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# Deliverable 2.2
# Upgraded RI Report

# Sol2H2O

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## 1. Introduction

In fulfilment of Sol2H2O[1] Grant Agreement on the obligations of the Consortium towards the Project Owner (PO) regarding project deliverables, the current document stands as Deliverable D2.2: Upgraded RI Report, as described in the project Description of Action (Part A).

Aiming at reporting the design, installation and commissioning state of the Widening RI upgrade developed along Sol2H2O JRA, this report includes not only information pertaining to the activities in Task 2.3 aiming at the upgrade of the Widening RI, including:

- Photovoltaic powered – Reverse Osmosis (PV-RO) desalination system;
- Solar powered Vacuum-enhanced air-gap Membrane Distillation system;
- Reactive Crystallization Unit;
- Solar-driven Evaporation Ponds;
- Layout schemes for installation and integration of the technologies for the seawater treatment chain,

but also the implementation of distributed facility features enabling the remote access and crossed services among the RIs of Sol2H2O Consortium partners, namely:

- remote monitoring: RI assets list (all RIs); system architecture; implementation scheme (assets, existing sensors, additional sensors, cabling, wireless communication, etc.);
- definition of common front-end;
- definition of data access rules, and implementation of data storage framework;
- description of implementation/functionality.

Despite delays with e.g. definition of external access to some of TOP partners' RI, impairing the full commissioning of the Widening RI upgrade and full fledged remote infrastructure, the activities completed secure its ensuing completion, and this report provides a concrete roadmap and calendar for the completion of the missing tasks to full commissioning.

## 2. Widening RI upgrade

In view of enabling a broader range of services, such as scale-up testing, process optimization, and demonstration activities and of establishing the groundwork for cutting-edge research in solar-driven water production, water treatment, and Zero Liquid Discharge (ZLD), the Research Infrastructure (RI) was upgraded in alignment with the "beyond state-of-the-art" concept developed in Sol2H2O (see Deliverable 2.1). The upgrade aimed to enhance the experimental capacity of the RI while supporting the demonstration and validation activities foreseen in the project.

Following a philosophy of optimization and flexibility, the definition of the Widening RI upgrade evolved from an initial concept with limited process integration towards a modular and scalable configuration. This new approach is based on the integration of Reverse Osmosis (RO), a Multiple-Feed Plug Flow Reactor (MF-PFR) for selective precipitation, and Membrane Distillation (MD) for final concentration and water recovery. The system allows independent or sequential operation of each module, maximizing the range of potential services, testing conditions, and process combinations. The configuration also ensures effective coupling with the existing CPC field, reinforcing the RI's role as a multidisciplinary platform for solar-driven water and energy research.

### 2.1 RI upgrade design and layout

To implement the upgrade of the Widening RI within the Sol2H2O project, a new desalination loop was designed and constructed, integrating multiple modular units powered by renewable energy. The upgraded infrastructure, designated as the UÉVORA Solar Desalination and Water

[1] Project: 101079305 — Sol2H2O — HORIZON-WIDERA-2021-ACCESS-03

Treatment (SDWT), was conceived to support advanced research in solar-driven desalination, brine valorization, ZLD processes and waste water treatment and is composed of two components, illustrated in Figure 2.1:

- a ZLD pilot desalination plant - SDWT Desalination loop;
- a direct solar photocatalysis system - SDWT Water Treatment loop.

This infrastructure is supplied with solar energy primarily at the electrical level by a photovoltaic (PV) field, which powers the RI assets. Provisions have been included for future thermal integration with the Compound Parabolic Collector (CPC) field to enable direct solar heating of the pilots, as illustrated in Figure 2.2.

(a) (b)

**Figure 2.1: View of the Widening RI loops (a) SDWT Desalination loop and (b) SDWT Water Treatment loop**

(a) (b)

**Figure 2.2: View of the Widening RI loops (a) Compound Parabolic Collector field and (b) Photovoltaic field**

The desalination loop consists of complementary process modules, illustrated in Figure 2.3, configured to enable flexible operation and testing under different conditions:

- Pre-filtration, comprising filtration and conditioning systems to prepare the feedwater;
- Photovoltaic-powered Reverse Osmosis (PVRO) unit for primary desalination and freshwater production;
- Multiple Feed Plug Flow Reactor (MF-PFR) for selective precipitation of magnesium and calcium salts from the RO brine;
- Membrane Distillation (MD) system for further concentration and water recovery, currently operated with electrical heating;
- Solar evaporation ponds, designed for final crystallization and salt recovery under ZLD conditions.


a) b)


c) d)

e) f)

**Figure 2.3: View of the Widening RI, SDWT Desalination loop: a) Sand filter unit; b) Seawater storage tanks; c) RO unit; d) MD unit; e) MF-PFR unit and f) Solar evaporation ponds and buffer tanks**

Each module is equipped with dedicated inlet and outlet manifolds, control and shut-off valves, temperature and conductivity sensors, and flow measurement sensors, ensuring full monitoring and process control in each system separately. The configuration is prepared for both independent and sequential operation of the modules (e.g., RO–MF-PFR, MF-PFR–MD), maximizing experimental versatility.

A schematic representation of the SDWT loops and its process flow is shown in Figure 2.4 and 2.5. The corresponding operational parameters of the SDWT Desalination loop, are summarized in Table 2.1. and the operational parameters of the SDWT Water Treatment loop, are summarized in Table 2.2.

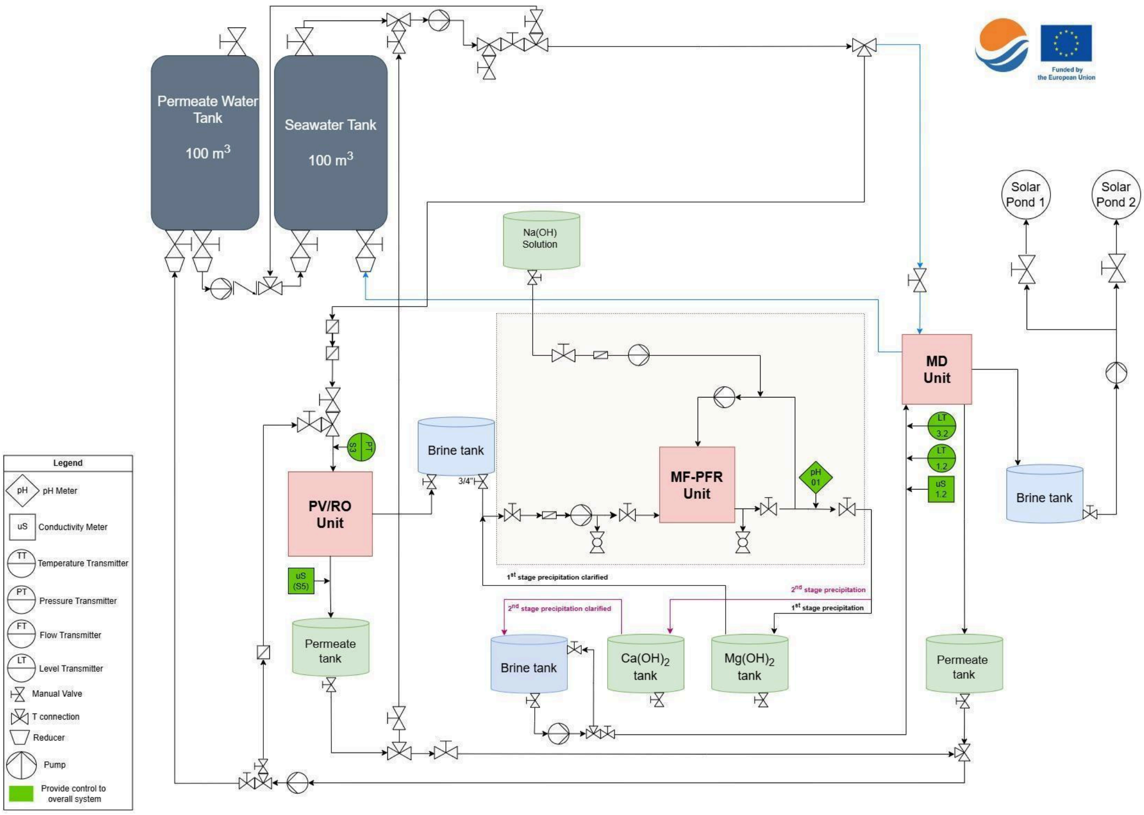


**Figure 2.4: UEVORA SDWT Desalination layout scheme and identification of components**

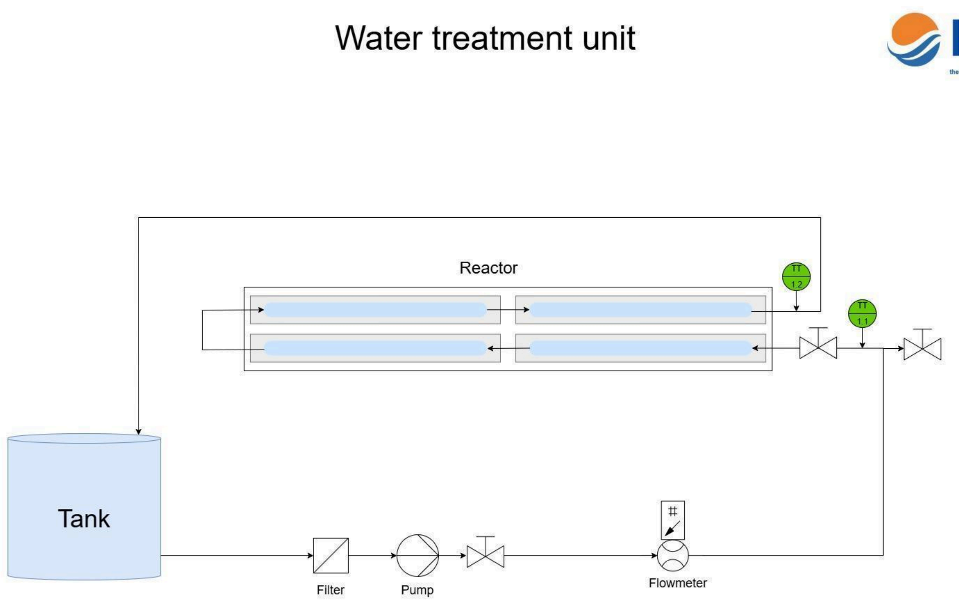



**Figure 2.5: UEVORA SDWT Water Treatment Layout scheme and identification of components**

**Table 2.1. Main components of the SDWT Desalination loop.**

| Component | Model | Specification | Purpose |
|---|---|---|---|
| RO unit | AQSEP WM11000E DOW/AQSEP SW30-3040 (membranes) | 69 bar, approx.50% recovery (flow rate) 4 modules, | Primary water recovery Seawater desalination |

| | | | |
|---|---|---|---|
| | ERD - APPM2 type | Memb. Area: 20.48 m² | |
| MF-PFR | ResourSEAs MF-PFR-B17 | pH: 10 - 12.5<br>Flow rate: 75-225 L/h | Selective precipitation of Mg and Ca |
| MD unit | Aquastill V-AGMD, AS26 | Memb. Area: 25.92 m²<br>Flow rate: 10–100 L/h<br>Temp.: 60–80°C heat and 20–30°C cooling | Brine concentration and water recovery |
| Solar ponds | — | 1.5 m²<br>NaCl pond | Final crystallization |

**Table 2.2. Main components of the SDWT Water Treatment loop.**

| Component | Model | Specification | Purpose |
|---|---|---|---|
| Tubular photoreactor | — | Inclination: 40º<br>Volume: 150 L; 62.32 L illuminated volume<br>Flow rate: 120 L/min<br>Opening area = 1.83 m²<br>Receiving tube: 125 mm Ø and 1.5 m length | Water treatment |

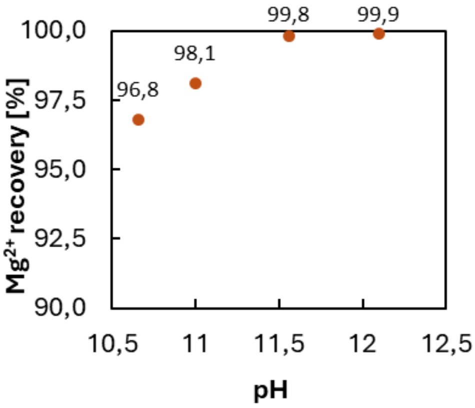
## 2.2 Current status of installation and commissioning

The installation of the upgraded desalination loop at the RI has been completed, and the system is currently in the testing phase. All major process systems: Pre-filtration, PVRO, MF-PFR, and MD have been mechanically and electrically installed and hydraulically interconnected, enabling both standalone and sequential operation modes.

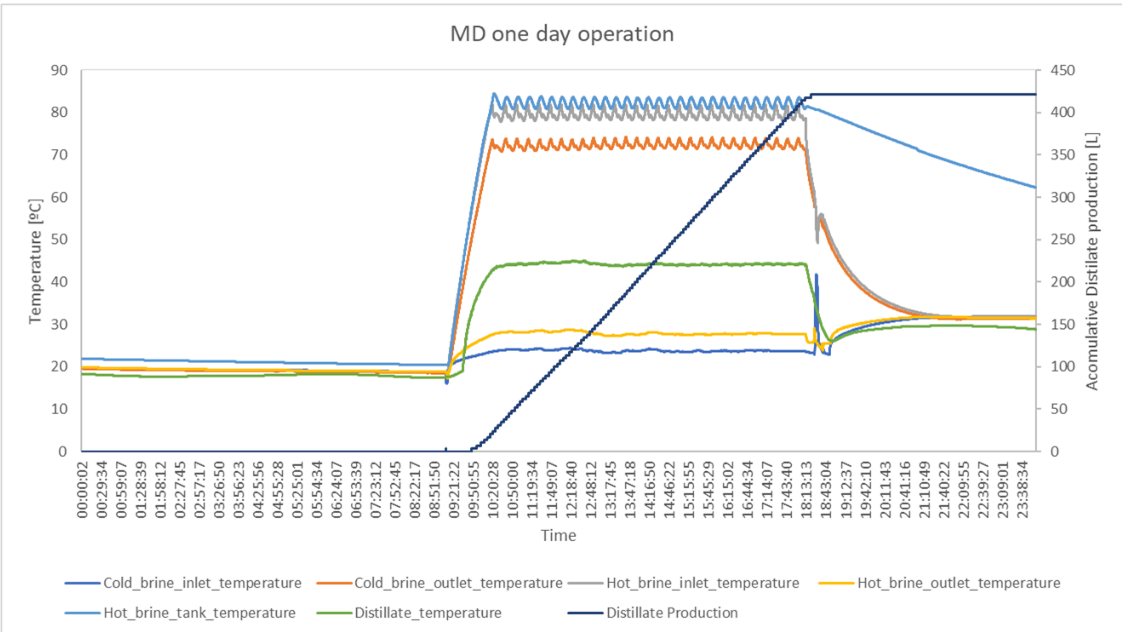
The commissioning process aims to validate the measurements of all installed instrumentation and confirm overall operational readiness. This process involves, in several cases, validation in collaboration with the respective equipment suppliers, particularly for calibration and performance checks of specialized instruments. An illustration of the commissioning work carried out in collaboration between UEvora and UNIPA is presented in Figure 2.6

**Figure 2.6: Illustration of the work developed during commissioning in collaboration between UEvora and UNIPA**

The commissioning phase culminated in the successful validation of the complete Solar Desalination loop through multiple experimental campaigns. The treatment chain was designed to process approximately 1 m³ of seawater per day, corresponding to about 500 L of RO brine per campaign at 50 % recovery. Each campaign was conducted sequentially, operating the RO, MF-PFR, and MD units in series to process the same brine volume, ensuring process stability and compatibility with the system's buffer capacities. The MF-PFR was typically operated at 100–120 L/h, while the MD unit circulated clarified brine at 750 L/h and a feed temperature of 80 °C. ZLD operation results of $Mg^{2+}$ for different pH values (a) and one-day MD operation characterization (b) are illustrated in Figure 2.7.




(a)




(b)

**Figure 2.7: ZLD operation results of $Mg^{2+}$ for different pH values (a) and one-day MD operation characterization (b)**

The integrated pilot system demonstrated stable and reproducible performance across campaigns, achieving a total water recovery of approximately 84.6 %, exceeding the 80 % target initially defined for the prototype. The energy performance of the system was also assessed. The RO module required an average electrical power of 1.8 kW (≈ 3.8 kWh/m³ permeate), consistent with typical seawater RO operation. The MF-PFR exhibited low energy demand (≈ 1.95 kWh per batch), while the MD unit consumed ≈ 69 kWh per 242L of distillate, equivalent to 285 kWh/m³. Integration with solar heat is expected to significantly reduce this figure.

Overall, the system has been fully commissioned and validated under operational conditions, confirming the performance of each module and the reliability of the integrated configuration.

## 2.3 Additional services offered at the Widening RI

Before the Sol2H2O upgrade, the services provided by the RI were primarily limited to water treatment experiments using a photocatalytic reactor. The recent upgrade has considerably expanded the infrastructure's capacity, transforming it into an experimental platform for solar-driven desalination, brine valorization, and ZLD processes within the Solar Desalination loop.

The Widening RI upgrade positions the infrastructure as a testing bed for desalination technologies and components, capable of operating under real seawater feeds. In alignment with the Sol2H2O "beyond state-of-the-art" concept, the upgraded SDWT desalination loop provides a multi-process platform that integrates a RO system, a MF-PFR for selective precipitation, and MD unit. This configuration enables technology testing, control strategy optimization, and performance benchmarking, offering a wide range of services for academic, industrial, and institutional users, supporting both fundamental research and applied technology validation, as illustrated in Figure 2.8.

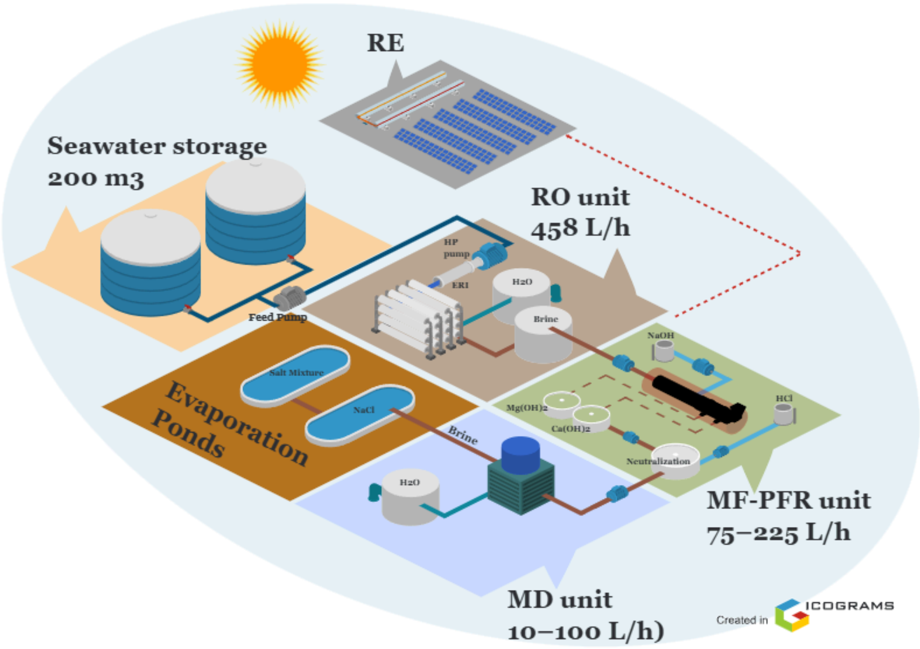



**Figure 2.8: Sol2H2O "beyond State-of-the-Art concept"**

The key new services include:

- Production of customized concentrated brines;
- Testing and coupling of external systems, such as membrane units, crystallizers, or electrochemical systems;
- In-line analytical and sensor validation for water quality monitoring and calibration;
- Integration of Grafana dashboards for real-time data acquisition and visualization, supporting advanced digital monitoring of experiments;
- Photocatalytic reactor testing for wastewater treatment, such as evaluation of photocatalysts, reactor performance, and light-assisted pollutant degradation;
- Training and demonstration activities, serving as a live educational and demonstration platform, offering hands-on training for students, researchers, and industry.

Through this evolution, the Widening RI extends its functionality beyond single-process experimentation toward a flexible and modular test platform. This transformation reinforces its role as a multi-purpose, open-access research infrastructure, supporting the integration, validation, and demonstration of cutting-edge water technologies. A summarized list of services and parameters is provided in Table 2.3.

**Table 2.3: Additional services offered at the Widening RI.**

| Service | System | Electrical supply | | Thermal supply | |
|---|---|---|---|---|---|
| | | V | Pmax | Tmax - Tmin | Pmax - Pmin |
| Desalination testing (feed water to permeate and brine) | PV-RO module | **230 VAC, 50 Hz** (single-phase) | 2.2 kW | | |
| Brine treatment / selective precipitation | MF-PFR | **230 VAC, 50 Hz** (single-phase) | 2.0 kW | | |
| Thermal brine concentration and permeate (ZLD operation) | MD module | **400 VAC, 50 Hz** (three-phase) | 16 kW | typical operation 60–80 °C | 16 - 0.5 kW.th |
| Photocatalytic wastewater treatment | Photo-rea ctor | **230 VAC, 50 Hz** (single-phase) | 1.2 kW | | |

## 3. Distributed Facility

Aiming at the ensuing development of remote R&D activities and services in the Widening RI, besides exploiting the possibilities opened by external access and multi-site service modes with TOP partners RIs, the design, installation and commissioning of a distributed facility, encompassing the remote monitoring of different testing parameters in different assets of the RIs, ensuring data processing and backup, enforcing FAIR (findable, accessible, interoperable and reusable) research data management, providing proper data security (including data recovery), implemented within a Data Management Plan, was sought within the scope of Sol2H2O Task 2.4.

The Distributed Facility represents the digital backbone of the consortium's integrated research infrastructure. Its conception, design, and implementation aimed to create a shared digital environment capable of interconnecting the various pilot systems operated across the participating partners — ITC, CIEMAT, UNIPA and UEvora — to enable remote monitoring, data processing, and collaborative R&D activities.

In the definition and implementation of a pilot of this distributed facility:

- a list of assets to be integrated, on the side of each RI, was defined;
- a list of sensors and a layout scheme for each asset was defined;
- a common front-end was defined;
- a framework for data management, access and storage was defined.

Implementation of the distributed facility functionalities follows a shared system architecture and common front-end, enabling the consecutive addition of additional assets over time.

### 3.1 System architecture definition

The distributed facility functions as the central integration layer that links different research assets and pilot units in different RIs, establishing the foundation for data collection, processing, visualization, and secure access. It was conceived to support remote access to research and innovation activities by integrating RIs and RI assets pertaining to Sol2H2O JRA topics into an interoperable digital system. Although each Research Infrastructure (RI) operates independently at its respective location, all of them contribute data to a shared digital environment, ensuring interoperability, synchronization, and consistent access to experimental information.

The remote monitoring system developed within the Sol2H2O project enables the acquisition, storage, and visualization of operational data generated across its experimental systems. Conceived as a distributed yet integrated platform, the architecture interconnects three different levels of information:

- pilot asset: each pilot (equipment, system, prototype, etc.) operated independently under its own local control and safety system;
- RI: the data gathered in each of the pilot assets therein is gathered in an RI based local server;
- distributed facility: data gathered in each of the RIs local servers is linked to a central server upon a common database and front-end structure.

To achieve this, the architecture follows a structured data flow:

1. **Data collection** – Each pilot unit exports daily CSV files containing sensor measurements;
2. **Data upload** – A Python-based script reads these files and uploads the data to InfluxDB, a dedicated time-series database, stored in the local RI server;
3. **Data mapping** – A JSON configuration file defines the meaning of each variable (e.g., temperature, location, timestamp) and is stored in the respective RI local server, ensuring standardized structure;
4. **Data display** – Grafana dashboards provide a uniformized environment for the visualization of data stored, through the use of the common database management framework provided by influxDB, in the different RI local servers, enabling visualization of the stored data through interactive charts, tables, and gauges accessible via a web interface
5. **User access and collaboration** – Access rights are managed locally, i.e., each RI defines access to the data stored on its local server. Access rules are implemented locally, by a unique RI admin user. User access falls into two different categories, ensuring secure multi-user collaboration across institutions: editors, who might edit dashboards, and viewers, who have view-only permissions.

This architecture is scalable, modular, and FAIR-oriented, supporting the principles of findability, accessibility, interoperability, and reusability. It is designed to evolve toward real time monitoring once stable internet connectivity is deployed across all pilot sites, enabling all participating RIs to contribute continuously to a unified digital map for collaborative research and data sharing. The system architecture definition is presented in Figure 3.1.

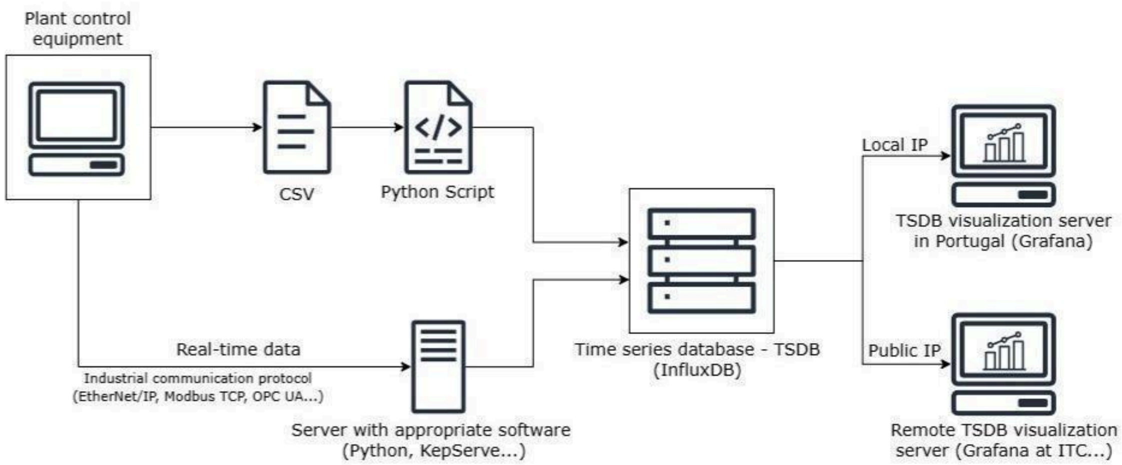


**Figure 3.1: System architecture definition**

## 3.2 Data management and access

The data management and access strategy developed within the Sol2H2O project ensures that all experimental information generated across the pilot systems is securely stored, systematically organized, and made available to authorized users. Building on the digital architecture described in the previous section, this framework governs how data is handled once acquired from storage and backup to access and visualization, guaranteeing transparency, traceability, and long-term availability.

The system architecture ensures both the independence and autonomy of each RI, responsible for the storage and securing of the data generated by its RIU assets, while ensuring interoperability and remote access through a common database and data visualization front-end framework.

The data storage framework is designed around a layered structure that integrates local acquisition and central management. Each RI temporarily stores data locally on acquisition systems. Once uploaded to the RI local server, all information is processed and stored in the InfluxDB time-series database, where each record is timestamped and tagged with metadata identifying its origin, loop, and variable type. Users interact with the data stored in each of the RI local servers, through the Grafana front-end, which connects directly to InfluxDB and enables both live and historical visualization.

### *3.2.1 User access*

All users authenticate through secure login protocols (HTTPS or VPN), ensuring that data access remains traceable and consistent with institutional cybersecurity standards. In addition to general authentication and VPN protection, user management within Grafana follows a role-based configuration that defines both the scope and permissions of each account.

Within Grafana - the centralized data visualization framework, thus the external access gate for remote users - access to specific data series can be provided, asset wise:

- to a group of assets across different RIs, organized in a “project” (e.g. Sol2H2O assets);
- to a group of assets within one given RI, organized in a folder (or, in alternative, in a project) (e.g. UEvora SDWT assets);
- to one single asset (e.g. UEvora SDWT - Desalination loop).

and, access type wise, in one of three different roles:

- **Viewers** can access dashboards in read-only mode;
- **Editors** can modify or create dashboards within their project folder;
- **Admins** have extended privileges to manage users, adjust data sources, or configure settings.

This structure enables control over access and prevents cross-project data exposure. This centralized definition of asset access and user roles is implemented, upon due instructions by the RI administrator, by the Grafana administrator of the RI (i.e., each RI has one administrator, responsible for providing instructions on access and users type, and one Grafana administrator, responsible for implementing those instructions in Grafana).

### *3.2.2 Open Access and FAIR Data*

In view of the public nature of both the RIs engaged in Sol2H2O distributed facility and of the funds used in the construction of the different assets therein existing (in a general sense, though there might be exceptions), by default (i.e. if not explicitly justified and approved otherwise) all data stored in the RI local servers is PUBLIC and its management through the common database framework ensures its FAIR principles compliance.

Exceptions to this default classification might be approved, within each RI, upon request duly framed and justified, which might apply, e.g. within the framework of service contracts pertaining to confidentiality of procedures and/or results.

To this end, a specific "Data Protection Request" form has been defined and implemented in the Sol2H2O website[2] to ensure management of experimental data across the project infrastructures. The form allows users to formally request temporary restrictions on data access related to specific assets, components, or sensors. Its main objective is to safeguard sensitive or proprietary data during defined experimental campaigns while maintaining full traceability and overall project data governance.

The form is structured to guide users through the process of defining and justifying their data protection requests. The initial section concerns the selection of the infrastructure–asset, while the following sections provide infrastructure-specific information, including visual representations and component details, as presented in the next Figure 3.2.


a)


b)

[2] https://www.sol2h2o.uevora.pt/private-data/

**Figure 3.2: Overview of the Data Protection Request Form: (a) General interface and (a) introductory section available on the Sol2H2O website**

Each infrastructure section includes a layout drawing of the system, a list of engaged components (Figure 3.3), a Process and Instrumentation Diagram, and a list of engaged sensors (Figure 3.4). These elements ensure that the scope of the request is clearly linked to the experimental configuration and monitored parameters.

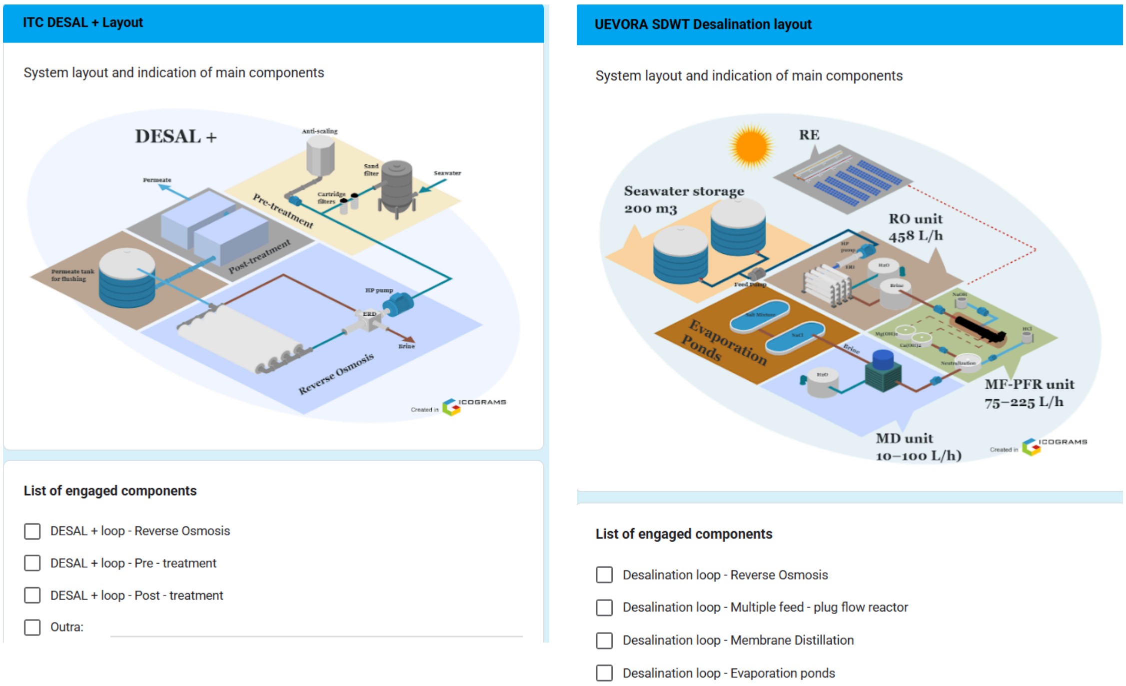



**Figure 3.3: Infrastructure layout example and list of engaged components for the selected infrastructure**

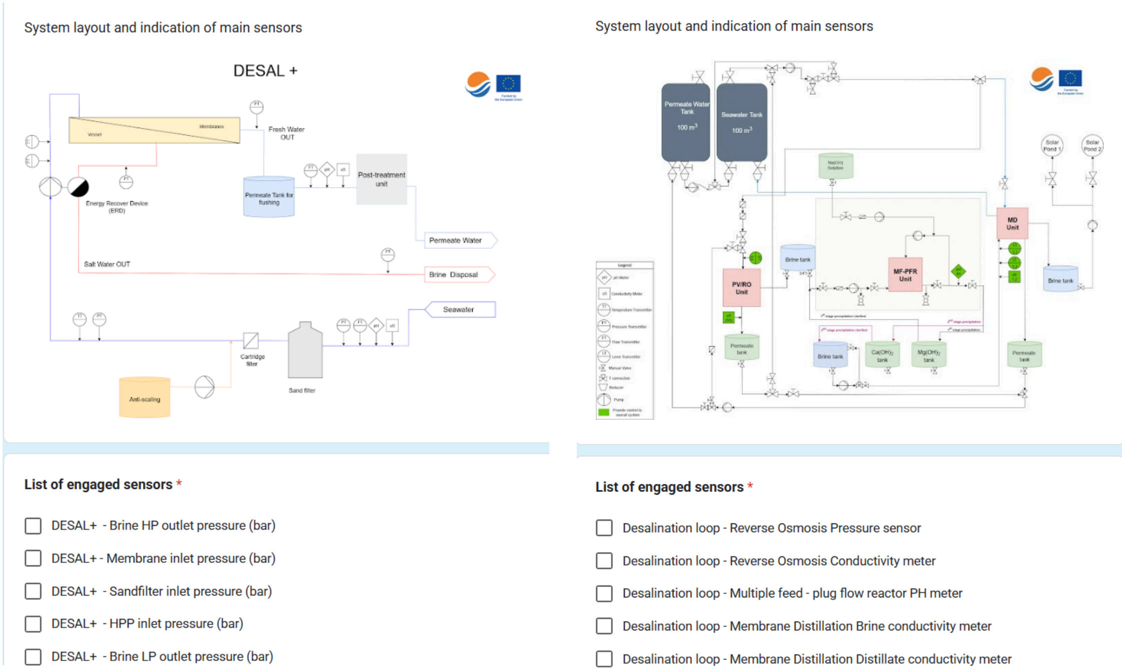



**Figure 3.4: Example of detailed process flow and monitored sensors**

Subsequent sections collect the description of the work, where users outline the objectives, experimental campaign details, and desired operational conditions, as well as the data protection description, including the justification of the request, definition of the protection period, and identification of the specific sensors or datasets to be protected, together with any exclusions, as illustrated in Figure 3.5.

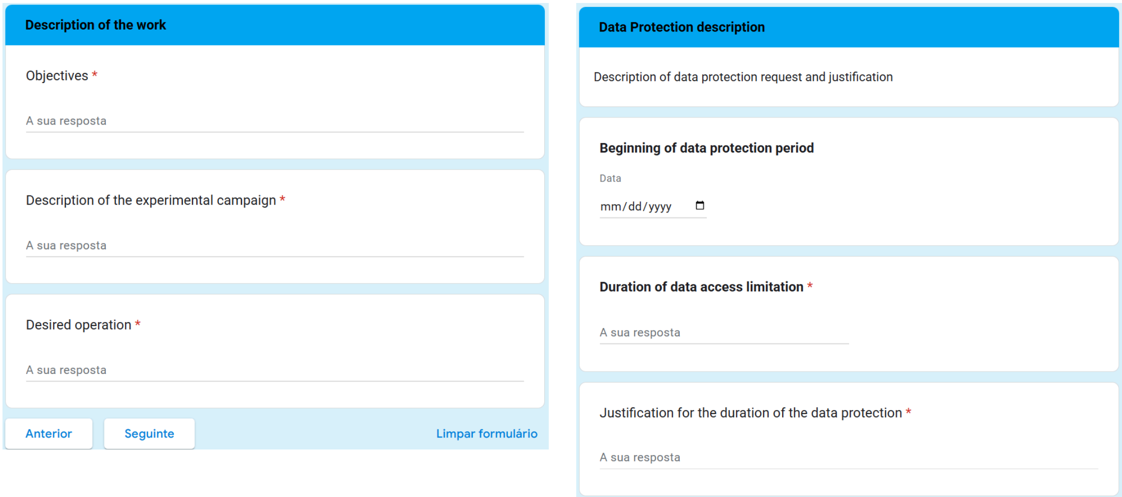



**Figure 3.5: Example of form fields for justification, period definition, and sensor selection**

By combining visual system representations with structured input fields, the form ensures that all data protection requests are standardized, traceable, and well-documented, enabling consistent data management procedures and secure collaboration. Once the request is reviewed and approved, the restriction on sensor data results is applied for the specified period, in accordance with the defined justification and duration.

## 3.3 Current status of installation and commissioning

The installation and commissioning activities for the remote monitoring system are currently in implementation. The system has been successfully deployed on a local server at the Widening RI, hosting both InfluxDB and Grafana within Docker containers. This configuration allows continuous data collection, visualization, and testing of monitoring functionalities. The current setup is operational and is being validated with data from the experimental loops to check for stability and compatibility with the monitoring architecture described in the previous sections. The Python-based data upload routine is functional. User accounts have been configured according to defined access levels (Viewer, Editor, Admin), and preliminary dashboards have been developed to display historical variables from the SDWT systems.

Each experimental loop is equipped with sensors that monitor key operational parameters such as temperature, pressure, flow, level, and electrical resistance, essential for system control and safety. Where required, additional sensors, such as conductivity and total dissolved solids (TDS) probes, can be installed to enhance data resolution and support detailed water quality monitoring.

At the current stage, most pilot systems export data locally in CSV format. These data files are automatically processed by a Python-based ingestion routine, which reads and reformats them according to the corresponding JSON configuration, as shown in Figure 3.6.

```
{
  "FIC-1.1": {
    "measurement": "Flow",
    "field": "Brine inlet"
  },
  "P-1.1 OP": {
    "measurement": "Frequency",
    "field": "Brine inlet pump"
  },
  "P-1.1 SP": {
    "measurement": "Flow",
    "field": "Brine inlet pump SP"
```


**Figure 3.6: Schematic representation of the data mapping process, where the JSON file defines how parameters from CSV files are identified**

The processed datasets are then uploaded to InfluxDB, as shown in Figure 3.7, where they are stored as time-series data. Once in the database, they become instantly accessible through Grafana dashboards for visualization. As network connectivity improves across all pilot sites, the architecture will evolve to support real-time data streaming. This upgrade will allow near-instantaneous synchronization between local systems and the central monitoring platform, reducing manual intervention and improving the timeliness of data analysis.

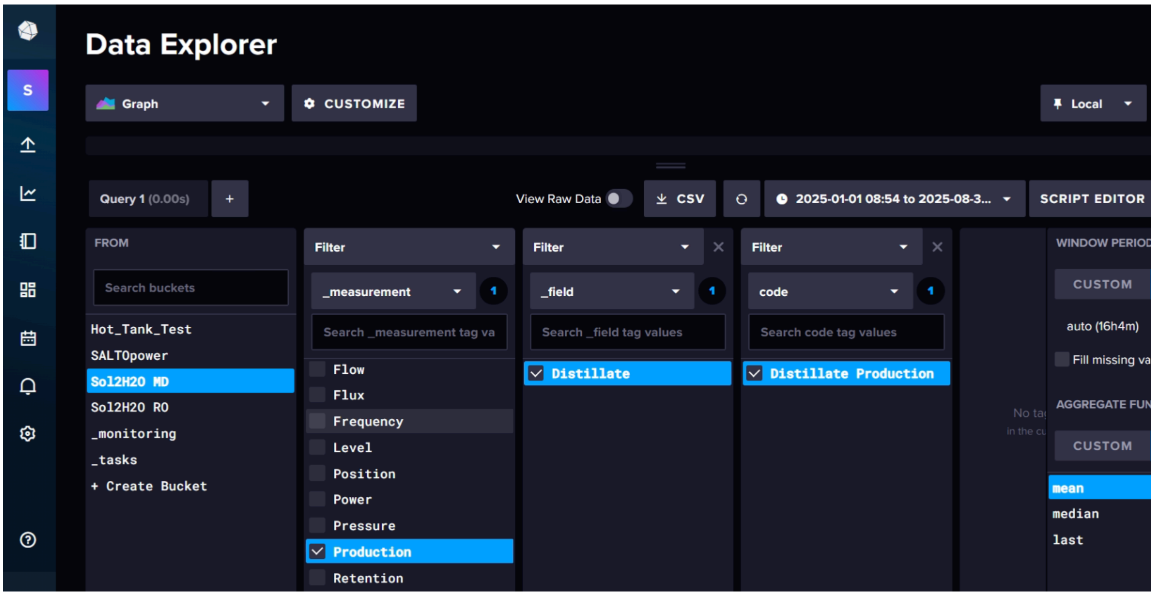



**Figure 3.7: Data stored InfluxDB definition**

A shared visualization platform based on Grafana provides access to monitoring data from all RIs within the Sol2H2O project, as illustrated on Figure 3.8. Grafana acts as the digital gateway to the monitoring environment, retrieving information directly from InfluxDB and displaying it through customizable dashboards. Dashboards are organized by project and system, enabling users to explore data from individual experiments. Researchers and operators can interact with the dashboards and export visualizations for further analysis. As network infrastructure advances, Grafana will also support real-time dashboards, enhancing system supervision and collaboration among distributed partners.


**Figure 3.8: Example of visualization dashboard on Grafana**

The current tests of implementation at the local RI server and connection to the centralized Grafana framework through the common InfluxDB database framework are to be extended to the remaining RI local servers at ITC and UNIPA.

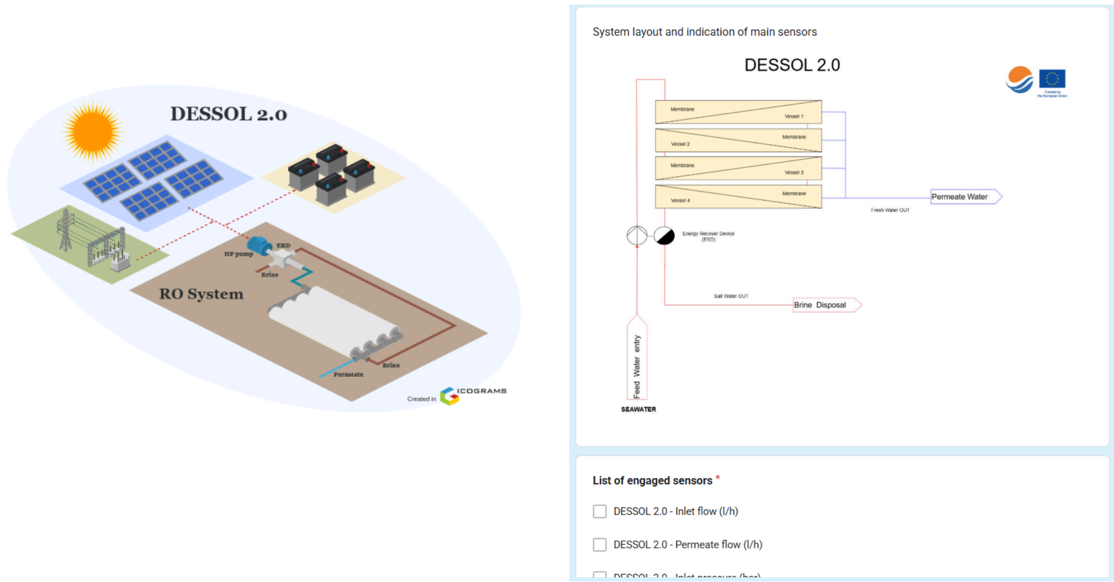
To this end, a list of assets to be included in the Sol2H2O distributed facility has already been defined for each of the engaged RIs, as presented in Table 3.1, each of which includes a layout scheme and a list of sensors, enabling due information to be included in the Data Privacy Request form described in section 3.2.

**Table 3.1: Remote Monitoring RI Assets description.**

| RI | Loop | Main Components | Engaged sensors |
|---|---|---|---|
| UEvora | SDWT - Desalination loop | - Reverse Osmosis<br>- Multiple feed - plug flow reactor<br>- Membrane Distillation<br>- Evaporation ponds | - RO Pressure sensor<br>- RO Conductivity meter<br>- MF-PFR PH meter<br>- MD conductivity meters<br>- MD flow meters<br>- MD Temperature sensors<br>- MD PH meter<br>- Power consumption (kWh) |
| | SDWT - Water Treatment loop | Photo Reactor | - Temperature sensor inlet/outlet<br>- Flow meter<br>- Radiometer<br>- Pyranometer<br>- Power consumption (kWh) |
| ITC | DESAL + loop | - Reverse Osmosis<br>- Pre - treatment<br>- Post - treatment | - Pressure sensors (bar)<br>- Flow meters (m3/h)<br>- PH meters<br>- Temperature sensors (ºC)<br>- Conductivity meters (µS/cm)<br>- Power consumption (kWh) |
| | DESSOL 2.0 | - Reverse Osmosis | - Flow meters (l/h) |

| | | | |
|---|---|---|---|
| | loop | - Photovoltaic<br>- Batteries | - Pressure sensors (bar)<br>- Conductivity meters (µS/cm)<br>- Temperature sensor (ºC)<br>- Recovery rate (%)<br>- Plant power (W)<br>- PV power (W)<br>- External source power (W)<br>- Battery power (W)<br>- Battery voltage (V)<br>- Battery current (A)<br>- Battery level (%)<br>- Battery temperature (°C)<br>- PV total yield (kWh)<br>- Solar irradiance (W/m²)<br>- PV to battery energy (kWh)<br>- PV to plant energy (kWh)<br>- Batteries to plant energy (kWh) |
| UNIPA | Electrodeionization Loop | - Electrodeionization | - Flow meter (l/h)<br>- Conductivity meters (µS/cm)<br>- Pressure transmitter<br>- Multimeter |

Figure 3.9 shows an example of the ITC Dessol 2.0 Loop. The schematic layout (a) illustrates the main system components, and the Process and Instrumentation Diagram (b) details the corresponding sensor positions and control points integrated into the monitoring system.




a) b)

**Figure 3.9: Schematic layout (a) and Process and Instrumentation Diagram (b)**

At the current stage, the system operates through a Docker-based environment installed on a dedicated local computer with a fixed IP address, Figure 3.10. Within this setup, both InfluxDB and Grafana run as containers, forming an integrated environment for data storage and visualization. This configuration was adopted as an interim solution during the commissioning phase, allowing the team to test, validate, and refine the monitoring workflows before deployment on the final server.

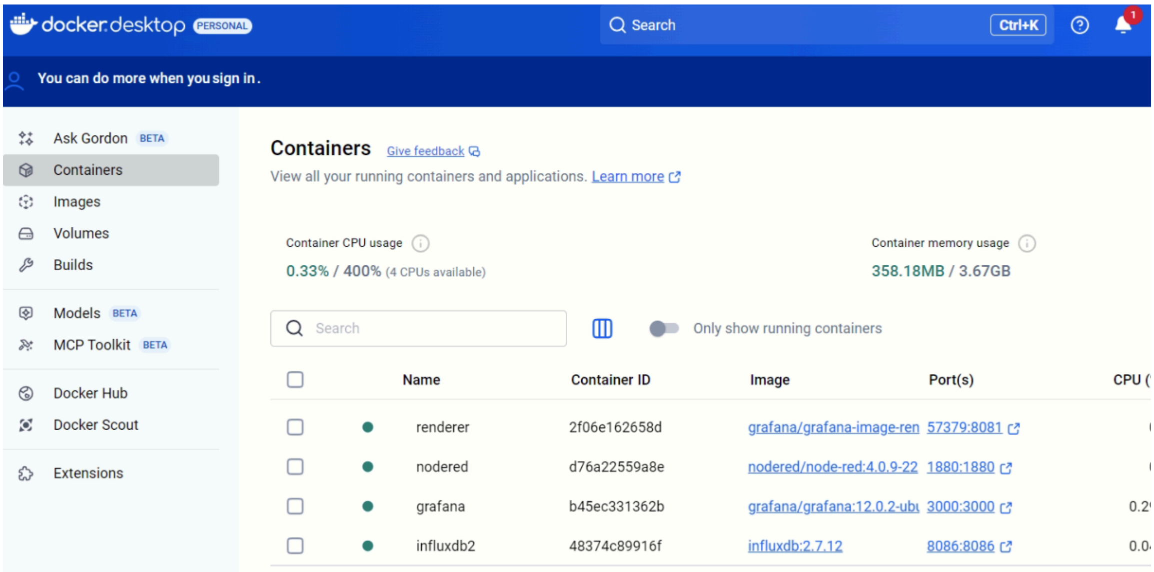



**Figure 3.10: Docker-based environment definition**

A migration plan has already been defined to move the local setup to the institutional server hosted by the High Performance Computing (HPC) center of the University of Évora. The future configuration will consolidate all components within a secure and scalable infrastructure managed by the HPC Division. This transition will ensure higher data availability, improved cybersecurity, and automated backup routines.

The migration process will involve creating complete Docker backups of the InfluxDB database and Grafana dashboards, transferring these containers to the institutional server, restoring the database from the exported volumes, and reconfiguring IP settings and access permissions to maintain continuity across the system. Once finalized, the server-based system will become the permanent data hub for the Sol2H2O monitoring framework.

The next steps before full commissioning, summarized in Table 3.2, include:

- Migration to the institutional HPC server, following the backup and deployment procedure defined in Section 3.2;
- Integration of additional RIs into the monitoring framework, ensuring that each pilot site transmits data using the same format and conventions;
- Configuration of automated backup routines within the HPC environment to ensure data redundancy and recovery;
- Development of standardized dashboard templates to unify data visualization across projects;
- User training and access validation, ensuring all partners can log in and navigate their assigned workspaces;
- Final verification tests to confirm data integrity and continuous synchronization between local acquisition units and the central database.

**Table 3.2: Foreseen calendar for completion of the remaining installation and commissioning activities of the Sol2H2O remote monitoring system.**

| Designation of works | Oct' 25 | Nov' 25 | Dec' 25 | Jan' 26 |
|---|---|---|---|---|
| Migration to the institutional HPC server | | | | |
| Integration of additional RIs into the monitoring framework | | | | |
| Configuration of automated backup routines within the HPC | | | | |

| | | | | |
|---|---|---|---|---|
| environment | | | | |
| Development of standardized dashboard templates | | | | |
| User training and access validation | | | | |
| Final verification tests and full commissioning | | | | |

## 4. Related Plans (following PM² methodology)

### Deliverables Acceptance Plan

The management of the formal customer's acceptance of project deliverables (responsibilities, activities and the criteria for the deliverables acceptance) is described in the *Deliverables Acceptance Plan*. The location of this artifact is found in Appendix 1.

### Project Description of Action

The *Project Description of Action* includes the project Work Plan and captures all types of resource requirements, schedule and effort/costs foreseen for the deliverables acceptance activities. The location of this artifact is found in Appendix 1.

## Appendix 1: References and Related Documents

The Project documents will be stored in a shared drive in Google Drive. The access will be granted by that partner, and each user will have a different access according to their profile, role and responsibility in the project.

The Project Steering Committee (PSC) will have access and editing permissions to all folders in the drive. The Project Core Team (PCT) will have editing access to respective WP folders and reading access to the remaining ones. Project Support Team (PST) will have reading access to WP folders, and finally, Project Owner (PO) may have reading access to all folders, including legal documents.

In each folder, the latest PDF and Word versions of each document will be available, and the previous versions shall be conserved in a separate folder named [versions] until the end of the project.

At the end of the project, each partner will make a copy of the shared folder to be stored in their own organisation's drive, and this must be kept following internal organisational procedures.

| ID | Reference or <Related Document> | Source or <Link/Location> |
|---|---|---|
| 1 | Project folder | |
| 2 | Project Description of Action (Part A and B)<br><Grant Agreement-101079305-Sol2H2O-1.pdf> | Project folder |
| 3 | Task 2.4 Distributed Facility<br><Task 2.4 – Distributed Facility> | Project folder |
| 4 | ZLD prototype sensors list | Project Folder |

| ID | Reference or <Related Document> | Source or <Link/Location> |
|---|---|---|
| | <ZLD prototype sensors list> | |
| 5 | Deliverables acceptance plan<br><br><[08.I.PM2.v3].Deliverables_Acceptance_Plan.SOL2H2O.16-02-2023.v.1> | Project Folder |
| 6 | Deliverables acceptance note<br><[29.I.PM2.v3].Deliverables_Acceptance_Checklist.SOL2H2O.26-05-2023.v1.0.xls> | Project Folder |
| 7 | Deliverables acceptance Checklist<br><br><[29.I.PM2.v3].Deliverables_Acceptance_Checklist.SOL2H2O.16-02-2023.v1.0> | Project Folder |