

# **Data Management Plan**

D9.2







### **D9.2 – Data Management Plan**

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Abstract	The Data Management Plan for the SOLARIS project outlines the approach for managing the data generated during the project lifecycle, ensuring it adheres to the FAIR principles (Findable, Accessible, Interoperable, and Reusable). This document provides a framework for data collection, storage, sharing, and long-term preservation, with an emphasis on transparency and data accessibility across partners. Additionally, it ensures compliance with legal, ethical, and security requirements, supporting the efficient use and exchange of data throughout the project.
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## **EXECUTIVE SUMMARY**

The Data Management Plan (DMP) for the SOLARIS project outlines the methodologies, processes, and standards for managing the data generated throughout the project. The main goal of this DMP is to ensure that all project data is handled in accordance with the principles of FAIR







(Findable, Accessible, Interoperable, and Reusable) data management, as prescribed by Horizon Europe. This plan will guide the collection, processing, storage, and sharing of data across the consortium, ensuring that all stakeholders have proper access to and control over the data while maintaining compliance with ethical, legal, and security requirements.

The DMP includes a comprehensive description of the data types expected to be generated during the project, including experimental data, simulations, modeling outputs, and technical reports. The plan specifies that data will be stored in centralized platforms such as SharePoint, accessible by all consortium members, with strict access control and data security measures in place. Metadata standards will be applied across all data types to ensure that data can be easily found, understood, and reused. Moreover, the plan outlines the procedures for long-term preservation of data and its availability for post-project use, including access to public deliverables through repositories like Zenodo.

A key aspect of the DMP is the integration of a robust framework for sharing data between partners and with external stakeholders, including the European Commission and the broader research community. The project will adopt standardized data naming conventions, file formats, and metadata protocols to facilitate interoperability. Additionally, the DMP will ensure that sensitive data is appropriately handled and that intellectual property rights are respected throughout the project lifecycle.

This DMP will be a living document, subject to revisions and updates as the project progresses. Periodic evaluations will be conducted to ensure the data management processes remain aligned with project needs and European Commission guidelines. The final version of the DMP will be submitted towards the end of the project, incorporating any additional insights and modifications that arise.

By adhering to the principles of the DMP, SOLARIS aims to ensure that all project data is not only effectively managed but also remains accessible and reusable in the long term, fostering collaboration and advancing innovation in the photovoltaic sector.







### **Main Abbreviation**

DMP	Data Management Plan
FAIR	Findable, Accessible, Interoperable, and Reusable
PV	Photovoltaic
WP	Work Package
DTU	Danmarks Tekniske Universitet
EC	European Commission
DOI	Digital Object Identifier
SCADA	Supervisory Control and Data Acquisition
API	Application Programming Interface
CSV	Comma-Separated Values
XLSX	Microsoft Excel Spreadsheet
GDPR	General Data Protection Regulation







## 1. Introduction to SOLARIS data management plan

The Data Management Plan for the SOLARIS project is designed to ensure that the data generated throughout the project is managed effectively and efficiently, following best practices for data integrity, accessibility, and compliance with the European Commission's Horizon Europe guidelines. This plan defines the processes, roles, and tools necessary for handling various types of data, such as meteorological data, performance data from PV systems, sensor data, and technical reports, which will be generated across the four demonstration sites: DTU (Risø), PPC (Thiva), Eilat, and FIB.

#### **Purpose of the DMP**

The main objective of this Data Management Plan is to establish a framework for the collection, storage, sharing, and long-term preservation of data generated during the SOLARIS project. It outlines how the project partners will handle sensitive, non-sensitive, and publicly available data, ensuring that the data is findable, accessible, interoperable, and reusable (FAIR principles).

This document will serve as a guideline to manage both technical and operational data, ensuring that the project's outputs remain valuable not only throughout the project lifetime but also beyond its completion.

#### Scope of the DMP

The SOLARIS project will generate a wide range of data types, including:

- **Meteorological data** for enhancing weather and power prediction models (e.g., temperature, wind speed, irradiance, humidity).
- **Performance data** from PV systems (e.g., energy production, power factors, inverter status).
- Sensor data from environmental sensors (e.g., dust sensors, wind load sensors).
- Technical documentation and reports detailing methodologies, results, and conclusions.

The plan defines how all of this data will be handled, including the integration of datasets from different partners, the standardization of data formats, and the sharing mechanisms in place to ensure smooth and transparent data exchange among all project stakeholders.

#### Data collection, storage, and access

The DMP outlines procedures for data collection at the demonstration sites, including details of sensor installations, data acquisition methods, and the technologies used for storing data (e.g., SharePoint, databases, cloud storage). All collected data will be stored in a centralized repository, accessible to all consortium partners with appropriate access control, and will be regularly







updated to ensure its accuracy and timeliness. The data will be linked with relevant metadata to ensure that it is searchable and easy to retrieve.

#### Data sharing and dissemination

The plan also covers the procedures for sharing data with external stakeholders, including how data will be made available to the European Commission, the public, and other interested parties. Where applicable, public datasets will be uploaded to trusted repositories like Zenodo, ensuring proper licensing and ensuring that datasets are preserved for long-term access.

#### Data security and compliance

To ensure data security and privacy, the DMP includes measures for safeguarding sensitive information, including compliance with relevant data protection regulations (e.g., GDPR). It specifies procedures for handling confidential data and any restrictions on data sharing.

#### **Evaluation and updates**

As the SOLARIS project progresses, the DMP will be evaluated and updated to reflect changes in data collection methods, new data sources, or evolving requirements from the European Commission. This ensures that the project's data management practices remain robust and responsive to the needs of the project and its stakeholders.

This DMP is a living document and will be reviewed periodically by the project partners to incorporate new insights or developments.





## 2. Data summary

This section outlines the data generated throughout the SOLARIS project, including data types, collection methods, and the tools and standards used for managing and ensuring the accessibility and reusability of the data.

### 2.1 Methodology

To manage the data generated during the SOLARIS project, all data will be systematically referenced and documented in the **Data Management Register**. This register will include details on each dataset, including type, format, origin, and intended use. The Data Management Register will be maintained as a living document, updated throughout the project's duration, and stored in a shared location (e.g., SharePoint) for access by all project partners.

The methodology for data collection will follow the FAIR principles (Findable, Accessible, Interoperable, Reusable) to ensure that data is properly documented, stored, and shared across the project consortium and external stakeholders. Each dataset will have associated metadata that describes how the data was collected, processed, and any relevant parameters used during its generation.

### 2.2 Data types

The SOLARIS project will produce several categories of data, which are essential for achieving the project's objectives related to enhancing the operation and maintenance of photovoltaic systems. These data types include:

#### 1. Performance data

- Description: Data related to the operation of the PV systems, including power output, voltage, and system health.
- Formats: Excel (.xlsx), CSV (.csv), Text (.txt), PDF (.pdf)
- Sources: Inverters, monitoring systems, SCADA systems, system logs.

#### 2. Meteorological data

- Description: Data related to weather conditions affecting PV system performance, such as temperature, irradiance, and wind speed.
- Formats: Excel (.xlsx), CSV (.csv), Text (.txt), PDF (.pdf)
- Sources: On-site weather stations, weather models from UBIMET, external meteorological data (global weather data, radar data, data from weather stations).







#### 3. Environmental sensor data

- Description: Data from environmental sensors, including dust accumulation, wind load, and temperature.
- o Formats: Excel (.xlsx), CSV (.csv), Text (.txt), PDF (.pdf)
- o **Sources:** Dust sensors (e.g., DustIQ), wind sensors, temperature sensors.

#### 4. Operational data

- Description: Data related to the operational status and fault detection of the PV system.
- o Formats: Excel (.xlsx), CSV (.csv), PDF (.pdf)
- o **Sources:** SCADA systems, system logs, maintenance reports.

#### 5. Historical data

- o **Description:** Historical data to support comparison and validation of models.
- Formats: Excel (.xlsx), CSV (.csv), Text (.txt)
- Sources: Data from previous years at demo sites or external repositories.

#### 6. Simulation and modeling data

- Description: Data from simulations and model outputs used for forecasting and optimization purposes.
- Formats: Excel (.xlsx), CSV (.csv), Text (.txt), PDF (.pdf)
- Sources: Internal modeling tools and software.

Data Type	Convention	Example
Dataset of Measure ment	SOLARIS_DS_ <name>_WP<x>_<version> _<creator>_<status></status></creator></version></x></name>	SOLARIS_DS_PV_Performance_WP2_ V1_DTU_Draft







Model	SOLARIS_MD_ <name>_WP<x>_<version> _<creator>_<status></status></creator></version></x></name>	SOLARIS_MD_SolarForecast_WP3_V1 _EmaZys_Final
Project Deliverab le	SOLARIS_D_ <name>_WP<x>_<version>_&lt; creator&gt;_<status></status></version></x></name>	SOLARIS_D_DataManagementPlan_ WP1_V1_DTU_Final
Presenta tion	SOLARIS_PS_ <name>_WP<x>_<version>_ <creator>_<status></status></creator></version></x></name>	SOLARIS_PS_MonthlyMeeting_WP2_ V1_DTU_Draft

#### **Explanation of the naming convention components:**

- **Data type**: Specifies the category of the data (e.g., dataset, model, deliverable, presentation).
- <name>: Descriptive name of the file (e.g., PV\_Performance, SolarForecast).
- WP<x>: The Work Package number (e.g., WP1, WP2, WP3).
- **<version>**: Version number of the document or dataset (e.g., V1, V2).
- <creator>: The organization or partner responsible for the file creation (e.g., DTU, UBI).
- <status>: Current status of the document (e.g., Draft, Final, Reviewed).

### 2.3 Data collection methods

Data will be collected from various sources, ensuring that all relevant datasets are documented and stored in an accessible format:

#### 1. Sensor deployment:

- Environmental sensors: Sensors such as DustIQ for soiling, wind speed, and temperature sensors will continuously collect data at the PV demonstration sites.
- Performance monitoring: Data from inverters and string-level monitoring systems will be collected and transmitted to the centralized system (e.g., SharePoint).

#### 2. SCADA and monitoring systems:

 SCADA systems will collect real-time operational data (e.g., power output, system health) from the PV plants.







 Data collection frequency will vary based on the data type (e.g., performance data every 5 minutes, environmental data every 1 hour).

#### 3. Weather stations:

 Dedicated weather stations at each demo site will provide real-time meteorological data, including temperature, humidity, and irradiance.

#### 4. External data:

 External weather and irradiance data from services such as ECMWF or satellite systems will be integrated to enhance predictions and provide supplementary information.

#### 5. Simulation data:

 Data from simulations related to PV performance, optimization, and forecasting will be collected using internal modeling software.

### 2.4 Data usage

The data collected during the SOLARIS project will be used for various research, development, and operational purposes:

#### 1. Performance optimization:

 The collected performance data will be analyzed to optimize PV system operations and improve forecasting models, enhancing system efficiency and reducing operational costs.

#### 2. Environmental impact assessment:

 Environmental data, such as soiling and wind load, will help develop strategies for optimizing maintenance schedules and improving panel cleaning processes.

#### 3. Fault detection and predictive maintenance:

 Operational data will be used to create predictive models for fault detection, minimizing downtime and reducing maintenance costs.

#### 4. Model calibration and validation:

 Historical data, weather data, and simulation outputs will be used to validate and improve forecasting models for energy production and system performance.

### 5. Long-term data analysis:







 The integration of long-term data from demo sites will support ongoing research and provide valuable insights into the durability and performance of PV systems under different environmental conditions.

### 2.5 Data storage and access

To ensure effective data management, all data will be stored securely in a centralized repository (e.g., SharePoint, cloud-based platforms). Access to data will be controlled to ensure that sensitive information is protected, while ensuring that non-sensitive data is freely available to relevant partners and stakeholders.

#### 1. Internal data storage:

 All data generated by the project will be stored in a secure, organized manner using SharePoint, accessible to all project partners through a controlled login system.

#### 2. Data sharing:

 Non-sensitive data will be shared among project partners and made publicly accessible when applicable, through repositories like Zenodo, in accordance with the project's dissemination strategy.

#### 3. Data security:

 Sensitive data will be stored in password-protected locations, with access granted only to authorized personnel. The project will implement encryption and other security measures to protect sensitive data during transmission and storage.

#### 4. Long-term preservation:

 All relevant datasets will be preserved for long-term access after the project concludes, ensuring that they remain usable and accessible for future research and applications.







## 3. FAIR data treatment and storage

In line with the European Commission's guidelines for **FAIR data** (Findable, Accessible, Interoperable, and Reusable), the SOLARIS project is committed to ensuring that all data collected, processed, and produced throughout the project is handled in accordance with the FAIR principles. This will ensure that the data generated can be easily accessed, understood, and used by the project partners, stakeholders, and the broader research community, both during and after the project. The following sections outline how each work package (WP) will contribute to making data findable, accessible, interoperable, and reusable.

#### 3.1 Findable

To ensure that data is easily findable, the following steps will be taken:

- Metadata standards: All datasets will be accompanied by rich metadata following standardized formats such as Dublin Core or DataCite. This will include descriptions of the dataset, including the variables measured, data sources, and methodology used. Metadata will be stored in a common registry or repository to support searchability.
- **Data naming conventions**: A consistent naming convention will be adopted (as outlined in Section 2) to allow users to easily locate and identify datasets based on their type, source, and collection date.
- Persistent identifiers (DOIs): Datasets intended for public use will be assigned persistent identifiers (DOIs) to ensure that they can be easily referenced and tracked. Datasets uploaded to repositories like Zenodo will be assigned DOIs for long-term citation and traceability.

#### 3.2 Accessible

In order to ensure that data is easily accessible:

- Centralized data repositories: All project data will be stored in centralized repositories
  such as SharePoint for internal access and Zenodo for public access. Data will be stored in
  a way that makes it easy for project partners to retrieve, but with tiered access control to
  ensure that sensitive data is appropriately protected.
- **Data sharing policy**: SOLARIS will follow an open-access policy for non-sensitive data. Public datasets will be made available on well-established platforms, such as Zenodo or a project-specific repository, with clear instructions on how to access them.
- Data access rights: Access to the data will be clearly defined through role-based access controls (RBAC) on the storage platforms. Restricted or proprietary data will be available







to relevant partners and stakeholders based on the terms outlined in the data management and dissemination plan.

#### 3.3 Interoperable

To ensure that data is interoperable with other datasets and systems:

- Standardized data formats: Data will be stored in common, widely-used formats, such as CSV, XLSX, and JSON for structured data, and PDF for technical documents and reports. These formats ensure compatibility with various data analysis tools and platforms.
- **Controlled vocabularies and taxonomies**: A set of controlled vocabularies and taxonomies will be developed and used across the project to ensure consistent data descriptions, particularly for technical specifications and environmental conditions. These vocabularies will be based on relevant industry standards.
- APIs and data integration: Where applicable, data will be made available through APIs or web services to allow other systems to access and integrate it seamlessly. This ensures that external systems and applications can leverage the data generated by SOLARIS.

#### 3.4 Reusable

To ensure that data can be reused:

- Licensing and permissions: All datasets will be shared with appropriate licenses, such as
  Creative Commons (CC BY) to enable reuse, redistribution, and modification of data.
  Sensitive or proprietary data will be clearly marked, and access will be restricted
  accordingly.
- Clear documentation and data provenance: Each dataset will be accompanied by comprehensive documentation that explains its structure, contents, and how it was generated. Provenance tracking will ensure that users can understand the origins of the data and any transformations it may have undergone.
- Version control: Data versions will be clearly documented and versioned to track updates
  and modifications. For example, every update to a dataset or model will be reflected in a
  new version number, ensuring that users can access the most recent data and historical
  data when needed.

#### 3.5 Compliance and monitoring

Throughout the SOLARIS project, WP leaders will monitor the progress of data management to ensure compliance with the FAIR principles. Data management practices will be regularly reviewed during internal project meetings, and any required adjustments will be made to improve data treatment and storage practices. Regular evaluations of the data's compliance with





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the FAIR principles will be conducted to ensure continued alignment with the project's data management goals.

By following these principles, the SOLARIS project will create a data ecosystem that ensures its data is findable, accessible, interoperable, and reusable, thereby maximizing the value of the data produced throughout the project's lifecycle and beyond.





## 4. Other research outputs

In addition to the core datasets, the SOLARIS project will generate several other types of research outputs aimed at enhancing the dissemination and application of project results. These outputs will include publications, presentations, software tools, models, and other deliverables that will contribute to advancing knowledge in the photovoltaic sector. The following sections describe these research outputs and their management.

#### 4.1 Publications

The SOLARIS project will produce a variety of publications to disseminate its findings to the scientific and industrial communities. These publications include:

- **Scientific papers**: Peer-reviewed articles submitted to high-impact journals and conferences, covering topics such as PV system optimization, predictive maintenance models, and energy forecasting techniques.
- White papers and technical papers: Documents that summarize the project's technical advancements and best practices, primarily aimed at industry stakeholders, regulators, and policymakers.
- **Conference proceedings**: Papers and abstracts presented at international conferences, workshops, and symposiums. These will provide a platform to showcase the project's results and foster collaboration with external experts in the field.

All publications will be made accessible through institutional repositories and open-access platforms, in line with the project's open-access policy.

#### 4.2 Software tools and models

The SOLARIS project will develop several software tools and models that are crucial for improving the operation and maintenance of PV systems:

- Forecasting and optimization models: These models will predict PV system performance based on weather conditions, operational data, and environmental factors, optimizing energy output.
- Fault detection and predictive maintenance tools: These tools will use data to detect
  faults early and optimize maintenance schedules, reducing downtime and improving
  system reliability.
- Data analysis and visualization tools: Platforms that facilitate data analysis and visualization of PV system performance metrics, providing decision-makers with actionable insights.







These tools and models will be made available to the wider community, either as open-source software or through collaborative partnerships, with documentation and user guides to support their adoption.

#### 4.3 Presentations and dissemination materials

The SOLARIS project will create a range of dissemination materials to communicate its findings effectively:

- **Conference presentations and posters**: These materials will be used in international conferences to present the project's key results and technological innovations.
- **Public reports and brochures**: Accessible summaries of the project's work, targeted at non-technical audiences, including industry stakeholders, policymakers, and the public.
- **Webinars and workshops**: Events that will facilitate knowledge transfer and engage with stakeholders, focusing on the practical application of the project's results.

All presentations and dissemination materials will be uploaded to the SOLARIS website (<a href="https://www.solaris-heu.eu">www.solaris-heu.eu</a>) and shared via project social media channels to maximize visibility.

### 4.4 Data-driven insights and best practices

As a result of the large-scale demonstrations, SOLARIS will produce several **case studies** and **best practice guidelines**:

- **Case studies**: Detailed analyses from the demonstration sites, focusing on the effectiveness of developed solutions in real-world settings, including system optimization, fault detection, and maintenance improvements.
- Best practice guidelines: Practical recommendations for optimizing PV system operation, based on project findings. These guidelines will help industry stakeholders implement the most effective strategies for PV maintenance and performance improvement.

These outputs will be made publicly available on the SOLARIS website and in relevant industry publications to ensure wide dissemination.

#### 4.5 Workshops and training materials

The project will organize workshops and produce training materials to ensure that the results and tools developed are effectively communicated to industry professionals, researchers (particularly through other EU initiatives such as sister projects), and other stakeholders:

 Workshops: Events where SOLARIS tools, models, and methodologies will be demonstrated and discussed with participants.







 Training guides: Detailed user manuals and tutorials to help users implement the project's tools and methods in their own PV systems. These resources will be available in video and document formats.

All training materials will be freely available on the SOLARIS website and will be shared with relevant industry groups and partners.

#### 4.6 Other outputs

In addition to the above-mentioned outputs, SOLARIS will generate:

- **Datasets**: The project will make all non-sensitive datasets publicly available through openaccess repositories such as Zenodo, where appropriate.
- **Technical documentation**: Detailed documentation for the software tools, methodologies, and models developed in the project, ensuring that external users can effectively use and build upon SOLARIS outputs.

#### 4.7 SOLARIS website

The **SOLARIS project website** (<u>www.solaris-heu.eu</u>) will serve as the primary platform for disseminating information about the project and sharing its results with the research community and the general public. The website is designed to provide easy access to the project's key outputs, progress updates, and event announcements, while promoting transparency and fostering communication among all stakeholders involved in the project.

The website will contain an overview of the project, detailing its objectives, work packages, and partners, as well as providing information on the progress and impact of the project. It will also host research outputs such as publications, deliverables, technical reports, case studies, and datasets, making these resources available to a broad audience. The SOLARIS website will be regularly updated with news on upcoming events, workshops, webinars, and conferences, ensuring that stakeholders are kept informed about the project's developments and milestones.

Additionally, the website will facilitate stakeholder engagement by providing a platform for external partners, industry professionals, and policymakers to stay connected with the project's activities. It will also offer a means for users to reach out to the project coordinators and team members with questions or feedback. All non-sensitive research data and publications will be made openly accessible through the website, supporting the project's open-access policy.

The SOLARIS website will be maintained and updated throughout the project's duration to reflect the latest research, findings, and developments. It will ensure that SOLARIS' outputs are widely shared and accessible, maximizing the impact of the project and fostering collaboration and engagement with the broader PV community.







## 5. Allocation of resources

In line with the Grant Agreement, any activity related to data generation and handling will be accounted for within the person-month allocation for each partner, which includes direct personnel costs. The effort invested in data management will be crucial to achieving the project's goals and ensuring the successful completion of the project's outcomes. These activities will involve generating, processing, analyzing, and sharing data, with specific attention given to ensuring data is compliant with the FAIR principles.

The project coordinator (DTU) will be responsible for the development and ongoing updates to the Data Management Plan throughout the project's duration. This includes providing guidance and support to all project partners to ensure compliance with the data management strategy and that all project-related data is handled according to the agreed standards. Each Work Package Leader will be responsible for ensuring the quality of data generated within their respective work packages, ensuring that the generated data and metadata meet the necessary quality assurance standards.

The long-term preservation of data will be discussed among the consortium partners, with decisions made regarding the appropriate platforms and strategies for ensuring that the project's data remains accessible and usable after the completion of the project.





## 6. Data security

Data security is a key priority for the SOLARIS project, and all partners will take the necessary precautions to ensure the protection of data, products, and services from unauthorized use or access. This includes applying appropriate technologies to safeguard the integrity and confidentiality of project data throughout its lifecycle.

For sensitive data, controlled access will be implemented, with only authorized personnel from each partner given access to the relevant data. Access will be managed via username and password protocols, and access levels will be determined based on the role and responsibility of the user within the project. All shared, processed, and operational data will be stored in secure environments at each consortium partner's location. Access to this data will be restricted to the relevant project members, ensuring that only those who need it for their specific tasks can access it.

In instances where data needs to be exchanged between partners, either within the same work package or across different work packages, secure data transfer mechanisms will be implemented. The use of SharePoint or other encrypted file-sharing platforms is strongly recommended to ensure the safe exchange of data across the consortium.





## 7. Legal and Ethical Aspects

As per the Horizon Europe ethics self-assessment, there are no ethical issues anticipated arising from the research activities of the SOLARIS project. However, it is important to recognize that any changes to the scope or context of the project may introduce new legal or ethical considerations, which will be addressed accordingly.

The project will ensure that all activities comply with relevant data protection and privacy laws, such as the General Data Protection Regulation (GDPR), and any other applicable national and international regulations. All partners will be required to follow the legal frameworks governing data handling, intellectual property rights, and the use of research outputs. Ethical considerations will be revisited if there are any modifications to the project's activities that could affect the legal or ethical aspects of the research.



## **ANNEX: TITLE**

Annexes will be added later during the project.







