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## SHIFT to Direct Current

### Deliverable D7.4

### Data Management Plan

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## Disclaimer

This document has been produced in the context of the SHIFT2DC project. Views and opinions expressed in this document are however those of the authors only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

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## Executive Summary

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This deliverable introduces the first version of SHIFT2DC Data Management Plan (DMP), a document built to establish data handling practices within the project. It provides a comprehensive framework for managing research data, including guidelines for data generation, sharing, metadata definition, storage, and open data accessibility.

This DMP delineates the varieties of research data anticipated to be produced during the initiative and identifies which segments may be disseminated within the scientific community and across industries utilizing medium and low voltage direct current (DC) solutions. It presents comprehensive guidelines to maintain the data's integrity and facilitate its utility across its lifecycle, ensuring that findings can support advancements in electric power systems and contribute to the broader application of DC solutions in Europe.

Furthermore, the DMP includes a curated list of deliverables, offering stakeholders insight into the project's data-related milestones and objectives. Scheduled updates and revisions of the DMP will occur at month 36 (M36) or as necessary to adapt to project developments.

Prepared by the leader of Work Package (WP) 7 – INESC ID, the DMP is complemented by a Data Definition Catalogue (DDC), a spreadsheet for monitoring and managing data generation activities. The DDC's maintenance is overseen by the Project Manager (PM), with support from work package and task leaders.

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## Acronym

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|          |   |
|----------|---|
| Apache   | Apache License  |
| APC      | Article Processing Charge   |
| BSD      | Berkeley Software Distribution                                    |
| BY       | Attribution ( <i>also</i> )                                       |
| BY-NC    | Attribution-ShareAlike  |
| BY-NC-ND | Attribution-NoDerivatives   |
| BY-NC-SA | Attribution-NonCommercial   |
| BY-ND    | Attribution-NonCommercial-ShareAlike                              |
| BY-SA    | Attribution NonCommercial-NoDerivatives                           |
| CC       | Creative Commons  |
| CINEA    | European Climate, Infrastructure and Environment Executive Agency |
| DB       | Database  |
| DC       | Direct Current  |
| DDC      | Data Definition Catalogue   |
| DMP      | Data Management Plan  |
| DOI      | Digital Object Identifier   |
| EC       | European Commission   |
| ECSite   | European Commission CORDIS website                                |
| EU       | European Union  |
| FAIR     | Findable, Accessible, Interoperable, and Reusable                 |
| GA       | Grant Agreement   |
| GDPR     | General Data Protection Regulation                                |
| GPL      | General Public License  |
| GNU      | GNU's Not Unix  |
| IM       | Innovation Manager  |
| IoT      | Internet of Things  |
| IPR      | Intellectual Property Rights                                      |
| LGPL     | Lesser General Public License                                     |
| LV       | Low voltage   |
| MIT      | Massachusetts Institute of Technology                             |
| Mozilla  | Mozilla Public License  |
| MV       | Medium Voltage  |
| OpenAIRE | Open Access Infrastructure for Research in Europe                 |
| PDF      | Portable Document Format  |
| PM       | Project Manager   |
| PO       | Project Officer   |
| R        | Report  |
| Sen      | Sensitive   |
| Shift2DC | Shift to Direct Current   |
| SP       | Scientific Publication  |



## 1 Introduction

---

### 1.1 Scope and Objectives

---

In accordance with the Commission's Open Research Data Management standards, the Shift2DC project is dedicated to fostering enhanced accessibility and reusability of research data. Balancing these objectives against considerations of scientific integrity, commercial interests, Intellectual Property Rights (IPR), privacy, and security, the project operates under the guiding principle of "as open as possible, as closed as necessary" [1].

The DMP serves as a roadmap for collecting, processing, and generating data throughout the project's lifecycle. Project partners have unanimously agreed to publish most of the project's data in reputable repositories, ensuring open access under appropriate licensing agreements. Instances where data access must be restricted will be rigorously justified within the DMP.

Furthermore, the DMP ensures that research data adheres to the Findable, Accessible, Interoperable, and Reusable (FAIR) Principles. It provides *i*) comprehensive guidance on data management practices during and after the project, *ii*) specifics on data collection methods and anticipated datasets, *iii*) plans for data sharing and open access, and *iv*) strategies for data curation and preservation. Regular updates to the DMP are scheduled to be submitted at M36 or as dictated by the requirements outlined in the Grant Agreement (GA).

### 1.2 Structure

---

This deliverable is structured into four sections. Section 1, the introduction, offers context and overview of the organization of this deliverable. Section 2 delves into the concepts underlying the definition of the DMP. This includes Horizon Europe's contractual basis for Open Science, FAIR Principles and Open Science Practices, DMP General Concerns such as Data Privacy and the European Union (EU) General Data Protection Regulation (GDPR) [2], [3], Open Access Publications, Repositories for Research Data, and Licenses schema for datasets, publications, and software.

Section 3 focuses on the aspects, rules, and recommendations of this DMP. It covers a range of topics, including a summary of the data, FAIR data principles, and other research outputs. It also addresses resource allocation, data security, partner organizations, and their roles. Concrete rules and recommendations for managing and sharing project data are provided, including *Deliverables*, *Publications*, *Datasets*, *Software* code and *Other Data* elements.

Section 4 offers conclusions and considerations regarding the deliverable. This DMP is complemented by an additional artifact: the *Data Definition Catalogue*, available in Excel format (.xlsx) in the Shift2DC Microsoft Teams/SharePoint folder.

### 1.3 Relationship with other deliverables

Figure 1 illustrates the identification and organization of the Work Packages (WPs) within the project. The Data Management Plan guides the management, share, and preserves the research data generated across various WPs. It outlines protocols for data handling during and after the project, including metadata definition, storage, and open data accessibility.

The DMP is part of WP 7 - Project Management. This deliverable is closely linked to all activities and deliverables concerning data collection and analysis from all WPs. Additionally, future updates to the DMP, to be reflected in deliverables such as D7.5 (Data Management Plan - Updated), will ensure ongoing alignment with project developments and requirements, reinforcing its integral role in facilitating effective data management throughout the project lifecycle.

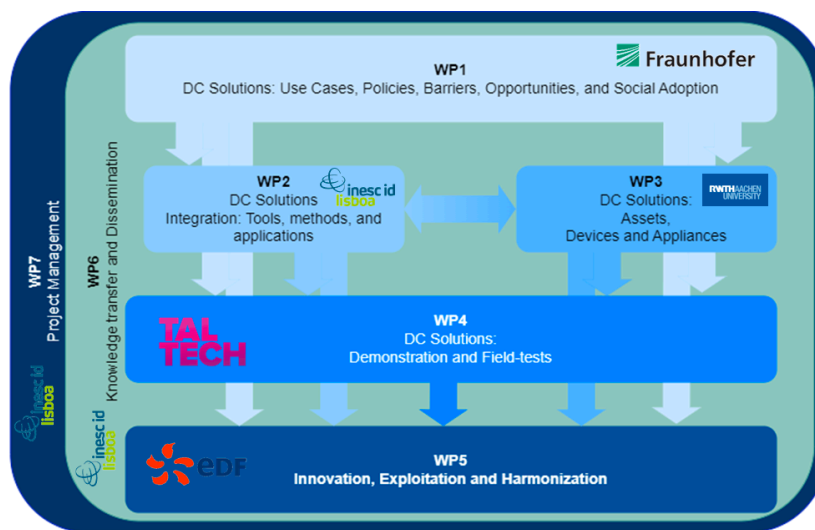


Figure 1-1 – Shift2DC Work Packages Identification and Organization (from grant proposal)

## 2 Background

---

The Shift2DC Project will align with the regulations set out for the Horizon Europe program. Section 2 provides an overview of the fundamental principles guiding the development of the DMP, including the Horizon Europe Contractual Basis for Open Science, Fair Principles and Open Science Practices, DMP General Considerations, Data Privacy, Open Access Publications, Licensing, and Research Data Repositories.

### 2.1 Horizon Europe Contractual Basis for Open Science

---

In line with the Horizon Europe program guide by the EC [1], there's an essential move towards Open Science, departing from the previous *Horizon 2020's Open Access model*. This shift introduces a set of obligatory and suggested practices outlined in Article 17, annex 5 of the GA [4], emphasizing the need for openness in scientific endeavours. Furthermore, beneficiaries shall follow the principle that data should be *as open as possible, as closed as necessary*, and when possible, make accessible elements such as software, data, related to scientific publications, free of charge, for third parties to exploit, reproduce, and disseminate.

Article 17 also underscores the importance of promptly sharing peer-reviewed publications and research findings through pre-prints, open science journals, and reputable repositories. Furthermore, it advocates for the transparent dissemination of data and associated components to facilitate broader utilization unless there are compelling reasons for restrictions. These measures ensure accessibility, transparency, and the availability of scientific findings for validation in alignment with the FAIR principles. Additionally, in moments of urgency, all research outputs must be promptly accessible upon request from the granting authority [4].

### 2.2 FAIR Principles and Open Science Practices

---

The FAIR principles for managing research data, which stand for Findable, Accessible, Interoperable, and Reusable, were established after *Jointly designing the data FAIRPORT* international conference held in January 2014 [5]. They were subsequently published in Nature's Journal of Scientific Data in 2016 [6]. These principles were adopted worldwide as the foundation policy for data management and research [7].

Various funding agencies now necessitate conformity to FAIR data principles, including the European Commission (EC), which stipulates that every EC-funded project must incorporate a DMP aligned with FAIR data standards [1]. The FAIR principles ensure that using qualified links makes data easily discoverable, accessible, and referenceable, facilitating its integration and utilization. They also guarantee the clear identification and management of original data via specific licenses, prioritizing data reuse [8].

As articulated in the original publication, *the FAIR principles put specific emphasis on enhancing the ability of machines to automatically find and use the data, in addition to supporting its reuse by individuals* [6]. These principles extend beyond data to encompass algorithms, tools, and workflows integral to data generation. Despite sensitive information, all elements of research, including data and

associated components, must be accessible to promote transparency, reproducibility, and maximize data utility.

## 2.3 DMP General Concerns

---

As outlined in the *Practical Guide to the International Alignment of Research Data Management* [9], DMPs should encompass a minimum of six significant areas, which, with associated queries, constitute the fundamental prerequisites for crafting a robust DMP.

These topics are outlined as follows:

- 1. Data description and collection or re-use of existing data**  
This entails providing a description of how data is collected, produced, and reused.
- 2. Documentation and data quality**  
It involves describing the data using relevant metadata and ensuring data quality through appropriate control measures.
- 3. Storage and backup during the research process**  
This section details the storage and backup procedures for both data and metadata, emphasizing security measures and the protection of sensitive data.
- 4. Legal and ethical requirements, codes of conduct**  
This aspect covers compliance with legal and ethical standards, including regulations related to personal data processing, data security, and management of intellectual property rights and ownership.
- 5. Data sharing and long-term preservation**  
It includes plans for data sharing, preservation, and identification to ensure long-term accessibility and usability.
- 6. Data management responsibilities and resources**  
This involves identifying individuals responsible for data management and the resources required to ensure that data management practices adhere to FAIR principles.

The concerns and questions outlined in the previous section serve as guidance for developing the DMP and its supplementary artifact, the DDC (in .x/sx format). These documents help ensure that research data is effectively managed and aligned with international standards and best practices.

## 2.4 Data Privacy

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Privacy and the management of personal data are significant concerns in contemporary society, leading nations and international federations to enact stringent laws to prevent or mitigate abuses and misbehaviours. The EU's GDPR, enforced on May 25, 2018, is regarded as one of the most stringent privacy and security laws globally [3]. The GDPR establishes regulations to safeguard the fundamental rights of individuals regarding the processing and free movement of personal data. It emphasizes that *the free movement of personal data within the Union shall be neither restricted nor prohibited for reasons connected with the protection of natural persons with regard to the processing of personal data* [10].

GDPR outlines various principles and rights of data subjects that must be upheld by any organization or individual involved in collecting, processing, or disclosing personal data. Consequently, within the scope of the Shift2DC project, all partners must adhere to GDPR requirements. Specifically, partners must ensure that personal data is processed lawfully, fairly, and transparently, collected for specific, legitimate purposes without further processing incompatible with those purposes, kept accurate and up-to-date, and retained only for as long as necessary for the intended purposes while maintaining appropriate security measures. Additionally, ethical concerns can be addressed and discussed during scientific committee (SC) meetings throughout the project if necessary.

## 2.5 Open Access Publications

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Open access (OA) refers to the practice of making research outputs freely available online to everyone without any financial barriers. This includes a wide range of materials, such as peer-reviewed and non-peer-reviewed academic journal articles, conference papers, theses, dissertations, book chapters, monographs, research reports, and images. When adopting OA, materials are typically accompanied by an open license for copyright, enabling reuse by others.

There are different models of OA publishing, but the most popular are [11], [12]:

- **Golden OA**

In this model, publishers make articles and related content freely available on the journal's website immediately upon publication. However, authors are typically required to pay a publication fee, known as an Article Processing Charge (APC). Notably, under the Horizon Europe program, publication fees in fully open access venues are reimbursed. Additionally, articles published under Golden OA are licensed for sharing and reuse via Creative Commons licenses or similar mechanisms.

- **Green OA**

This model permits authors to self-archive their work. Authors can upload their manuscripts to a website controlled by them, their affiliated research institution, or an independent central open repository. This allows people to freely download the work without any charges. Green OA is typically free for the author and complements traditional publishing practices.

In the Shift2DC project, there is a strong encouragement for immediate open access to research data, with a preference for depositing data in certified or trusted-community-recognized repositories (Section 2.7), in alignment with Horizon Europe policies.

## 2.6 Licenses

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Horizon Europe requires that open data be licensed and shared in recognized and certified repositories, accompanied by appropriate metadata. This ensures transparency, accountability, and the facilitation of knowledge dissemination in alignment with open science principles. In this sense, a license is a legal agreement between the creator of an artifact and the end-user, outlining the permissible actions users can take with the artifact. Licenses come in various forms for publications,

software, datasets, and other intellectual properties and serve to protect intellectual property rights while granting others the ability to utilize, modify, or create new artifacts based on the original work.

### 2.6.1 Data and Publication Licences

---

The most common licenses for data and publications are Creative Commons (CC) licenses. These licenses are designed to grant users specific permissions while protecting the rights of the creators. Here's an explanation of the common types of data licenses according to the Creative Commons scheme [13]:

- **Attribution (CC BY)**  
This license allows others to distribute, remix, tweak, and build upon the work, even for commercial purposes, if they credit the original author. It is the most accommodating of licenses, recommended for maximum dissemination and use of the licensed materials.
- **Attribution-ShareAlike (CC BY-SA)**  
This license permits others to remix, tweak, and build upon the work for commercial purposes, provided they credit the author and license their new creations under identical terms. It is akin to "copyleft" licenses in the open-source software realm, ensuring that derivative works carry the same license terms.
- **Attribution-NoDerivatives (CC BY-ND)**  
This license allows others to reuse the work for any purpose, including commercial use, but prohibits the sharing of adaptations. Credit must still be given to the author.
- **Attribution-NonCommercial (CC BY-NC)**  
This license permits others to remix, tweak, and build upon the work for non-commercial purposes. While derivative works must acknowledge the author and be non-commercial, they do not need to be licensed under the same terms.
- **Attribution-NonCommercial-ShareAlike (CC BY-NC-SA)**  
This license allows others to remix, tweak, and build upon the work for non-commercial purposes, requiring that they credit the author and license their new creations under identical terms.
- **Attribution NonCommercial-NoDerivatives (CC BY-NC-ND):**  
This license is the most restrictive, only allowing others to download and share the work if they credit the author. However, no changes can be made, and commercial use is prohibited.
- **Attribution (CC 0)**  
This is not a traditional license but rather a public dedication tool, essentially placing the work in the public domain with no restrictions.

To ensure the dissemination and accessibility of research outputs while maintaining appropriate attribution and licensing requirements in the context of Horizon Europe policies, scientific peer-reviewed publications and book chapters are recommended to be published under the latest version of the Creative Commons Attribution International Public License, specifically CC BY 4.0. Long-text formats can also be published under CC BY, CC BY-NC, CC BY-ND, CC BY-NC-ND, or equivalent licenses. Additionally, it is required that metadata be licensed under CC0 or an equivalent license [4].

## 2.6.2 Software Licences

---

Software should have appropriate licenses, with examples listed in references [14], [15]. These licenses fall into three categories: proprietary, free and open source, and hybrid, as described in [16]. Free and open-source licenses may be permissive, such as Berkeley Software Distribution (BSD), Massachusetts Institute of Technology (MIT), and Apache Software Foundation (Apache), or based on copyleft principles, such as GNU General Public License (GPL), GNU Lesser General Public License (LGPL), and Mozilla Public License (Mozilla), according to [17]. Software licenses define the terms under which third parties can use the software, including any restrictions on usage. It is essential for ensuring legal compliance and protecting intellectual property rights. Without a proper license, software cannot be legally used. Additionally, the metadata associated with software should also be licensed. This helps establish mechanisms for referencing the software and ensures that proper credit is given to the creators.

## 2.7 Repositories for Research Data

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Research data repositories are comprehensive platforms for managing, sharing, accessing, and preserving datasets and scientific outputs. The Horizon Europe programme emphasizes the importance of disseminating open data through trustworthy and/or accredited repositories, providing a list of recommended repositories [2]. The Shift2DC consortium has chosen *Zenodo* for storing data and publications. *GitHub* was selected for managing source code, as detailed in Section 3.4.

*Zenodo* facilitates the sharing of research findings for credit and recognition. It is agnostic to data type, format, size, and licensing, making it a versatile choice for researchers. Additionally, it supports the storage of private and restricted content, which can be made public at a later stage<sup>1</sup>. *GitHub*, a leading online platform for software development hosting over 330 million repositories, supports the creation, scaling, and collaboration of software projects in a secure environment<sup>2</sup>.

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<sup>1</sup> <https://zenodo.org/communities/shift2dc>

<sup>2</sup> <https://github.com/SHIFT2DC>

## 3 Data Management Plan

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This report is complemented by the DDC, accessible on the Shift2DC Microsoft Teams/SharePoint as an Excel file. The responsibility of maintaining the DDC lies with the PM. The DDC facilitates a uniform and methodical systematization of all deliverables and data elements—both utilized (input) and generated (output)—within the project's framework. Deliverables refer to the official reports that encapsulate the core outcomes of the project's WPs, while data elements denote various components used or produced throughout the project's research activities.

### 3.1 Data Summary

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#### 3.1.1 Data Types

---

In Shift2DC, the data generated or utilized is organized into the following main categories:

##### **Deliverables**

These are official reports created as part of the project work and associated with specific WPs. PM or Coordination Team submits these reports to the EC portal, where they undergo formal approval by an EC project officer (PO). Once submitted and approved, these deliverables are stored and made available on the Shift2DC project website and the CORDIS website (ECSite).

##### **Data Elements**

This category encompasses both formal and informal components produced during the project. These elements are identified, managed, and potentially shared or reused by project partners or, when available publicly, by specific target groups. Data elements include:

- **Publications:** This covers a broad spectrum of outputs such as books, book chapters, conference papers, journal articles, patents, preprints, reports, theses, technical notes, and working papers. Research papers refer to those submitted to conferences and journals. Peer-reviewed scientific papers have undergone a review process by peers in the field, and preprints are research papers not yet submitted or accepted by journals or conferences but are available on platforms like *Zenodo*.
- **Software:** Consists of source code and accompanying technical documentation, typically maintained in a source code repository. Such repositories support version control and other development tools, including file hosting and bug and issue tracking.
- **Datasets:** These are compilations of data derived from research activities, which can be numerical data or text, such as questionnaire responses.
- **Other:** This includes various resources that may be produced and shared, including posters, videos, images, and presentations.

#### 3.1.2 Data Sources

---

The Shift2DC project will leverage various data sources, prioritizing the reuse of existing public databases and partner data when feasible. Additionally, new data will be generated from demonstration sites to evaluate the project's proposed solutions and management strategies.

Key data sources include:

#### **Public Databases & Literature Review**

- Literature Review: Open data obtained through literature surveys.
- Public databases and Literature Review (WP1 & WP2): Leverage databases like *IEEE Xplore* and *ScienceDirect* and conduct literature reviews to support tasks T1.1, T1.2, and T1.4. These sources will provide knowledge on DC applications, challenges, and solutions development, informing the creation of advanced tools and methodologies for network design.
- Consortium Details: including names, emails, roles, and institutions, accessible only to consortium members.

#### **Manual Data Collection**

- Interviews with Experts and Case Studies (WP1 & WP6): Engage industry professionals and policymakers through interviews for tasks T1.6 (Users adoption and perception) and leverage case studies in T6.1 (Dissemination Plan) to gather insights into end-user perspectives and market needs, enhancing the project's dissemination activities.
- Participants' Feedback (WP5 & WP6): Gather and analyse feedback from stakeholders involved in tasks T5.4 (DC Roadmap and Business Opportunities) and T6.2 (Knowledge Transfer), to refine project outputs and dissemination strategies.
- Data from Demonstration Sites (WP4): Critical insights will be derived from the operation and monitoring of demonstration sites (T4.1d, T4.2d, T4.3d, and T4.4d), providing practical data on the application and performance of DC solutions.
- Data Provided by Partners (All WPs): Utilize the collaborative network of Shift2DC, where each partner contributes data and insights relevant to their tasks, fostering innovation and the development of new solutions.
- Other Market research surveys and Participants' Feedback.

#### **Automated Data Collection via Technology**

- Sensors and IoT Devices (WP4): Collect real-time data from demonstration sites in tasks T4.1 to T4.4, to monitor DC systems' performance in data centers, buildings, industry, and ports, directly informing the evaluation and analysis phases.
- Simulation Tools and Digital Twins (WP2 & WP4): Utilize simulation tools developed in tasks WP2 (Advanced tools and methodologies) to develop digital twins on T4.3 (Industry) and T4.4 (Port).
- Data from Demonstration Sites (WP4): Critical insights will be derived from the operation and monitoring of demonstration sites (T4.1d, T4.2d, T4.3d, and T4.4d), providing practical data on the application and performance of DC solutions.
- Data from related projects where access is permitted.

Further data sources may be integrated into the project as identified, and updates will be documented in this DMP.

### 3.1.3 Data Formats

---

In the Shift2DC project, open data formats will be utilized whenever possible. The anticipated file formats for various types of project materials are as follows:

- Text documents, reports, and published materials: .doc/.pdf
- Energy consumption and charging time databases: .csv
- Excel spreadsheets: .xlsx
- Photographs from demonstration locations: .jpg, .tif
- Video footage from demonstration locations: .avi, .mp4

For instance, questionnaire responses may be saved as text documents, spreadsheets, or PDFs (.txt, .doc, .pdf, .xlsx). Numerical data collected automatically at demonstration sites can be archived in .csv format databases. Images captured during demonstration activities might be stored in either .jpg or Tagged Image File Format (.tif), while video content could be in .avi or .mp4 formats.

### 3.1.4 Data Storage

---

Relevant data will be accessible to partners and preserved within the Shift2DC exclusive Microsoft Teams/SharePoint or four years post-project completion. Each data set will be catalogued with detailed metadata that includes: the project acronym, grant number, work package number, task leader's name, file name, version, date of creation or modification, file format, a description for the Digital Object Identifier (DOI), details on access and licensing, related publications, and keywords.

Publicly released deliverables will be made available on the project's official website and the EC website. Scientific research articles related to the project will be uploaded to the project's website. Openly accessible databases generated by the project will be hosted on the *Zenodo* platform, within the dedicated Shift2DC community, accessible via: <https://zenodo.org/communities/shift2dc/>.

### 3.1.5 Data Utility and Size

---

The data generated by this project will be utilized by the Shift2DC consortium and hold value for a broad spectrum of stakeholders, including scientific researchers, aggregators, system operators, and regulatory authorities. Throughout the project's duration, the Project Management Committee (PMC) will estimate the volume of data stored in Shift2DC's databases, paying attention to any size constraints set by Consortium partners, affiliated entities, and associated bodies of Shift2DC.

## 3.2 FAIR Data

---

The Shift2DC project is committed to optimizing the availability and utility of its data, adhering to the FAIR Data principles to ensure data is findable, accessible, interoperable, and reusable while safeguarding sensitive data for patenting purposes. This approach aligns with the project's goal to enhance the sharing and utilization of data to implement a top-down application-agnostic approach for the design, simulation, test, validation, and application of both medium (MV) and low voltage (LV) DC solutions while protecting the integrity and confidentiality of proprietary information.

The subsequent sections detail the strategies that Shift2DC has put in place, outlining the project's approach to implementation, management, and execution.

### 3.2.1 Making Data Findable, including Provisions for Metadata

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Ensuring data and its accompanying metadata are easily located and identified. Shift2DC strategy to make data more findable is:

- Each dataset uploaded to *Zenodo* will be given a DOI to ensure it has a persistent link.
- To enhance discoverability, data on *Zenodo* will include comprehensive metadata detailing the data's content, including:
  - Grant Number,
  - Project Acronym,
  - File name,
  - Version,
  - Date,
  - File type,
  - DOI,
  - Description,
  - Access and licensing information,
  - Related publications (optional),
  - keywords.
- Keywords associated with metadata will be descriptive. A set of general keywords provided are: *Direct Current, Buildings, Industry, Data Centres, Ports, Business models, Cost-benefit analyses*.
- A uniform naming convention will be applied to all files to maintain consistency:  
***SHIFT2DC\_<FileType>\_WP<WPId>\_T<TaskId>\_<Description>\_<LastUpdateDate>\_V<version>***

*FileType*: *DB* (Database), *DEL* (Deliverable), *SP* (Scientific publication), *R* (Report), *I* (Images)

- *WPId* – designate Work Packages using the format *WP* followed by a number ranging from 1 to 7, ensuring sequential numbering for clarity.
- *TaskId* – Use a consistent format such as "T" followed by the WP ID and a sequential number (e.g., *T1.1* for WP 1, Task 1).
- *Description* – Ensure concise file descriptions within a 40-character limit. Avoid special characters for compatibility and accurately reflect file content.
- *LastUpdateDate* – It is recommended to use the *yyyymmdd* format. Here, *yyyy* stands for the year, *mm* for the month, and *aa* for the day. For example, if the date is March 7th, 2024, it should be represented as 20240307.

- *Version* – Versioning follows the format  $(X.Y)$ , where  $X$  denotes major updates and  $Y$  minor revisions; conventionally, 1.0 represents the first final version.

For example, for the D1.1 the string would be:

*SHIFT2DC\_DEL\_WP1\_T1.1\_DC applications, opportunities and scenarios\_20240331\_V1.0*

### 3.2.2 Making Data Accessible

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The accessibility principle guarantees that data can be accessed by interested parties through well-defined protocols. As outlined previously, all public data from the Shift2DC project will be archived in reputable repositories, aligning with the guidelines of the Horizon Europe programme. Specifically, the project open data will be hosted on *Zenodo*, primarily encompassing scientific publications, project deliverables, and datasets. Additionally, the data management will extend across various key platforms, managed decentralized by the participants:

#### **Project Public Website (WebSite)**

- This WordPress setup platform will oversee the dissemination of both public and controlled data access for a duration of five years.
- Accessible via <https://www.shift2dc.eu>

#### **Project Private Repository (PrivRep)**

- This Microsoft Teams/SharePoint platform is designated for the exchange of general documents, templates for internal collaboration, databases in the processing phase, and data restricted from public access, along with their metadata.

#### **Project Open Data Repository (DataRep)**

- This repository is advised for the management and sharing of public data such as datasets, videos, images, presentations, and for referencing open publications and software repositories.
- Accessible via <https://zenodo.org/communities/SHIFT2DC/>

#### **Project Code Repository (CodeRep)**

- This GitHub organization is the recommended venue for handling software developed within the project, facilitating sharing among project participants and with the public.
- Located at <https://github.com/SHIFT2DC>.

#### **Journal and Conference Publishers Sites (PublisherSite)**

- These sites represent the publishers that disseminate peer-reviewed articles authored by project members, showcasing the project's principal scientific advancements.

#### **Project Site at EC CORDIS (ECSite)**

- the CORDIS website serves as the EC's principal outlet for outcomes from EU-funded research and innovation projects, from Framework Programme 1 (FP1) through to

Horizon Europe. This project micro-site is established and maintained within the scope of EC CORDIS.

- Available at <https://cordis.europa.eu/project/id/101136131>

Data flagged by the SC for IPR protection and patenting considerations will be exempt from open access provisions and instead will be conserved in secure private and institutional repositories.

### 3.2.3 Making Data Interoperable

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Making data interoperable ensures it can be integrated with other datasets, applications, or systems. As previously highlighted, the Shift2DC consortium is committed to utilizing open file formats as much as possible, along with standardized metadata for data description. Detailed guidance on achieving data interoperability, particularly with respect to metadata, including the use of metadata vocabularies, standards, formats, or methodologies, will be elaborated in future iterations of the DMP.

### 3.2.4 Making Data Re-usable

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Reusability pertains to the capability for data to be efficiently repurposed in compliance with transparent and readily available data usage policies. The Shift2DC consortium commits to the maxima of *as open as possible, as closed as necessary* to facilitate third-party access for the extraction, utilization, replication, and dissemination of all publicly available datasets under Creative Commons Licenses. Open-source software will be accessible via free software licenses.

Concurrent with the publication of research in academic journals, the corresponding data will be made accessible through the *Zenodo* platform or as a preprint on *arXiv.org* or academic institutional repositories. Similarly, data related to publicly released reports or scholarly articles will be shared promptly upon receiving approval from the EC or the respective journal via *Zenodo*. Any non-anonymized data that may exist will be expunged at the project's conclusion, such as personal details collected from the contact us section on the website, including names, email addresses, and messages.

## 3.3 Other Research Outputs

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In addition to generating datasets, publications, books, and project deliverables, Shift2DC will develop software, tools, and models. The FAIR principles outlined for datasets will equally apply to any publicly available software and models.

## 3.4 Allocation of Resources

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Shift2DC is committed to utilizing complimentary research data repositories such as *Zenodo*, *GitHub*, the project's website, and CORDIS to ensure the openness and adherence to FAIR principles of all project's public data. INESC ID will oversee data management, with the support of the WP leaders who will ensure compliance with established guidelines.

### 3.5 Data Security

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Confidential documents pertaining to Shift2DC are circulated within the consortium through the project's Microsoft Teams/SharePoint, accessible exclusively to authorized consortium members. Public data and software are securely stored on *Zenodo* and *GitHub*, which are equipped with robust security protocols.

Additionally, the project Coordination will maintain a detailed list of individuals authorized to access these services. This list will be reviewed and updated every three months and whenever a member leaves the project to ensure ongoing security and proper access control.

### 3.6 Organizations and Roles

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The project involves a range of stakeholders, including: (i) partners, (ii) *affiliated entities*, (iii) associated partners, (iv) the project's funding entity, the EC, (v) individuals affiliated with these organizations, and (vi) identified target groups who show an interest in the project's outcomes.

The DMP recognizes certain roles within these stakeholders as crucial to data management:

- Project Coordinator (PC)
- Project Manager
- Entities: Including 21 partners, 6 affiliated entities and 6 associated partners in the Shift2DC project.
- WP Leader
- Task Leader
- General Assembly: Consisting of the PC, PM, and a representative from each partner.
- Scientific Committee: Comprising WP leaders, the PC, the PM and the Innovation Manager (IM)
- Project Management Committee: Including the PC, PM, IM, and Communication Officer.
- Correspondence Author: Responsible for submitting publications.

### 3.7 Workflow to Define and Manage the DMP

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The process for establishing and managing the DMP throughout the project lifecycle includes the workflow of defining and managing the following activities:

A1. (M1-M6; DMPLeader, PC, PM): Initially define and release DMP version 1.0, including the DDC in Excel format.

A2. (M1-M6; PM with additional support): Set up essential systems such as the project website and repositories for data and code, creating and setting up key supported systems, namely: project WebSite, PrivRep, DataRep, CodeRep, and ECSite.

**A3. (M6; PC, PM): Submit DMP version 1.0 for EC approval.**

A4. (M7-M8; PC, PM): Disseminate DMP version 1.0 among partners to gather feedback and information on planned data.

A5. (M8-M9; DMPLLeader, PC, PM): Update and publish DMP version 2.0, incorporating partner feedback.

**A6. (M9; PM) Seek EC approval for DMP version 2.0.**

A7. (M10-M34; PM): Ongoing monitoring and potential updating of the DMP.

A8. (M34-M36; DMPLLeader, PM, PC): Finalize and publish the DMP's concluding version, reflecting lessons learned and the definitive version of DDC with an exhaustive list of the main results of the project.

**A9. (M36; PM) Submit the final DMP for EC approval.**

## 3.8 Rules

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In line with the DMP, the following are mandatory rules and advisory guidelines that project partners must observe concerning the creation, publication, and dissemination of various data types. The forthcoming rules are structured systematically using the format:

*R.type(category).number(responsible party)*

where *type* signifies the category of the rule, such as output, publication, dataset, or software, and *number* represents the sequence of the rule. The *responsible party* denotes the role responsible for implementation, such as the *Project Manager, Project Coordinator, Consortium*, etc.

### 3.8.1 Deliverables

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All approved project outputs should be made openly accessible on the EC Portal by default, and any deviations must be justified.

R.Deliverable.A.1 (Partners): Generate project output using agreed-upon tools and platforms (such as cloud-based file systems like OneDrive).

R.Deliverable.A.2 (TaskLeader): Internally submit the output for review one month prior to the due date (in both PDF and DOC formats) to PrivRep.

R.Deliverable.A.3 (PM): Upon reaching the due date, submit the output for approval via the EC Portal.

R.Deliverable.A.4 (CO): Following EC approval, publish the output (PDF format) on the Project Website.

### 3.8.2 Publications

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Publications that are accepted should, as a standard practice, be made available through open access. Exceptions to this practice should be clearly explained.

R.Publication.A.1 (Partners): Create a publication utilizing the agreed-upon tools and platforms, such as cloud-based systems such as OneDrive.

R.Publication.A.2 (CAuthor): Forward the publication for consideration to a suitable journal, conference, or organization.

R.Publication.A.3 (CAuthor): Upon acceptance of the publication, proceed with the preparation and submission of the final proofs. Ensure the publication is then accessible on the publisher's site.

R.Publication.A.4 (CAuthor): Notify the PM once the publication is accepted and appears online. The PM will handle the inclusion of the reference/citation on the Project Website.

R.Publication.A.5 (CAuthor): In instances where the publication is either not accepted or pending publication, consider distributing a preprint via *ArXiv* on DataRep. Request the addition of this preprint reference/citation on the Project Website.

R.Publication.A.6 (PM): Add the provided reference/citation to the Project Website.

### 3.8.3 Datasets

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Research datasets can be published according to different access rights (e.g. Open, Closed, Restricted, or Embargoed) and licensing schemes to support a balance between IPR and business interests with data openness, transparency, and reusability principles.

R.Dataset.A.1 (Partners): Produce a dataset with the tools and environments decided by the partners involved.

R.Dataset.A.1a (WPLLeader or TaskLeader): If the dataset involves personal data, consider privacy and personal data regulations, namely GDPR. Ask and manage users' consents. Request additional support from PM if necessary.

R.Dataset.A.2 (TaskLeader): Submit the dataset in the DataRep, stating the access right and licence schema. Complement the dataset description with additional metadata as supported by the chosen DataRep.

R.Dataset.A.3 (TaskLeader): Send information to PO. The PO will keep the records of the dataset and will publish it on the WebSite.

### 3.8.4 Software Code

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The publication of software code, subject to varying access rights and licenses, should also strive to balance intellectual property and commercial interests with openness and reusability.

R.Software.A.1 (Partners): Develop software using agreed tools and computing environments, and establish a code repository on CodeRep, deciding on the appropriate software license.

R.Software.A.2 (Partners): Compile technical documentation beneficial for end-users and developers and include it in CodeRep.

R.Software.A.3 (TaskLeader): For public code repositories with related data sets, link and cite these in DataRep, and register this citation on the Project Website.

R.Software.A.4 (PM): If requested, add the citation to the Project Website and keep a record of it.

### 3.8.5 Other Data Elements

Partners responsible for the creation and production of data elements such as videos, images, or presentations will oversee their direct management. Typically, these elements are maintained in the PrivRep (Project Private Repository) and the repositories of the respective partners. Should these data elements be deemed significant enough to warrant formal registration and preservation, they may be entered into the DataRep, and their references catalogued on the project’s website.

## 3.9 Deliverables

Shift2DC will generate 36 deliverables, with 35 being publicly accessible. These are catalogued in Table 1, moreover for detailed classification and supplementary information are contained within the DDC.

**Table 1 – Shift2DC deliverable list**

| WP | Deliverable No | Deliverable Name   | Type  | Dissemination level |
|----|----------------|--|-------|---------------------|
| 1  | D1.1           | DC Applications, Challenges, Opportunities and Evolution Scenarios       | R     | PU                  |
| 1  | D1.2           | Policies, Regulatory framework, and Market Architecture for DC solutions | R     | PU                  |
| 1  | D1.3           | Use Case Repository  | OTHER | PU                  |
| 1  | D1.4           | Specification of DC solutions, tools and devices                         | R     | PU                  |
| 1  | D1.5           | IT requirements for DC solutions (Demonstrators)                         | R     | PU                  |
| 1  | D1.6           | User adoption of DC solutions  | R     | PU                  |
| 2  | D2.1           | DC solutions design tool   | R     | PU                  |
| 2  | D2.2           | DC protection systems design tool  | OTHER | PU                  |
| 2  | D2.3           | DC solutions simulation tool   | OTHER | PU                  |
| 2  | D2.4           | MVDC grid stability & protection assessment tool                         | OTHER | PU                  |
| 2  | D2.5           | DC control and protection integration strategies                         | R     | PU                  |
| 2  | D2.6           | EMS for Hybrid AC/DC systems   | OTHER | PU                  |
| 2  | D2.7           | Conditioning monitoring tools for DC systems and devices                 | R     | PU                  |
| 2  | D2.8           | IT monitoring platform   | R     | PU                  |
| 3  | D3.1           | WP3 Activities intermediate report                                       | R     | SEN                 |
| 3  | D3.2           | D3.2 LVDC smart and sustainable system cable                             | OTHER | PU                  |
| 3  | D3.3           | Distributed Energy Resources – Solutions Report                          | R     | PU                  |
| 3  | D3.4           | DC Interfaces and rooting systems – Solutions Report                     | R     | PU                  |
| 3  | D3.5           | DC Protection and fault handling strategies for MVDC-LVDC converter      | R     | PU                  |
| 3  | D3.6           | Testing in DC Living Lab   | R     | PU                  |
| 4  | D4.1           | Detailed specification of the demonstrators                              | R     | PU                  |
| 4  | D4.2           | Demonstrators’ simulation results  | R     | PU                  |
| 4  | D4.3           | Digital twin testing environment   | R     | PU                  |

|   |      |  |   |    |
|---|------|--|---|----|
| 4 | D4.4 | Lessons learned in Demonstrators               | R | PU |
| 5 | D5.1 | Innovation and Exploitation Plan               | R | PU |
| 5 | D5.2 | D5.2 Innovation and Exploitation Plan- Updated | R | PU |
| 5 | D5.3 | Standardization and Harmonization activities   | R | PU |
| 5 | D5.4 | Cost Benefits Analysis of DC solutions         | R | PU |
| 5 | D5.5 | DC Roadmap and Business models                 | R | PU |
| 6 | D6.1 | Dissemination and Communication Plan           | R | PU |
| 6 | D6.2 | Dissemination and Communication Plan - Updated | R | PU |
| 7 | D7.1 | Project Management Plan                        | R | PU |
| 7 | D7.2 | Project Management Plan - Updated              | R | PU |
| 7 | D7.3 | Project Management Plan - Final                | R | PU |
| 7 | D7.4 | Data Management Plan                           | R | PU |
| 7 | D7.5 | Data Management Plan - Updated                 | R | PU |

## 4 Conclusions

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This document has outlined the DMP for the Shift2DC project, essential for adhering to Horizon Europe's requirements for open and FAIR data. The DMP provides a comprehensive framework of data management practices that consortium partners, especially WP and Task Leaders, are expected to follow, under the oversight of the PM and the data management team.

It is scheduled for an update at Month 36 (Deliverable D7.5) or in response to any significant amendments. Accompanying this DMP is the Data Definition Catalogue, a detailed log of the Shift2DC project's data elements to be populated throughout the project's lifecycle.

The upcoming deliverables within the Shift2DC project will build upon the established by the DMP to ensure data handling and dissemination. In line with Horizon Europe's requirements for open and FAIR data, the Deliverable *D1.3 - Use Case Repository*, will focus on documenting and sharing specific use cases identified within the project. This repository will serve as a resource for stakeholders, providing insights into the applications and outcomes of Shift2DC's research efforts.

Additionally, Deliverable *D4.1 - Detailed specification of the demonstrators* will play a role in advancing the project's objectives by providing detailed specifications for the demonstrators planned within the initiative. These specifications will outline the technical requirements and functionalities of the demonstrators, facilitating their development and implementation across various project sites. Together, these deliverables will contribute to the ongoing progress of the Shift2DC project, ensuring that data management practices align with project goals and regulatory standards.

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