Hydrogen Production at Very High Current Densities in Flow-Engineered Alkaline Electrolyser Stack

Data Management Plan

HyFlow Deliverable 6.4 (M4)

The project is supported by the Clean Energy Transition Partnership and its members		
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SEN	Sensitive, limited under the conditions of the Grant Agreement	☐
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Notices

For information, please contact the project coordinator, Micah Asistores, e-mail: micah.asistores@stargatehydrogen.com. This document is intended to fulfil the contractual obligations of the HyFlow project, which has received funding through the Clean Energy Partnership from each consortium member's national funding agency, concerning deliverable D6.4.

The Consortium Partners will use a common folder as the main data bank for agreements, collaborative documents, data and information relating to the work packages, reports, deliverables, etc.

The link for the shared folder can only be accessed by the partners within the consortium.

Authors

Micah Asistores, Stargate

Reviewer(s)

Renaud Delmelle, UCLouvain

Table of revisions

Version	Date	Description and reason	Author	Affected sections
V0.1	20.02.2026	First draft created	Micah Asistores, Stargate	all
V0.2	22.02.2026	1st internal review	Elo Meier, Stargate	all
V0.3	05.03.2026	Input from partners integrated	n/a	Section 2, Collected and generated Data
V1.0	27.03.2026	Final review	Renaud Delmelle, UCLouvain	all

List of Partners

Stargate Hydrogen Solutions OÜ (Stargate)
Université Catholique de Louvain (UCLouvain)
JEMA Belgium (JEMA)
JENTEC GmbH (JENTEC)
Fraunhofer IFAM (IFAM)

List of Abbreviations

CETP – Clean Energy Transition Partnership

DMP – Data Management Plan

DOI – Digital Object Identifier

DSA – Data Sharing Agreement

EU – European Union

FAIR – Findable, Accessible, Interoperable, and Reusable

GA – Grant Agreement

H_2 - Hydrogen

MTA – Material Transfer Agreements

PTL – Porous Transport Layer

PTE – Porous Transport Electrode

PGM – Platinum Group Metal

SOTA – State-of-the-Art

TDR – Trustworthy Digital Repositories

WP – Work Package

WPL – Work Package Leader

Table of Contents

1 DMP overview

The HyFlow Data Management Plan (DMP) is the Deliverable 6.4 (D6.4) from the list of deliverables stipulated in HyFlow project from the consortium agreement (CA) between Stargate, UCLouvain, JEMA, JENTEC, and IFAM. The DMP outlines the ways in which the project-related data is collected, generated and/or processed throughout the lifespan of HyFlow and supports achieving the project objectives with relevant data handling.

This project introduces a breakthrough concept focused on state-of-the-art (SOTA) technology, specifically examining the techno-economic impact of technology development on hydrogen (H_2) market uptake.

The technological innovation centres on:

- Flow engineering of porous transport electrodes (PTEs)
- Advanced electrode coating technologies

To achieve the listed innovations, the data will be generated, collected and processed during the three-year project implementation. Collecting and sharing of data within the consortium and relevant stakeholders is essential for reaching the goals of the project.

The purpose for data collection under each Work Package (WP) is outlined below:

WP1 Cell Component Development

WP1 aims to develop and fabricate flow-engineered PTEs for use in WP2 and WP5, as well as to improve the technological maturity of the electrode coating process by implementing an in-situ diagnostic tool based on current modulation. The data on improvements on electrode- and process-level that will be validated in small scale (4-20 cm^2) cell tests under regular flow conditions will be collected.

WP2 Forced Flow Concept Development

WP2 focuses on delivering a design for the new UCLouvain stack (200 cm2 electrodes) and adapting the existing design of the IFAM stack (2400 cm2 electrodes) with respect to the electrolyte flow characteristics, using advanced CFD simulation tools. The data to perform the necessary stack and pilot adjustments in WP4, and to ultimately test the new or adapted design on pilot level in WP5 will be collected from this WP.

WP3 Power Electronics Development

WP3 focuses on the demonstration of overlaying alternating current signal (2% of DC current magnitude) on top of the DC current (4800 A) at least 1 frequency. The data on innovative power electronics, including specific tailor-made power supply and in-situ diagnostics systems, will be collected for use in WP1, WP4, and WP5.

WP4 Adjustments of the Pilot

WP4 will further develop and modify the pilot facilities at IFAM and UC Louvain to prepare them for the validation of the forced-flow technology in WP5. Data for this will be collected for the stacks and the electrolyte circuit to be fundamentally adapted for this purpose.

WP5 Forced Flow Technology Validation on Stack (pilot) level

WP5 aims to validate the forced flow technology in two separate pilot plants (at IFAM and UCLouvain) and to demonstrate its influence on performance. Flow-engineered PTEs developed by Stargate in WP1 will be tested in different stacks and compared to 2D electrodes. The data based on the validation of the stacks in two separate pilot plants will be collected in this WP.

WP6 Reporting and Knowledge Community

WP6 is to perform a techno-economic study and summarise cross-cutting activities of the project. To ensure smooth overall project management (costs, time, results) with an emphasis on meeting CETP requirements (reports, formal reviews). To promote awareness and raise interest within the industrial scientific and commercial fields. To create a path for successful exploitation of the outcomes, disseminate the results among the target groups, and manage data and intellectual property. The data will be collected for this WP based on the deliverables and reports needed to carry out the project and disseminate to target groups.

2 Collected and generated data

The data will be collected from various sources. Types of data collected during the project will include:

- Experimental and observational data collected using measurement devices and analytical instruments
- Derived data from experiments or published literature
- Survey and interview data, from HyFlow partners, potential stakeholders and target groups

- Market-related information
- Methodologies and workflows, standard operating procedures
- Multimedia and physical documents (reports, spreadsheets, presentations) to present project data
- Images
- Videos
- Recorded data, if applicable (lectures, interviews, workshops, etc.)
- Laboratory notebooks, field notebooks, diaries (if applicable)

The main formats of data generated/collected will include:

- Reports, spreadsheets, presentations - Microsoft Office formats, .ai
- Observed data (experimental) - original format, .csv, .txt
- Images – .jpg, .gif, .png, .tiff, .ai
- Audio – .mp3
- Videos – .mpg, .avi, .mp4

The data generated for the work packages will be as follows:

WP TASK	Data Type	Description	Data Origin	Est Data Size
WP1 (T1.1)	Report Document, Pdf	Report on electrode development starting on 100 cm2 electrode size and gradually increasing to 2400 cm2 and and 3800 cm2	Result of Electrode Development in the Lab	10-50MB
WP1 (T1.2)	Demo Images, Document	Documentation of selected PTEs for pilot stacks	Demonstrated developed PTEs	1-5MB
WP1 (T1.3)	Report Document, Excel, Pdf	Report on Fabrication Process	Based on the galvanic bath diagnostic tool tests performed	1-10MB
WP1 (T1.4)	Report Document, Excel, Pdf	Cell Level Material Evaluation Report	Lab-scale testing scenarios	1-10MB

WP2 (T2.1)	Report document, source files from simulations, images, graphs, excel, pdf	Report including single-phase simulations of electrolyte flow in pilot configuration	Generated by single-phase CFD simulations	50-100MB
WP2 (T2.2)	Demo images and plans, document	Plans/documentation of prototype Stack design	Based on simulation output (T2.1)	0.5-10MB
WP2 (T2.3)	Report document, images, graphs, excel, pdf	Report including the results of the forced flow experiments performed on a lab-scale	Result of electrode testing in the lab	0.5-10MB
WP3 (T3.1)	Report document, schematics and plans, calculation & design notes, pdf	Design file for the IFAM electrolyser's power supply	Result of simulation, calculation and detailed design	0.5-10MB
WP3 (T3.2)	Report document, schematics and plans, calculation & design notes, pdf	Design file for the UCLouvain electrolyser's power supply	Result of simulation, calculation and detailed design	0.5-10MB
WP3 (T3.3)	Report document, schematics and plans, calculation & design notes, pdf	Design file for the Stargage's galvanic bath power supply	Result of simulation, calculation and detailed design	0.5-10MB
WP4 (T4.1)	Report document, Images, pdf	Report on the adjustment of the IFAM pilot	Engineering based on results from WP2	50-100 MB
WP4 (T4.2)	Report document, graphs,Images, pdf	Report on the adjustment of the UCLouvain pilot	Engineering based on results from WP2	50-100 MB
WP5 (T5.1)	Protocol document	Harmonised Testprotocol	Based on objectives, test benches and EU	0.5-10MB

			harmonised test protocols	
WP5 (T5.2)	Report document, images, graphs, excel, pdf	Report/Documentation on validation of forced flow experiments in modified stacks	Stack test experiments	50-100 MB
WP5 (T5.3)	Report document, images, graphs, excel, pdf	Report/Documentation on validation of forced flow experiments in modified stacks	Stack test experiments	50-100 MB
WP5 (T5.4)	Report Document, Images, excel, pdf	Report on test results on the commercial stacks	Tests on Alkaline Electrolysis Stack by Stargate	5-50 MB
WP6 (T6.1)	Report document, images, graphs, excel, pdf	Techno-economical study on impact of forced flow technology	Project results and experimental results, calculations	50-100MB
WP6 (T6.2)	Excel, pdf files, reports, graphs, images, powerpoint presentations, documents	This task will collect and produce relevant reports and documents on Project Management, and produce D6.3 and 6.4	Project Results and Deliverables on project sharepoint	50-100MB
WP6 (T6.3)	Document, images, excel, pdf	Document describing the dissemination, communication and exploitation actions planned	Dissemination tools and actions planned by the consortium	0.5-10MB

2.1 Reuse of existing data

As HyFlow is committed to expand the knowledge in the techno-economic feasibility of the technology, previously generated datasets will be utilised to take advantage and build up on the past advances made in the field. The existing data utilised comes mainly from previous data collected by the partners and from scientific literature. In addition, public and commercial databases will be used to collect required information. Specific envisioned instances for the re-use of existing data include e.g.:

- Peer-reviewed published data and data disclosed in public repositories will be studied when implementing the project tasks
- In WP2, we will reuse publicly available data on forced flow concept development as well as data from previous projects.
- In WP3, we will compare the data against benchmarks from industry partner, previous projects and experiments, to develop innovative power electronics.
- For WP6, publicly available data about the technology and markets will be collected via online search and available reports.

2.2 Origin of the data

The data will be derived from numerous sources throughout the project, including:

- Lab trials and experiments
- Prototype experiments
- Models
- Literature
- External databases
- Stakeholders
- From HyFlow partners' previous and/or ongoing projects (when possible)
- Data subjects who interact with the project website
- Data subjects (surveys, interviews, training workshops, questionnaires)
- Mathematical simulations

2.3 Size of the data

Expected size of data collected in each WP is presented in the Table 1. Size values will be revised during project execution.

Table 1 Type and estimated size of data collected in the WPs.

WP	Types of data	Estimated size
1	Observations, experiments, raw and processed data (.csv, .idf, .tiff, .elid, .odt, .emsa, .spa)	< 10 GB
2	Data on electrodes and PTE development for pilot testing (.xlsx, .docx, .pptx, .tiff, .csv,.txt, .jpg, .gif, .png, .mp3, .mpg, .avi, .mp4)	< 50 GB

3	Observations, experiments, raw and processed data, and modelling data (.csv, .idf, .tiff, .elid, .odt, .emsa, .spa)	< 10 GB
4	Potentiostat data (.idf, .xlsx) and COMSOL model data (.mph)	< 10 GB
5	Stack repeating-unit and stack testing data (.csv, .xslx) + test report (.txt, .docx) Stack component microstructural and other analyses (.tiff, .csv, .xslx, .txt) Stack CAD drawings (.step)	< 1 GB
6	Website user data (e.g. page visits and engagement) Documentation (.xlsx, .docx, .pdf, .pptx, .ai)	<5MB <100 MB
7	Documentation (.xlsx, .docx, .pdf, .pptx)	<100 MB

2.4 **Utilisation**

The data generated throughout the project will provide significant value to the consortium partners, supporting their individual research activities and enabling the effective exploitation of project outcomes. To facilitate efficient knowledge transfer, datasets will be actively shared among consortium members.

Beyond the consortium, the generated data will also be relevant to researchers working in related disciplines, including but not limited to:

- Materials science
- Electrochemical Engineering
- Sustainability
- Techno-economic feasibility of green hydrogen projects

Furthermore, the project results will contribute to raising awareness among a broad range of societal actors, including the general public, stakeholders, researchers, and policymakers about the solutions offered by HyFlow. They will also highlight the importance of developing a CO_2-based industrial sector as a strategy to combat climate change while strengthening the EU economy.

3 FAIR data

3.1 Making data findable, including provisions for metadata

To make data findable, metadata will be used. All partners will agree in terms of providing relevant metadata and keywords, so that their data will be easily discoverable. Clear version numbers will be included, and standard naming conventions will be defined.

Naming conventions

The naming convention to be used for documents in the EXSOTHyC project will be as follows:

WPX_HyFlow_L_N_YYYYMMDD_vX.Y	
WPX	Work Package This can be left out for documents that are not related to a specific WP.
L	Label and number of the dataset/document Examples: Deliverable 7.4 – D7.4 Technical report M24 – TR_M24 Financial report M24 – FR_M24
N	Name of the dataset/document
YYYYMMDD	Date
vX.Y	Version

Version numbers incremented at each revision will be included in the filenames. The version control will be as follows:

- Initial drafts (before submission) will be labelled as v0.X
- Revisions to draft prior to submission will be numbered in ascending order (e.g. v0.1, v0.2, v0.3)
- The submitted document (final draft) will be labelled as v1.0Final
- If a document needs to be resubmitted, or requires major changes, the first number in the version identifier will increase by 1 (e.g. v2.0, v3.0)

Metadata

A data object should be accompanied with metadata that makes it easily findable for both humans and computers. Descriptive metadata is essential also for allowing stakeholders outside the project to re-utilise the generated datasets. We outline the discoverability of data by fostering the use of metadata standards providing specific information for data

related to the project. If no specific recommended standard exists for the dataset type or the repository, DataCite's metadata standard will be followed.

Examples of metadata expected to be generated include:

- Title of project (including 'European Union (EU)' 'Horizon Europe' 'Clean Hydrogen Partnership', project acronym and grant number)
- Title of dataset
- Name of data owner
- Date of submission
- Subject
- Description of data
- Format of data
- Type of data (e.g. data set, article, audio file, image)
- Digital Object Identifier (DOI)
- Access rights
- Keywords

To ensure that the data is easily findable, the metadata of all datasets deposited in repositories will include keywords, which are selected from controlled vocabularies that are suitable for the specific type of data, e.g. following the officially recommended analytical nomenclature mandated by recognised associations and unions.

The bibliographic metadata will include the following:

- the terms "European Union (EU)", "CETP"
- the name of the action, acronym and grant / consortium number,
- the publication date and the length of embargo period, if applicable,
- a persistent identifier

3.2 **Making data available**

All the project-generated documentation will be internally stored in a *Microsoft sharepoint.com* shared folder which is restricted to project partner contacts who have been appointed by partners as main contacts. We consider also an internal platform of the project website (https://www.hyflowh2.com/) for storing project related documents. Suitable and well-described conditions for access will be defined for the users to enter the internal area by using username and password.

During the project course, it will be identified which data will be made openly available and which cannot be shared due to legitimate issues or shared under restriction (e.g. in a protected internal platform of the project website). Access to confidential or restricted data will be awarded under the discretion of the Work Package Leader (WPL) of the work package that generates the data, alongside the coordinator.

The consortium aims at using the project website or other easily accessible repositories for open-access data, ensuring easy access. For the data, which is made publicly available, we will take all necessary actions to ensure free access to peer-reviewed

articles resulting from the project. Such actions may include either green or gold open access.

Data will be made accessible through online repositories and, therefore, specialist software tools should not be required to access the data. Whenever possible, the data will be shared in a format that is readable with cost-free software. If special software or tools are required for accessing the data, a short text file (e.g. ASCII) will be provided with the data file to explain the software required. The research data and associated metadata, documentation and code will be deposited to one of these repositories.

To protect the copyright of the knowledge generated in the project, Creative Commons license will be used in certain circumstances. The access to the data repository will be layered, integrating a pertinent licensing system, with the purpose of limiting the accessibility to the different types of data depending on the data owners' agreement. Any associated metadata, documentation and code will also be deposited in the repository.

When data are publicly shared, the person accessing the data will not be directly identified. The users are expected to follow 'The European Code of Conduct for Research Integrity.

3.3 **Making data accessible**

The data will be made available following the 'as open as possible, as closed as necessary' principle, meaning that all the data will be made available for verification and re-use, unless the owner of the data can justify why data cannot be made openly accessible. To maximise the impact of the HyFlow project, selected data and results will be shared with the scientific community and other stakeholders by publishing them in scientific journals, by presenting them at scientific conferences and by sharing them in open access data repositories. Unless there is a specific reason why the data cannot be made public, all the data associated with scientific publications will be made openly available. The reasons why data cannot be made publicly available include, but are not limited:

- Sharing is restricted for legal and contractual reasons
- Data was obtained with the permission of third parties, but the third parties have not agreed to make the data publicly available
- Data compromises the protection of a partner(s) intellectual property
- Data is commercially sensitive

HyFlow will strictly follow an open access policy by providing on-line access to scientific information that is free of charge to the end-user and that is re-usable. In the context of this project, scientific information refers to peer reviewed scientific research articles (published in scholarly journals), pre-print articles, conference papers, patents, books and research data (data underlying publications, curated data and/or raw data). Each consortium partner commits to deposit each latest publication as soon as possible. Each partner will ensure open access to the publications immediately, if an electronic version is available for free via the publisher, or within six months of publication, if it is not.

3.4 **Making data interoperable**

Provisions are taken to make data interoperable, making it easier to exchange and reuse them across research institutions. This could be more difficult for project-specific technical datasets, but we strive in making all open data interoperable.

For example, HyFlow consortium tries to follow EU Harmonised Testing protocols for low-temperature electrolysers. In addition, we are developing new methodologies (e.g. forced flow technology testing, methodology that simulates renewable (intermittent) load profiles, thus contributing to cross-cutting activities) which will help and feed into future projects.

To ensure that the data can be easily read and understood, it will be accompanied by standardised metadata. The relevant metadata and its presentation depend on the type of the dataset and the used repository and thus the metadata standard used will be individually selected for each dataset.

3.5 **Increase data re-use**

HyFlow commits to sharing data as openly as possible. However, to protect the ownership of the datasets, Creative Commons licenses might be assigned in certain circumstances like for digital creations (web page, contents of digital channels, etc.); other software might have specific (owner defined) terms of use. The owner of the data will determine which of these licenses will be used when data is posted on the repositories.

Information regarding the reusability of the data will be provided for each dataset separately. For data used in articles published in open access journals, data sharing may be limited due to an embargo period. The consortium will provide relevant information on embargo periods and the intended period that their data will remain reusable. European Commission recommends a maximum embargo period of 6 months. Access to datasets deposited on public data repositories such as the project website will be unlimited.

Restrictions on re-use policy will be applied on data that requires protection and can be re-used only by the consortium.

Datasets will not be published before the date of publication of the associated scientific article, considering any restrictions and embargo periods. Data Reports will become available after each related deliverable if the dissemination level allows it. Data produced and/or used in the project will be useable by third parties for any purpose dependent on the selected licences and confidentiality requirements. The data that is re-useable will be intended to be so for its lifetime.

Files classified as public will be accessible and downloadable for at least three years after the end of the project. Files classified as internal and/or confidential will be accessible only to project partners from the internal platform for at least three years after the end of the project.

4 Other research outputs

Managing other research outputs involves considering various factors to ensure they are effectively handled and shared in line with the FAIR principles. Firstly, the consortium will identify the types of outputs, whether they are digital (e.g., software, models) or physical (e.g., materials, samples) and then assesses their FAIRness. For each output, proper metadata standards and protocols will be implemented to enhance their discoverability and usability.

Access to research outputs will be governed by a tiered system based on the level of sensitivity and intellectual property considerations. All digital outputs, including software, workflows, and models, will be made openly accessible through reputable repositories immediately upon publication or project completion, under appropriate open licenses to facilitate reuse and reproducibility. Physical outputs, such as e.g. materials, will be made available upon request to qualified researchers, subject to material transfer agreements (MTAs) to safeguard intellectual property and ensure proper usage. In cases where outputs contain sensitive or proprietary information, access will be restricted to authorized personnel only, with provisions for controlled access mechanisms and data sharing agreements (DSAs) to protect confidentiality while enabling collaborative research endeavours. Clear guidelines and procedures for requesting access will be provided on project website and communicated to relevant stakeholders, ensuring transparency and adherence to ethical and legal standards.

The consortium will regularly update and maintain the outputs throughout the project lifecycle, documenting any changes or versioning. The outputs will be disseminated through appropriate repositories, platforms, or publication channels to maximize their impact and facilitate reusability by the research community.

5 Allocation of resources

Although there are no specific efforts defined for data management, most of the activities foreseen to carry out the DMP fall into WP6. And at this point, it is hard to estimate the exact costs for making research data and outputs FAIR. HyFlow has considered costs for publications, patents and has allocated resources for dissemination purposes. These costs are compliant with the Grant Agreement which states that costs related to open access of the research data in CETP are eligible for reimbursement. If a cost-free repository is used, there will be no allocation of resources necessary for data storage.

The project coordinator will be responsible for data management and quality assurance with the help of WPLs. However, each partner must respect the policies set out in this DMP and the datasets must be created, managed and stored appropriately and in line with applicable legislation. The partner that generates the data is responsible for the validation and registration of the datasets, for providing the required metadata and for sharing the data through the open access repositories.

If selected repositories do not provide the desired storage length, additional resources for long term preservation of data will be evaluated based on the type and the size of the data requiring long-term preservation.

6 Data security

For safe long-term preservation and curation of data we prefer certified Trustworthy Digital Repositories (TDR) with General Data Protection Regulation 2016/679 (GDPR 2016/679) compliant features and security measures. Archiving and preservation of data generated by HyFlow partners at their respective institutions is the responsibility of the partners individually.

To ensure the security of sensitive data, the following guidelines are followed:

- Files are named systematically to ensure coherence of the final dataset
- Data is stored in at least two separate locations to avoid the loss of data
- Data is encrypted, if necessary
- The use of Universal Serial Bus (USB) flash drives will be minimised

All project deliverables and data will be stored and shared in the Stargate's sharepoint shared folder restricted to the project consortium, in the DISCCO portal, and in the project's website. Initially, only the consortium members will have access to the folders where datasets and metadata are filed.

The consortium partners are encouraged to refrain from using AI to process the data in the shared folders, including any third-party technology platforms to take notes during meetings as this information can be stored and processed to an unsecured server.

7 Ethics

Each project partner must adhere to their own institutional policies and procedures for data management and strictly follow to the European Commission policies on open data management principles.

Although in HyFlow, we do not foresee any data-related ethics and/or legal issues causing any impact on data sharing as the project objectives, methodology and outcomes are not causing any ethical issues themselves, all partners will assure that the EU standards regarding ethics and data management are fulfilled in compliance with confidentiality and security and ethics and values principles. Shall any of the ethics issues raise, the consortium respects fundamental ethical principles and follows researcher ethics rules as

laid down in the Charter of Fundamental Rights of the European Union, as well as The European Charter for Researchers. In all phases of the project crucial ethical and legal aspects will be considered.

8 Other issues

At this time, we do not foresee to use other procedures for data management, however we are open to include, shall it be needed.