



TwinERGY Integrated Platform - Beta Release

D5.4

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Deliverable

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DELIVERABLE REFERENCE NUMBER AND TITLE

D5.4 TwinERGY Integrated Platform – Beta Release

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AUTHORS

Tasos Tsitsanis	Marios Phinikettos
Suite5	Suite5



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Statement of Originality

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Executive Summary

The Beta Release of the TwinERGY Integrated Platform is presented in Deliverable 5.4, along with a description of the platform's services (Data Collection, Data Security, Data Storage, Platform Management). In this document, all services and their corresponding functionalities are detailed, using as a basis the TwinERGY conceptual architecture, as introduced in D5.3, in order to inform the TwinERGY Core Data Management Platform (CDMP) users about the range of functionalities that they are enabled with.

Deliverable D5.4 focuses on Deliverable D5.3's [1] research, which detailed the TwinERGY CDMP Services. This deliverable expands on platform functions per service, addressing the Data Collection Service's requirements for data ingestion, data mapping, data curation, and metadata editing. The Data Security Service also includes access policy controlling in order to prevent unauthorized data access. The Data Storage Service includes both data store and the CIM store, as well as data backup and recovery mechanisms. Finally, the Platform Management Service includes identity, search and data retrieval management, as well as notification handling functionalities. Appropriate screenshots of the TwinERGY Integrated Platform are provided for this purpose, in order to show the functionalities included in the Core Data Management Platform Beta Release. The most important functionalities are presented and described in detail, together with suggested guidelines, so that TwinERGY CDMP users have a comprehensive understanding of what is available to them.

Based on the results of this deliverable, the next release of the TwinERGY Integrated Platform (due in M24) will focus on: a) enriching the already introduced functionalities of the TwinERGY Core Data Management Platform, and b) evaluating the identified needs towards the potential introduction of new Platform functionalities, if they are deemed necessary by the pilot partners.

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1. Introduction

1.1 Purpose of this deliverable

Deliverable 5.4 presents the TwinERGY Integrated Platform's beta release, including the current implementation state of the platform's services, namely the Data Collection, Data Security, Data Storage, and Platform Management services. This deliverable is an updated version of D5.3, "TwinERGY Integrated Platform - Alpha, Mock-ups Release," which covers all services and their related functionalities, as well as the extent of the TwinERGY Core Data Management Platform users' access to those functionalities.

The process for establishing and performing the core platform functionalities is outlined via intuitive and extensive screenshots.

1.2 Scope of this deliverable

The TwinERGY Core Data Management Platform's implementation status is detailed in Deliverable D5.4, "TwinERGY Integrated Platform - Beta Release", which outlines the latest functionality available to its intended users. The most essential user routines for performing fundamental platform functions, as well as the many functionalities implemented, are available in this beta release. To that aim, an end-to-end usage overview is provided, completed with specific instructions and appropriate screenshots.

1.3 Structure of the document

D5.4 is structured as follows:

Section 2 presents an overview of the TwinERGY Core Data Management Platform.

The Data Collection, Data Security, Data Storage, and Platform Management Services are described in detail in Sections 3 through 6. In order to advise and inform TwinERGY CDMP users on the available functionalities of the TwinERGY Integrated Platform, the state of implementation of their respective functionalities is also disclosed, along with appropriate screenshots.

Section 7 concludes the deliverable by presenting a brief overview of what has been described within the document.

1.4 Abbreviation List

Acronym	Full Name
API	Application Programming Interface
CA	Consortium Agreement
CDMP	Core Data Management Platform
CIM	Common Information Model
CSV	Comma Separated Values
D	Deliverable
DER	Distributed Energy Resources
EC	European Commission
EMS	Energy Management System
ICT	Information and Communication Technology
GA	Grant Agreement
H2020	Horizon 2020 The EU Framework Programme for Research and Innovation
JSON	JavaScript Object Notation
PubSub	Publish-Subscribe
XML	Extensible Markup Language
WP	Work package

2. TwinERGY Core Data Management Platform

The project's backbone is an "open", modular and interoperable Big Data Management Platform which enables open standards-based data collection and management communication across the TwinERGY project's energy value chain. The TwinERGY Core Data Management Platform follows existing open energy standards. The CDMP also incorporates a homogenized Common Information Model (TwinERGY CIM) that ensures semantic interoperability of the digitalized energy assets deployed in the pilot sites, as well as seamless integration, communication, and operation on top of any Energy Management System and Smart Home systems and devices. The TwinERGY Data Management Platform is equipped with appropriate data security, privacy, authentication, and authorization processes to ensure end-user data protection and non-repudiation of DER assets.

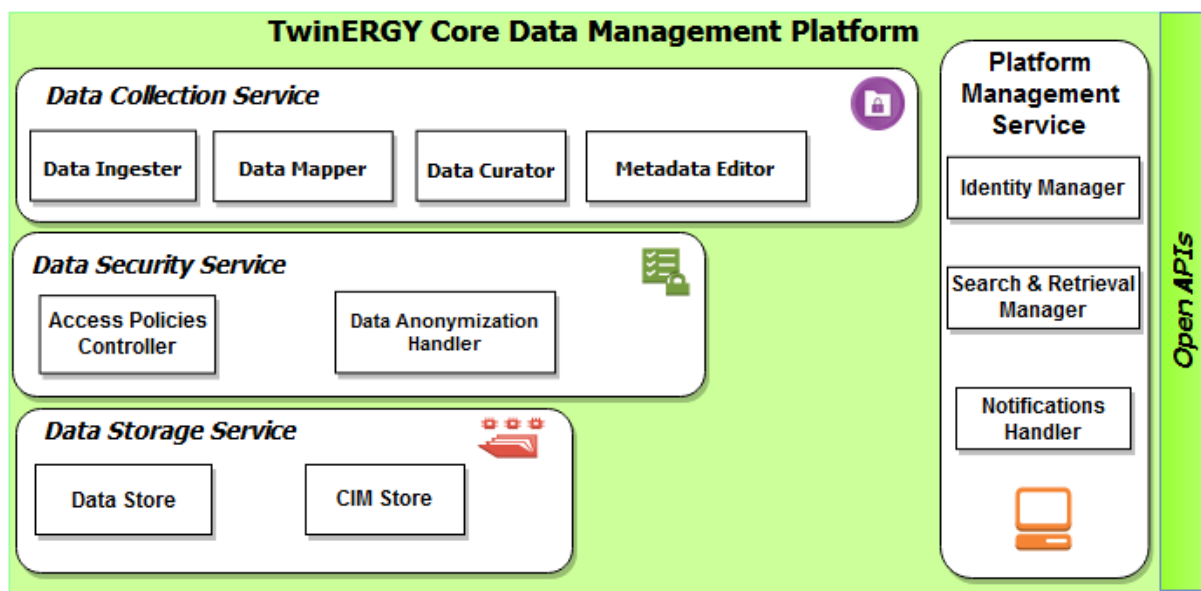


Figure 1 TwinERGY Core Data Management Platform Conceptual Architecture

The TwinERGY Core Big Data platform is made up of the following essential services, as shown in Figure 1 above:

- Data Collection Service
- Data Security Service
- Data Storage Service
- Platform Management Service

The TwinERGY Core Data Management Platform, which can be found at <https://twinergy.s5labs.eu/>, is included in this deliverable.

As shown in Figure 2, the landing page welcomes users to the TwinERGY CDMP and invites them to register or log in using their existing accounts.

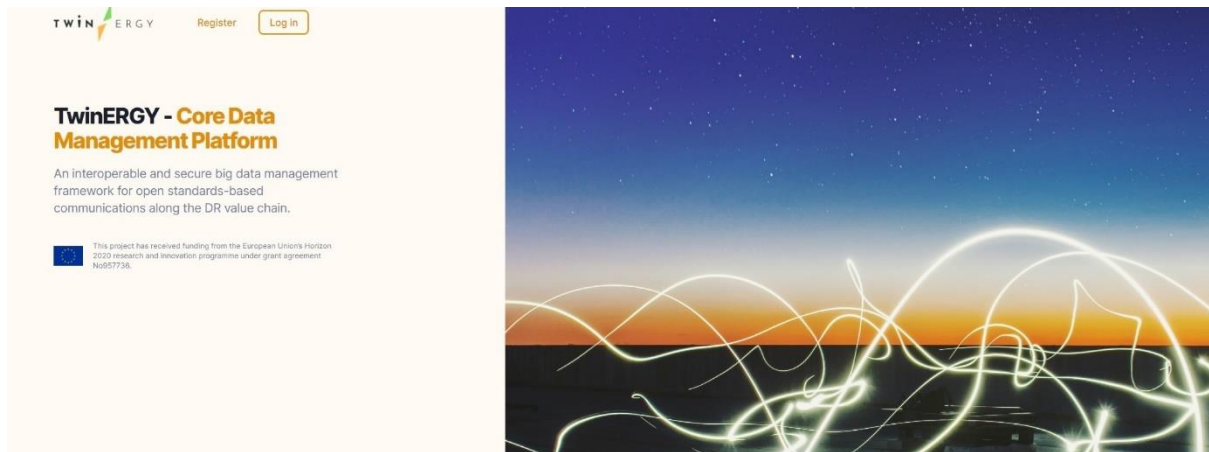


Figure 2 TwinERGY CDMP Landing Page

Users of the TwinERGY CDMP can commence the registration process by providing their first and last names, a username, an e-mail address, and a password that must meet specific requirements and be submitted twice, as shown in Figure 3.

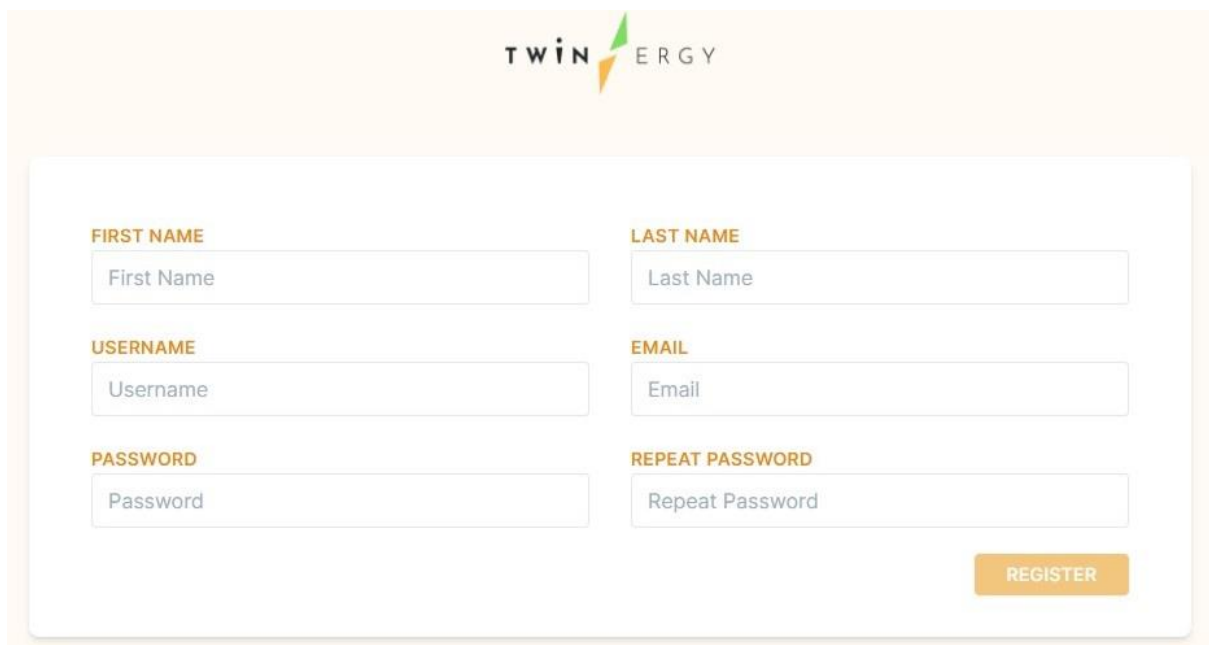


Figure 3 User registration

After completing the registration process, users are routed to the login page, where they can submit their credentials and log in to the TwinERGY Core Data Management Platform. Both actions (registration and login) are part of the Platform Management Service and serve the purpose of the Identity Manager functionality.

3. Data Collection Service

The Data Collection service is responsible for the data ingestion process in the TwinERGY Core Data Management Platform; thus, it is a vital aspect of the overall platform configuration. Data ingestion from various sources, semantic mapping of the data ingested in the platform, data curation to assure the correctness and integrity of the data to be processed later, and metadata editing to enrich the dataset with the necessary additional information are all part of the process.

The Data Collection Service presents a set of functionalities for configuring the data ingestion process. Any TwinERGY CDMP user can upload data to the TwinERGY Integrated Platform infrastructure via stable and secure mechanisms, such as direct batch data uploading or real-time data uploading through APIs, making use of the Data Ingester functionality. Additionally, any outcome of a data ingestion job is saved as a dataset in the TwinERGY Core Data Management Platform. This process is enabled by the Metadata Editor functionality.

The platform's user interface is duly built, to provide platform users with appropriate advice so that they can map all of the fields of ingested data using the TwinERGY Common Information Model (CIM), as part of the Data Mapper functionality.

The user can also specify the constraints and limitations that data ingested into the platform may have, as well as the specific actions that must be performed if any of these constraints are breached. The Data Curator functionality guarantees that the ingested data is of high quality and value. A curation routine is created by combining a validation option with a corrective action for a specific field, and then all of the curation routines are applied to the converted data (deriving from the mapping process to the Common Information Model), resulting in curated data.

3.1 Data Ingestion Job Creation

The Data Collection page is displayed when the users first access the platform. After clicking the Create button on the top navigation bar, the data ingestion job is created. In addition, the platform users must submit data ingestion job parameters and select suitable processing rules.

The process begins with the creation of a new data ingestion job and the specification of appropriate data processing routines. The user is asked to enter some basic information about the data ingestion job, such as the title and a brief description of the dataset that will be ingested, as well as the data processing routines that will be applied. The data ingester, data mapper, and data store data processing routines are pre-selected; however, because the data curator routine is optional, the platform users can choose whether or not to curate the dataset, as depicted in Figure 4.

The screenshot shows the 'Create Data Ingestion Job' interface. It features a green header with navigation links for 'Data Collection', 'Datasets', and 'Search'. The main content area is divided into several sections:

- Job Details:** A section for providing basic information about the job, including a 'NAME' field (pre-filled with 'PV Generation') and a 'DESCRIPTION' field (pre-filled with 'Information about the generation of the photovoltaic').
- Data Processing Routines:** A section explaining that users can use additional tools to prepare data before importing it. Below this, there is a list of routines:
 - DATA INGESTER: Collect data through files, webserver APIs or other services.
 - DATA MAPPER: Map your data to the common data model.
 - DATA CURATOR: Detect and generate data quality issues, such as corrupt or inaccurate records.
 - DATA INGESTION METHOD: Load the processed data to the data storage.

Figure 4 Data Ingestion Job Creation

After the required information is provided, the job is created and listed in the data ingestion jobs list, as shown in Figure 5.

The screenshot shows the 'Data Ingestion Jobs' list. At the top right, there is a '+ Create' button. The list contains one job entry:

- PV Generation:** A card showing the job name, the user 'TwinERGY User', and the update date 'Updated on Mar 2, 2022'. A 'CONFIGURATION: DATA INGESTER' link is visible on the right side of the card.

Figure 5 Display of the data ingestion jobs page

3.1.1 Data Ingester

When the TwinERGY Core Data Management Platform user selects the Data Ingester on a new data ingestion job, the user can determine how the data will be ingested into the platform, either via direct file uploading or data ingestion via API. In the file uploading option, platform users can choose between different file types. As shown in Figure 6, this process is completed by submitting a sample and the actual file to be uploaded.

The screenshot shows the configuration page for the 'Data Ingestion Method'. It includes the following sections:

- Data Ingestion Method:** A question 'How do you plan to store your data to the platform?' with a radio button selected for 'FILE UPLOAD' (Direct file upload (CSV, JSON)).
- Data Ingestion Routines:** A question 'Select the format of the file you will use' with radio buttons for 'CSV' (selected) and 'JSON'.
- Sample Upload:** A question 'Upload a sample of your data to be used in next steps' with a 'BROWSE' button and a file selection showing 'PV_Generation_Sample.csv' (289.0 B).
- Upload File(s):** A question 'Upload your file(s) to be processed (if in csv, json)' with a 'BROWSE' button and a file selection showing 'PV_Generation.csv' (255.3 KB).

Figure 6 File uploading in the TwinERGY CDMP

When all of the required information is provided, platform users are provided with a summary of the sample file they selected, as depicted in Figure 7. Then they are able to Save and Finalize the configuration.

ADDED FILES		
D PV_Generation.csv		255.3 KB ×
DATETIME	PV PRODUCTION, KW	RELATEDGENERATIONTECHNOLOGY
12-03-19 00:00	0	3
12-03-19 01:00	7987.40113	3
12-03-19 02:00	3113.56546	3
12-03-19 03:00	3235.074906	3
12-03-19 04:00	4793.323944	3
12-03-19 05:00	3563.919926	3
12-03-19 06:00	5626.647834	3
12-03-19 07:00	9901.117318	3

Figure 7 Overview of the sampling of the files uploaded

Platform users can also use the TwinERGY platform's API retrieval feature if they retain data in their organization systems and expose it through APIs. They are presented with a configuration screen, as illustrated in Figure 8, to begin the process of ingesting their data. After selecting the type of authentication, the platform user is asked to provide the whole API URL, as well as the method to be used (e.g., GET), as well as define any potential request parameters.

Data Ingestion Method
How do you plan to store your data to the platform?

DATA PROVIDER'S AVAILABLE API
Collect data from the APIs provided by applications and systems of the data provider or from open APIs

Authentication Details
Details about the authentication policies of the API

None
 Bearer
 Custom

Method, URL & Body ⌵
The method, URL and query body of the request.

GET
https://api.openweathermap.org/data/2.5/weather?q=athens&appid=290eef18c9bea92b70b0e04f4c602609
✎

Request Parameters
Any url, query or body parameters that will be used on the API calls

PARAMETER	VALUE	TYPE	SENSITIVE
⌵ q	athens	Query	✎ ✕
⌵ appid	290eef18c9bea92b70b0e04f4c...	Query	✎ ✕

+ ADD QUERY PARAMETER

Figure 8 API Data Ingestion

Users of the platform are also requested to choose how frequently they like to retrieve data via the API and to set appropriate scheduling intervals. In order to quickly evaluate

the data that will be saved on the platform, the user is given a summary of the structure that is recorded, as well as selected concepts.

3.1.2 Data Mapper

Following the completion of the Data Ingestor configuration, the process of mapping the ingested data to the TwinERGY CIM specified concepts in D5.1 [2] begins, by clicking the Configure Data Mapper button. Initially, the platform displays the model's name, the standards considered in the development of the TwinERGY Common Information Model, which can be selected if the user knows the corresponding standard to which the ingested data adheres, and a list of the TwinERGY CIM concepts defined to select the mapping process's entry point.

Then, users of the TwinERGY CDMP are redirected to the mapping playground, where they can map the ingested data with the TwinERGY CIM's concepts and fields, as shown in Figure 9.

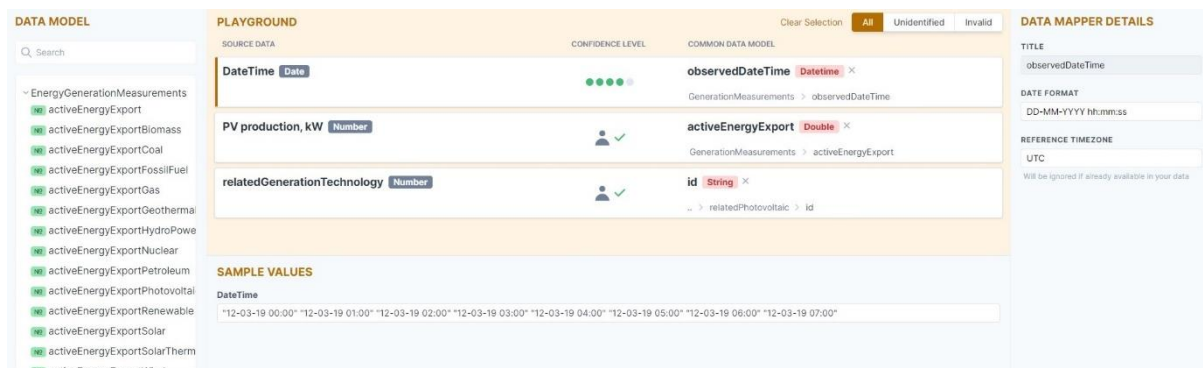


Figure 9 Mapping data to the TwinERGY CIM

On the left side of the mapping playground page, the users of the TwinERGY CDMP can search through the TwinERGY CIM and find the list of fields for the concept specified in the previous step. In addition, in the centre of the page, the user can view the data that has been ingested into the platform, and on the right side of the page, the user can define the mapping details for each field selected. To make the mapping process easier, the user is given appropriate assistance and mapping recommendations, as well as relevant confidence levels, search and drag-and-drop functionality, field descriptions, and a data sample display. A validation option is also available, which indicates to the user whether the mapping performed is correct. If not, the user can always make the required changes in order to complete the process.

Once the users are satisfied with the applicable mapping, they can choose to Save and Finish the process and continue with the Data Curator routine (if selected).

3.1.3 Data Curator

The users are redirected to the Data Curator configuration page, after completing the Data Mapper Configuration, where they can apply curation routines to the ingested data. As shown in Figure 10, users are given the option of defining one or more curation routines, as well as associated outliers' criteria, for each of the data fields in order to eliminate inaccurate values before they are eventually stored in the platform.

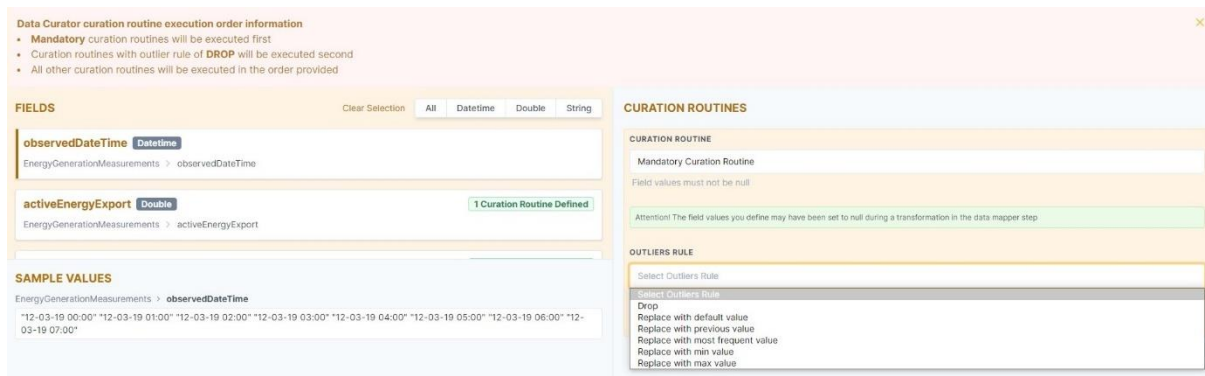


Figure 10 Curation Routines definition

Afterwards, the TwinERGY CDMP users can review the curation routines defined for each and every data field once the Data Curator configuration is finished, and then they can complete the curation process.

3.2 Data Storage Service

The Data Storage service of the TwinERGY Core Data Management Platform provides robust measures and multiple indexing approaches to suit the demand for trustworthy data storage and indexing. The Data Storage Service is responsible for the effective and reliable storing of a wide range of data, as well as the metadata that goes with it. Depending on the type of data stored in the TwinERGY CDMP and how it is accessible when it comes to data storage, different storage and indexing capabilities are intended to fulfil different needs. At the same time, suitable metadata is collected in order for all TwinERGY modules to access it. This service also stores log-related data for the TwinERGY Core Data Management platform's operation and usage, such as users and any administrative data required to keep the TwinERGY CDMP up and running.

3.2.1 Data Store

Data Store is the final stage of a successful data ingestion job. At this point, TwinERGY CDMP users are required to provide a title for the dataset and a brief description of the data that will be saved in the platform, as shown in Figure 11.

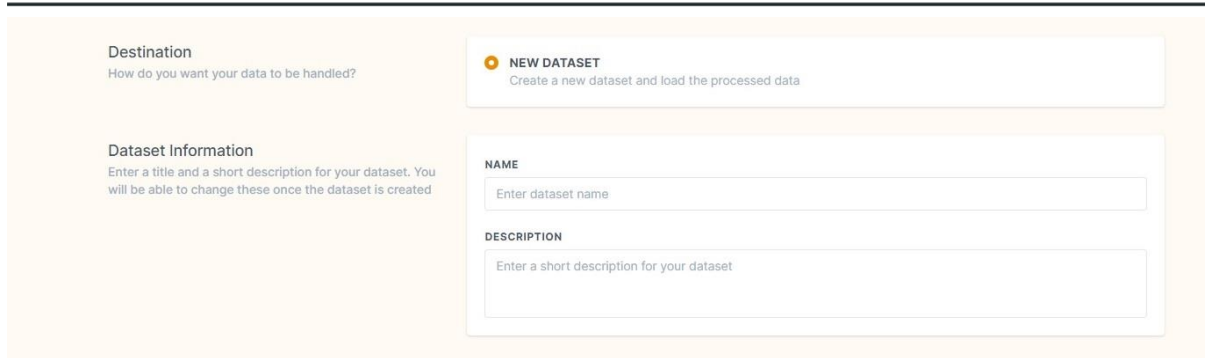


Figure 11 Data Store Configuration

Accordingly, the users of the platform are notified that the data ingestion job is complete after providing all necessary information about the dataset to be stored in the TwinERGY Core Data Management Platform, and they are redirected to the data ingestion job page, as shown in Figure 12, where they can find all the data ingestion jobs initiated as well as their respective completion status.



Data Ingestion Jobs		+ Create
PV Generation	COMPLETED	
<small>TwinERGY User</small> <small>Updated on Mar 2, 2022</small>		
Weather API Athens	CONFIGURATION, DATA MAPPER	
<small>TwinERGY User</small> <small>Updated on Mar 2, 2022</small>		

Figure 12 Data Ingestion Jobs overview and completion status

3.3 Metadata Editor

In the TwinERGY Core Data Management Platform, any outcome of a data ingestion job is preserved as a dataset, therefore platform users must specify a complete profile of the dataset. Platform users are prompted to give a title for the dataset and a description of what it contains after heading to the Datasets tab on the top navigation bar, as depicted in Figure 13. When completing the dataset profile, users are also asked to define any applicable tags.

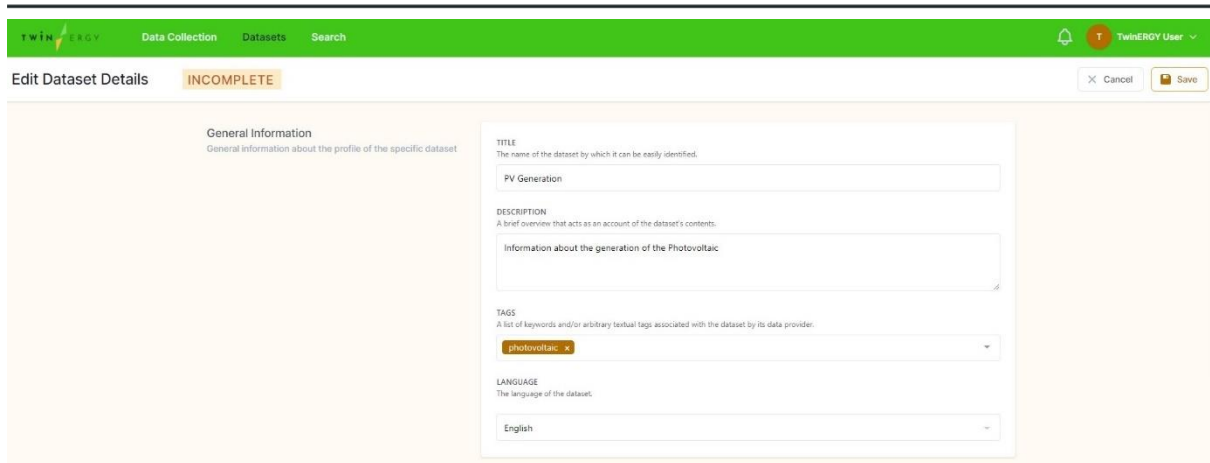


Figure 13 Dataset's Metadata Editing

Information about the dataset's coverage and granularity, as well as specifics about the temporal coverage, spatial coverage, temporal resolution, and spatial resolution units of the data are also required, in order to delineate the type of dataset, the format of the dataset to which the data are available, the dataset's language, and the dataset's temporal coverage, spatial coverage, temporal resolution, and spatial resolution units, as depicted in Figure 14.

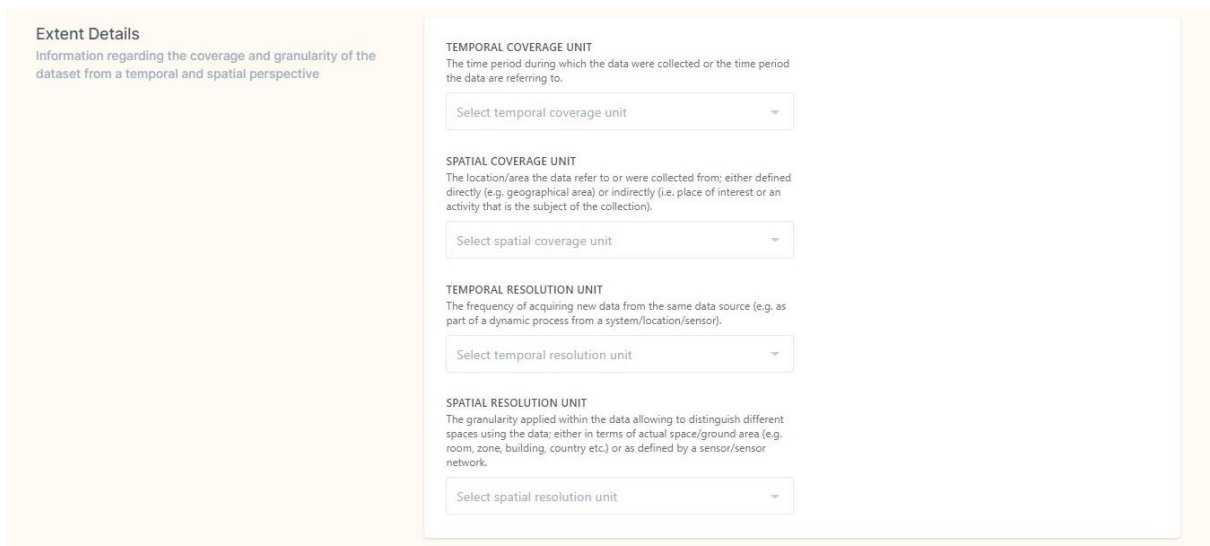


Figure 14 Provision of information on the granularity and coverage of the dataset

As part of the metadata editing process, specific access policies per dataset can be applied, which is covered as a functionality in the next chapter, under Access Policies Controller section.

4. Data Security Service

The TwinERGY CDMP users' data security and privacy concerns about data that will be ingested and handled in the TwinERGY Core Data Management Platform are addressed by the Data Security Service. By allowing users to define straightforward and adaptable access routines that restrict access requests to their data on the platform, the Data Security Service helps users gain confidence in the TwinERGY CDMP. Access policy routines for each dataset can be designed using the Access Policies Controller functionality to maximize effectiveness. Users can establish advanced access policy routines for their datasets using a graphical user interface. The routines are preserved, and the user can make changes to them right away using the provided interface.

4.1 Access Policies Controller

The visibility levels and access policy routines for the corresponding datasets can be configured by TwinERGY CDMP users. By choosing visibility levels, users can choose whether the dataset is for: i) Private access (access to the dataset is allowed only provided access policy routines are followed) or ii) General access (Free access to the dataset, no requirement for access policy routines to be met), as depicted in Figure 15.

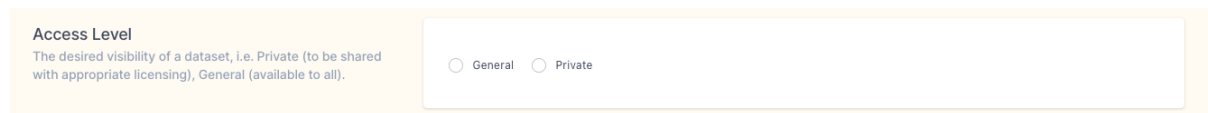


Figure 15 Access Level Definition

The necessary access regulations, as well as the relevant approach (Allow-all) and the inclusion of certain exceptions, must be configured if the access level is set to Private, as shown in Figure 16. To add exceptions, platform users must select a user parameter, a condition (such as equal, not equal, etc.), and the value of the parameter.

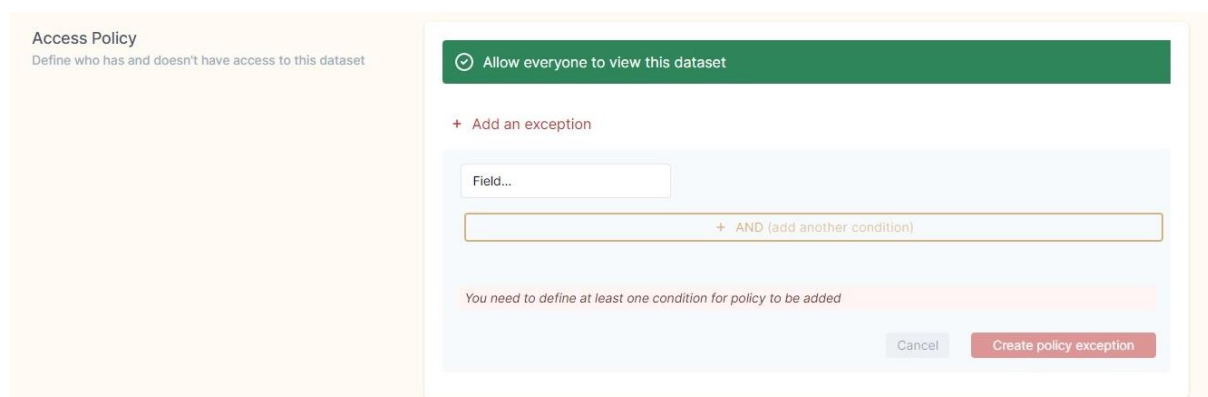


Figure 16 Access Policies Definition

5. Platform Management Service

The Platform Management Service in TwinERGY's platform is critical because it establishes the means and processes for users to register securely and reliably on the platform. Users are provided access to the data, they are eligible to use through proper authentication and safety methods. The Identity Manager functionality represents identity provider responsibilities such as creating and managing identification information for those who are authorized to access the TwinERGY CDMP, as well as providing authentication and authorization services to restrict access to approved users, as described in Section 2. TwinERGY Core Data Management Platform) of this document. With the introduction of a user-friendly data search that enables for different search options, platform users are able to search for data using the Search & Retrieval Manager functionality. Additionally, authorized apps are able to use the TwinERGY Open APIs to configure data retrieval from a single dataset when configuring APIs for data retrieval. Filters, which are represented by API request parameters, and the selection of specific data fields are used to fine-tune the delivered results.

Finally, the Notifications Handler functionality provides platform users with real-time updates on the progress of a data ingestion job's execution (successful or unsuccessful). They can also look into various notifications and respond to them, as well as delete them if necessary.

5.1 Search & Retrieval Manager

The functionality is critical for TwinERGY's Core Data Management Platform, as it allows users to search for and discover relevant data, determine and define which of the available data is crucial, and lastly, see a clear and comprehensive overview of the results. After accessing and clicking on the appropriate tab in the platform's top navigation bar, users of the TwinERGY CDMP can see a list of the datasets they possess. They are given the necessary filtering capabilities to filter the datasets according to their data type. It's worth noting that the platform users can choose from datasets that have been published by them or by other users, as illustrated in Figure 17.

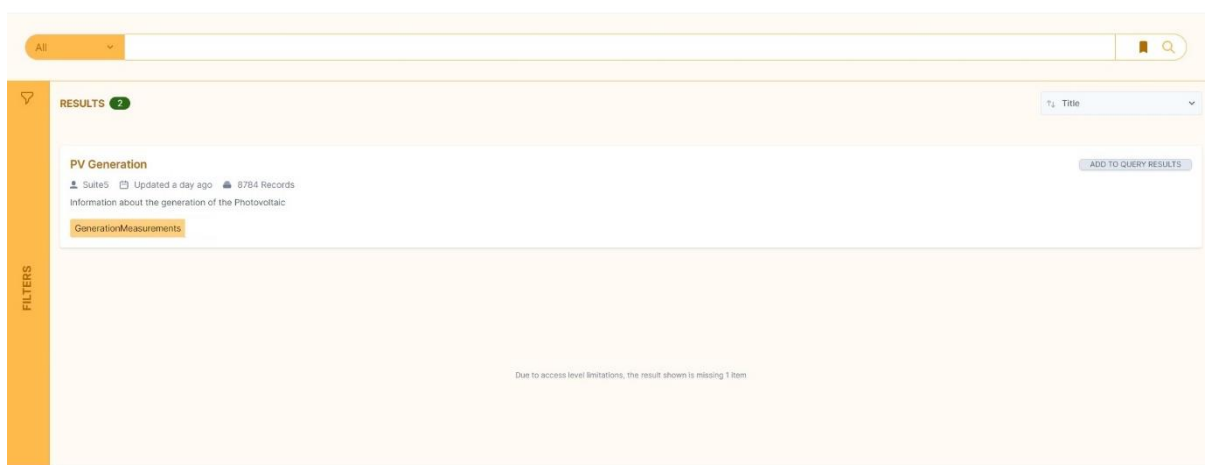


Figure 17 Retrieval of datasets

The users of the platform can also create queries utilizing a flexible free-text search and data filtering, providing them more options in how they find and search for data within the TwinERGY Core Data Management Platform. The platform's users can look for data that is relevant to their needs, explore the results, and go further into the data to find eligible candidates for retrieval. The options for retrieval must be defined through APIs, with the choice of the concepts that a user wishes to acquire from each dataset. Furthermore, concepts that are utilized as query parameters to filter query results must be defined. The retrieval configuration ends with instructions on how to utilize the TwinERGY APIs to acquire the retrieval results. To that purpose, authentication instructions are included alongside the endpoints (i.e., for GET and POST methods).

5.2 Notifications Handler

Users of the TwinERGY Core Data Management Platform get relevant notifications about the progress and current status of their data ingestion jobs, as depicted in Figure 18.

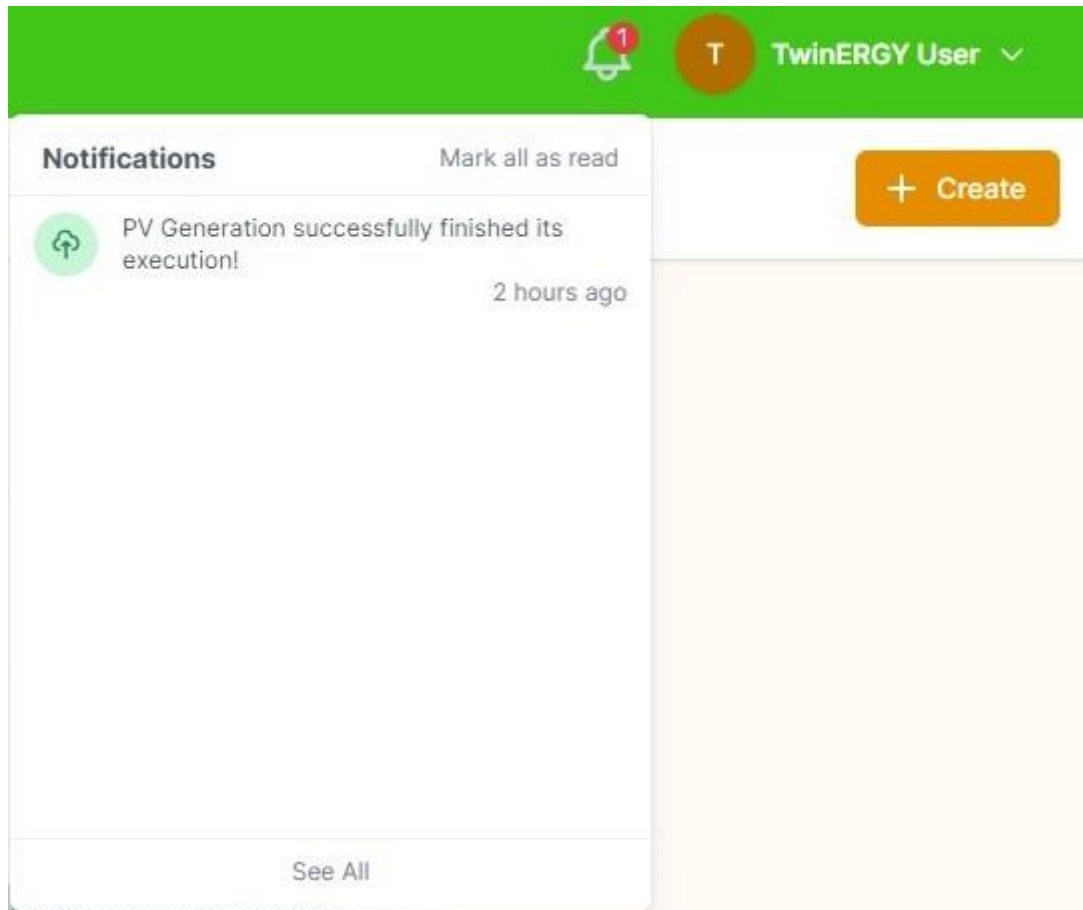


Figure 18 Notifications on ongoing/finished data ingestion jobs

6. Conclusions

The Beta Release of the TwinERGY Integrated Platform, as well as the services that constitute the platform (Data Collection, Data Security, Data Storage and Platform Management), are described in Deliverable 5.4. The current state of the platform's services, as well as the range of the functionalities provided to the TwinERGY CDMP users, are also assessed. In particular, this deliverable elaborated on:

- The platform's data ingestion process (through direct file uploading and APIs), the mapping with the TwinERGY CIM, and data processing routines definition during this process.
- The Data Security Service, which is responsible for addressing the platform users' data security and privacy concerns regarding the data that are ingested in the TwinERGY CDMP. Utilizing the functionalities offered by this Service, platform users can establish access policies for the datasets they ingest into the platform, in order to prevent unauthorized access to them.
- The Data Storage Service, which is responsible for addressing the demand of the platform users for reliable data storage and indexing.
- The platform management functionalities introduced within the TwinERGY Core Data Management Platform. Users of the TwinERGY CDMP can edit and modify their personal profile information, as well as change their existing password. They can also look for data that they are allowed to use according to the access policies that have been set up. The users are given the ability to filter the available results, select and use the ones that best suit their needs. Finally, they can be notified about the success or failure of a data ingestion job.

D5.5 "Data Collection, Security, Storage & Management Services Bundles – Release 1.00" [3] will provide a more mature and enriched version of the services in comparison to Deliverable D5.2 "Data Collection, Security, Storage & Management Services Bundles" [4], while D5.6 "TwinERGY Integrated Platform– Release 1.00" [5], will present an enriched version of the functionalities included in the current deliverable, including Data Ingester enhancements to cover data streaming input and the update of data by appending new rows.

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