second revision of data management plan.

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8 Bibliography

[1] European Commission, “Data Management Plan Template,” 2021. [Online]. Available: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/temp-form/report/data-management-plan_he_en.docx. [Accessed 12 05 2023].

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Project Partners:

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2	**IVECO**	IVECO SPA	IT
3	**FPT**	FPT Industrial SPA	IT
4	**IFPEN**	IFP Énergies nouvelles	FR
5	**POLITO**	Politecnico di Torino	IT
6	**LT**	Lead Tech SRL	IT
7	**VIL**	Villinger GmbH	AT
8	**CID**	Fundación CIDETEC	ES
9	**CTE**	CT Engineering GmbH	AT
10	**GLO**	GRUBER Logistics S.p.A.	IT
11	**BRE**	BREMBO SPA	IT
12	**IIT**	Istituto per Innovazioni Tecnologiche Bolzano S.c.a.r.l.	IT
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