D3.4 SYNERGY Integrated Platform & Open APIs – Beta Release

Digitising and transforming European industry and services: digital innovation hubs and platforms

Deliverable nº:	**D3.4**
Deliverable name:	**SYNERGY Integrated Platform & Open APIs – Beta Release**
Version:	2.0
Release date:	17/11/2021
Dissemination level:	Public
Status:	Draft
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This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

Document history:

Version	Date of issue	Content and changes	Edited by
0.1	18/01/2021	Template version for DEM deliverables	Suite5
0.2	14/05/2021	Initial D3.3 Table of Contents	MAG
0.3	11/06/2021	Initial contributions to Sections 2, 3, 4	MAG, Suite5, UBITECH
0.4	18/06/2021	Updated contributions to Sections 2, 3, 4, 5	MAG, Suite5, UBITECH, KBIZ
0.5	22/06/2021	Draft section 6	MAG, Suite5
0.6	23/06/2021	Draft circulated for internal review	MAG
0.7	29/06/2021	Updates based on the internal review feedback	MAG, Suite5, UBITECH
1.0	02/07/2021	Final version to be submitted to the EC	MAG
1.1	10/11/2021	Updated version adding the background technologies (Table 3) in Section 2	MAG, Suite5, UBITECH
1.2	15/11/2021	Draft circulated for internal review	MAG
2.0	17/11/2021	Final version to be submitted to the EC	MAG

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Deliverable beneficiaries:

WP / Task	WP / Task	WP / Task
WP3 / T3.2-T3.5	WP5 / T5.1-T5.4	WP7 / T7.1-T7.4
WP4 / T4.1-T4.5	WP6 / T6.1-T6.4	WP8 / T8.1-T8.4

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Abbreviations and Acronyms

Acronym	Description
AI	Artificial Intelligence
API	Application Programming Interface
CIM	Common Information Model
CSV	Comma-Separated Values
DL	Deep Learning
DLT	Distributed Ledger Technologies
DoA	Description of Action (annex I of the Grant Agreement)
DCJ	Data Check-in Job
JSON	JavaScript Object Notation
ML	Machine Learning
OPE	On-Premise Environment
SASL	Simple Authentication and Security Layer
TSV	Tab-Separated Values
XML	Extensible Markup Language
WP	Work Package

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Executive summary

This document D3.4 “SYNERGY Integrated Platform & Open APIs – Beta Release” presents the beta release of the SYNERGY Integrated Platform that integrates the beta release of the services bundles developed under WP3 “End-to-end Interoperable Big Data Management Platform”, and WP4 “Big Data Analytics and Data Sharing Mechanisms”, in order to deliver a seamless user experience. These services bundles include the Data Collection Services Bundle, the Data Security Services Bundle, the Data Sharing Services Bundle, the Data Matchmaking Services Bundle, the Data Analytics Services Bundle, the Data Governance Services Bundle, the Data Storage Services Bundle, and the Platform Management Services Bundle.

The purpose of this deliverable is to document the functionalities of the beta version of the SYNERGY Integrated Platform that brings added value to the different electricity data value chain stakeholders for efficient data management, trusted data sharing and insightful data analytics. To this end, the set of core functionalities that are offered by the SYNERGY Integrated Platform are described from a user-oriented perspective across three core user journeys: (a) the data check-in user journey that describes the process that data asset providers need to follow to make their assets available in the SYNERGY platform; (b) the data search and acquisition user journey which describes the process of searching, exploring, and acquiring data assets (that belong to other organizations) through the SYNERGY Data & AI Marketplace; and (c) the data analytics user journey that describes the workflow of designing data analytics pipelines and their execution, in order for the data asset providers / consumers to gain valuable insights regarding their own and/or acquired data assets. Moreover, the beta version of the SYNERGY Platform enables organization-based access, prepares the ground for single sign-on functionalities with the SYNERGY energy apps and allows the lifecycle management of the SYNERGY Common Information Model (CIM).

The current deliverable presents the Beta version of the SYNERGY Integrated Platform that provides the foundations for the implementation of the upcoming versions. Towards this end, additional refinements and enhancements will be analysed and introduced as needed in release 1.00 (expected on M24), according to the SYNERGY integration plan and requirements, as well as to the feedback that will be collected by the SYNERGY energy apps (in WP5-WP7), the demonstration activities (in WP8), and the living lab activities (engaging external stakeholders) in WP9.

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1 Introduction

1.1 Purpose of the document

The SYNERGY Deliverable D3.4 "SYNERGY Integrated Platform & Open APIs – Beta Release" accompanies the beta release of the SYNERGY Integrated Platform and intends to document its functionalities from a user-oriented perspective. The SYNERGY Integrated Platform is mainly delivered under task T3.5 "Platform and Services Bundles Continuous Integration and SYNERGY Open APIs Delivery", in collaboration with tasks T3.2 "Platform Backbone Infrastructure, On-Premise and Secure Experimentation Playground Data Containers Development", T3.3 "Core Big Data Ingestion, Curation and Management Services", T3.4 "Data Assets Security, Encryption and Privacy Mechanisms", T4.1 "Big Data Analytics Workbench and Jobs Execution Engines", T4.4 "Blockchain-enabled, Trusted Multi-Party Data Sharing Services", and T4.5 "Big Data Exploration and Matchmaking Services". The documentation presented in D3.4 focuses on the end-to-end, integrated functionalities delivered through the different data services bundles, namely the Data Collection Services Bundle, the Data Security Services Bundle, the Data Sharing Services Bundle, the Data Matchmaking Services Bundle, the Data Analytics Services Bundle, the Data Governance Services Bundle, the Data Storage Services Bundle, and the Platform Management Services Bundle. Specifically, this deliverable focuses on providing a thorough description of the workflows and their corresponding functionalities supported by the beta release of the SYNERGY Platform, and any other additional platform functionality that was developed under WP3 "End-to-end Interoperable Big Data Management Platform" and WP4 "Big Data Analytics and Data Sharing Mechanisms" as reported in the beta release of all services bundles that was documented in the SYNERGY Deliverables D3.2 and D4.1. Essentially, this documentation provides a detailed step-by-step explanation of the various developed platform functionalities and associated workflows supported in the beta release of the SYNERGY Integrated Platform & Open APIs.

1.2 Scope of the document

The scope of this deliverable is to document the beta release of the SYNERGY Integrated Platform, by building on the initial, planned functionality of the alpha version (documented in the SYNERGY Deliverable D3.3), and by introducing the on-demand APIs that provide either full access or access to selected data assets that can be legitimately uploaded or retrieved by external legacy systems of the

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energy stakeholders or other third parties, according to their needs. More precisely, the scope of this document is:

- To present the beta version of the SYNERGY Integrated Platform including a thorough description of the platform's core functionalities. These functionalities are described by three different core user journeys namely: (a) the data check-in user journey that denotes the process of uploading data assets to the platform; (b) the data search and acquisition user journey that involves any process related to data search, exploration and acquisition; and (c) the data analytics user journey that describes the process of creating and executing data analytics pipelines and visualizations to gain valuable insights from certain data assets.
- To present the additional functionalities that are provided along with the core platform's functionalities, to support different tasks related to the common information model lifecycle management, user and organization profile management, and wallet creation.
- To provide description regarding the open APIs that are customized per stakeholder and data asset and delivered along with the SYNERGY Integrated Platform beta release. The process of generating customized, open APIs will be available to SYNERGY stakeholders to support their energy-related applications that are to be developed.

The beta version of the SYNERGY Integrated Platform provides a well-documented description of the platform functionalities designed and developed under WP3 and WP4, and described in D3.2 "Data Collection, Security, Storage, Governance & Management Services Bundles – Beta Release", D3.3 "SYNERGY Integrated Platform – Alpha, Mock-ups Release", and D4.1 "SYNERGY Data Analytics, Sharing & Matchmaking Services Bundles – Beta Release". Moreover, the development of the SYNERGY Integrated Platform is properly aligned to the technical requirements and use cases of the SYNERGY project as documented in D2.1 "End-user and Business requirements analysis for big data-driven innovative energy services and ecosystems", as well as the SYNERGY Architecture defined in D2.6 "SYNERGY Framework Architecture including functional, technical and communication specifications v1".

1.3 Structure of the document

The structure of the remainder of this document is organized as follows:

- Section 2 provides a high-level view of the SYNERGY Integrated Platform, describing the main components and services bundles that are already integrated within the platform.

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- Section 3 presents the data check-in user journey that guides the energy data value chain stakeholders, acting as data asset providers, through the data collection and management functionalities including both the design and the execution phases.
- Section 3 presents the data search and acquisition user journey that guides the energy data value chain stakeholders, acting as data consumers, through the search and acquisition functionalities that are available in the SYNERGY Data & AI Marketplace.
- Section 4 presents the data analytics user journey that the SYNERGY Integrated Platform offers to the energy data value chain stakeholders, acting as data providers or consumers, for designing and executing data analytics pipelines in order to gain valuable insights and visualizations for a particular data asset.
- Section 5 presents all the additional functionalities that are provided along with the core functionalities of the SYNERGY Integrated Platform. These functionalities support various management mechanisms for platform's users, organization profiles, and the lifecycle of the common information model.
- Section 6 summarises the overall integration and support approach followed in the SYNERGY Platform.
- Section 7 concludes this deliverable and provides future steps that are to be followed in the project.
- Section 8 includes the list of relevant references.

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2 SYNERGY Beta Platform at a Glance

In accordance with the integration plan that was presented in D3.3, the SYNERGY Integrated Platform on its beta release has delivered the planned functionalities for the Cloud Platform (including the Secure Experimentation Playgrounds that are spawn per organisation) and the Server On-Premise Environment. The core workflows concerning data check-in, data search and sharing, and data analytics, are supported as described in the SYNERGY Integrated Platform Alpha Release (in D3.3) and the beta release of the various Data Services Bundles (as described in D3.2 and D4.1). An overview of the core functionalities associated with each services bundle is depicted in Figure 1. The features delivered in the beta release appear as underlined in the figure.

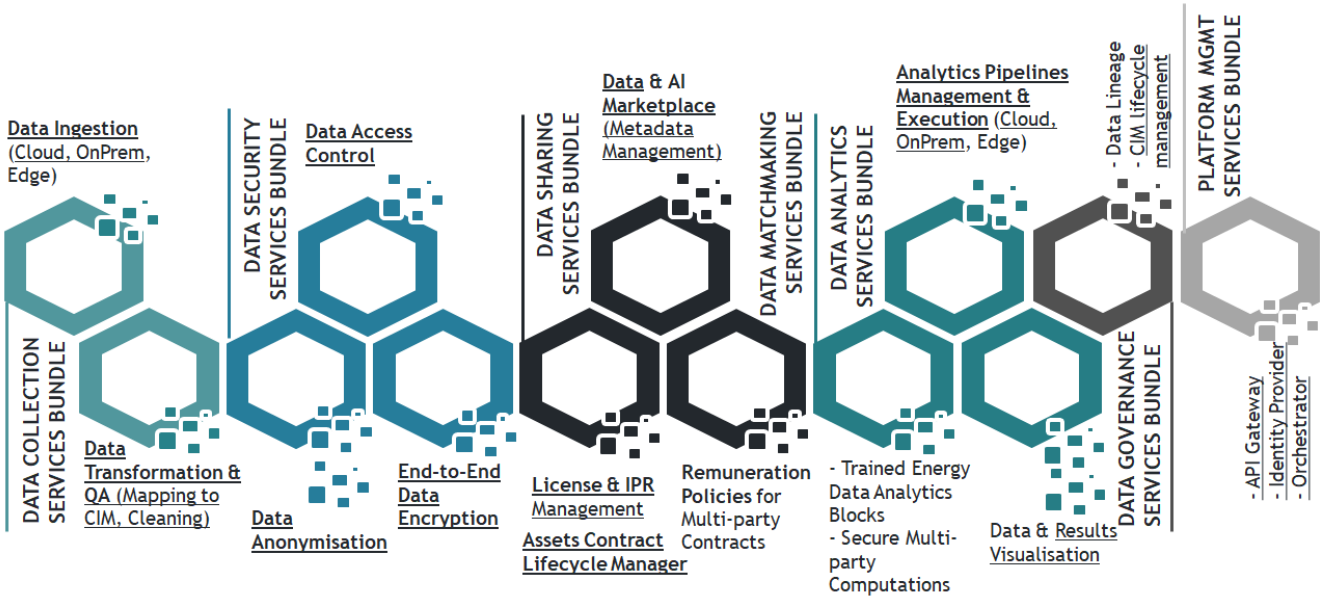

Figure 1: SYNERGY Services Bundles

In more detail, the main functionalities delivered through the SYNERGY Beta Platform release towards the different electricity data value chain stakeholders who at any moment may assume the role of data asset providers and / or data asset consumers, are briefly described in Table 1 below.

Table 1: SYNERGY Beta Platform - Delivered Functionalities

Data Collection Services Bundle
✓ Configuration of the data check-in process by the data provider, and its proper execution in the SYNERGY Cloud Infrastructure and / or the Server On-Premise Environment.
✓ Configuration and execution of different data ingestion, mapping and transformation and cleaning services that are invoked as-needed to appropriately handle batch, near real-time (through push and pull mechanisms) and streaming data collection.

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Data Security Services Bundle
✓ Configuration of data anonymization for privacy and confidentiality preservation purposes (from an individual or business perspective).
✓ End-to-end data encryption for securing transfer from the Server On-Premise Environment to the Cloud Platform.
✓ Enforcement of access policies per data asset to control who can or cannot view a data asset in the SYNERGY Marketplace.
Data Matchmaking Services Bundle
✓ Navigation to the Data Marketplace (as the AI aspects are planned for delivery on M24), search and exploration over datasets that data consumers are eligible to view and potentially acquire (based on the applicable access policies).
✓ DLT-based contract lifecycle management (including preparation, negotiation, and activation) for legitimately sharing datasets in an immutable manner.
Data Analytics Services Bundle
✓ Design of data analytics pipelines, along with different data manipulation configuration, the basic and baseline (pre-trained) machine learning and deep learning algorithms configuration and the visualization/results configuration.
✓ Execution of the designed and configured data analytics pipelines in both the Secure Experimentation Playgrounds and the Server On-Premise Environments.
Data Storage Services Bundle
✓ Storage of: (a) data assets and their accompanying metadata, along with their indexing; (b) data check-in/analysis jobs-related configuration and retrieval-related configuration; (c) algorithms, models and pipelines; (d) contracts' ledger in DLT; (e) log-related information for the SYNERGY platform operation and usage.
✓ Secure, encrypted storage of sensitive data
Data Governance Services Bundle
✓ Coordination and end-to-end management of the data across all layers of the SYNERGY platform.
✓ Lifecycle management of the Common Information Model (presented in D3.1)
Platform Management Services Bundle
✓ Retrieval of user-defined data through custom API endpoints exposed on-demand by the SYNERGY Platform
✓ Management of the underlying platform's resources.
✓ Security and authentication aspects of the platform under the SYNERGY realm. Support for Single Sign-On of the SYNERGY energy apps.
✓ Management of platform notifications.

The status of integration among the different SYNERGY platform components is depicted in the following table. Such interactions essentially remain the same for the Cloud Platform (including the Secure Experimentation Playgrounds that are spawn per organisation) and the On-Premise Environments (in their server and edge edition). Obviously, the integration of the Data Storage Services Bundle has been ensured and it effectively communicates with all components and services in the SYNERGY Platform. It needs to be noted that the beta release integrated the core

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functionalities of the SYNERGY Platform, so added-value functionalities that were not at the core (e.g. recommendations for additional data assets of interest or for electricity data value chain stakeholders who could potentially have/create the requested data asset) were postponed for integration in the next releases (even in cases when the beta release of the specific components had been already available as documented in D3.2 and D4.1).

Table 2: SYNERGY Components Integration Status

Component	Related Components with which there is interaction/integration	Status in SYNERGY Platform Beta Release
Data Collection Services Bundle		
Data Handling Manager	Matching Prediction Engine	Integration Completed
	Access Policy Engine	Integration Completed
	Master Controller	Integration Completed
Matching Prediction Engine	Mapping & Transformation Service	Integration Completed
	CIM Manager	Integration Completed
Data Ingestion Service	Master Controller	Integration Completed
Mapping & Transformation Service	Master Controller	Integration Completed
Cleaning Service	Master Controller	Integration Completed
Data Security Services Bundle		
Anonymisation Service	Master Controller	Integration Completed
Encryption Engine	Master Controller	Integration Completed
	Wallet Manager	Partial Integration
Access Policy Engine	Data Handling Manager	Integration Completed
	Data & AI Marketplace	Integration Completed
	Analytics Workbench	Integration Completed
	API Gateway	Integration Completed
Data Sharing Services Bundle		
Data & AI Marketplace	Query Builder	Integration Completed
	Matchmaking Engine	Integration Completed
	Contract Lifecycle Manager	Integration Completed
Contract Lifecycle Manager	Remuneration Engine	Not Planned for the Beta Release
	Notifications Engine	Integration Completed
	Master Controller	Integration Completed
Remuneration Engine	Wallet Manager	Not Planned for the Beta Release
Wallet Manager	Encryption Engine	Partial Integration
	Remuneration Engine	Not Planned for the Beta Release
Data Matchmaking Services Bundle		
Query Builder	Data & AI Marketplace	Integration Completed
	Matchmaking Engine	Integration Completed
	API Gateway	Integration Completed
Matchmaking Engine	Query Builder	Integration Postponed for the upcoming releases

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	Data & AI Marketplace	Integration Postponed for the upcoming releases
Data Analytics Services Bundle		
Analytics Workbench	Visualization & Reporting Engine	Integration Completed
	Data & AI Marketplace	Integration Completed
	API Gateway	Integration Completed
Visualization & Reporting Engine	Service Secure Results Export Service	Integration Completed
Data Manipulation Service	Master Controller	Integration Completed
Analytics Execution	Master Controller	Integration Completed
Service Secure Results Export Service	Master Controller	Integration Completed
Data Governance Services Bundle		
Master Controller	Access Policy Engine, Contract Lifecycle Manager, Data Ingestion Service, Mapping & Transformation Service, Cleaning Service, Anonymisation Service, Encryption Engine, Data Manipulation Service, Analytics Execution, Service Secure Results Export Service, Data Handling Manager, Analytics Workbench	Integration Completed for all components
Data Lineage Service	Master Controller	Not Planned for the Beta Release
CIM Manager	Matching Prediction Engine	Integration Completed
	Query Builder	Integration Completed
Platform Management Services Bundle		
Resources Orchestrator	Master Controller	Integration Completed
Notifications Engine	Master Controller	Integration Completed
	Contract Lifecycle Manager	Integration Completed
Security, Authentication & Authorisation Engine	All Components & Services	Integration Completed
Platform Analytics Engine	Data Handling Manager, Data & AI Marketplace, Contract Lifecycle Manager	Not Planned for the Beta Release
API Gateway	Access Policy Engine	Integration Completed
	Contract Lifecycle Manager	Integration Completed
	Query Builder	Integration Completed
	Service Secure Results Export Service	Integration Completed

As an Innovation Action project, SYNERGY builds on different background technologies that have been brought by the core technical partners (namely Suite5, UBITECH and MAG). The following table presents the background technologies that have been leveraged in each component and the updates that have been already introduced in the beta release of the SYNERGY Platform. It needs to be noted that the SYNERGY Data Storage Services as well as the SYNERGY Server On-Premise Environment, have been developed from scratch based on open-source technologies (as described in D3.2).

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Table 3: Background technologies for the SYNERGY Components

Component	Background Technologies	Updates Introduced in Beta Release
Data Collection Services Bundle		
Data Handling Manager	Developed from scratch (leveraging the experiences from past big data projects, especially ICARUS, and open-source technologies)	Functionalities described in detail in D3.2
Matching Prediction Engine	Developed from scratch (leveraging the experiences from past big data projects, especially ICARUS, and open-source technologies)	Functionalities described in detail in D3.2
Data Ingestion Service	Developed from scratch (leveraging the experiences from past big data projects, especially ICARUS, and open-source technologies)	Functionalities described in detail in D3.2
Mapping & Transformation Service	ICARUS Mapper	• Refactoring for performance improvements (for big batch data and real-time data) • More sophisticated and domain-specific transformations for data harmonization (e.g. supported datetime formats, timezone conversions, measurement unit transformations) • Collection of mapping service execution metrics and generation of mapping reports
Cleaning Service	ICARUS Cleanser	• Refactoring for performance improvements (for batch data and real-time data) • Inclusion of consistency checks between the data harvesting method and the permitted cleaning rules (per data type) • Collection of cleaning service execution metrics and generation of cleaning reports
Data Security Services Bundle		
Anonymisation Service	ICARUS Anonymiser	• Refactoring for performance improvements (for batch data) • Inclusion of consistency checks between the data harvesting method and the permitted anonymization rules (per data type) • Collection of anonymization service execution metrics and generation of anonymization reports
Encryption Engine	ICARUS Encryption Manager, ICARUS Decryption Manager, ICARUS Key Pair Administrator	• Refactoring for performance improvements in the required encryption/decryption time • Redesigned key exchange process

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Component	Background Technologies	Updates Introduced in Beta Release
Access Policy Engine	Developed from scratch (leveraging the knowledge gained from the ICARUS Policy Manager)	Functionalities described in detail in D3.2
Data Sharing Services Bundle		
Data & AI Marketplace	CYBELE Data Policy and Assets Brokerage Engine	• Redesigned user experience in the SYNERGY Data Marketplace • Extended metadata schema for data assets
Contract Lifecycle Manager	CYBELE Data Policy and Assets Brokerage Engine	• Updated smart contracts structure and mechanism in blockchain (e.g. inclusion of license metadata and payable addresses, effective handling of expired contracts) • Support for transferring acquired datasets between the Secure Experimentation Playgrounds of different organizations
Remuneration Engine	None - To be developed from scratch in future releases	-
Wallet Manager	CYBELE Data Policy and Assets Brokerage Engine	Adopted with minor adaptations, required during the integration activities
Data Matchmaking Services Bundle		
Query Builder	None - Developed from scratch (based on open-source technologies)	Functionalities described in detail in D4.1
Matchmaking Engine	None - Developed from scratch (based on open-source technologies)	Functionalities described in detail in D4.1
Data Analytics Services Bundle		
Analytics Workbench	Suite5 Enterprise Analytics Suite	• Support for pipelines to be configured and executed in Spark MLlib • Support for pipelines to be executed in Server On-Premise Environments • Partially implemented support for pre-trained energy data analytics models blocks – to be fully supported in release 1.00 (and documented in D4.2, D4.3)
Visualization & Reporting Engine	None - Developed from scratch (based on open-source technologies)	Functionalities described in detail in D4.1
Data Manipulation Service	Suite5 Enterprise Analytics Suite	• Support for additional data manipulation functions (e.g. for more advanced datetime transformations and aggregations)
Analytics Execution	Suite5 Enterprise Analytics Suite	• Generation of detailed log for each pipeline's execution • Storage of results as data assets (in order to be eventually available in the SYNERGY Marketplace in the next release)

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Component	Background Technologies	Updates Introduced in Beta Release
Service Secure Results Export Service	None - Developed from scratch (based on open-source technologies)	Functionalities described in detail in D4.1
Data Governance Services Bundle		
Master Controller	None - Developed from scratch (leveraging the experiences from past big data projects, especially ICARUS, and open-source technologies)	Functionalities described in detail in D3.2
Data Lineage Service	None – To be developed from scratch in future releases	-
CIM Manager	None - Developed from scratch (based on open-source technologies)	Functionalities described in detail in D3.2
Platform Management Services Bundle		
Resources Orchestrator	None - Developed from scratch (leveraging the experiences from past cloud projects, especially UNICORN and MATILDA, and open-source technologies)	Functionalities described in detail in D3.2
Notifications Engine	None - Developed from scratch (based on open-source technologies)	Functionalities described in detail in D3.2
Security, Authentication & Authorisation Engine	None - Developed from scratch (based on open-source technologies)	Functionalities described in detail in D3.2
Platform Analytics Engine	None - To be developed from scratch in future releases	-
API Gateway	None - Developed from scratch	Functionalities described in detail in D3.2

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3 Data Check-in User Journey

This section describes the data check-in user journey including the various steps a data asset provider needs to follow for loading data on the SYNERGY Platform. In the data check-in workflow (depicted in Figure 2), the data asset provider starts by creating a new data check-in job, configures the data ingestion process that is responsible to load the data on the SYNERGY Platform, defines the pre-processing rules that are to be applied on the data asset, defines the data asset's metadata and licensing details, and finally executes the data check-in job that triggers the data loading to the SYNERGY Platform.

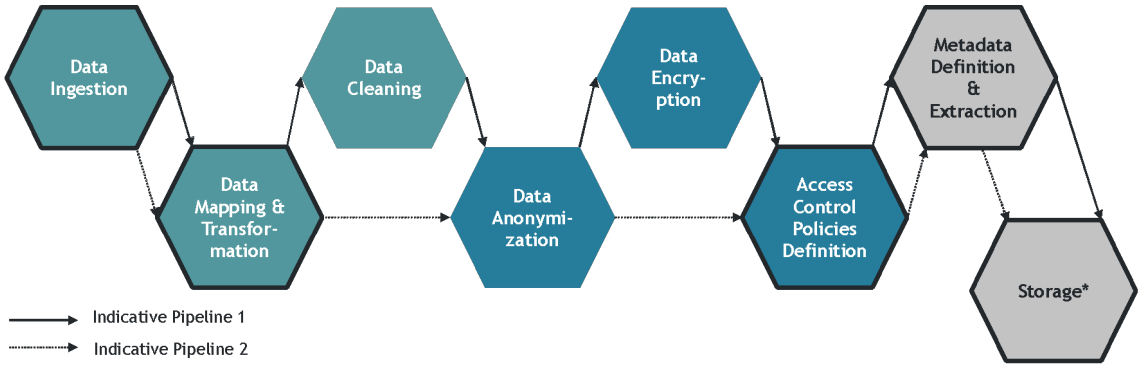

Figure 2: Data Check-in Pipelines

It needs to be noted that there is a distinct separation between the creation and configuration (design) phase of the data check-in job as described in Section 3.1, and the actual execution of the configured data check-in job by the SYNERGY Platform as described in Section 3.3 and 3.4.

3.1 View all Data Check-in Jobs

A summary list including all the created/configured data check-in jobs appears in the Data Check-in Jobs view as shown in Figure 3. The data asset provider may view all the details regarding the data check-in jobs in a list view, including the job status and available actions depending on the job status. The date of creation and the user (within the organization) that has created the data check-in job, as well as the status of execution for each data check-in job, are also presented. In particular, when the data check-in job is already executed, a tick mark, cross mark, or exclamation mark will appear next to the corresponding data check-in step (i.e. Harvester, Mapping, Cleaning, Anonymiser, Encryption, Loader) if the execution for this step was successful, failed, or not processed in case of wrong configuration, respectively, for the steps that are relevant for the specific job. In the case where the

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data check-in job is not executed yet, but instead it is in the queue for execution, then a clock icon will appear denoting an execution pending status.

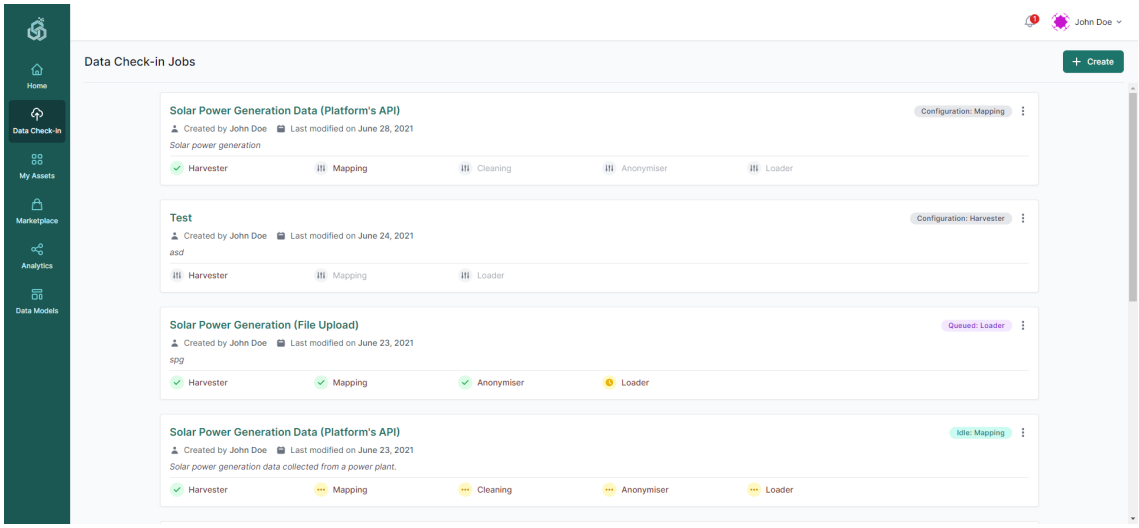

Figure 3: View All Data Check-in Jobs

3.2 Create a New Data Check-in Job

The first step of the data check-in workflow is the creation and configuration of a new data check-in job. The data asset provider may create a new data check-in job by selecting the Create button at the Data Check-in Jobs page which lists all the created data check-in jobs, as depicted in Figure 3. First, the data asset provider needs to provide basic information (i.e., title, and description) about the data check-in job in the Data Check-in Job Details section, as shown in Figure 4. Additionally, the data asset provider needs to select the pre-processing rules, that are to be applied on the loaded data, ranging from Mapping, Cleaning, Anonymiser. It needs to be noted that the selection of the Mapping step activates the selection of the other pre-processing steps (i.e., Cleaning, Anonymisation, Encryption). The final step for the creation of the data check-in job, is to select the environment where the data check-in job is to be executed. In particular, the data asset provider may select either Cloud Execution to run the data check-in job on the cloud, or On-premise Execution to run the data check-in job on-premise through a registered runner. Next, the data asset provider finalizes the creation of a data check-in job by selecting the Create button at the top right part of the page. Finally, the data check-in job is created and shown in the list of Data Check-in Jobs page (as depicted in Figure 3).

The data asset provider can proceed to configure the different pre-processing rules that were selected before. First, it is mandatory to configure the Harvester step that was pre-selected by

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default. The configuration can be done by selecting the appropriate data check-in job from the list, and then by selecting the Harvester option. The Harvester configuration determines the data ingestion method that is to be followed, which sets the way of loading the data on the SYNERGY Platform. As depicted in Figure 5, the data provider may select the data loading method as follows:

- File Upload Method, allowing data asset providers to upload files in different formats (i.e., CSV, JSON, XML, and other formats) containing batch historical and operational data.
- Application's Own (External) API Method, which supports the use of an external API, owned by the data provider or any other third party, for importing the API request results.
- Platform's (Internal) API Method, which allows data uploading to API endpoints provided by the SYNERGY Platform and customized to the data that are to be pushed.
- Platform's (Internal) Kafka PubSub Method, which can be configured to upload streaming data to the Kafka Publish-Subscribe (PubSub) mechanism provided by the SYNERGY Platform.
- Application's Own (External) Kafka PubSub Method, allowing data providers to use their own Kafka PubSub mechanism and grant access to the SYNERGY Platform to collect the streaming data they publish in a specific topic.

By selecting the "Finalize Configuration" button, the corresponding configuration page depending on the selection will appear.

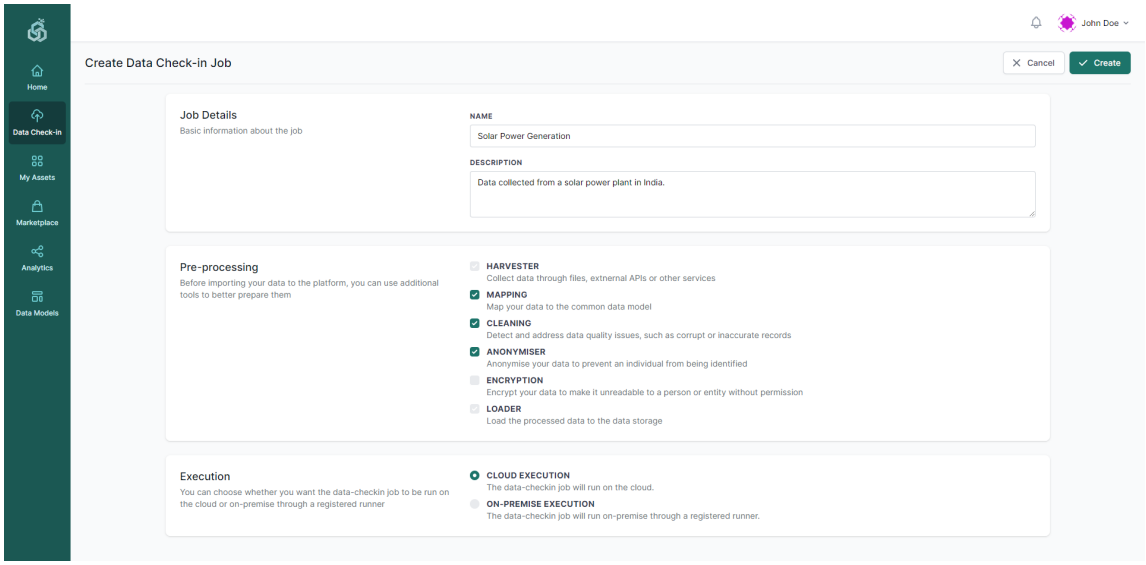

Figure 4: Create a new Data Check-in Job (DCJ)

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3.2.1 Data Ingestion Configuration

3.2.1.1 File Upload Method

Once the data asset provider has selected the data upload option (shown in Figure 5), the Data Ingestion configuration page appears as depicted in Figure 6.

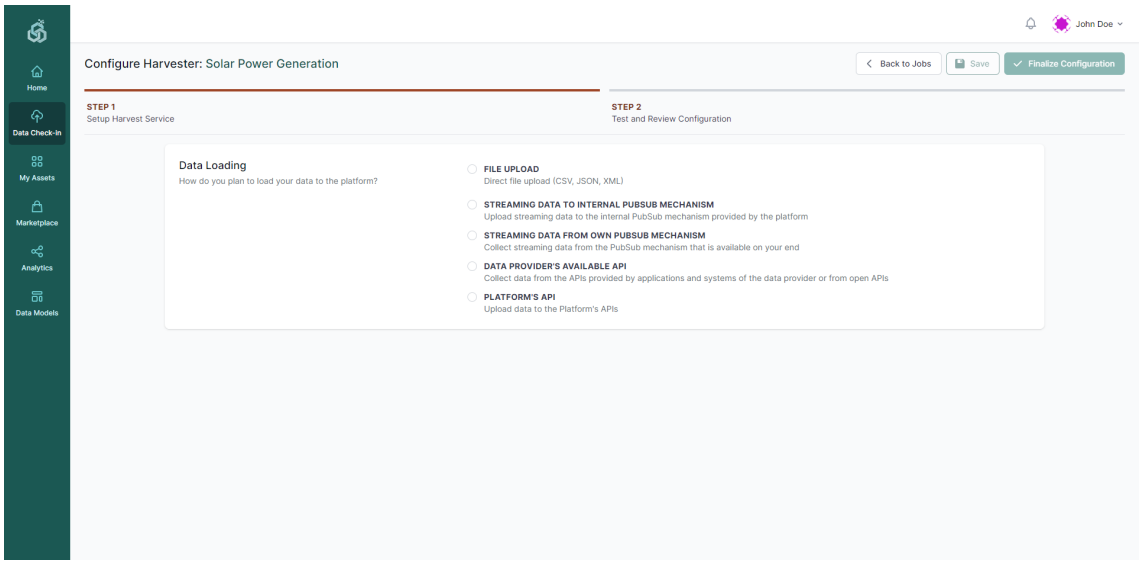

Figure 5: Data loading method

In the configuration page, the file format of the data that are to be uploaded needs to be selected. Following that, the data asset provider should upload a sample file including an indicative number of entries from the whole data asset (applies to CSV, TSV, JSON, and XML files only), and the actual file that is to be uploaded. In the case that the data provider selects not to upload the data directly in

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the cloud, the location of the file where it will be stored locally and retrieved from the On-Premise Environment, needs to be provided accordingly.

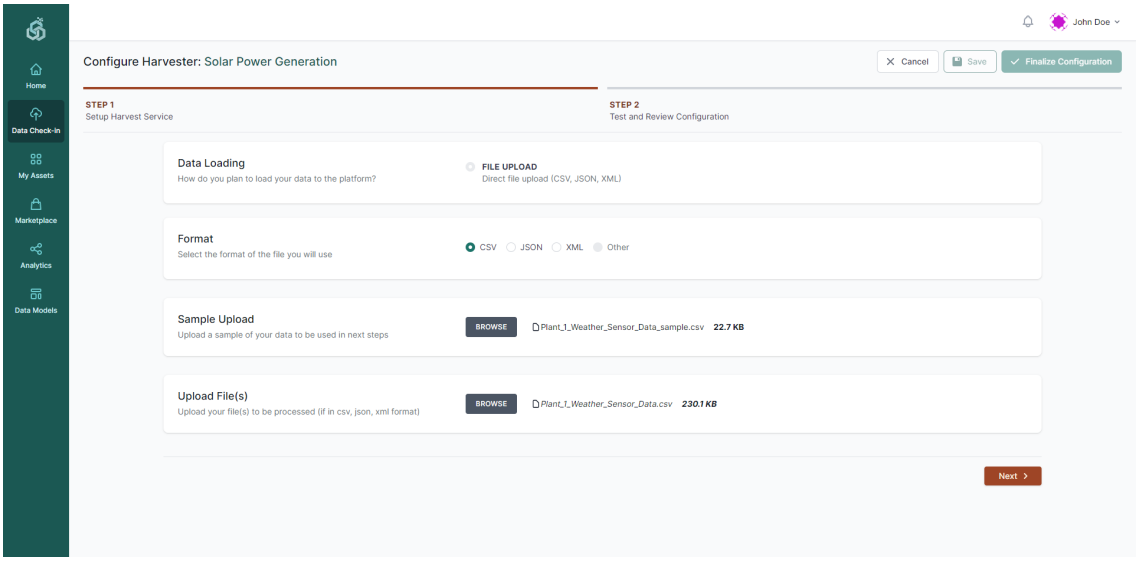

Figure 6: Data Check-in – File Upload Method - Setup Harvest Service (Step 1)

By selecting the Next button, the data asset provider may view the details of the data sample that was uploaded in a tabular view, or tree view for non-flat formats, as depicted in Figure 7. Finally, the data provider may save the configuration provided so far or finalize the configuration button that essentially completes the Harvester configuration.

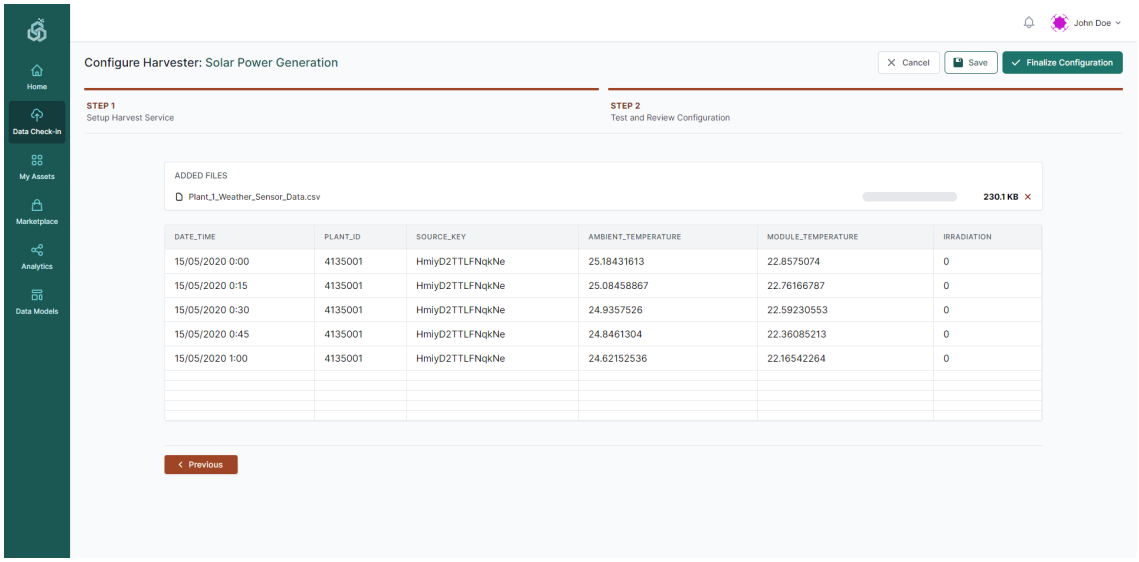

Figure 7: Data Check-in - File Upload Method - Review (Step 2)

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3.2.1.2 Application's own (external) API method

Once the data asset provider has chosen to ingest data from an own (external) API that is exposed by his/her organisation's systems, the corresponding configuration page will appear as shown in Figure 8. Initially, the data asset provider is asked to select the format of the API response (e.g. JSON or XML), and the authentication details regarding the API access policies (e.g. None, if no authentication is needed; Bearer if authentication that involves security tokens is needed; and Custom, if the external API support the use of a custom URL for authentication). Following that, more details need to be provided, depending on the authentication type selection (e.g. for Custom Authentication, the Authentication URL and the Authentication Query Body, in order to retrieve the Access Token, allowing the data asset provider to test the authentication policies inserted, by selecting the Test Login button). Then, the full API path including the base URL, along with the appropriate method (i.e., GET, POST, PUT), need to be inserted. If a POST method is selected, the query body of the request needs to be also provided.

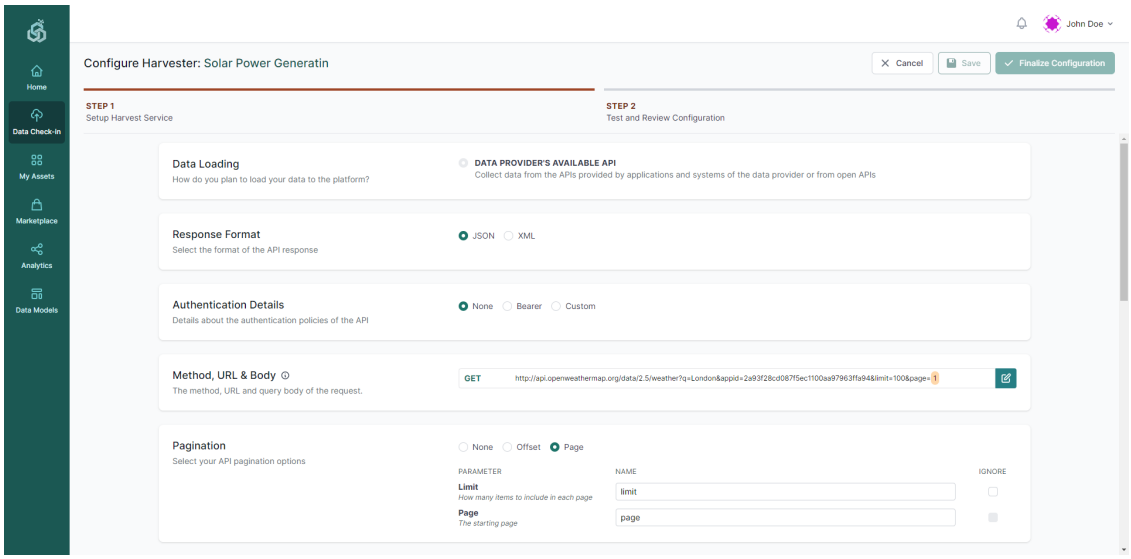

Figure 8: Data Check-in - API (external) – Setup Harvest Service (Step 1a)

Once the full API path is provided, the corresponding request parameters will appear automatically in the Request Parameters section where one can edit them, remove them, or even add new query parameters, as depicted in Figure 9. Different options for pagination of the API responses, such as offset or page, are also provided to define how paginated API responses should be handled. By inserting the API method URL and query body, the corresponding request parameters will appear in the Request Parameters sections, where the data asset provider may also insert additional request parameters. In addition to the request parameters, the data asset provider may also add extra

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headers to the API calls by selecting the Add Header button. It needs to be noted that any request parameter and extra header can be treated as sensitive (that essentially means that it is stored in an encrypted form), depending on the data asset provider's preference.

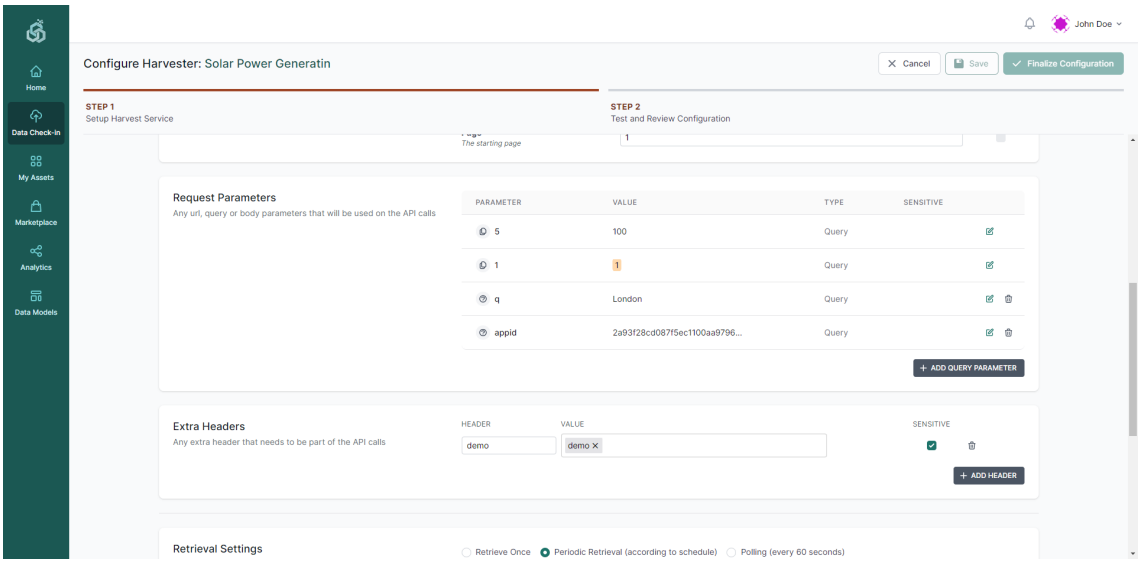

Figure 9: Data Check-in - API (external) – Setup Harvest Service (Step 1b)

Another important step of the external API data ingestion method is to define the retrieval settings regarding the schedule and periodicity of the data ingestion that the SYNERGY Platform should initiate to retrieve data from the specific API, as shown in Figure 10. In particular, the data asset provider may select the start and end date of the retrieval, and its periodicity (i.e., retrieve once, periodic retrieval according to schedule, and polling every 60 seconds). By selecting the periodic retrieval option, the data asset provider can configure the retrieval according to a schedule (or potentially multiple schedules), and the retrieval periodicity (i.e., hourly, daily, weekly, or monthly). The polling retrieval method is configured by default for ingesting data every minute. The next step of this workflow is to set the processing periodicity of the data retrieved, by selecting one of the options: (a) immediately, (b) on an hourly basis, (c) on a daily basis, or (d) on a weekly basis. Finally, the last option of this configuration is to determine the way that errors are handled. Currently there are two options available: (a) No action, and (b) Retry a specified number of retries every 30 seconds, in case that an error has occurred.

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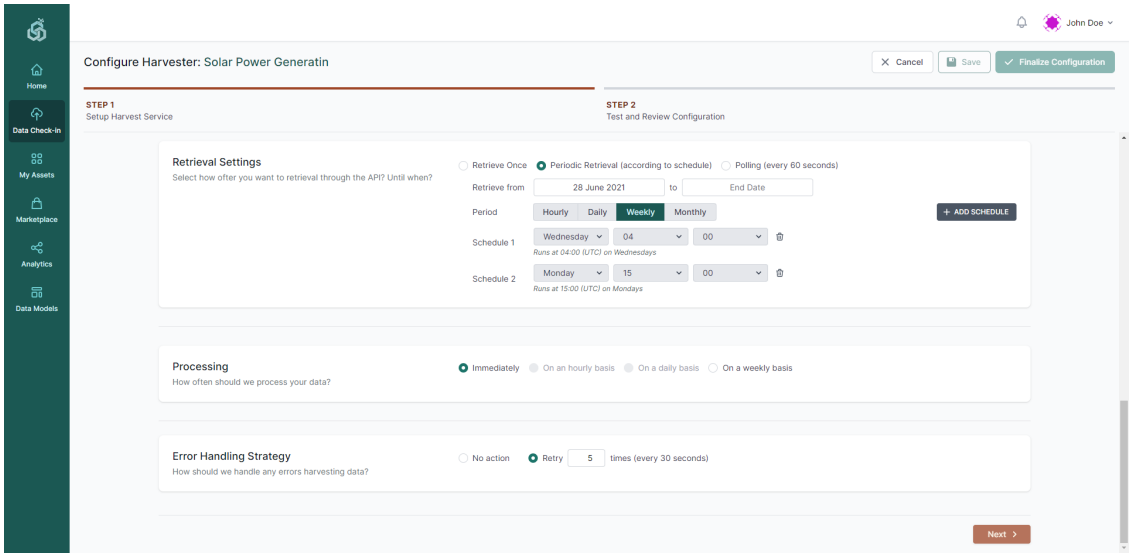

Figure 10: Data Check-in - API (external) – Setup Harvest Service (Step 1c)

By selecting the Next button, the SYNERGY platform will make a call to the API endpoint according to the configuration that has been set. If the API call is successful, the data asset provider comes across the Review step as depicted in Figure 11. During this step, the data asset provider may select the response handling method that determines whether each API response will be handled as a single object and stored as one individual record containing the concepts selected by the data asset provider, or whether each API response should be stored as multiple records that can be separated based on the selected path of the response. Additionally, the data asset provider may insert additional response data, associated with a value and its value type (e.g. static or dynamic). A static parameter added in each record/row of the response data, is a fixed value that does not change each time the API is called, while a dynamic parameter added in each record/row of the response data, contains datetime values that are updated each time the API is called.

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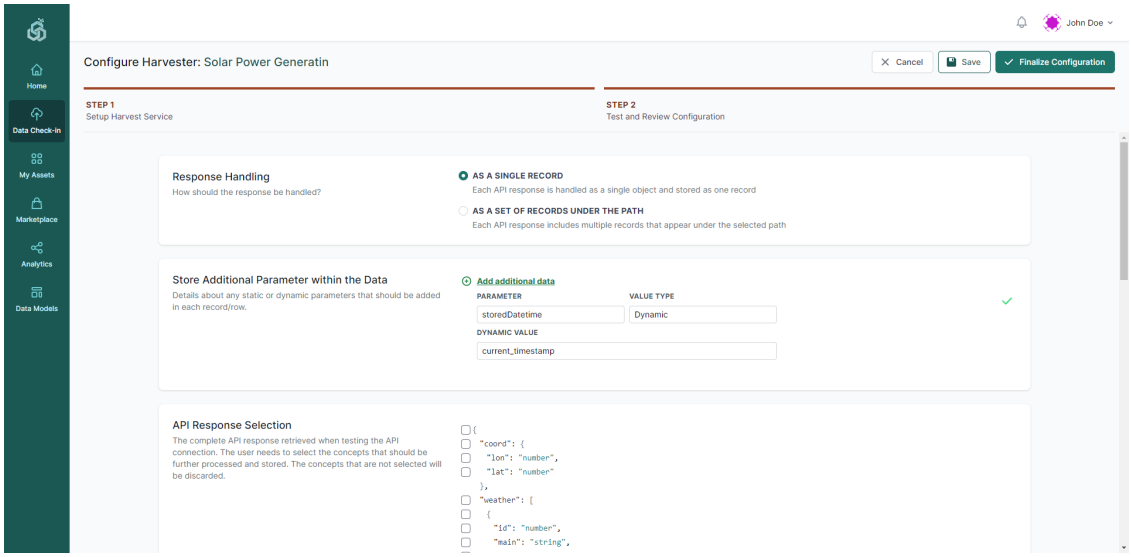

Figure 11: Data Check-in - API (external) – Review (Step 2a)

Finally, the data asset provider needs to review and select the concepts that should be further processed and stored to the SYNERGY platform, while a summary of the API's response that will be permanently stored, will be shown accordingly at the bottom of the page as shown in Figure 12.

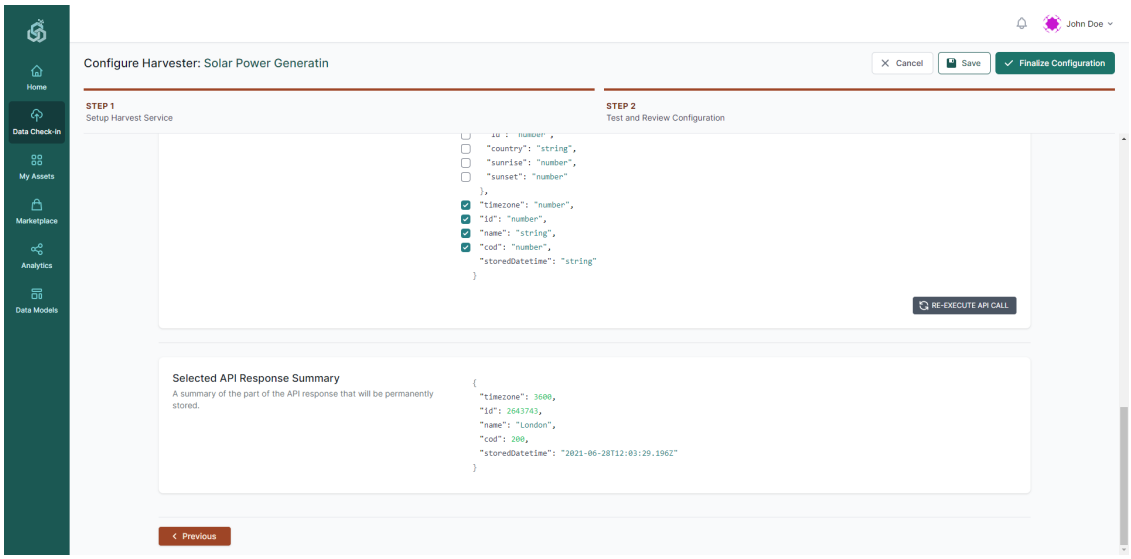

Figure 12: Data Check-in - API (external) – Review (Step 2b)

3.2.1.3 Platform's (internal) API method

Once the data asset provider has selected the Platform's API data harvesting method during the creation of the Check-in Job, its configuration page is shown as Figure 13 depicts. The data asset provider should select the type of the data that are to be uploaded (e.g. text, text and binary). In particular, the data asset provider may choose whether to upload text data (e.g. JSON, or XML) or

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text data along with binary data (including any file format, e.g. JPG, PDF, IFC, etc) through the generated API. In addition to this, the data asset provider needs to upload a sample file containing an indicative number of entries (rows) from the "text" data that will be sent to the SYNERGY Platform's API. Additionally, the data asset provider needs to select the processing periodicity of the data that are to be fetched among the options: (a) immediately, (b) on an hourly basis, (c) on a daily basis, or (d) on a weekly basis. This setting defines the frequency of the processing of the data, that are to be pushed to the SYNERGY Platform.

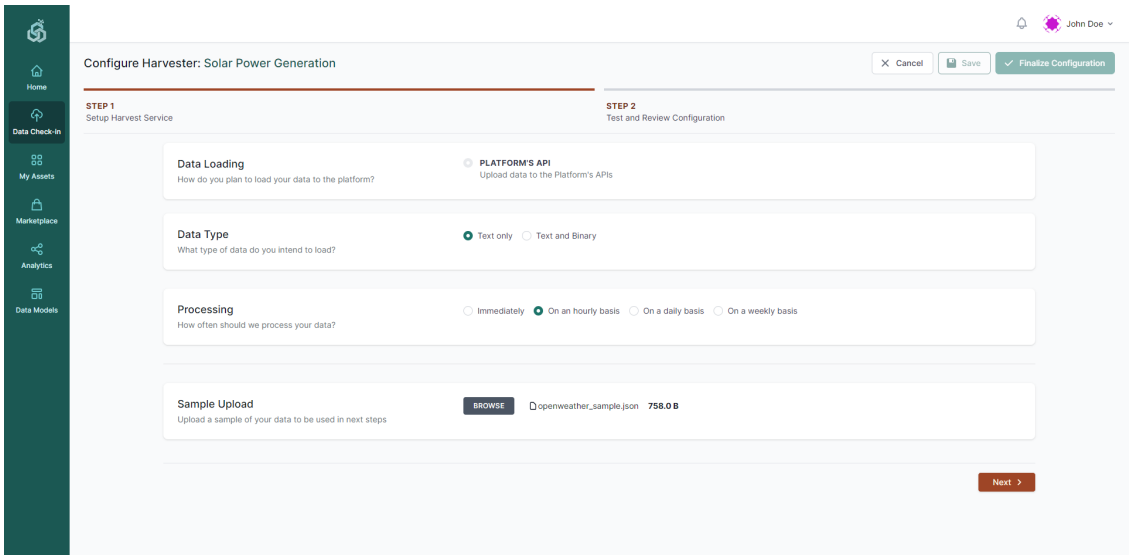

Figure 13: Data Check-in - API (internal) – Setup Harvest Service (Step 1)

During the second step (Test and Review phase) of the Platform's API data harvesting method that is shown in Figure 14, the data asset provider is able to see an auto-generated API endpoint in the SYNERGY platform. However, to use this generated API, the application should be authenticated using an already generated access token that needs to be added into an "X-API-TOKEN" header in the API request. If the application is not authenticated, the data asset provider should generate a new access token (with "upload" scope) by selecting the "generate a new one button" link as shown in Figure 14. Instructions on how to use the POST endpoint are provided accordingly. To upload binary files through the generated API, the data asset provider should select "Multipart/Form data" as the body type of the request, and to include an additional key-value pair (with key name "_uploaded_file" and value the binary file that is to be uploaded) in the request body accordingly. It needs to be noted that one API request can only send one binary file. Finally, the data asset provider may review the details of the configuration and the data sample that was uploaded in the previous step, and select Finalize to proceed to the configuration of next steps of the Data Check-in workflow (as described in Section 3.2.2).

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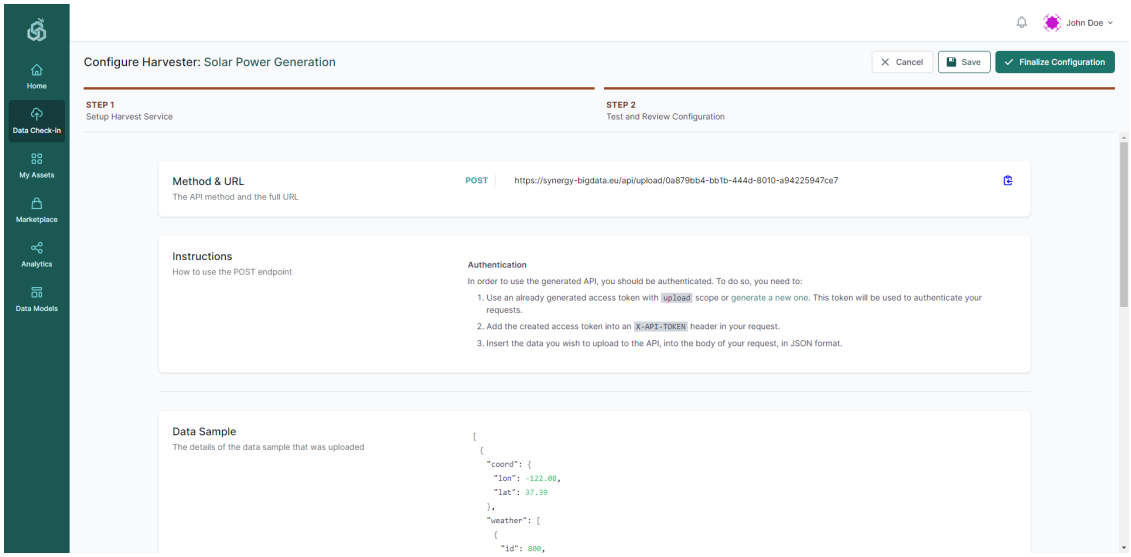

Figure 14: Data Check-in - API (internal) – Review (Step 2)

3.2.1.4 Streaming data to platform's (internal) mechanism

Once the data asset provider has selected to harvest data through the Platform's Kafka PubSub Mechanism, the corresponding configuration page is shown as in Figure 15.

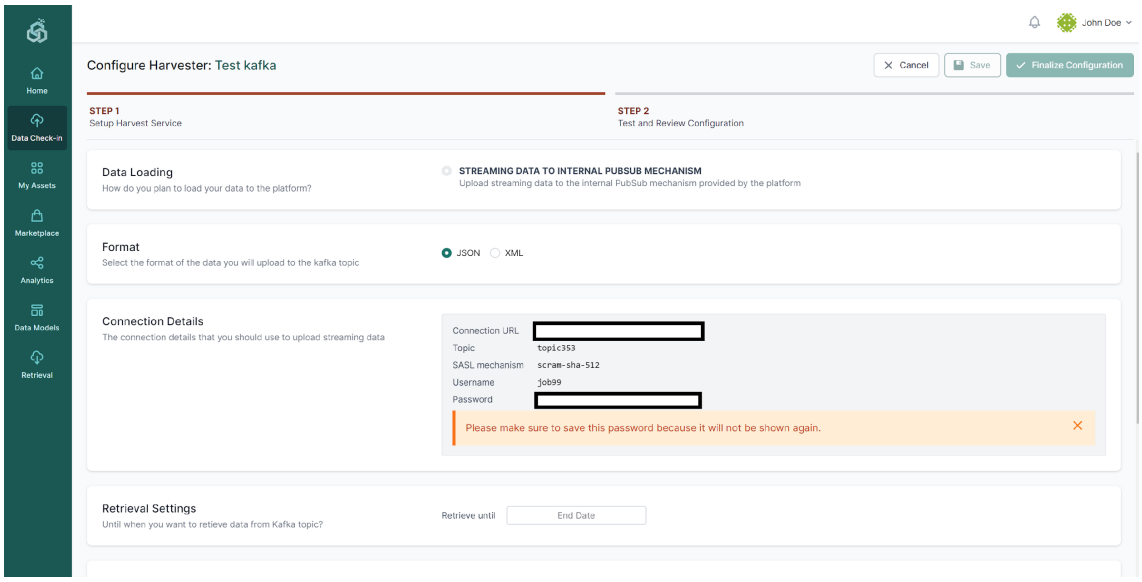

Figure 15: Data Check-in - Streaming data (internal) – Setup Harvest Service (Step 1)

During this configuration, the data asset provider should select the format of the data to be published (i.e., JSON, or XML). Then the data asset provider may view the connection details (i.e., the connection URL that refers to the platform's Kafka PubSub mechanism, the topic name in which the data should be published, the Simple Authentication and Security Layer (SASL) mechanism that is used, and the credentials that the data asset provider should use to publish data to the specific topic).

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The retrieval end date that defines the date that the streaming data retrieval has to be completed, the periodicity that defines how often the data are processed, and the error handling strategy have to be set accordingly. Finally, the data asset provider needs to upload a sample of the streaming data according to the file format selected (i.e., JSON, or XML), in order to proceed to view the sample in the next step.

During the review step, the data asset provider may finalize the harvesting configuration, after reviewing the streaming data structure (in a tree-view), and by selecting the Finalize button as depicted in Figure 16.

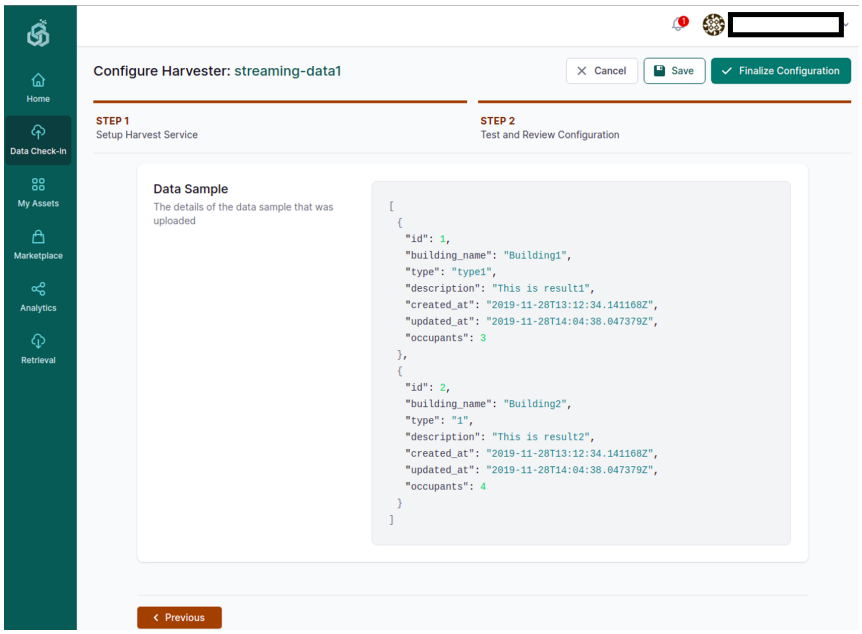

Figure 16: Data Check-in - Streaming data (internal) – Review (Step 2)

3.2.1.5 Streaming data from application's own (external) mechanism

Once the data asset provider has selected to use a Kafka PubSub mechanism provided by an external application (owned by the data provider), the corresponding configuration page for subscribing the SYNERGY Platform to the already published streaming data, as shown in Figure 17 is revealed. Initially, the data asset provider needs to select the format of the streaming data that is published (i.e., JSON, or XML) in the specific topic, and to upload a sample of the streaming data including a few entries from the streaming data. Moreover, the data asset provider shall insert the connection URL of the external Kafka that shall be used by the SYNERGY platform, the topic name to which the data will be published, the SASL mechanism that is used, the credentials that the SYNERGY Platform should use to access the Kafka mechanism and the group id, if applicable.

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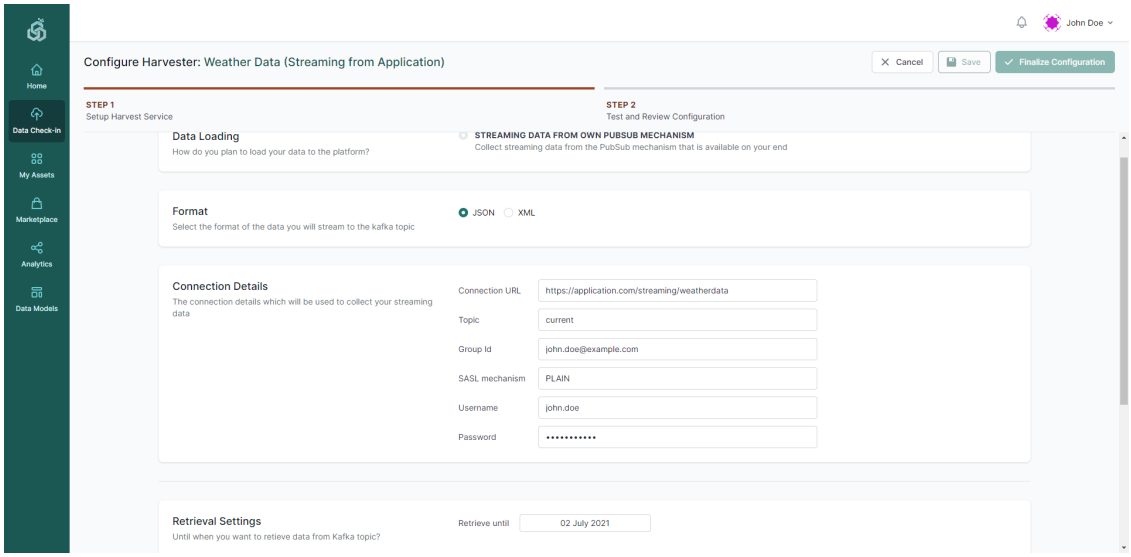

Figure 17: Data Check-in - Streaming data (external) – Setup Harvest Service (Step 1a)

The retrieval end date and the processing periodicity need to be defined as well, as shown in Figure 18. It needs to be noted that the processing periodicity will be by-passed if needed (e.g. if the volume of streaming data is very high or low).

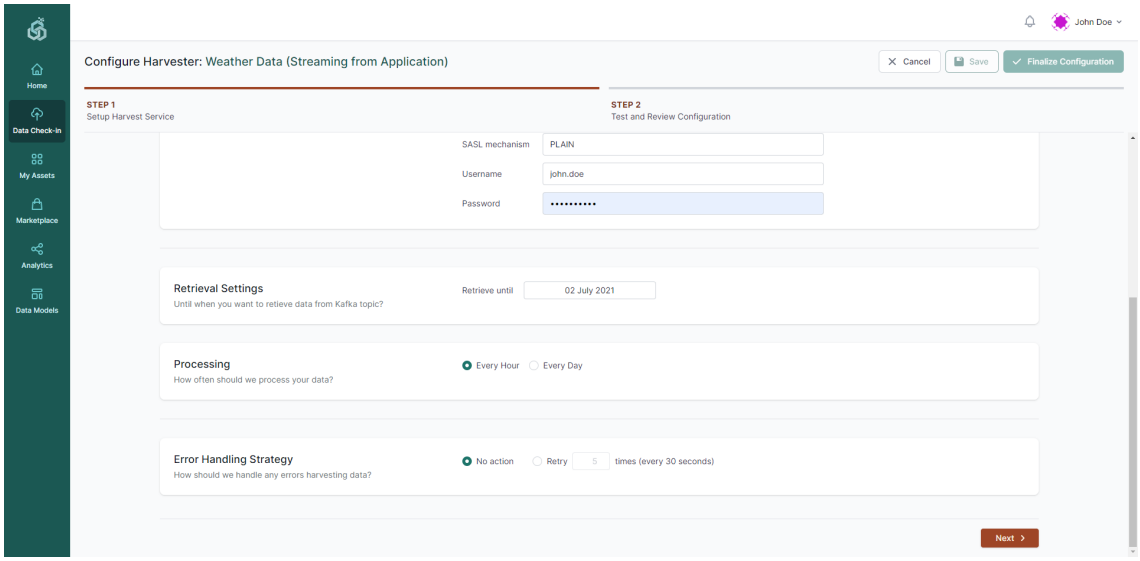

Figure 18: Data Check-in - Streaming data (external) – Setup Harvest Service (Step 1b)

3.2.2 Pre-processing Rules Definition

As mentioned in Section 3.1 which describes the creation of a new data check-in job, the data asset provider is asked to select some pre-processing rules to be applied on the data upon their injection

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to the SYNERGY Platform. The pre-processing rules that are available for selection, as shown in Figure 4, are Mapping, Cleaning, Anonymisation, and Encryption. Although mapping is not a mandatory step, it is strongly encouraged to be selected in order for the data to be mapped to the SYNERGY CIM. In addition, by enabling Mapping, the Cleaning, Anonymiser and Encryption steps also become available for selection, in order to solve data quality issues (e.g. corrupt or inaccurate records), and to anonymise the data to prevent an individual from being identified, respectively. It needs to be noted that the Encryption step is available only if the data asset provider has opted for on-premise execution. This section describes the workflow that a data asset provider needs to follow in order to configure these pre-processing rules, prior to their actual execution which is described in the subsequent Section 3.3.

3.2.2.1 Mapping Configuration

The mapping configuration, provided by the Data Collection Services Bundle as described in Section 2 of D3.2 “Data Collection, Security, Governance & Management Services Bundles – Beta Release”, is divided into three main steps namely the Mapping Info, the Mapping Configuration, and the Mapping Review and Confirmation. In the first step, the data asset provider is asked to select the standard to which the ingested data comply, if applicable, and the main category in which the data refer to, as depicted in Figure 19. Once the data asset provider selects a category, he/she needs to define the most appropriate concept that represents the data that will be uploaded.

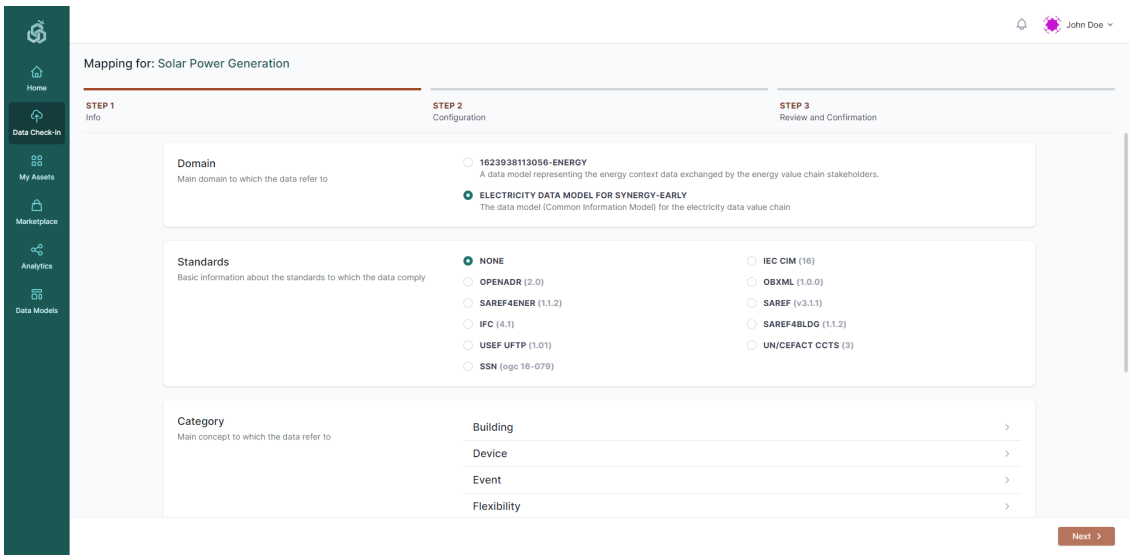

Figure 19: Mapping - Provide Mapping Info (Step 1)

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In the next step, the data asset provider comes across the predictions that the SYNERGY Platform has made about how the source data (from the sample provided in the Data Ingestion step) map to the SYNERGY Common Information Model (CIM) (that has been specified in the SYNERGY Deliverable D3.1) in the Mapping Playground, as depicted in Figure 20.

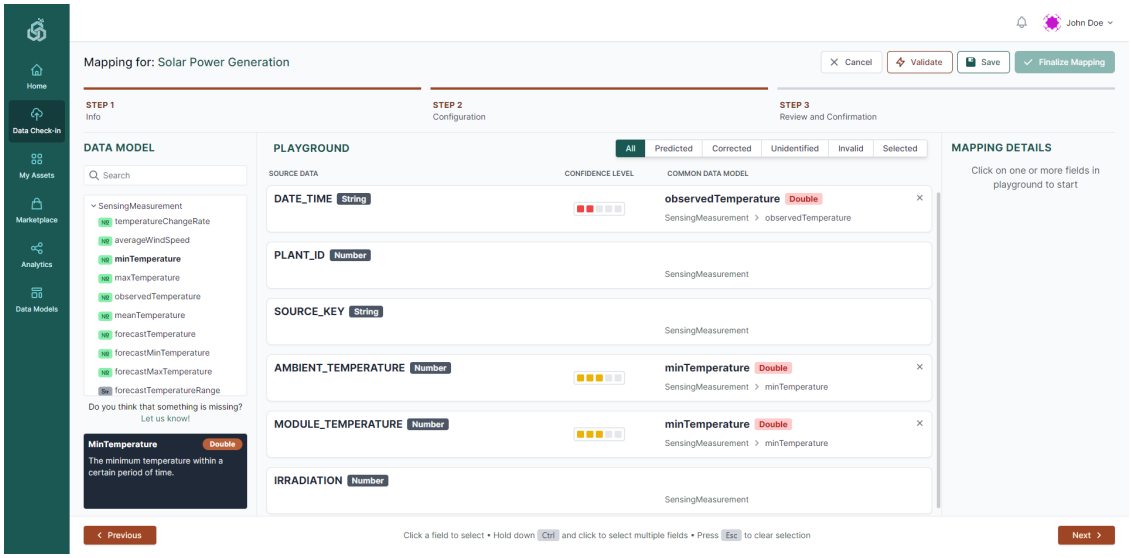

Figure 20: Mapping - Configuration (Step 2a)

These predictions are accompanied by certain confidence levels denoting how much uncertainty there is for a particular field/concept to be correctly predicted and mapped to the corresponding field/concept of the common data model. In case there is no predicted mapping, or the predicted mapping is wrong, the data asset provider can search for a particular field/concept under the Data Model section located at the left side, as shown in *Figure 20*, while a short description of the selected field/concept appears at the bottom left side. Additionally, the data asset provider can propose a new field/concept in case the CIM has not already foreseen it, by selecting the "Let us know" link which pop-ups a new window for proposing a new field/concept to be added in the common data model, as shown in Figure 21.

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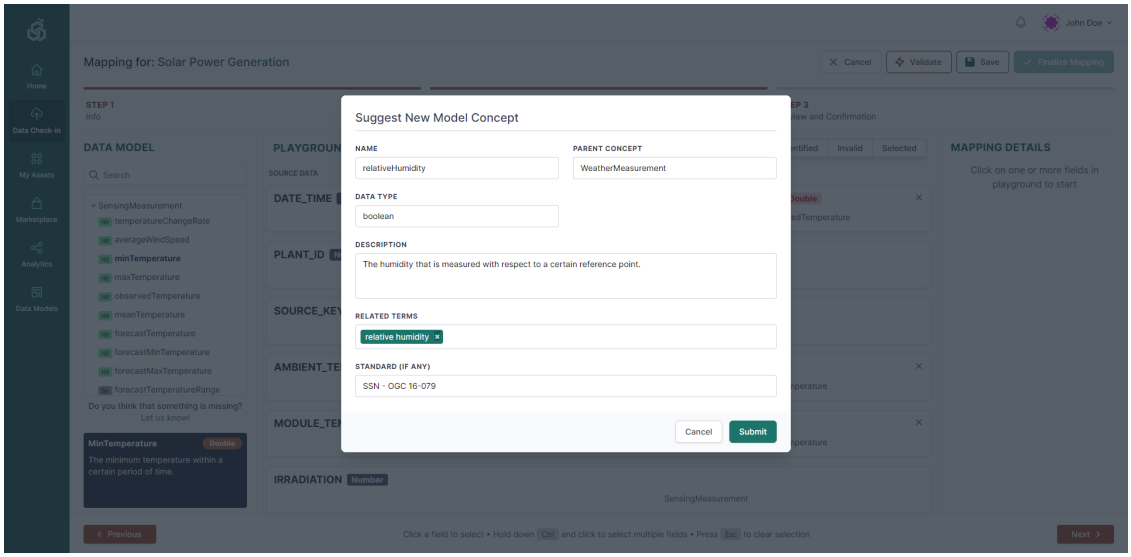

Figure 21: Mapping - Suggest New Model Concept

A particular column of the source (original) data may be mapped to a specific field or concept that is listed in the Data Model section. A column in the source data can be mapped to a field of the CIM by placing the appropriate field from CIM to the corresponding source data (row in the Mapping Playground) using the drag n' drop functionality. A column in the source data can be mapped to the fields of a related concept by selecting the corresponding row in the Mapping Playground and by selecting the related concept (along with a related prefix) from the dropdown menu that appears in the Mapping Details section located at the right side of the page, as shown in Figure 22. In cases the related concept can be customised (according to the CIM provisions), the data asset provider can provide his/her own prefix along with its definition.

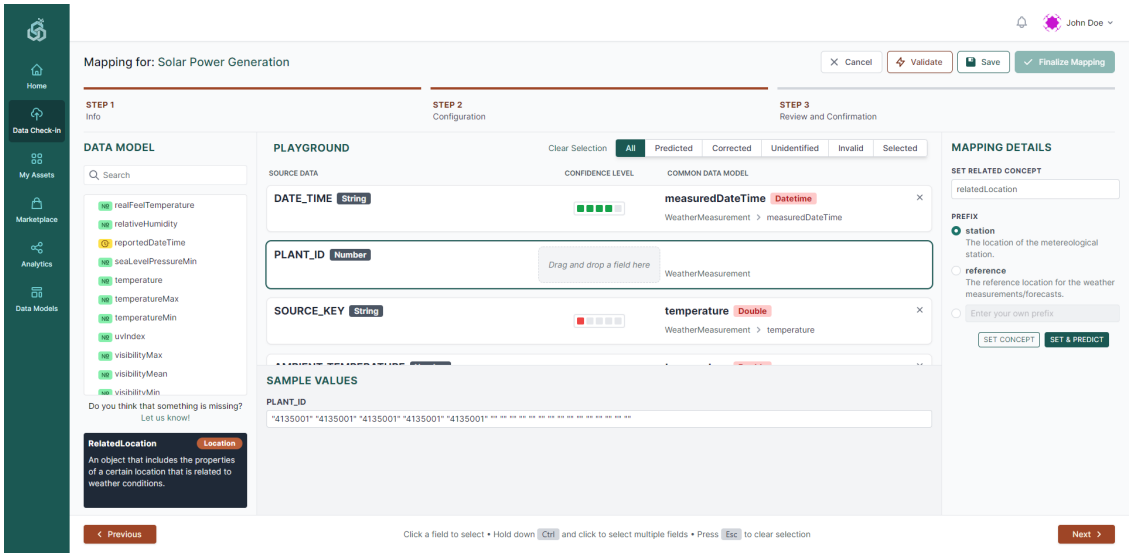

Figure 22: Mapping – Configuration (Step 2b)

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By selecting the Set Concept, the corresponding list of all the fields included in the related concept is revealed in the left Data Model section, allowing the data asset provider to map the input data (row in the Mapping Playground) to a particular field that is included in the related concept selected. This allows the connection of fields in the source data with other fields that are included in the selected related concept of the base concept that was selected in Step 1. The same procedure should be followed when the data asset provider selects the Set Concept & Predict, although in this case, the prediction service is executed once more to predict mappings between the input data and the selected related concept.

In the right section, the Transformation Details are shown providing more information including the transformations rules that are to be applied on the different fields depending on their data type and the CIM provisions. For numeric fields, the applicable measurement unit (whenever applicable according to the CIM) needs to be provided as shown in Figure 23. Depending on the selection that the data asset provider makes, he/she is informed whether the data will need to be transformed to the baseline measurement unit (followed in the SYNERGY CIM).

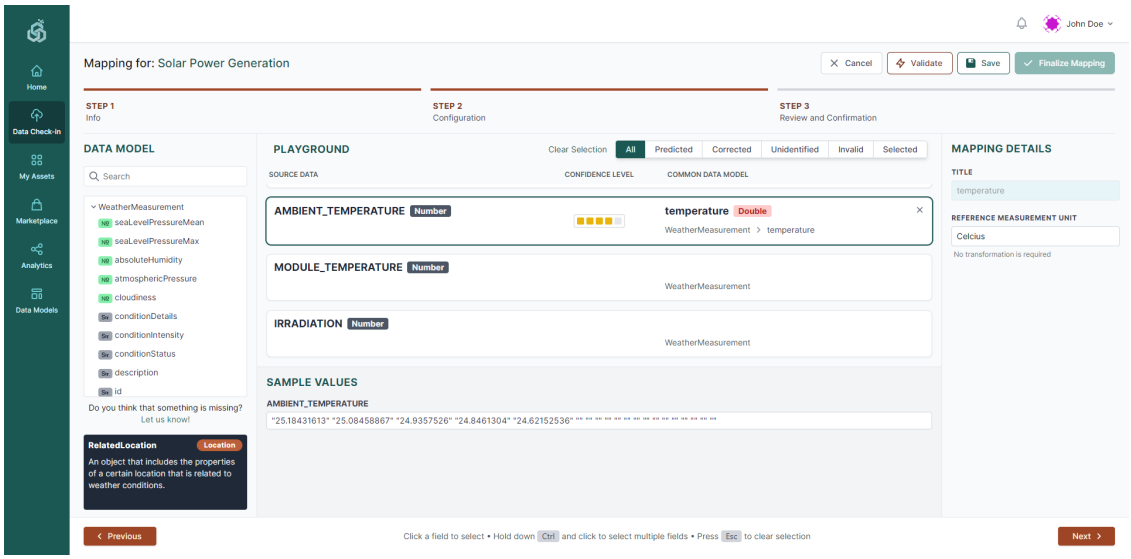

Figure 23: Mapping Configuration - Numeric Field Transformation

For datetime fields, the desired datetime format and the applicable time-zone (if enabled) should be defined as shown in Figure 24. It needs to be noted that during the mapping step, data type casting according to the CIM provisions is also performed (e.g. from integer to double, from string to datetime, etc.).

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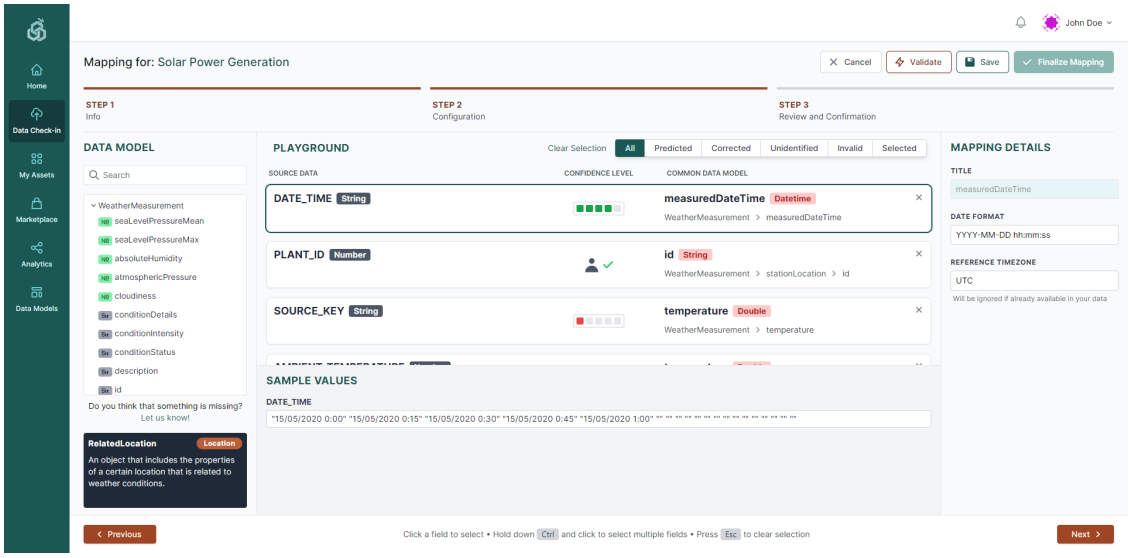

Figure 24: Mapping Configuration - Datetime Field Transformation

In the Mapping Playground section, the data asset provider may filter the view of the concepts by different categories (i.e., Predicted Mappings, Unidentified Mappings, Corrected Mappings, Invalid Mappings, and Selected Mappings). Once the data asset provider is satisfied with the mapping configuration, by clicking the Next button, the Mapping Review and Confirmation page is loaded as depicted in Figure 25. During this step, the data asset provider may view a summary of the concepts that are mapped to the SYNERGY CIM (described in D3.1 “SYNERGY Common Information Model”) and will be transformed according to the configuration provided during the previous step. Additionally, the data asset provider may view more details regarding the mapping and transformation for the source data (per field) by selecting a particular row as shown in Figure 25. In addition, users are able to view the Unidentified Concepts at the bottom of the page, where the title and data type of the concepts that are not mapped to the CIM, and thus they will be excluded from the mapped data that will be uploaded in the SYNERGY Platform and proceed to further processing.

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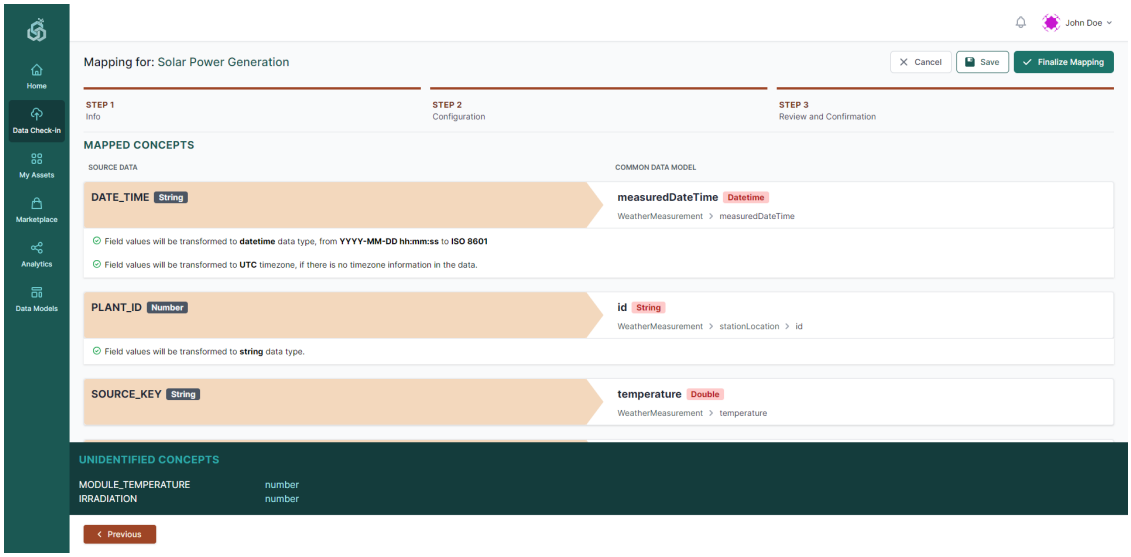

Figure 25: Finalize Mapping (Step 3)

3.2.2.2 Cleaning Configuration

If the cleaning step has been selected during the creation of the data check-in job, as shown in Figure 4, the corresponding workflow for manipulating and cleaning the data ingested into the SYNERGY Platform needs to be configured. This functionality aims at providing to the SYNERGY Platform, accurate, complete, and consistent data that could be used by the specific organization that owns the data asset, but also the overall electricity value chain that can potentially acquire it. The workflow on this functionality involves several features offered by the Cleaning Service described in Section 2 of D3.2 “Data Collection, Security, Governance & Management Services Bundles – Beta Release”. In particular, the data cleaning workflow involves the definition of data cleaning rules depending on the data type of each field in the dataset, in order to eventually store a high-quality dataset. The cleaning rules are divided into validation options and corrective actions. The former involves the definition of allowed value ranges, uniqueness constraints, mandatory constraints, regular expression patterns, and outliers identification, while the latter involves dropping unnecessary columns/entries and replacing values when needed. The first step of the data cleaning workflow allows the data asset

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provider to select the fields/columns to which he/she will define the cleaning rules and constraints, as shown in Figure 26.

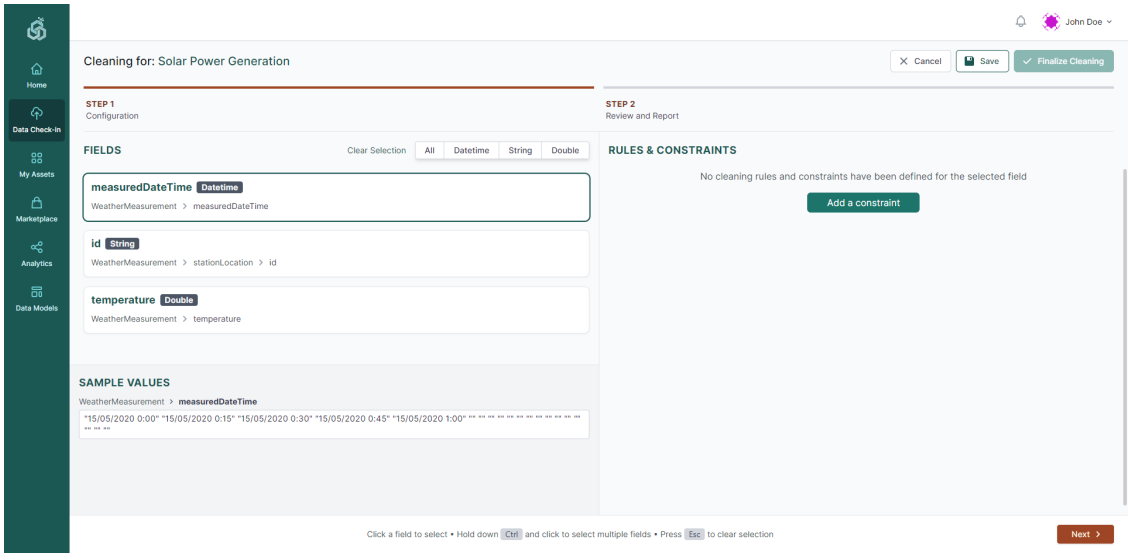

Figure 26: Cleaning Configuration – Select Fields for Cleaning (Step 1a)

It needs to be noted that the data asset provider is able to select multiple columns based on the same data type, in order to define rules that are applicable to more than one fields. As shown in Figure 27, the data asset provider may define different constraints (e.g. mandatory constraint where field values must not be null, regular expression pattern constraint where field values must have an exact match with a particular regular expression, and unique constraint where field values must be unique).

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Upon this selection, he/she may define an outlier rule (e.g. drop, or replace with a particular default value) in case a value is considered as outlier.

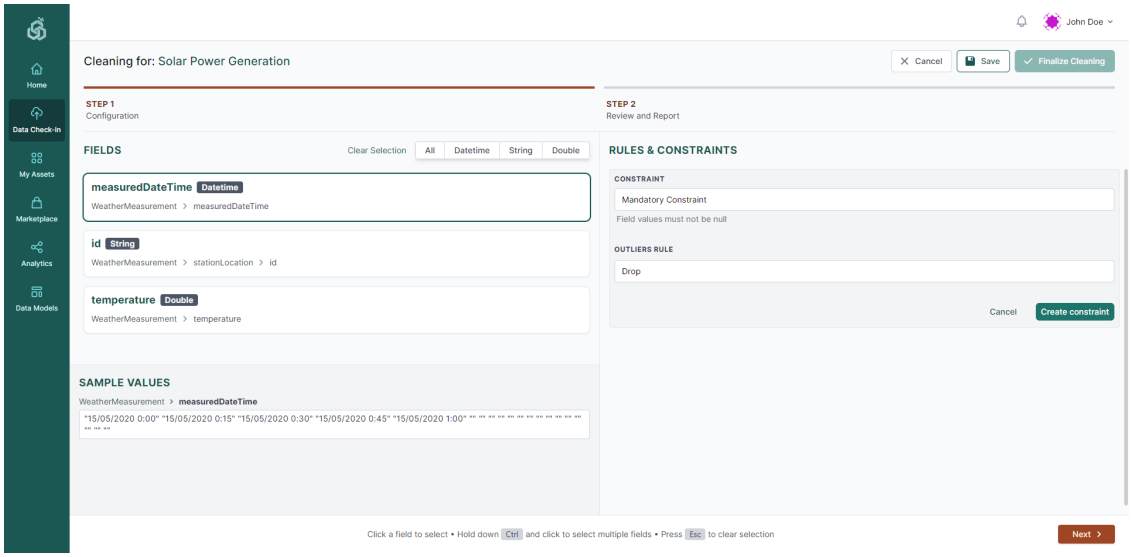

Figure 27: Cleaning Configuration - Set Rules & Constraints (Step 1b)

Each time a cleaning rule and constraint is added, the data asset provider can view what exactly will be applied in the data in simple language. In addition, the data asset provider may add a new rule and constraint, edit or remove an existing rule or constraint, or even change the order of the rules or constraints that are to be applied as shown in the Rules & Constraints section at the right part of Figure 28.

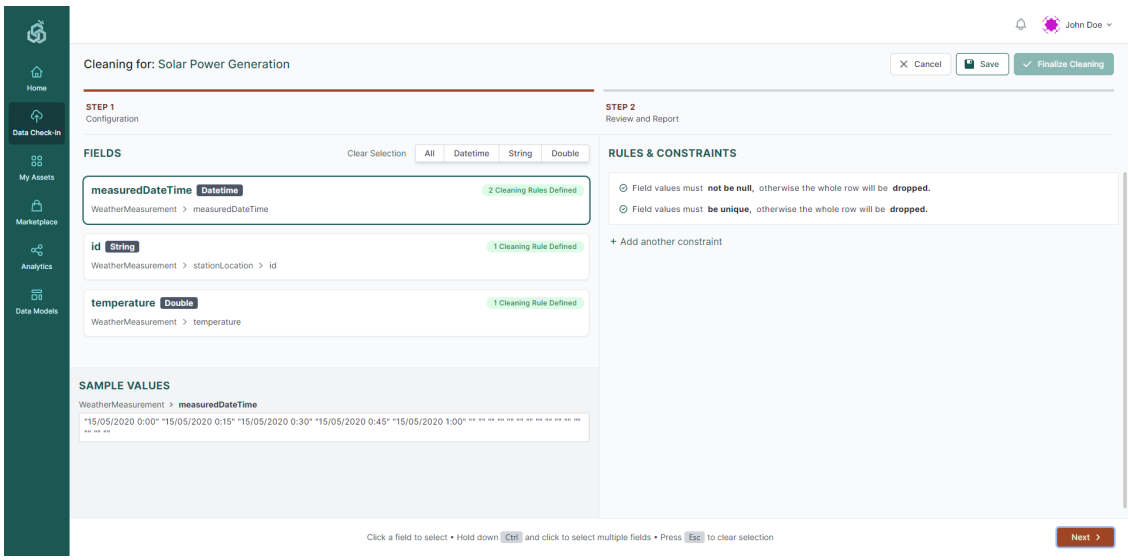

Figure 28: Cleaning Configuration - View Rules (Step 1c)

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Once the data asset provider is satisfied with the cleaning configuration, by selecting the Next button, the final step of reviewing the cleaning rules and constraints will appear as shown in Figure 29.

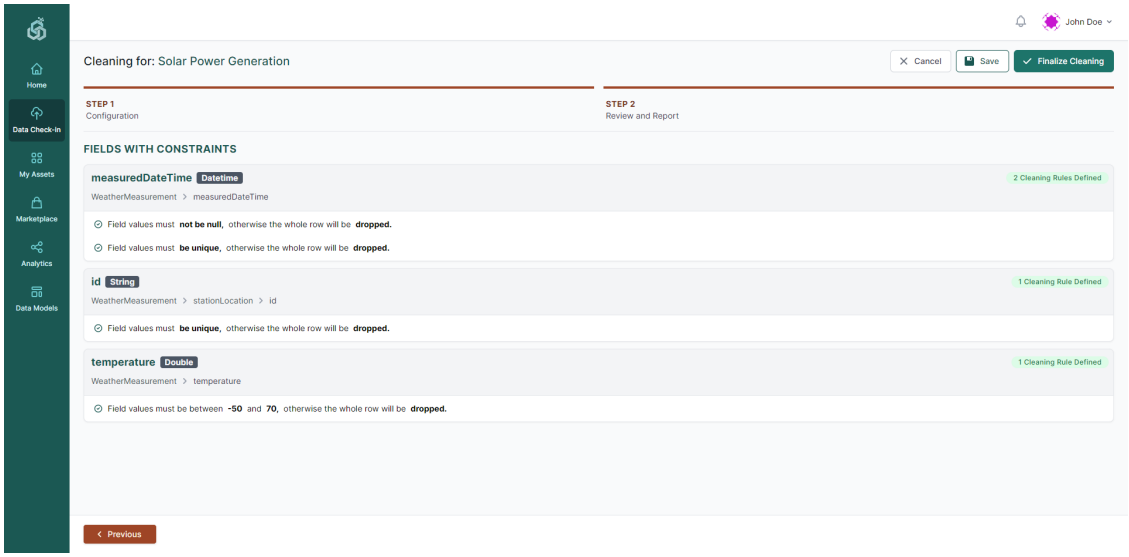

Figure 29: Finalize Cleaning (Step 2)

3.2.2.3 Anonymisation Configuration

Another optional pre-processing step of the data check-in job configuration is the Anonymisation step, offered by the Data Collection Services Bundle as described in Section 2 of D3.2 “Data Collection, Security, Governance & Management Services Bundles – Beta Release”. In particular, if the anonymisation step is enabled in the data check-in job configuration, the execution of the Anonymisation Service, which is described in Section 4.2.1 of D2.6 “SYNERGY Framework Architecture including functional, technical and communication specifications v1”, will be triggered, and the data asset provider shall define the data anonymisation rules to be executed as shown in Figure 30. During this step, a data asset provider defines which of the fields that have been mapped to the SYNERGY CIM during the Mapping step are sensitive, quasi-identifiers and identifiers since by default all fields are considered as insensitive. Sensitive data (that reveal private information such as genetic data, health data, ethnic origin, etc) should be protected by an anonymisation algorithm that ensures that an individual cannot be identified. If the data asset provider selects identifier (i.e. field that can be directly used to identify an individual) as the anonymisation type, then the particular column will be dropped from the dataset. Otherwise, if the data asset provider selects quasi-identifier (i.e. field that is not an identifier itself, but combined with other quasi-identifiers may uniquely identify an individual), the generalization method needs to be defined depending on the field type.

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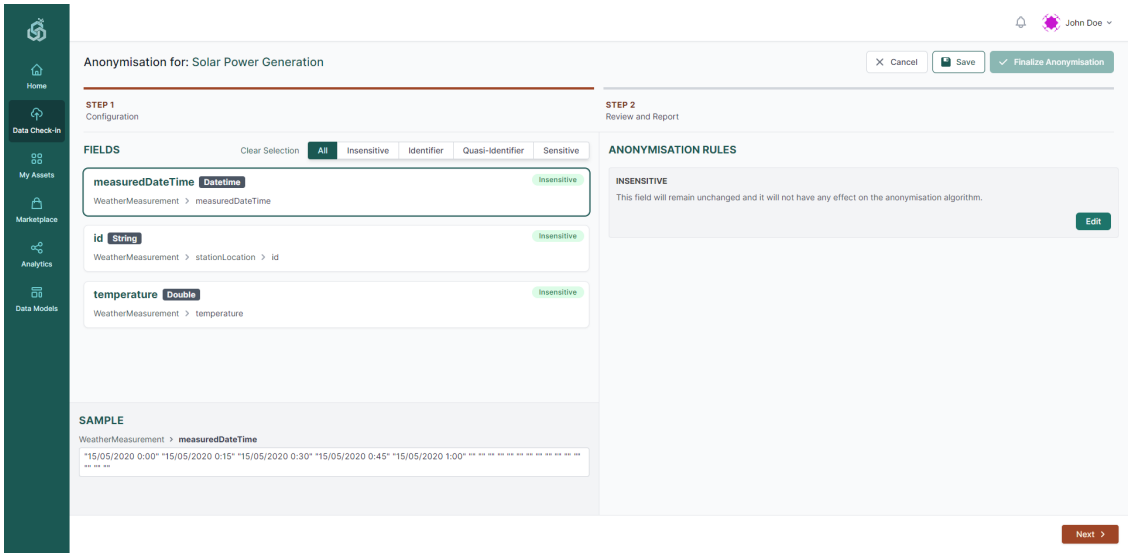

Figure 30: Anonymisation Configuration – Select Fields for Anonymisation (Step 1a)

To select one of the anonymisation rules, the data asset provider needs to select the field from the left Fields section, and then select the appropriate rule by selecting the Edit button from the Anonymisation Rules section at the right section as shown in Figure 31. Depending on the data type and the anonymisation type that the data asset provider selected for a field, different anonymisation methods become available providing different configuration options. Since the cleaning step is not compulsory and the null values may not be handled till this step, the data asset providers may need to select the way that the anonymisation step will handle the null values (i.e., keep, or replace with a value).

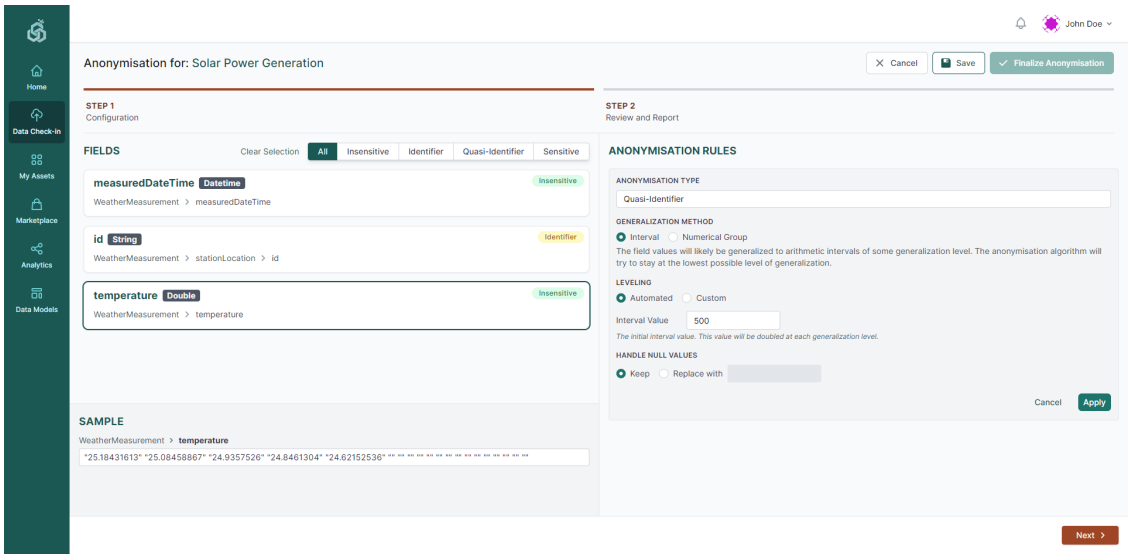

Figure 31: Anonymisation Configuration - Set Anonymisation Rules (Step 1b)

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As soon as the data asset provider is satisfied with the definition that he/she has provided for a field, he/she may select the Apply button in order for the Anonymisation Rules Preview section to appear as shown in Figure 32. In this section, the different anonymisation levels and examples are provided in order to make clear to the data asset provider what exactly will happen to the data.

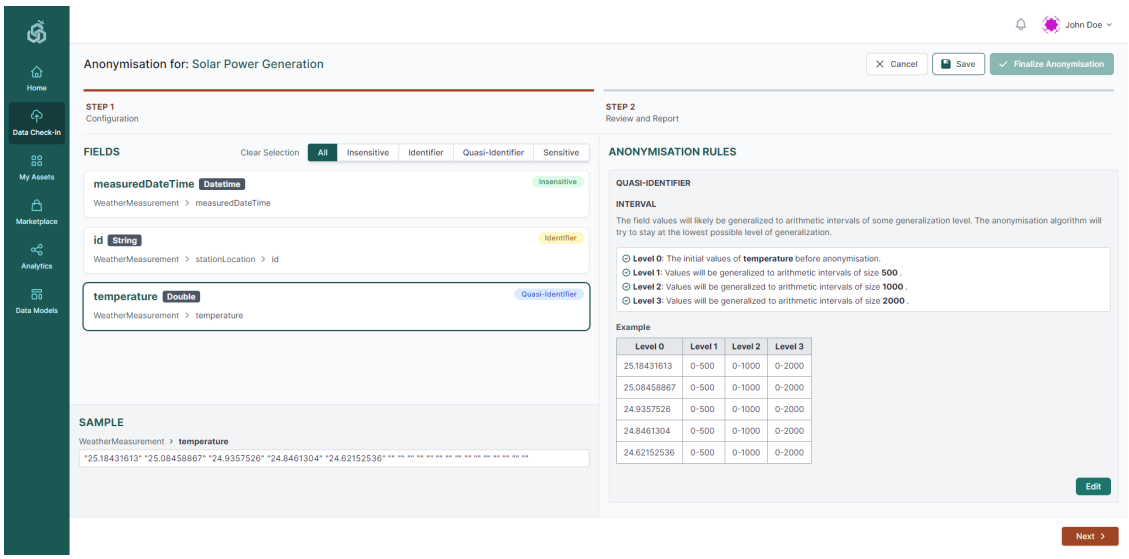

Figure 32: Anonymisation Configuration - View Anonymisation Rules (Step 1c)

Once the data asset provider has defined anonymisation rules for the fields of interest, he/she may proceed to the next step where the full set of anonymisation rules can be reviewed per anonymisation type, as displayed in Figure 33. The data asset provider may also define the acceptable information loss threshold and specific parameters of the selected anonymisation algorithm (e.g. for k-anonymity, the k-value needs to be filled in). It needs to be noted that if the desired anonymisation is not achieved or the resulting data loss is above the acceptable information loss threshold, the SYNERGY Platform will impose failure of the anonymisation step on purpose at execution time.

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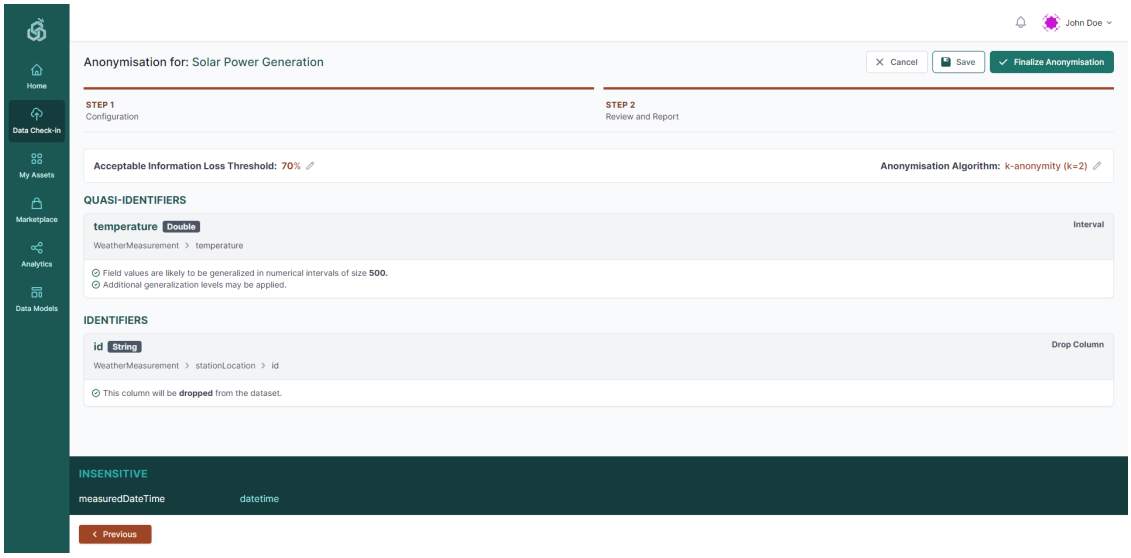

Figure 33: Finalize Anonymisation (Step 2)

3.2.2.4 Encryption Configuration

The data encryption functionality is available to data asset providers that require end-to-end security in the SYNERGY Platform and the On-Premise Environment (that has been installed locally) to eliminate the risk of unauthorized data access or leakage during the data transfer to the cloud. As Section 4.2.2 of D2.6 describes, data asset providers are able to (optionally) set encryption parameters to be applied on the whole dataset. It needs to be noted that, during the creation of the data check-in job, the data asset provider is asked whether to include the data encryption in the pre-processing steps (as in Figure 4).

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As depicted in Figure 34, the data asset provider is able to select the concepts of the dataset whose values are to be indexed to facilitate search (as presented in section 4.1).

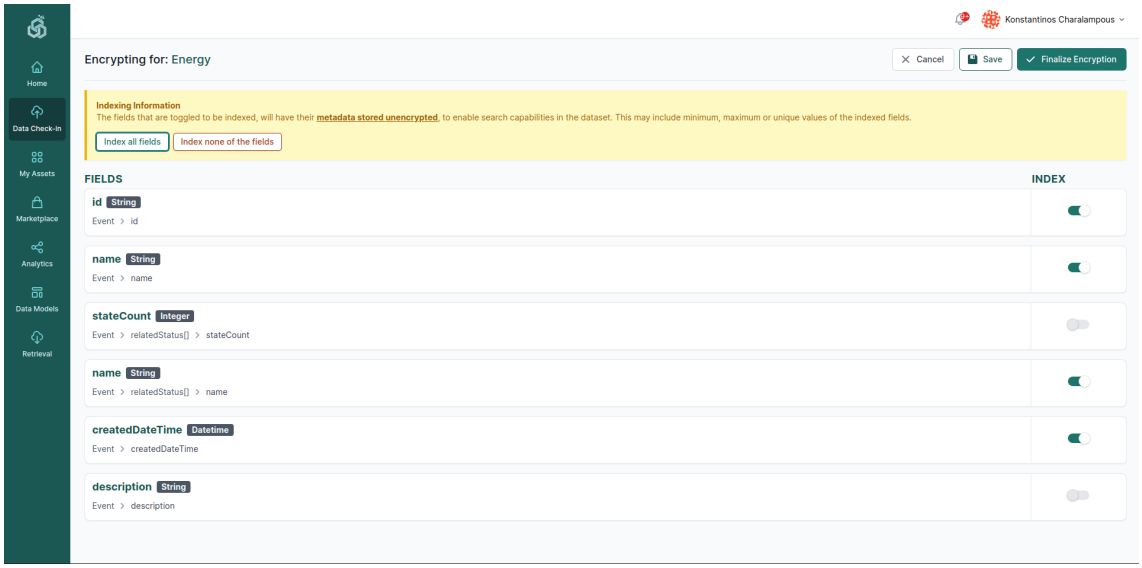

Figure 34: Encryption Configuration

3.2.3 Define New Data Asset Profile

The last step of the data check-in job configuration is to store the final processed data asset in the SYNERGY Platform. Hence the data asset provider is asked to provide a title and a short description for the processed data asset that is to be stored in the SYNERGY Platform, as shown in Figure 35.

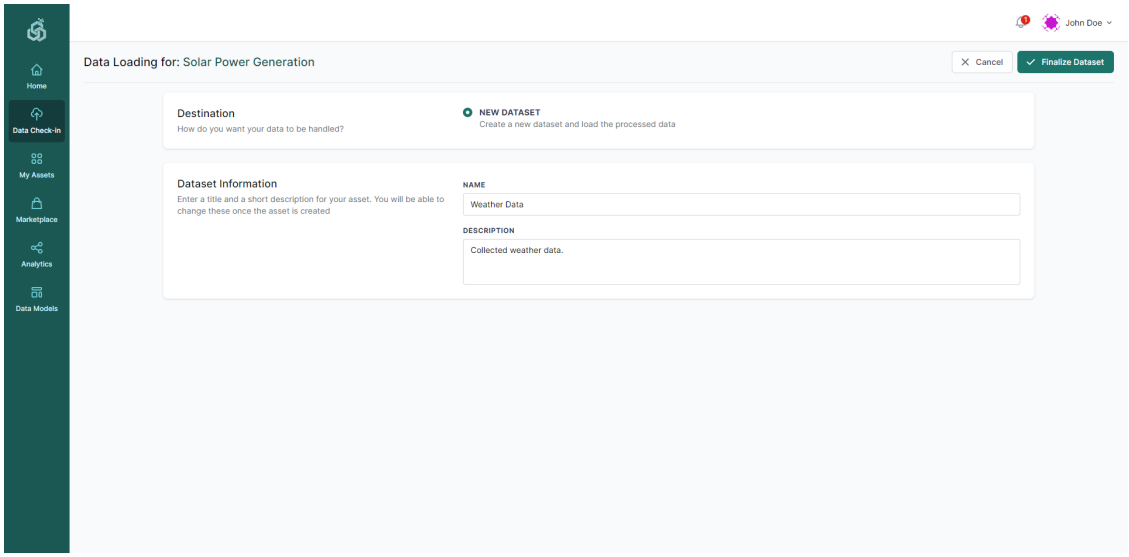

Figure 35: Create a new Data Asset Profile

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However, a more detailed data asset profile needs to be defined by the data provider, according to the SYNERGY Metadata Schema that is presented in D4.1. Thus, the data asset provider needs to navigate to Assets on the main navigation bar. As depicted in Figure 36, the data asset provider may change the title and the description of the stored data asset, and insert additional information such as tags, distribution details, extent details, licensing information, and pricing details, according to the SYNERGY metadata schema. Depending on the access level of the data asset, the data asset provider is requested to define the applicable access policies.

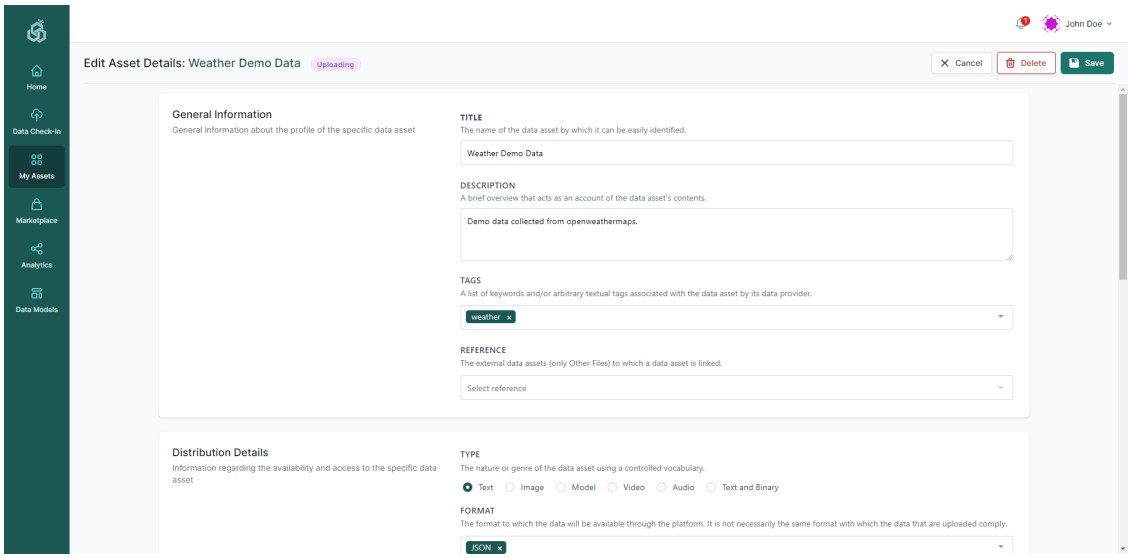

Figure 36: Define a new Data Asset Profile

In particular, the data asset provider needs to add tags (i.e., list of keywords, or arbitrary textual tags) that are associated with the data asset, as well as any potential reference to external data asset (already stored in the SYNERGY Platform) to which a data asset is linked. The type which describes the nature of dataset, the format of the data asset to which the data will be available, and the language of the data asset, need to be defined appropriately by selecting an item from the corresponding drop-down lists. Details regarding the temporal coverage, spatial coverage, temporal resolution, and spatial resolution units need to be defined as well by selecting the appropriate values for these units from the corresponding drop-down lists. It needs to be noted that for cases that the temporal or spatial coverage value cannot be specified in advance, the platform allows data asset providers to select temporal and spatial coverage based on the actual data that are uploaded, by selecting the “Calculated based on data” option, as shown in Figure 37.

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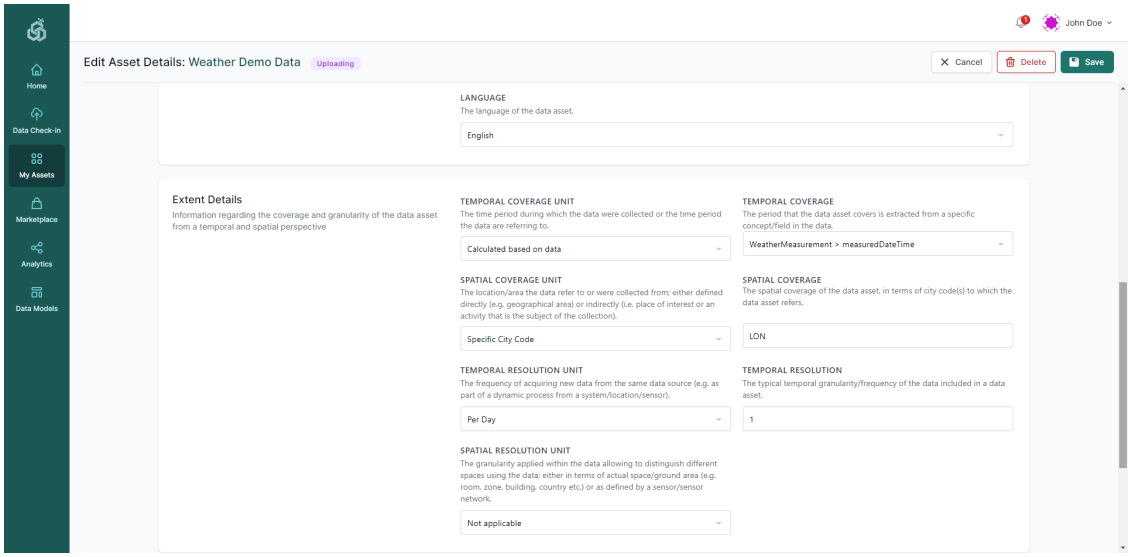

Figure 37: Define a New Data Asset Profile - Extent Details

Then, the data asset provider needs to set the access and licensing information which corresponds to the desired visibility of a data asset and the applicable access policies. Thus, the data asset provider needs to select the access level from three different options: (a) Public, allowing the access of the data asset to any organisation without requiring any access policies to be satisfied or the existence of a data contract; (b) Private, allowing other organisations to access the data asset if the access policies are satisfied and there is an active contract; and (c) Confidential, denying access of the data asset to external organisations as it is only intended for use within the organisation that owns it. In case that the access level is set to Confidential, there are no available options regarding licensing and its associated terms under which the data asset is made available, since it will be visible only to the data asset owner.

In contrast, if the access level is set to Public or Private, the data asset provider needs to fill the corresponding licensing information, as shown in Figure 38 and Figure 39, respectively. In particular, the name of the copyright owner and the data license stating the legal terms and giving the official permission to the data asset should be selected (or provided in case of custom licenses). If the data asset provider selects an already existing well-defined data license, then the licensing details are automatically filled, otherwise the data asset provider should select Custom to fill the licensing details according to his/her needs, as shown in Figure 39. Public access level allows the data asset profile to be available to all and thus the pricing details and access policy sections are disabled since the asset is accessible by everyone.

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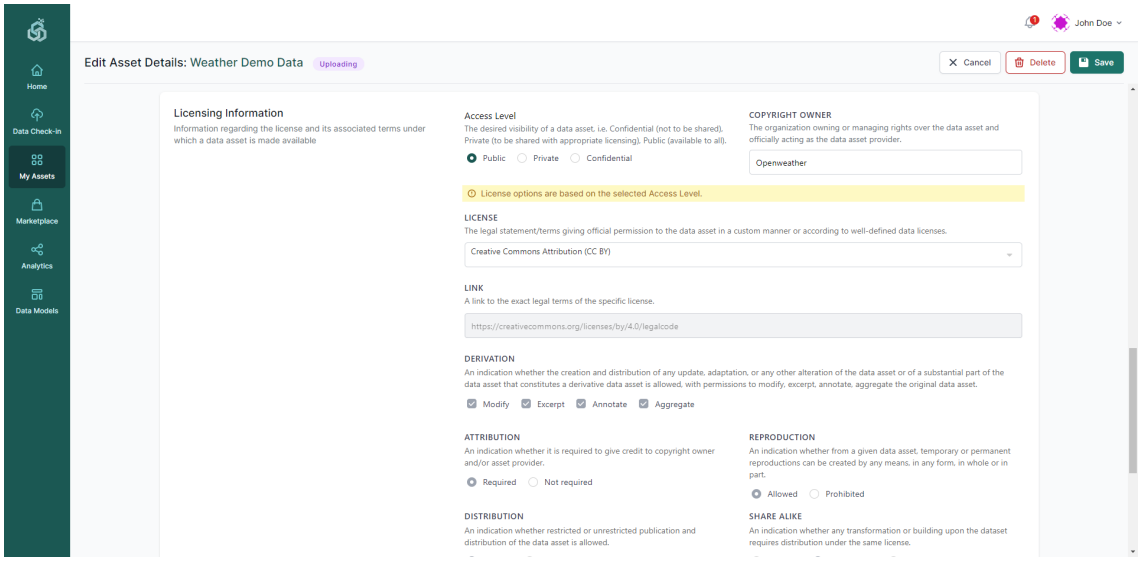

Figure 38: Define a New Data Asset Profile - Access Level - Public

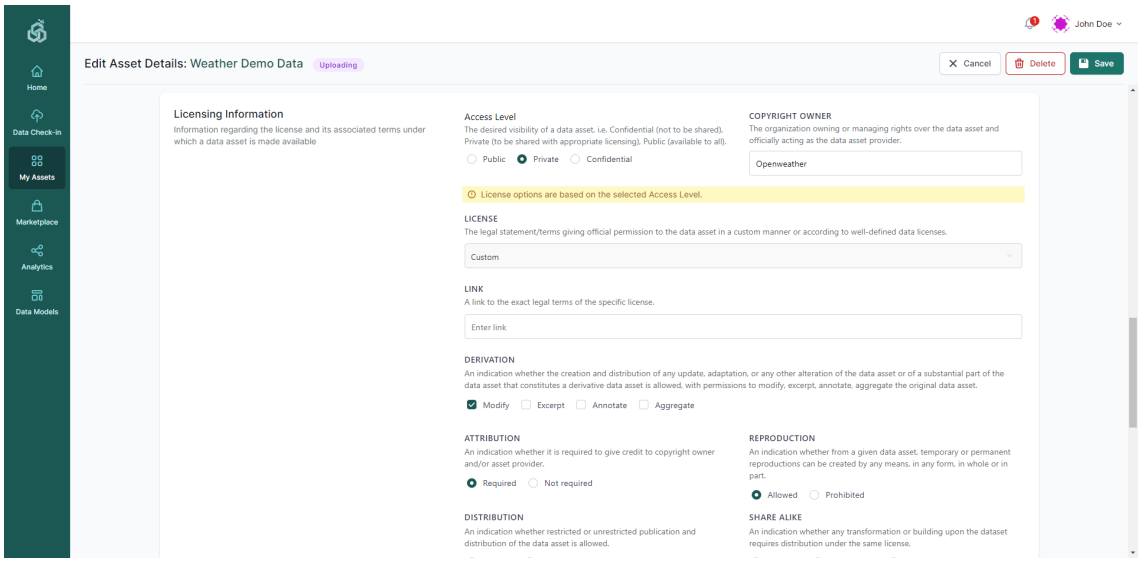

Figure 39: Define a New Data Asset Profile - Access Level - Private

By selecting Private access level, the data asset provider needs to add all the corresponding licensing information as mentioned before, along with pricing details regarding the payment and acquisition of the data asset, and the access policy defining who has access to the data asset or not, as shown in Figure 40. In particular the data asset provider needs to select the payment method (e.g. Credit / Debit Card, Bank Transfer, Online Payment Method, or Other), along with the calculation scheme (e.g. Fixed per Data Asset, Fixed per Row, or Request Depended) and the cost of the data asset with its currency.

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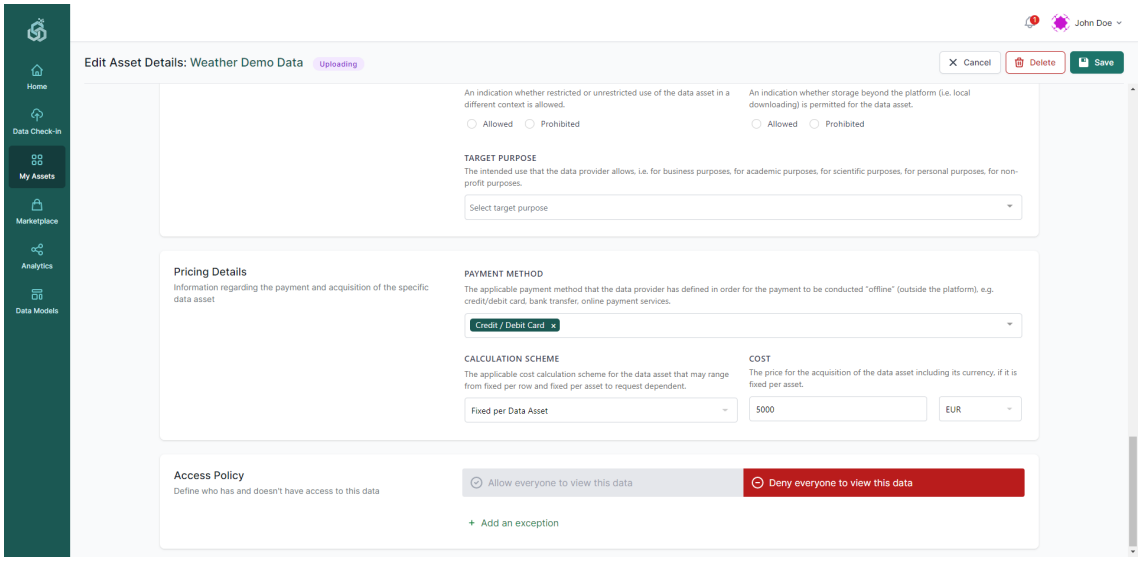

Figure 40: Define a New Data Asset Profile - Pricing Details

Finally, the access policies should be defined dictating whether certain users (or everyone) should be allowed or denied to view the data asset in the Marketplace (note: viewing a data asset in the Marketplace only means that the data asset consumer is eligible to acquire it – a contract needs to be put in place to get actual access to it as described in Section 4.2), by adding exceptions on certain organization or user parameters using logical conditions, e.g. on the user email or the organization type, as depicted in Figure 41.

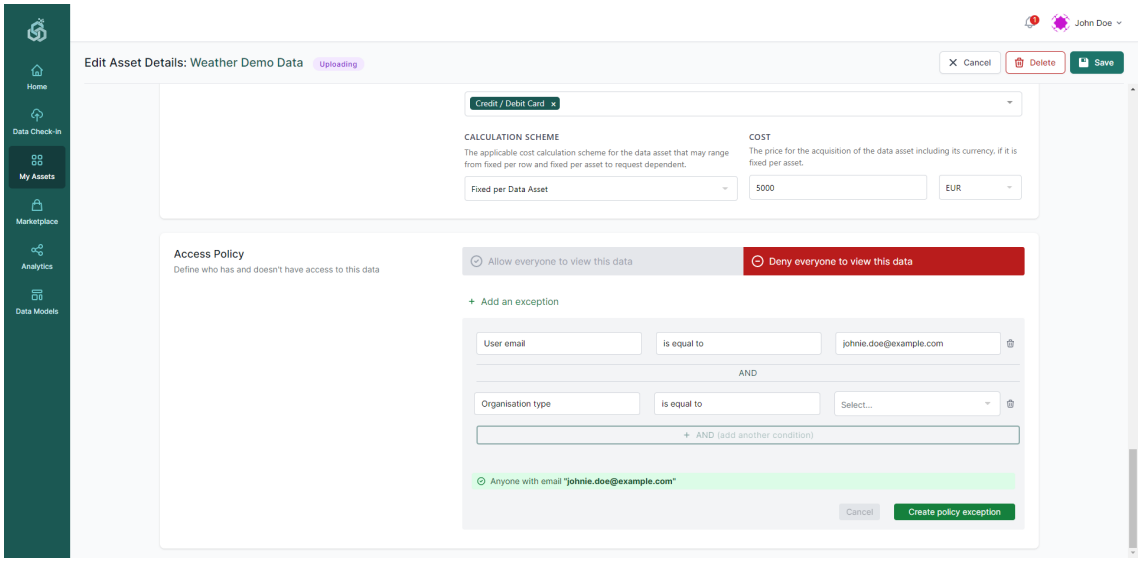

Figure 41: Define a New Data Asset – Private Access – Deny Everyone with Exceptions

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By selecting Save, the data asset profile is finalized, and the data asset provider may navigate to the overview, the license details and the data structure of the data asset profile that has been created and stored. The data asset profile overview, the license details and the data structure pages are depicted in Figure 42, Figure 43, Figure 44, and Figure 45, respectively.

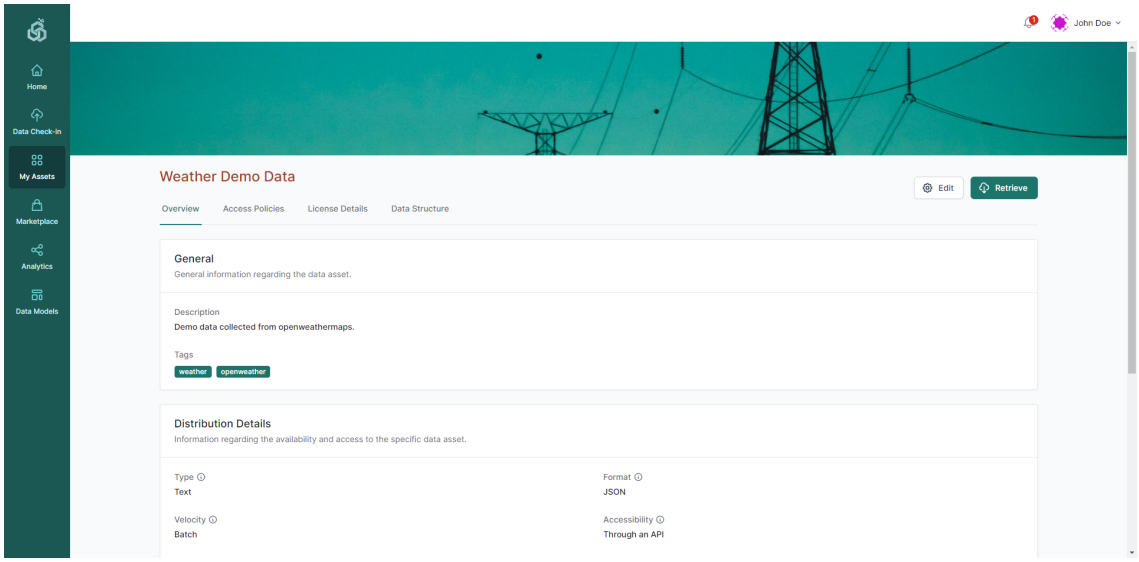

Figure 42: Define a new Data Asset Profile – Overview (visible to all)

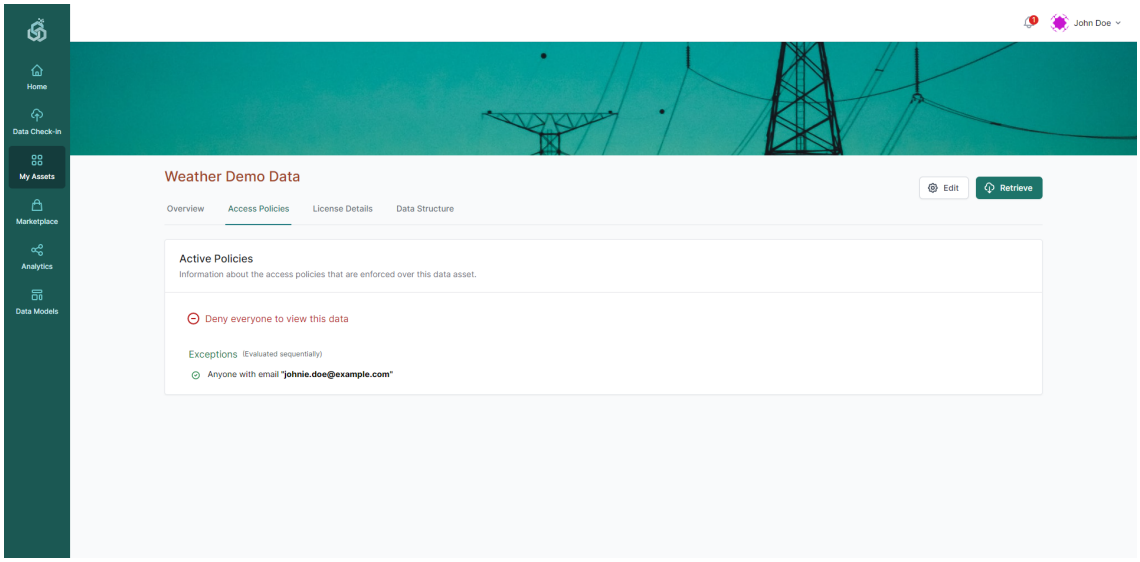

Figure 43: Define a new Data Asset Profile – Access Policies (visible only to the respective data asset provider)

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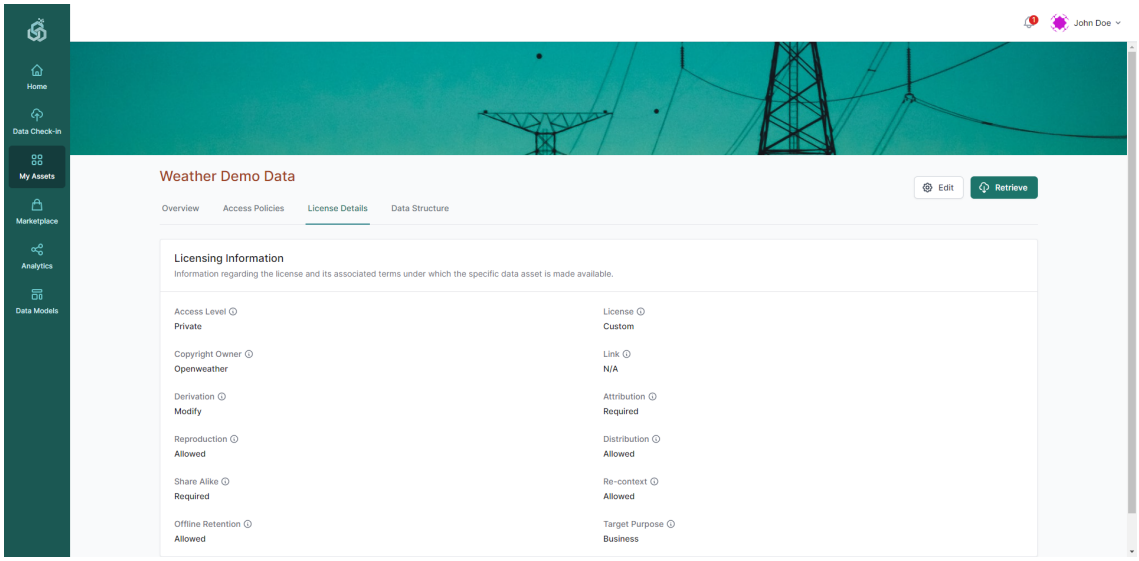

Figure 44: Define a new Data Asset Profile – License Details

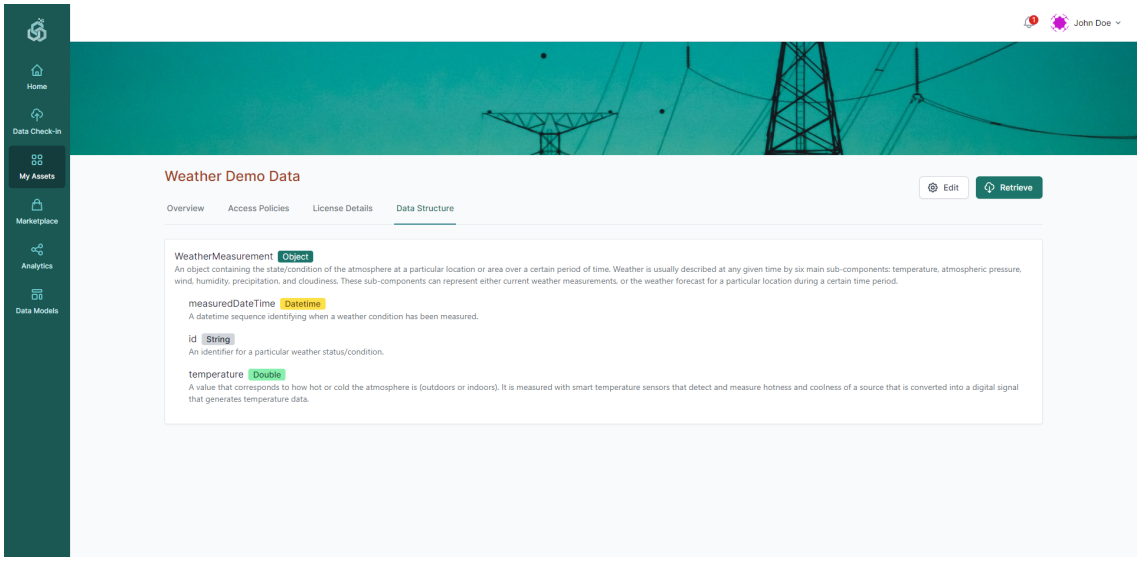

Figure 45: Define a new Data Asset Profile – Data Structure

Obviously, the data asset provider is able to edit the metadata (with the exception of the Data Structure) at any point through the Assets view (described in Section 3.5).

3.3 Execute a Data Check-in Job

3.3.1 Pre-processing Rules Execution

As mentioned already, the pre-processing steps configuration (at design time) has a distinct separation from the actual execution of each pre-processing step. In this section, a short description

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regarding the execution of each pre-processing step is provided accordingly. Note that, all the pre-processing steps (i.e., Mapping, Cleaning, Anonymisation, and Encryption) can be only executed if each pre-processing configuration has been finalised.

3.3.1.1 Mapping Execution

If the Mapping step has been successfully executed, the data asset provider may view what transformations happened on the data per field in the source data, as shown in Figure 46.

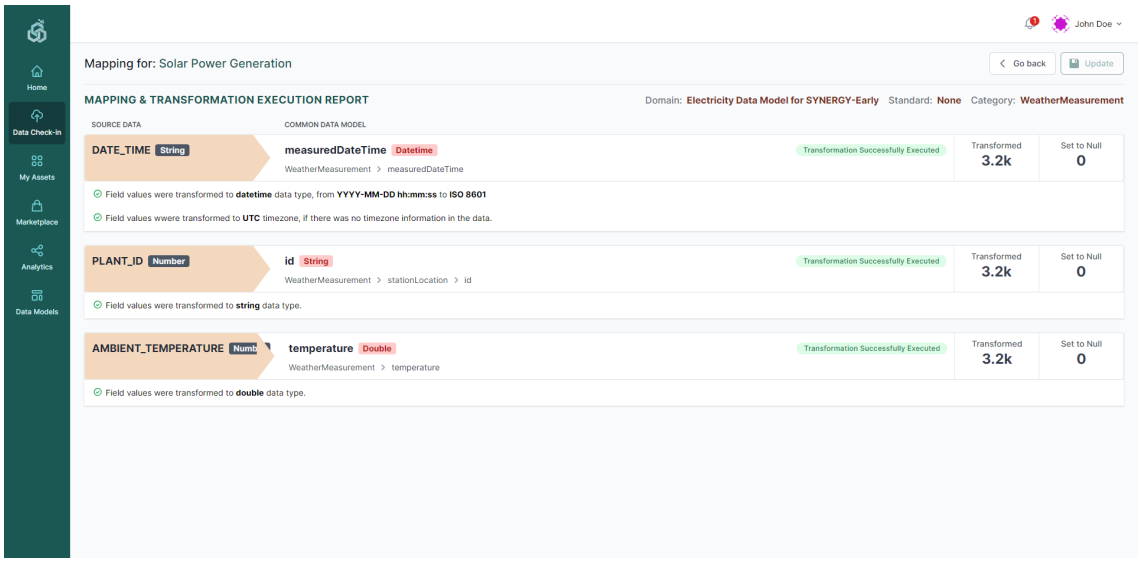

Figure 46: Mapping Execution - Successful

Otherwise, if the Mapping step failed due to wrong transformation rule definitions, the data asset provider may view the failed transformations that have been defined (as shown in Figure 47) and make the appropriate corrections in a new Data Check-in Job. It needs to be noted that in the case of recurring jobs, the Mapping step may have run successfully for n times and failed in the n+1 time, which is why exact number of rows/values are provided per execution.

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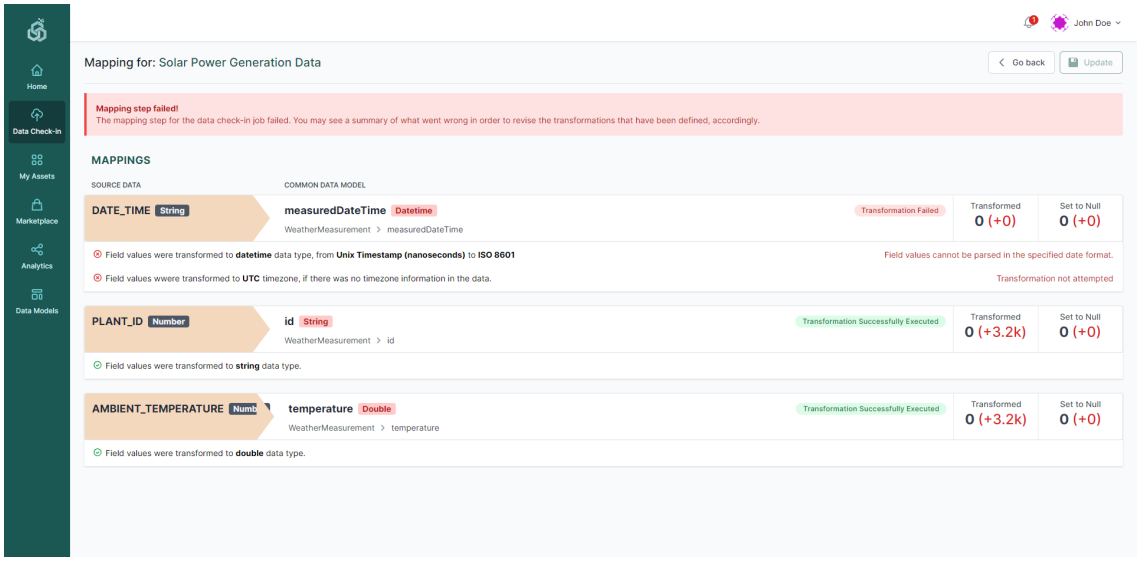

Figure 47: Mapping Execution - Failed

3.3.1.2 Cleaning Execution

Once the data provider completes the Cleaning configuration and it is executed, a pop-up appears notifying the user that the Cleaning step has been executed. An indicative example of a successful execution of the Cleaning rule is shown in Figure 48. In this step, the data asset provider may view what cleaning constraints were met and resulted into transformations per field in the source data.

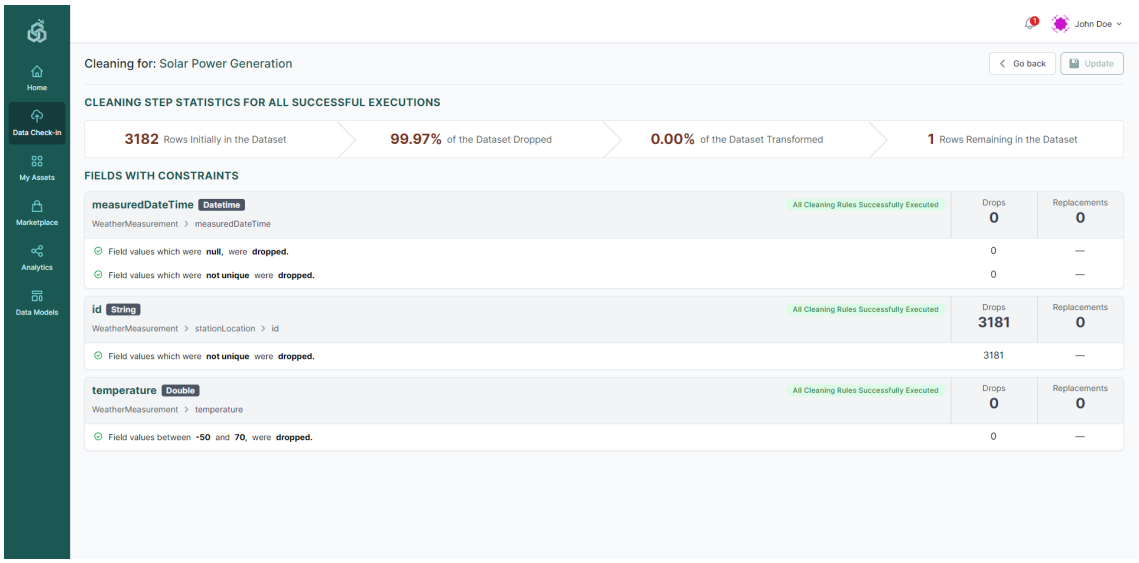

Figure 48: Cleaning Execution - Successful

However, in the case where the field values of a column do not follow the defined pattern, as configured in the Cleaning configuration rules, a failed Cleaning execution report page will appear,

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as shown in Figure 49, notifying the data asset provider to view the errors that have occurred, in order to revise the cleaning rules and constraints that have been defined.

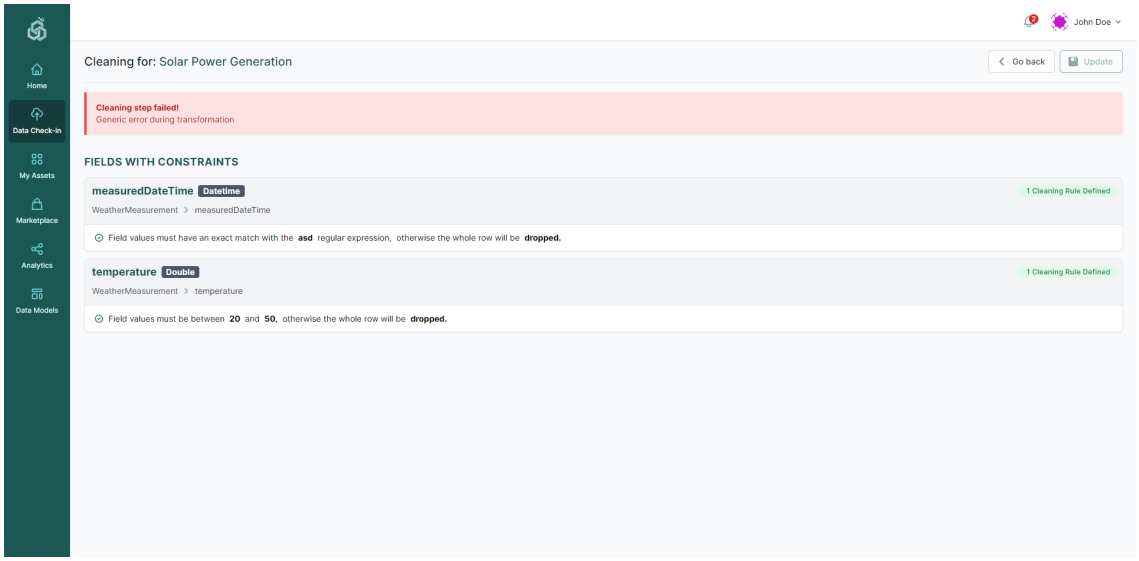

Figure 49: Cleaning Execution - Failed

3.3.1.3 Anonymisation Execution

If the Anonymisation step has been executed and the achieved information loss is less than the acceptable information loss threshold that has been defined during the configuration, the Anonymisation step is considered as successful as Figure 50 depicts.

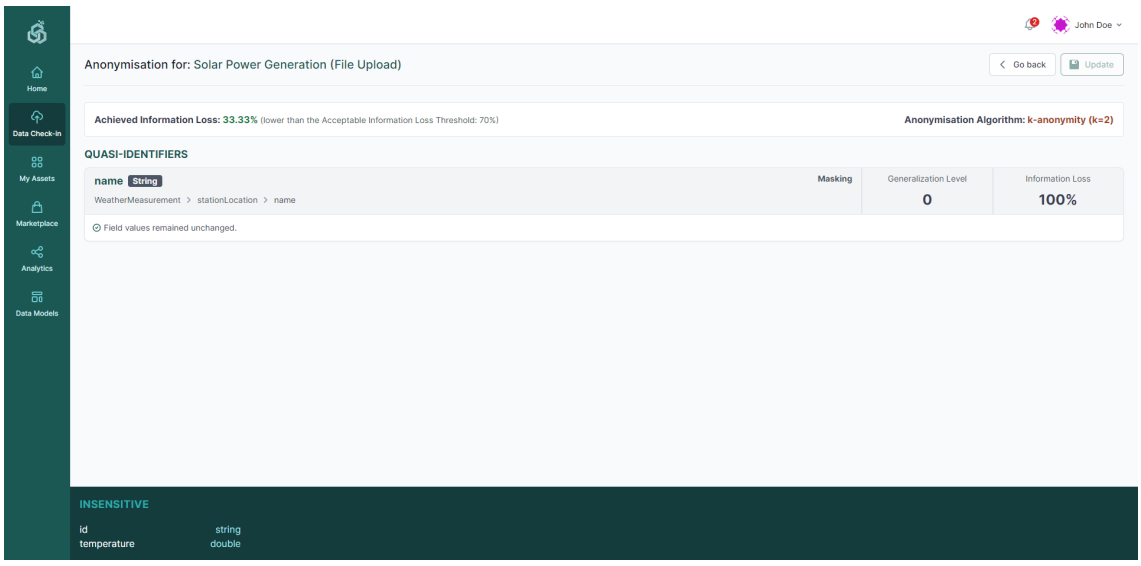

Figure 50: Anonymisation Execution - Successful

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On the contrary, if the achieved information loss is higher than the acceptable information loss threshold that had been defined during the configuration or if the desired level of anonymisation was not achieved, the Anonymisation step is considered as failed as Figure 51 suggests.

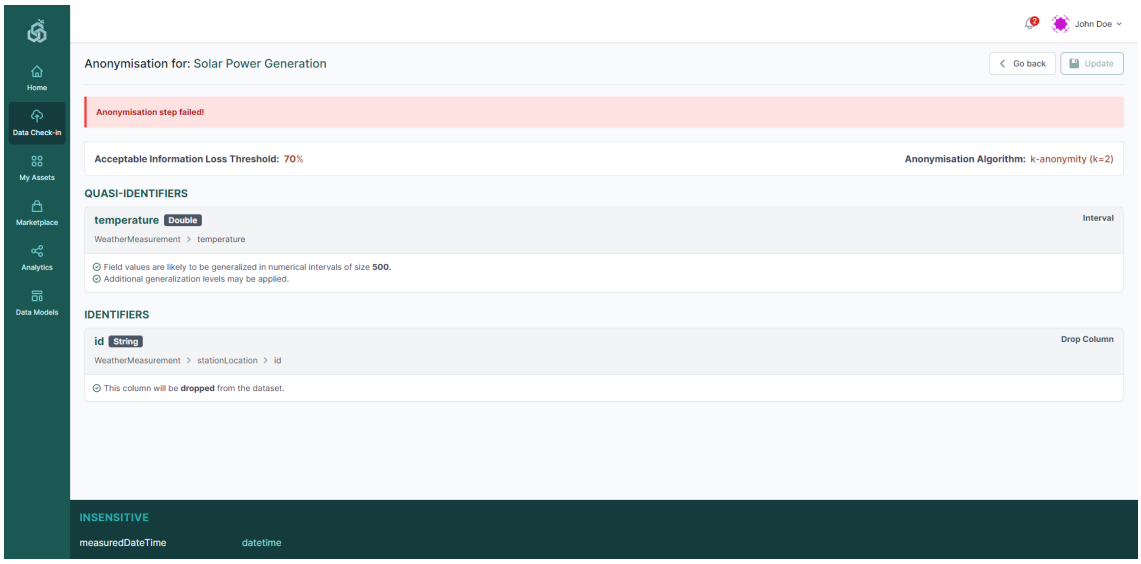

Figure 51: Anonymisation Execution - Failed

3.3.1.4 Encryption Execution

Similarly to the rest of the pre-processing steps, the data asset provider is able to view the report of the encryption execution, displaying whether the encryption step was executed and applied successfully or not (according to the configuration provided), as depicted in Figure 52.

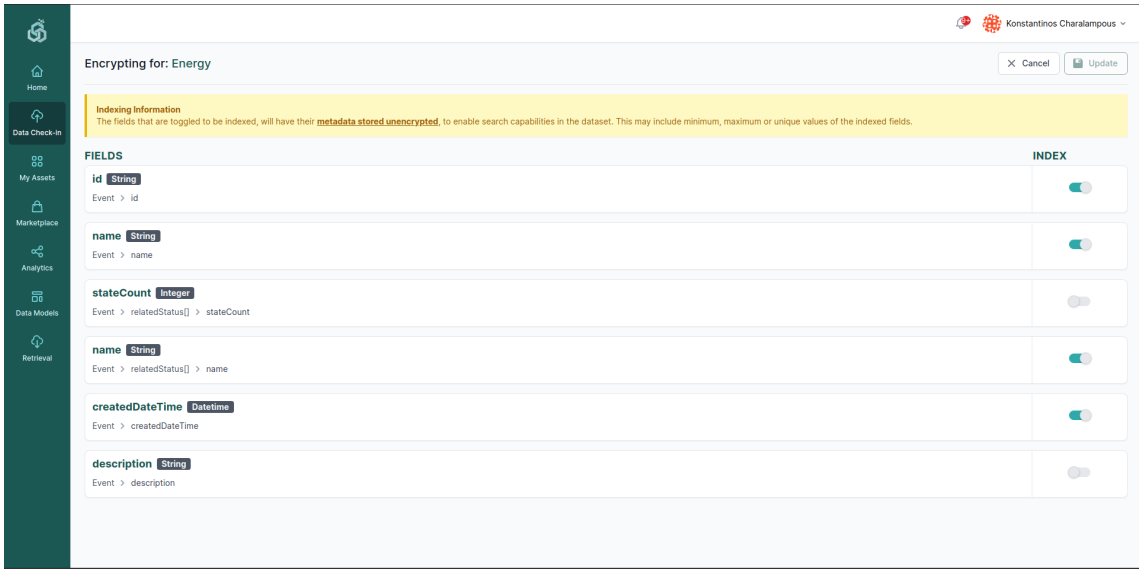

Figure 52: Encryption Execution

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3.4 Upload data through the On-Premise Runner

In the case that the data asset provider has already installed an On-Premise Runner and he/she needs to upload data through it, the On-Premise Execution option should be selected as shown in Figure 4. After selecting the pre-processing steps that are to be applied on the uploaded data, by selecting Save, the Setup Harvester page for the On-Premise Execution appears, as shown in Figure 53. It needs to be noted that the only data loading option that the data asset provider has using the On-Premise Execution method, is to upload files.

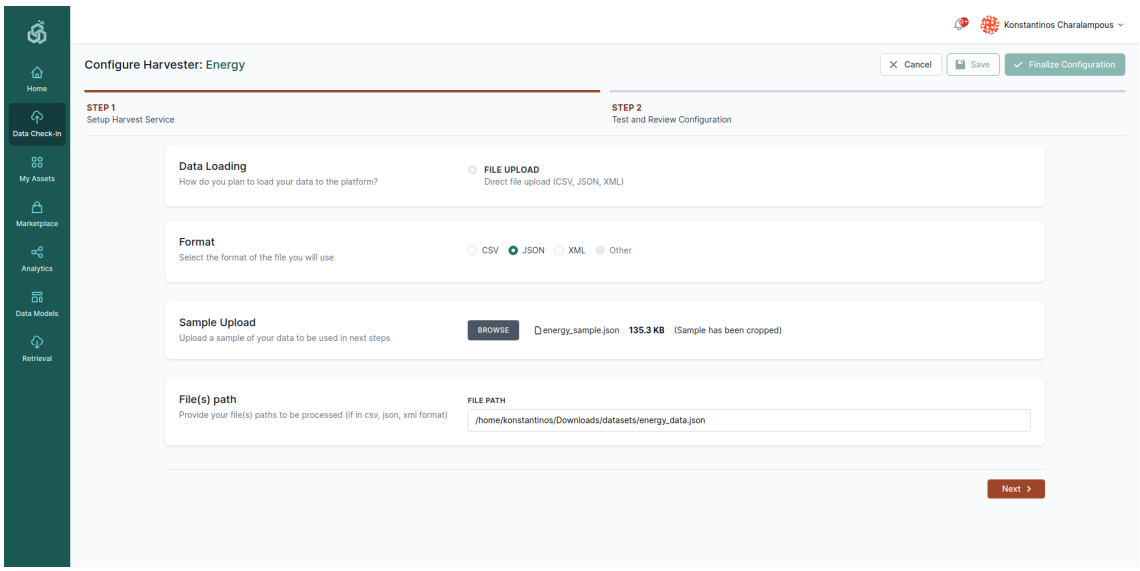

Figure 53: File Upload Method - On-Premise Execution - Setup Harvest Service (Step 1a)

Although the same procedure as in the File Upload Method in the Cloud Execution, for this case the data asset provider should include the full path to the file including the data, and in the next step the sample is uploaded in Step 1 and viewed in Step 2, as shown in Figure 54.

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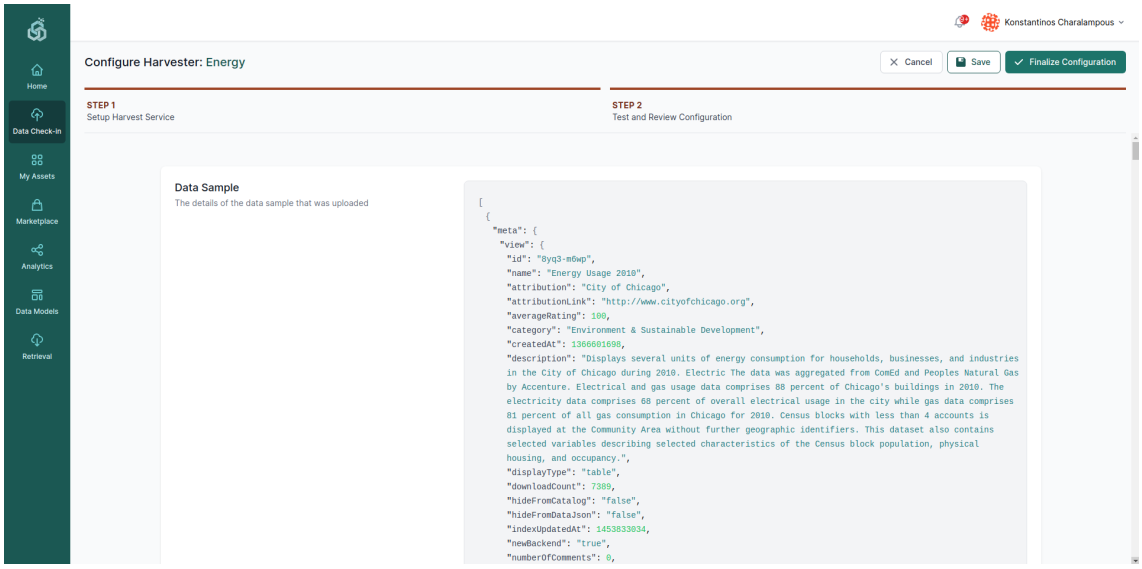

Figure 54: File Upload Method - On-Premise Execution - Setup Harvest Service (Step 2)

The rest of the steps are configured as presented in Section 3.2.

3.5 Manage Data Check-in Jobs

3.5.1 Edit a Data Check-in Job

Data asset providers are able to edit an existing data check-in job by navigating to the Data Check-in Jobs view, as shown in Figure 3. In particular, a data check-in job can be edited by selecting Edit from the options menu that is located at the right side of each data check-in job. Directly the Update Data Check-in Job view will be appear as depicted in Figure 55. Although the data asset provider is able to update the name and description of the data check-in job, the pre-processing rules and the data check-in execution location cannot be updated. By selecting the Update button at the top right part of this view, the data check-in job is updated and the data asset provider returns back to the Data Check-in Jobs view.

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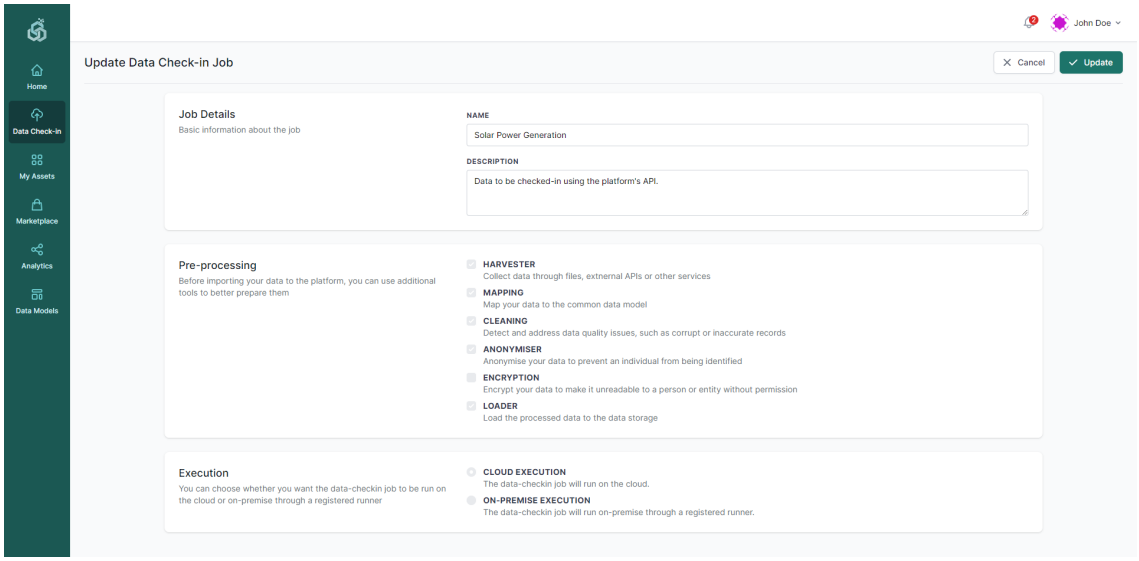

Figure 55: Update a Data Check-in Job

3.5.2 Delete a Data Check-in Job

In the Data Check-in Jobs view, depicted in Figure 3 by selecting Delete from the options menu at the right side of each data check-in job, the data asset provider can delete a data check-in job. This will delete completely and permanently the configuration which means that if a data asset provider wants to execute again a data check-in job, he/she will not be able to do so. It needs to be noted that deleting a data check-in job does not affect the data that have been already stored in the SYNERGY Platform which can be deleted as described in Section 3.6.2.

3.6 Manage Data Asset Profiles

3.6.1 View all Data Asset Profiles

The data asset provider may view the list of all the data asset profiles that belong to his/her organisation or have been acquired by his/her organisation in the Assets View as shown in Figure 56, regardless its status (e.g. deprecated, incomplete, available). By selecting the options icon located at the right side of each row, the data asset provider may delete, or edit a particular data asset profile. The editing of a data asset profile, involves the same procedure followed during the definition of a new data asset profile as described in Section 3.2.3.

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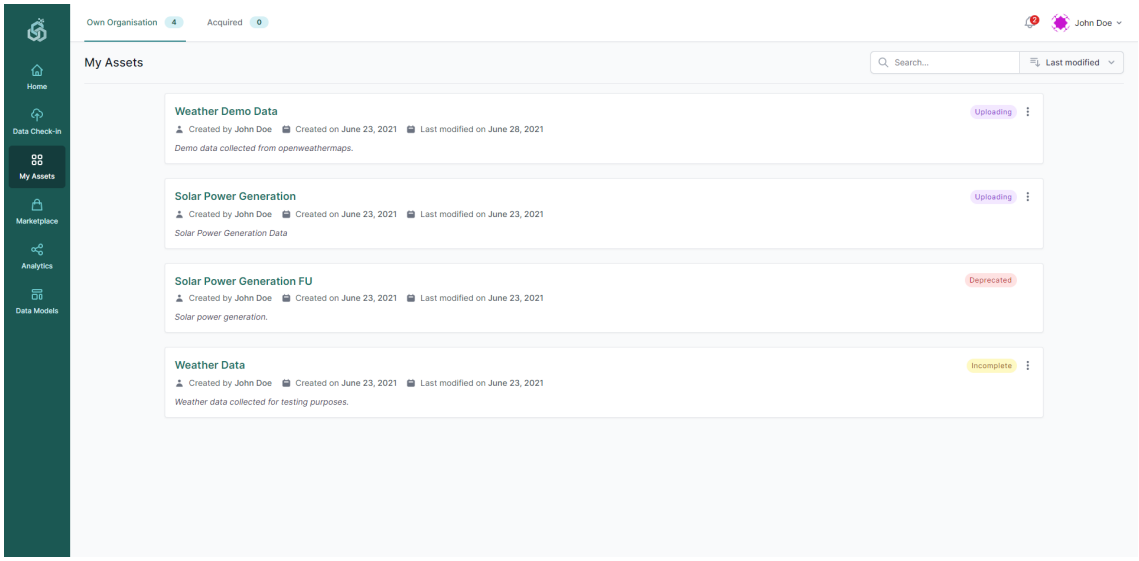

Figure 56: View all Data Asset Profiles

3.6.2 Delete a Data Asset Profile

A data asset provider may delete a Data Asset Profile by selecting Delete from the options menu located at the right side of each Data Asset Profile, as depicted in Figure 56. It needs to be noted that the actual data associated with the Data Asset Profile are deleted in case there is no active data asset contract. Any data retrieval operations associated with the specific dataset (as described in Section 4.3) are not available after the deletion of a particular Data Asset Profile, while the corresponding entry (in terms of metadata) will remain in the SYNERGY Platform as a deprecated Data Asset.

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4 Data Search and Acquisition User Journey

A fundamental goal of the SYNERGY Platform is to provide all the functionalities needed for sharing and trading data assets in a secure and trustful manner, to stakeholders of the electricity data value chain. It needs to be noted that data assets can range from raw data, to datasets, analytics results, and others. Hence, it is of high importance that data asset consumers that need to acquire data assets from data asset providers, reach an agreement stating the data sharing terms that is prepared based on the contract preparation process followed in the SYNERGY Platform. The contract preparation process is described in the subsequent subsections, while the different steps are depicted in Figure 57. In particular, a data asset consumer may request for quotation for a particular (or possibly multiple) data assets; the data asset provider receives the request for this data asset, checks its content, and prepares a draft data asset contract which is then sent back to the asset consumer to accept, negotiate, or reject the prepared draft contract accordingly. This process is repeated until the data asset consumer and the data asset provider reach consensus, and hence they can settle the contract which is then activated by the SYNERGY Platform.

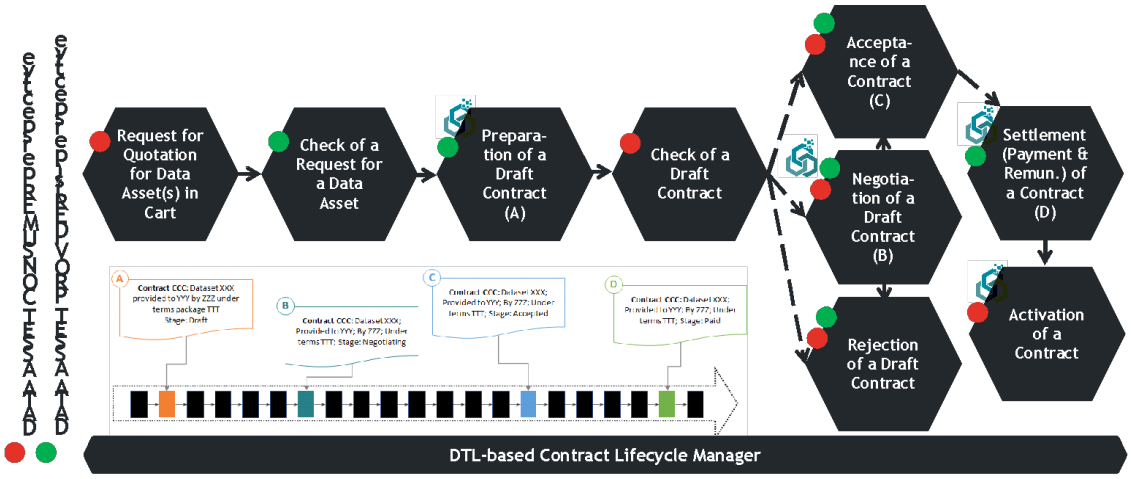

Figure 57: Contract Preparation Process

Once the data asset consumer has an active contract with the provider, the acquired data asset is available for use in the SYNERGY Platform (in the consumer's organization Secure Experimentation Playground and / or locally in consumer's On-Premise Environment, if the contract's terms allow it). It needs to be noted that both stakeholders of the electricity data value chain and the SYNERGY energy apps developers are expected to utilize the data search and acquisition user journey to get access to data from different stakeholders in the SYNERGY Platform. In this section, the core three components involved in the Data Sharing Services Bundle, namely (a) the Data & AI Marketplace, (b)

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the Contracts Lifecycle Manager, and (c) the Remuneration Engine are described through the Data Search and Acquisition User Journey.

4.1 Navigate to the SYNERGY Marketplace

Data asset consumers may access the SYNERGY Data & AI Marketplace where they can navigate through the data assets that they are eligible to view (upon satisfying the access policies set by their respective providers).

As depicted in Figure 58, data asset consumers view highlight info regarding each data asset such as the type of data asset (i.e., dataset in this beta release), the title of the data asset, a short description regarding the data asset, the organisation that owns or manages the data asset, and a cover image related to the data asset. It needs to be noted that data assets that are stored locally are considered as not to be shared and are not shown in the SYNERGY Marketplace.

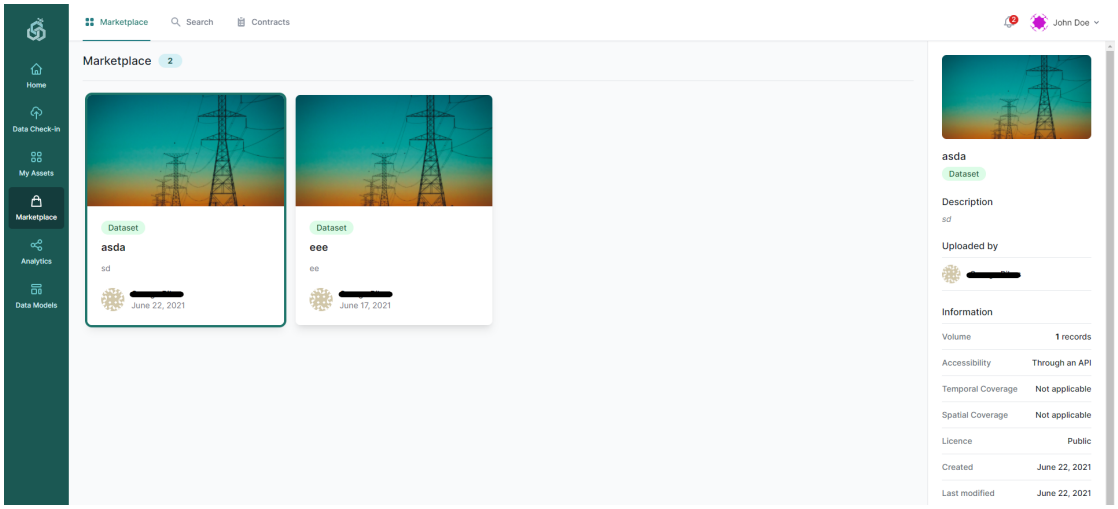

Figure 58: SYNERGY Data & AI Marketplace

Data asset consumers navigating through the SYNERGY Marketplace, can potentially search for a particular data asset by typing in the search bar, and/or by browsing data assets by different parameters (e.g. domain, category, accessibility, type, format, and language). The corresponding results from the search functionality are filtered and displayed directly in the Results View, as depicted in Figure 59, where one can sort the results based on relevance, title, date available, date modified, and volume.

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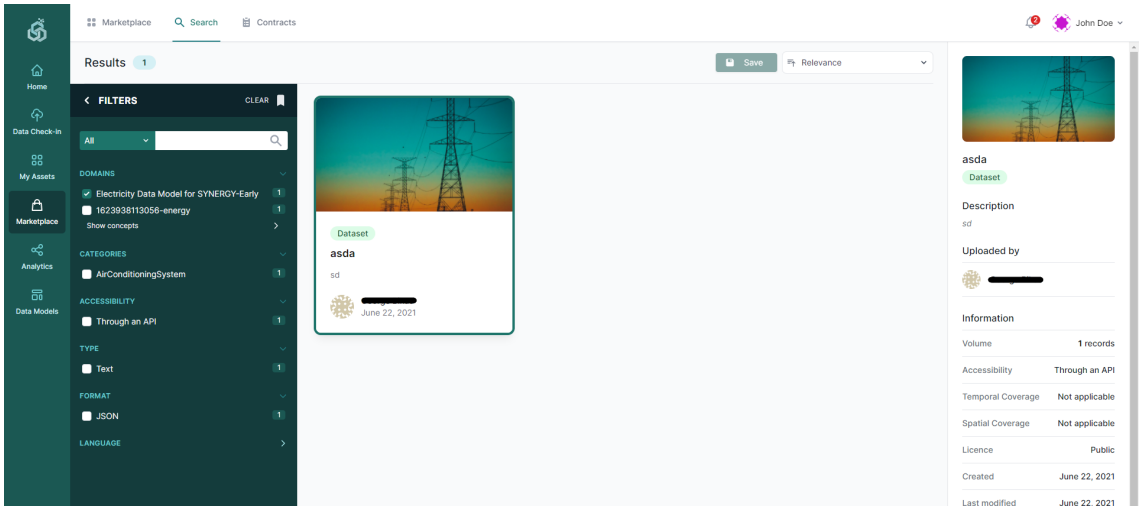

Figure 59: Search Page

If the data asset consumer selects a particular data asset in the Marketplace, he/she will be redirected in a new browser tab where the overview and more detailed information of the data asset regarding license information, and data structure (as described in Section 3.1.3) will appear.

Additionally, a data asset consumer may perform advanced queries by selecting a domain of his/her interest which reveals the Show concepts button that enables the Concepts slideover as shown in Figure 60. Hence the data asset consumer may select multiple fields/concepts to build a data query, which enables the Data Query slideover for adding, editing, or removing conditions to the query.

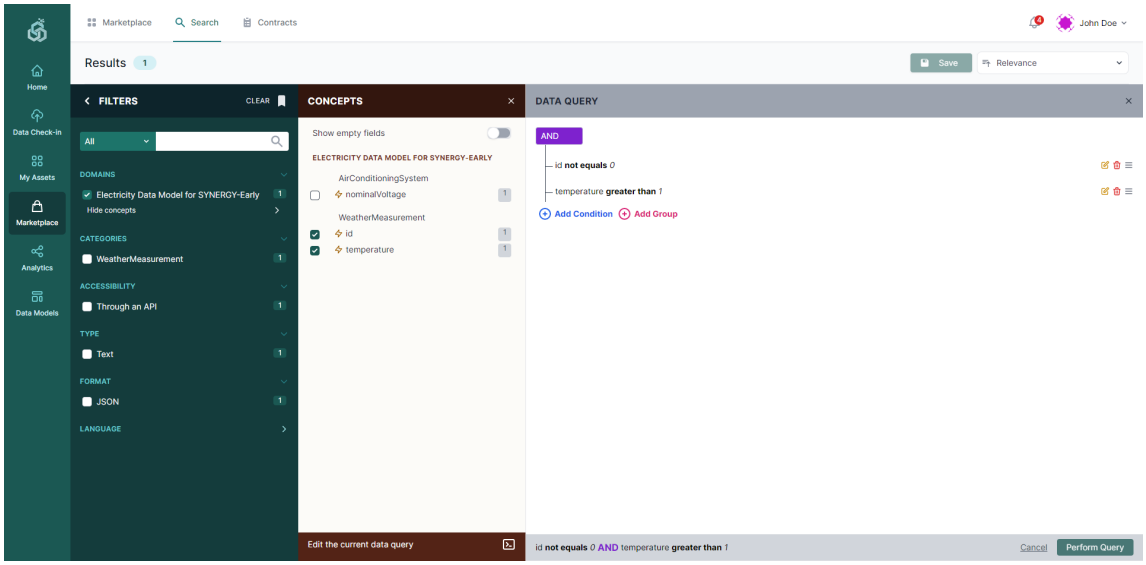

Figure 60: Search Page - Advanced Data Query

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Selecting to “Perform a Query”, a search within the selected concepts and the added conditions is triggered, and the corresponding results are shown as in Figure 61.

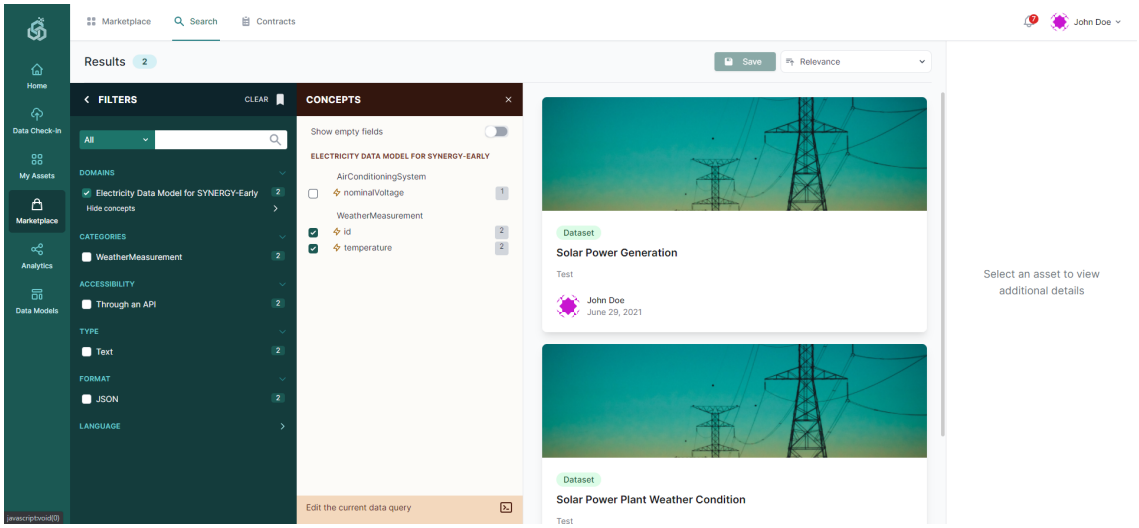

Figure 61: Search Page - Advanced Data Query - Results

4.2 Acquire a Data Asset

As organisations in the SYNERGY Platform may undertake the role of both data asset providers and consumers, their members may view the contracts of the data assets they are involved in (as data asset providers or consumers), search for a particular contract, filter the contracts based on their status, and sort them, as shown in Figure 62. These contracts are visible in a list view, while for each contract, basic information such as the data asset title, the contract details (i.e., date created, date last updated, data asset provider, data consumer), the contract status, and any available action.

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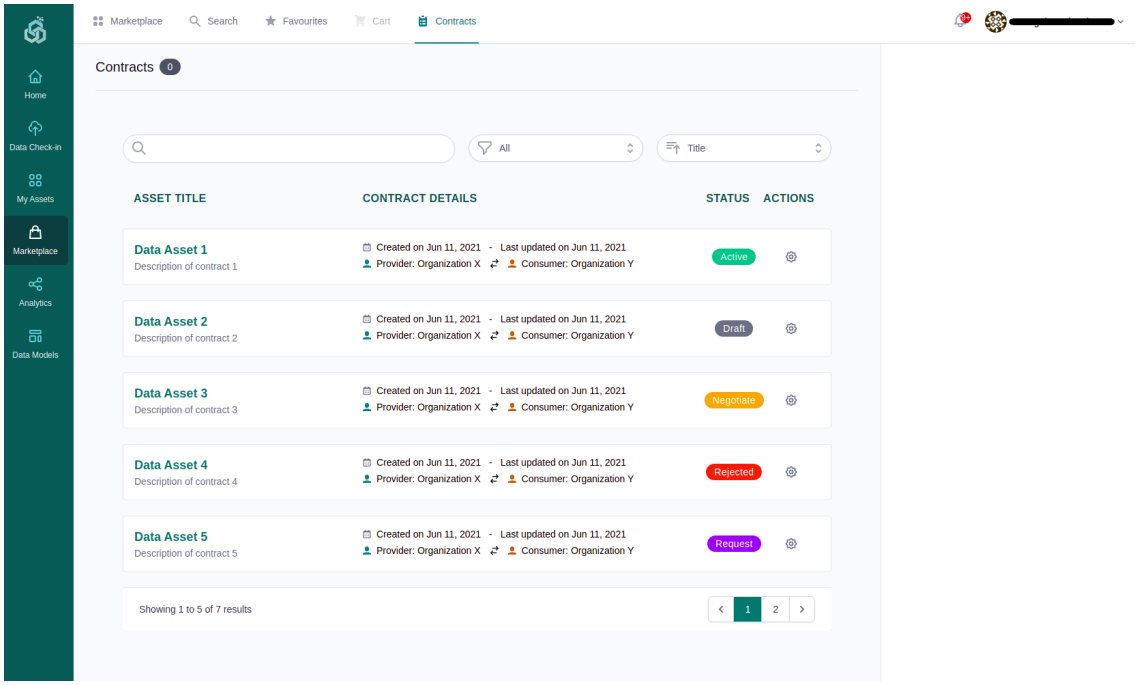

Figure 62: SYNERGY Data & AI Marketplace – Contracts List

Data asset consumers may initiate the process for formally acquiring a data asset by creating a request to the data asset provider as shown in Figure 63. In particular, the data asset consumer needs to insert the details regarding the data asset request, and specifically to select the duration of use of the data asset (including any updates available during the respective period), to select whether the data asset will be used exclusively in the SYNERGY platform or if the data consumer would like to download the data asset "locally" through the SYNERGY Platform APIs. In addition to these, the data asset consumer should optionally insert a message to be provided to the data asset provider, describing how the data asset will be used. Then, the data asset consumer may view the data asset structure and the processing rules that have been applied on the data, and select the exact fields to be acquired, if not the whole data asset. During this step, the data asset consumer may also apply filters to the (unencrypted) fields to obtain a data asset "slice", whenever applicable. Once the data

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asset consumer is satisfied with the details inserted regarding the request of the data asset, he/she is able to submit the request to the organisation's manager at the data asset provider side.

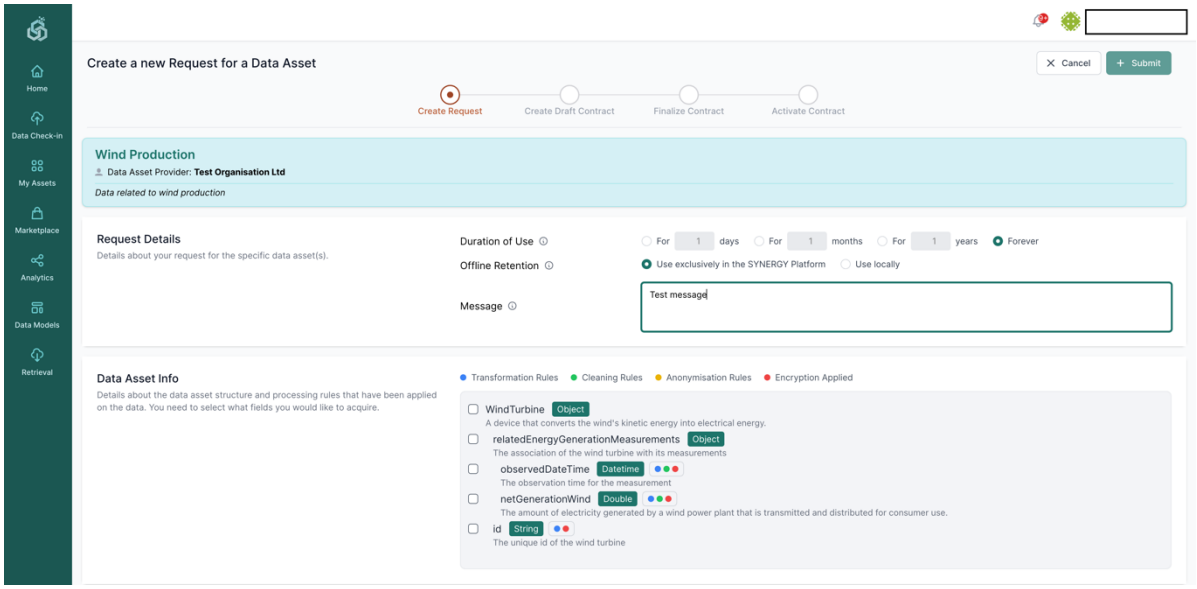

Figure 63: Request for Data Asset Acquisition by the Organisation's Manager (Consumer Perspective)

4.2.1 Review a Data Asset Request (Data Asset Provider Perspective)

The manager of the organisation (acting as the data asset provider) is able to review the details of each request made by a potential data asset consumer. He/she proceeds to reject or accept the request for the data asset based on the information provided, as depicted in Figure 64.

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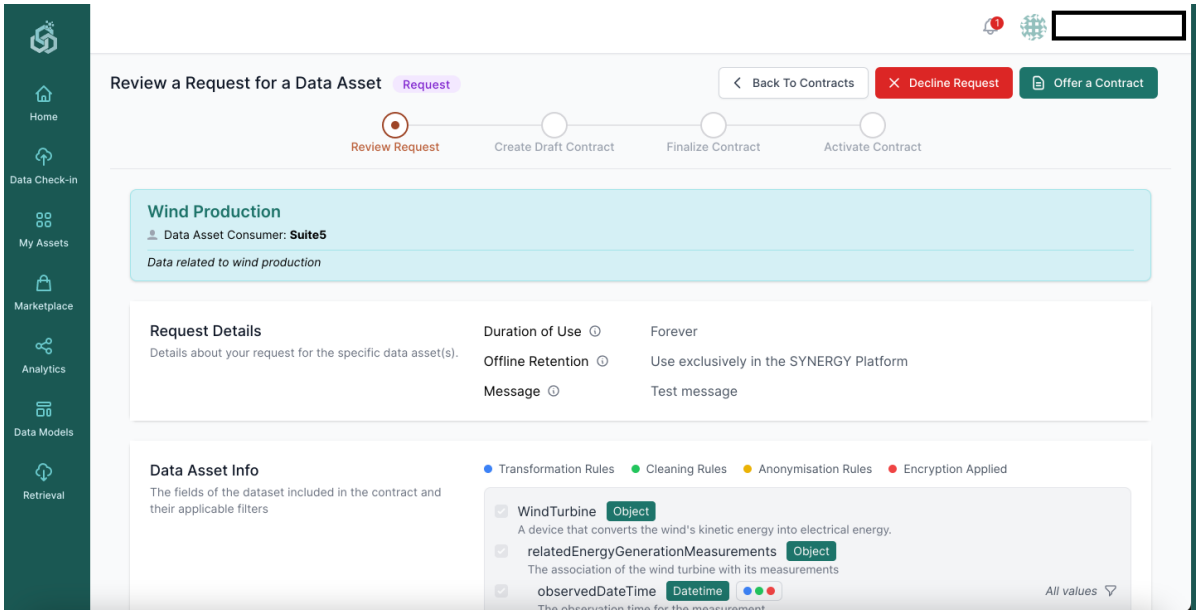

Figure 64: Review Request for Data Asset Acquisition by the Organisation's Manager (Provider Perspective)

4.2.2 Prepare a draft contract (Data Asset Provider Perspective)

In case the organisation's manager acting as data asset provider has accepted the request, a draft contract for the corresponding data asset is prepared as shown in Figure 65. The manager may review once more the details regarding the data asset and its licensing, define the payment details, and prepare the contract terms that concern the data asset acquisition between the data asset provider and consumer. It needs to be noted that the terms that are enforced by the SYNERGY Platform are also listed and cannot be edited by any party.

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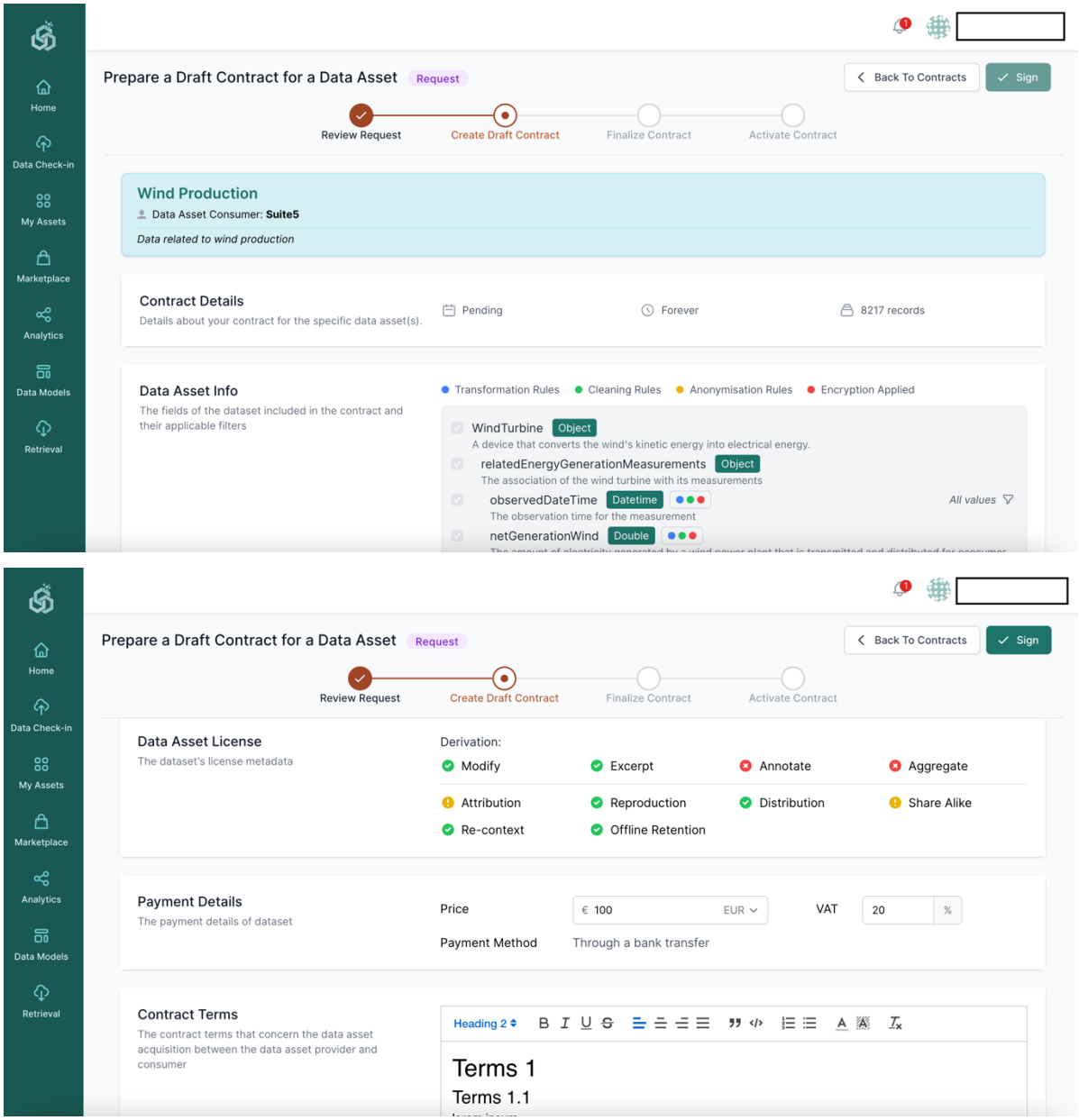

Figure 65: Create Draft Contract for Data Asset Acquisition by the Organisation's Manager (Provider Perspective)

The organisation's manager is then able to sign the draft contract upon inserting the password of the organisation's wallet (which he/she manages), in order to unlock the wallet and sign the draft contract in the blockchain.

4.2.3 Review a draft contract (Data Asset Consumer Perspective)

Once a draft contract is signed by the data asset provider organisation, the manager of the data consumer organisation is notified and may view the contract details, as shown in Figure 66. Upon

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reviewing the details of the draft contract prepared by the data asset provider, the manager of the data asset consumer may accept, negotiate or reject the offer accordingly. During this step, the data asset consumer is also able to download the draft contract as a pdf file.

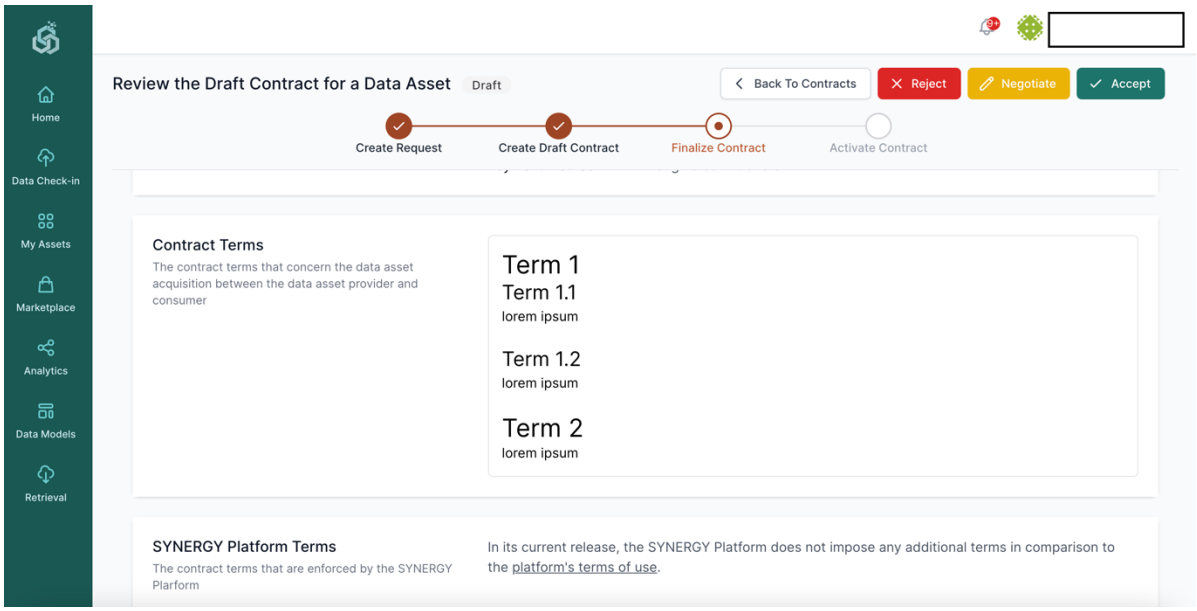

Figure 66: Review Draft Contract for Data Asset Acquisition (Consumer Perspective)

If the manager representing the data asset consumer has opted to accept the draft contract, he/she is prompted to insert the organisation's wallet password and write the contract to the SYNERGY blockchain (as depicted in Figure 67). The process continues as described in Section 4.2.7.

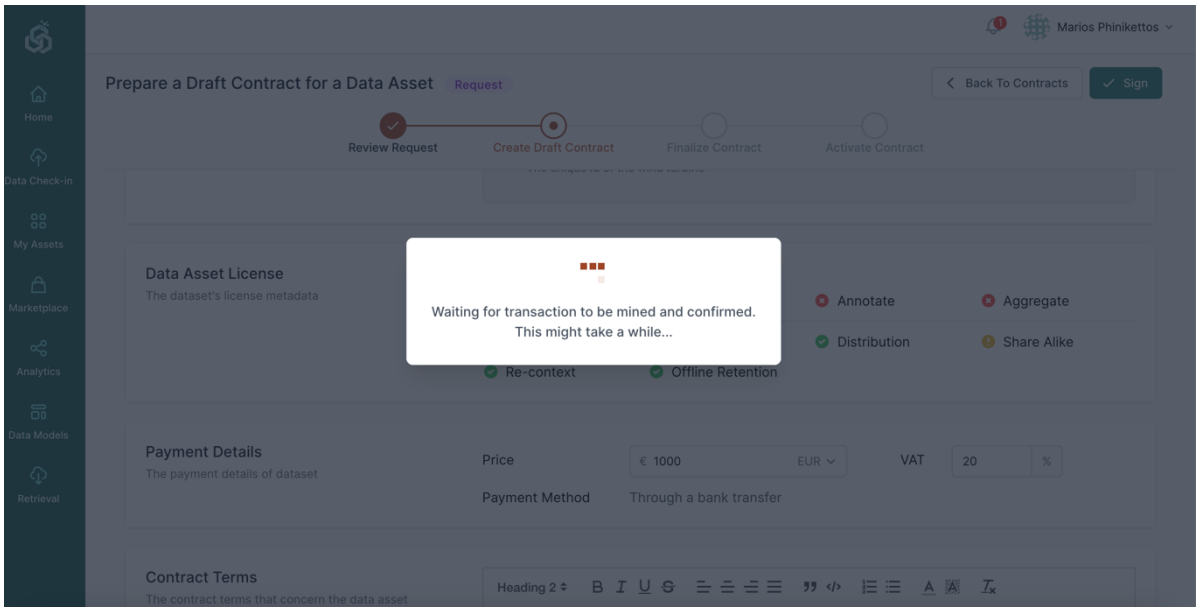

Figure 67: Sign a Contract for Data Asset Acquisition (Consumer/Provider Perspective)

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On the contrary, if the manager representing the data asset consumer has rejected the draft contract's terms, then the process concludes, and the data asset consumer does not get access to the requested data asset. The data asset provider also views the contract with "rejected" status.

4.2.4 Negotiate a draft contract (Data Asset Consumer Perspective)

In case that the data asset consumer chooses to negotiate any part of the contract, e.g. regarding payment and/or terms (as displayed in Figure 68), he/she is able to change the payment details such as the cost, as well as update the contract terms by adding new terms, editing or removing the existing ones. Following that, the data consumer manager will be able to sign the revised contract, by inserting the organisation's wallet password and writing the contract to the SYNERGY blockchain.

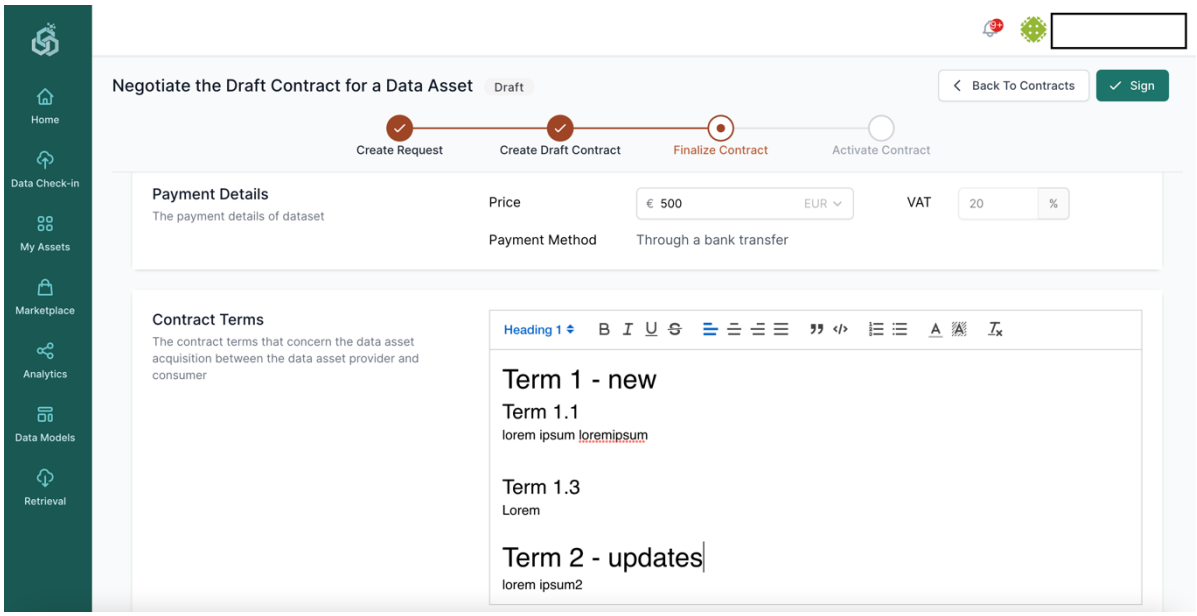

Figure 68: Negotiate Draft Contract for Data Asset Acquisition (Consumer Perspective)

4.2.5 Review a revised contract (Data Asset Provider Perspective)

Once a contract is revised, the data asset provider manager needs to review the changes that the data consumer asked for, as shown in Figure 69. As it happened in the case of the draft contract on behalf of the data asset consumer, though, in Section 3.3.4, a data asset provider is able to accept, reject or further negotiate the revised contract.

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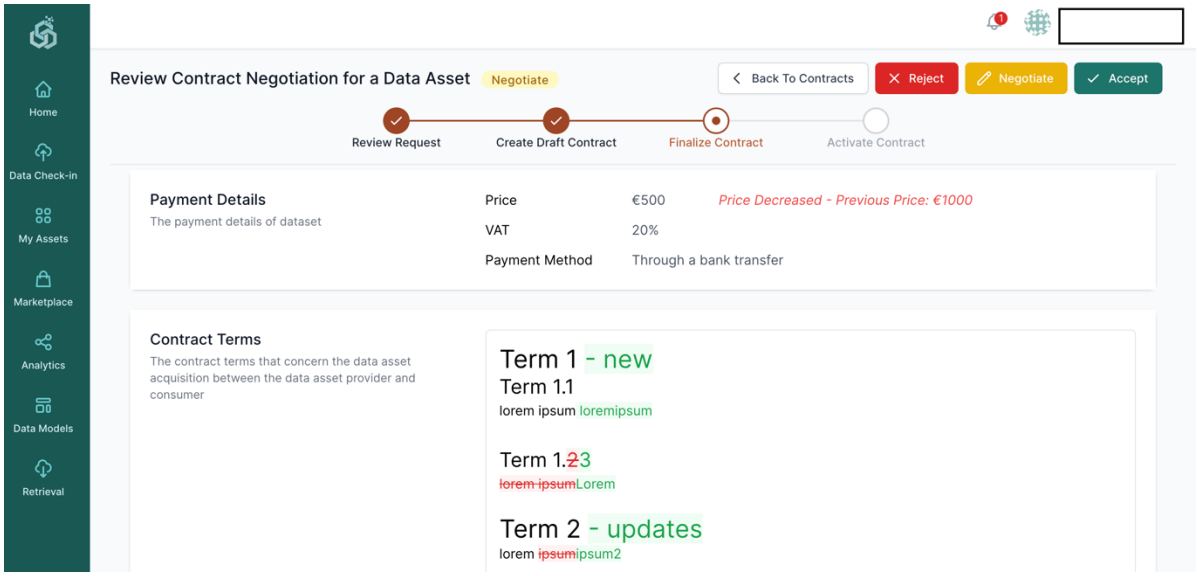

Figure 69: Review Updated Draft Contract for Data Asset Acquisition (Provider Perspective)

It needs to be noted that this procedure described in Sections 4.2.4, 4.2.5 and 4.2.6 may iterate until both the data asset provider and data asset consumer are satisfied with the contract for the data asset acquisition.

4.2.6 Settle a finalized contract (Data Asset Provider Perspective)

Once the data asset provider and the data asset consumer have reached consensus and signed the same version of the contract, the respective payment, if any, needs to be settled according to the payment method that is mentioned in the signed contract. In the initial version of the SYNERGY platform, when the data consumer has paid the price of the data asset as dictated in the contract's terms, the data asset provider needs to confirm the payment and thus the contract will be activated as shown in Figure 70.

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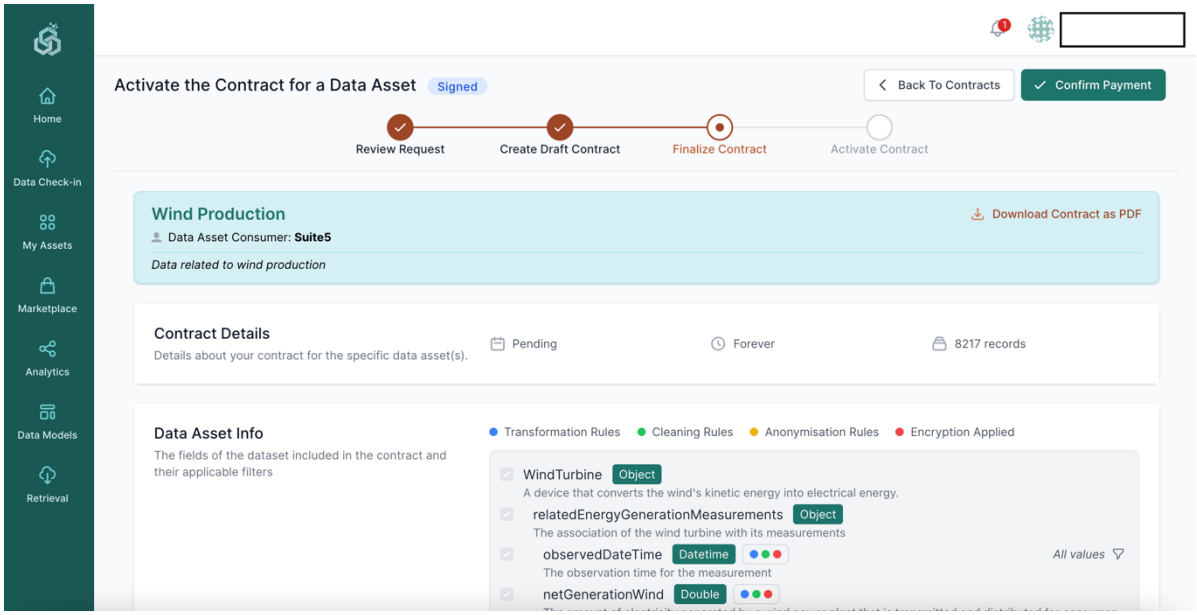

Figure 70: Activate Draft Contract for Data Asset Acquisition (Provider Perspective)

As soon as the contract has been activated by the data asset provider, the data consumer is eligible to acquire the data asset according to the contract's terms, e.g. the SYNERGY platform transfers the data asset to the data asset consumer's Secure Experimentation Playground (for use only in the SYNERGY platform).

4.3 Retrieve a Data Asset

4.3.1 Create a Retrieval Query

Data asset consumers may create a new Retrieval Query defining its title, description and acquisition method as described in the following figure.

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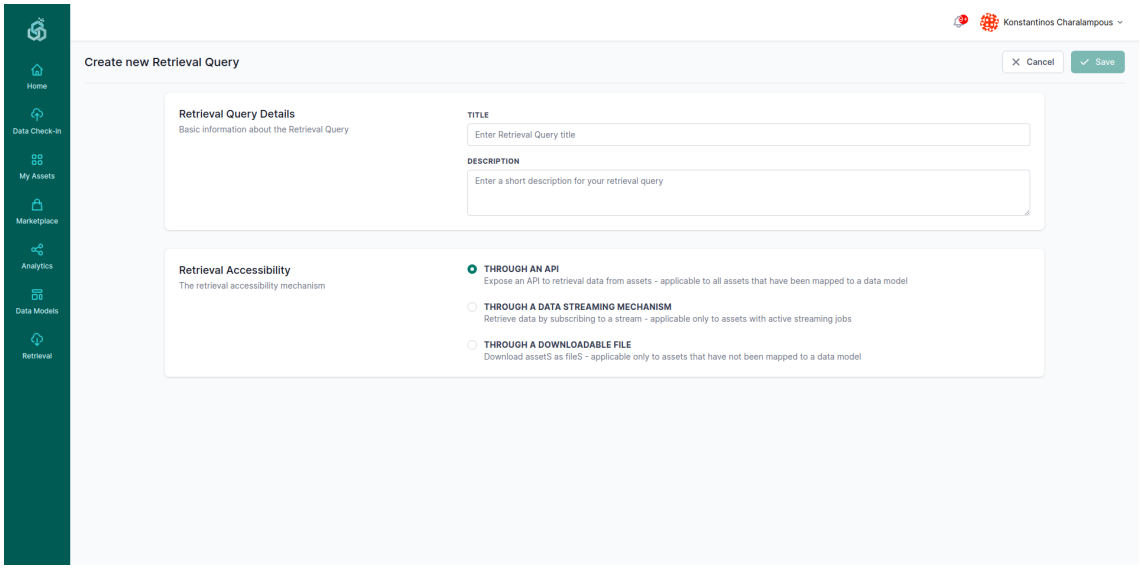

As depicted in Figure 71, he/she needs to select the concepts from the selected data assets that will be extracted and returned as search query results. In the next step, the retrieval configuration needs to be provided by selecting the concepts which the members of an organisation want to extract from each selected dataset. In addition, the concepts that will be used as query parameters to filter the query results need to be defined (with different options becoming available depending on the concept's data type). In case where two or more data assets were selected, the users need to define the join parameters (concepts) from each dataset that will be used to merge the different datasets in the data to be exposed through the SYNERGY APIs. The query results that will be returned can be filtered by different concepts/fields that can be used as query parameters.

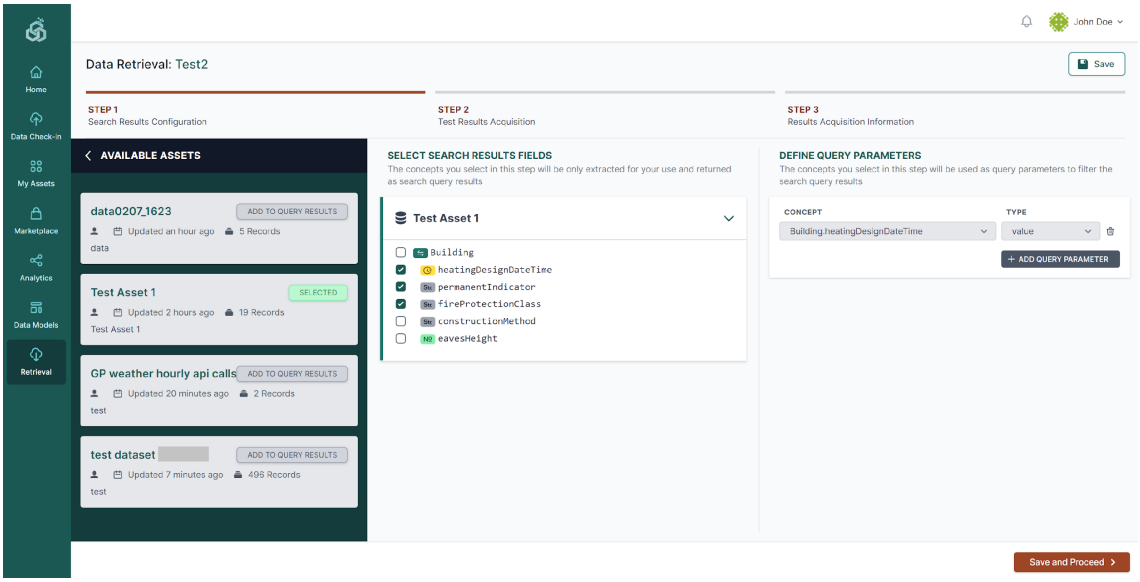

Figure 71: Search Query Definition (Step 1)

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Following that, as depicted in Figure 72, at the left side of this page, the users shall be able to edit the body with indicative values for the concepts/fields, to be used as the query parameters in order to appropriately filter the dataset, while at the right side of the page, a sample preview of the result is shown after selecting Run Query to acquire the sample of the query results.

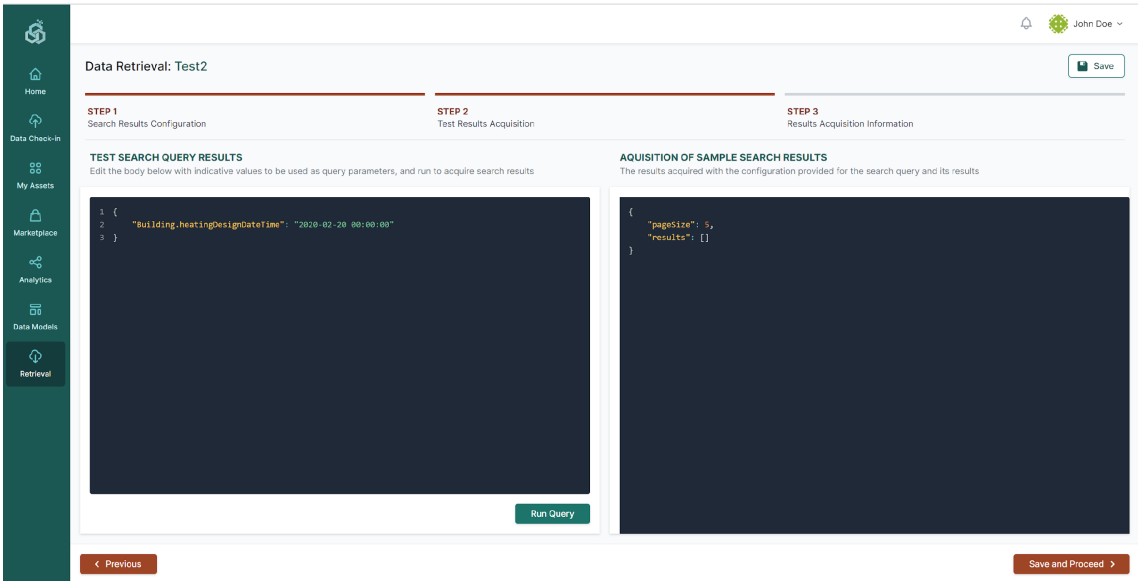

Figure 72: Search Results Configuration (Step 2)

The last step of the retrieval configuration, after selecting Save and Proceed, instructs the users how to acquire the retrieval results through the SYNERGY APIs as depicted in Figure 73. Instructions regarding authentication, API usage, pagination and sorting of results are provided in addition to the endpoints (i.e., for GET and POST methods) including the full API paths containing the BASE URL and the different path segments to be used for the query, and the query body (for the POST method). It needs to be noted that the platform requires the user requesting retrieval from API, and receiving the associated query results, to be authenticated by adding an already generated retrieve access token into an X-API-TOKEN header of the request. In case that there the data asset consumer does not have an already generated retrieve access token, he/she needs to generate one by selecting the "generate a new one" link, and then to follow the same procedure to add it into the request header. Finally, the API query results can be saved by selecting the Save button, while additional options for sorting and paginating the results are available. For sorting the results in a specific order, the data asset consumer needs to provide sorting query parameters (e.g. orderBy that specifies the full path of the field to be ordered by, and orderDirection that specifies the ordering direction - ASC for ascending ordering - and DESC for descending ordering) in the request. For paginating the results, the data asset consumer needs to provide a value for the pageSize parameter which is by default 50.

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Once the data asset consumer has executed the request, he/she will receive a lastRecordId variable that is a reference to the last retrieved record which needs to be included in the subsequent request as a parameter. The same process needs to be followed for paginating the next results. It needs to be noted that by default, a maximum of 100 results per dataset can be returned if the data asset consumer has selected multiple datasets in the first step of the Query Retrieval Creation, and hence he/she is responsible to adjust the query parameters as mentioned already to get more results.

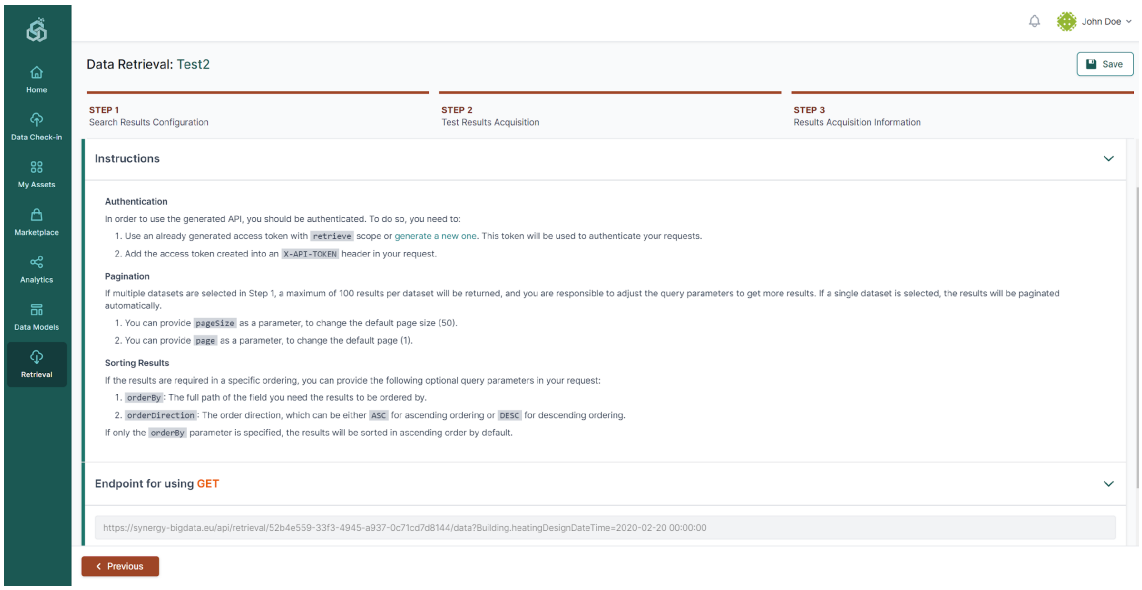

Figure 73: Test Results Acquisition (Step 3)

It needs to be noted that if any of the data assets appearing in a retrieval query has been deprecated or their respective provider(s) have revoked access to them (through changes in the access policies or the involved contract has expired), a notification is displayed to the data asset consumer.

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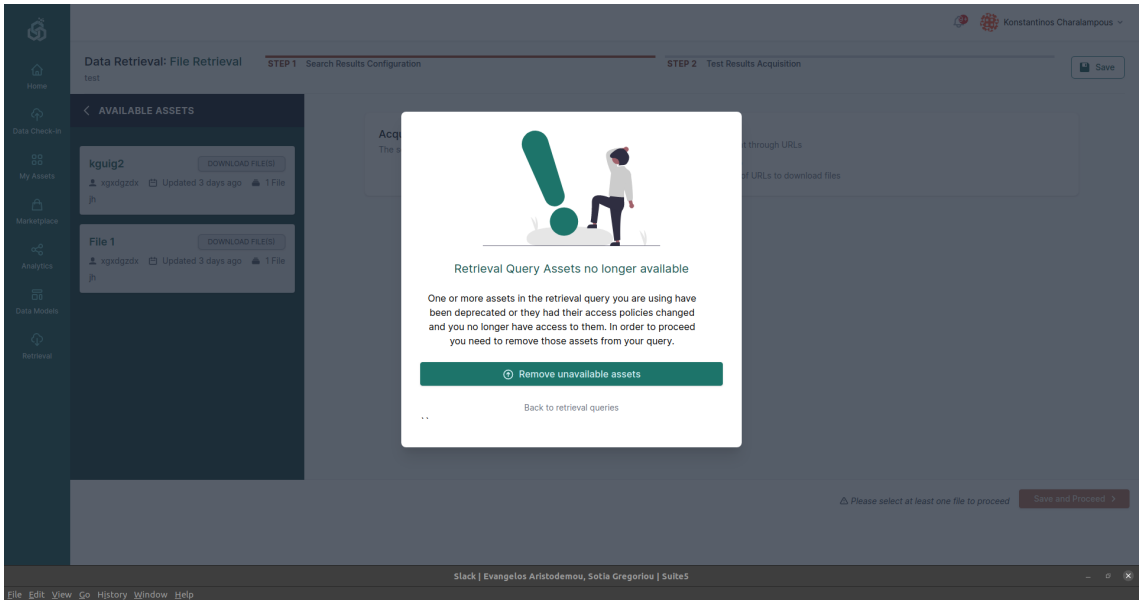

Figure 74: Effect of changes in data asset availability in retrieval queries

4.3.2 View all Saved Queries

A user may view all the queries that have been saved in the SYNERGY Platform, following the creation of a new retrieval query as described in the previous section. The list of saved queries can be accessed through the bookmark button located in the search bar as shown in Figure 75. The Saved Queries list allows the user to rename or delete a saved query by clicking on the options available for each query. Moreover, the user may access the saved query by clicking on its name from the Saved Queries list, and directly the data assets that were added to the query results will be automatically selected, allowing the user to edit the current saved query by adding or removing query results from the saved query.

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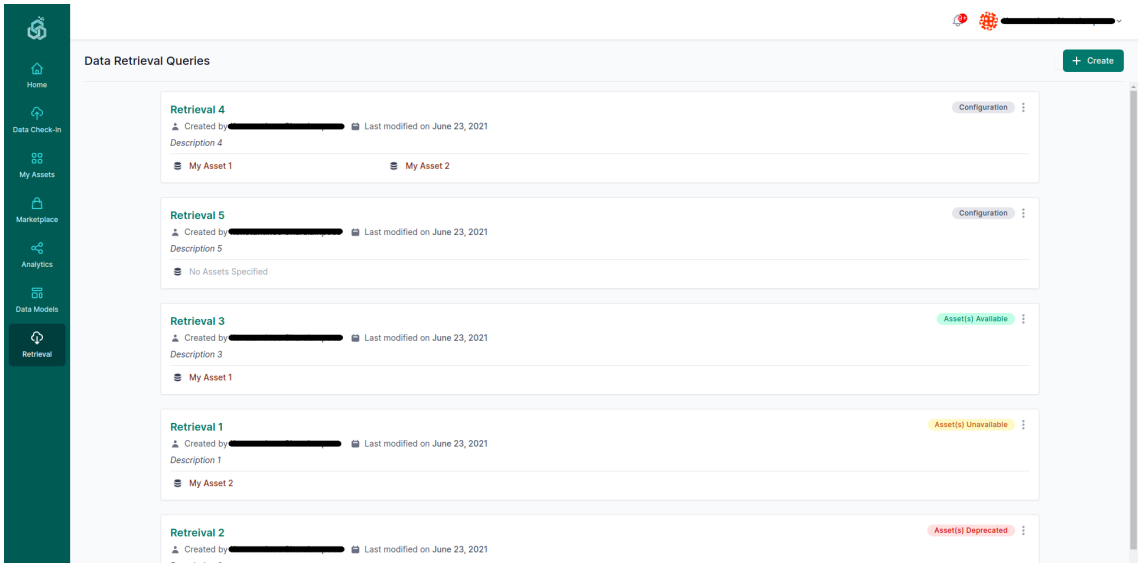

Figure 75: View Saved Queries

5 Data Analytics User Journey

The SYNERGY Platform provides the Data Analytics Services Bundle, described in D4.1 "SYNERGY Data Analytics, Sharing & Matchmaking Services Bundles – Beta Release", that offers all the functionalities around data processing and analysis to gain valuable insights over data assets that have been checked-in in the SYNERGY Platform as discussed in Section 3, or have been acquired from other electricity data value chain stakeholders (according to the Data Search & Acquisition User Journey described in Section 4). As mentioned in D4.1 "SYNERGY Data Analytics, Sharing & Matchmaking Services Bundles – Beta Release", there are five main components included in the Data Analytics Services Bundle, namely: (a) the Analytics Workbench, (b) the Visualization & Reporting Engine, (c) the Data Manipulation Service, (d) the Analytics Execution Service, and (e) the Secure Results Export Service. These components are described in this section divided into four different workflows (i.e. View all Analytics Pipelines, Create an Analytics Pipeline, Configure an Analytics Pipeline, and Visualization Results of an Analytics Pipeline). Similarly, as in the case of Data Check-in workflow, there is a distinct separation between the design of a data analytics pipeline and its execution either in the organisation's Secure Experimentation Playground in the cloud, or on-premise. Although both data asset providers and data asset consumers may proceed to the Data Analytics User Journey, they will be referred to as data asset consumers, for brevity. It needs to be noted that both stakeholders

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of the electricity data value chain and the SYNERGY energy apps developers are expected to utilize the data analytics user journey to run analytics on the SYNERGY Platform.

5.1 View all Analytics Pipelines

The data asset consumers may see all the analytics pipelines they have defined as depicted in Figure 76, where the details, the status and the available actions for each analytics pipeline is displayed. A data asset provider may sort the list of analytics pipelines by the title, the date it was created, the date it was executed, the latest execution(s) status (since a pipeline may be executed multiple times according to a schedule) and the data asset provider (within the organisation) who created it. Clear indications appear when the execution workflow definition of the pipeline is still incomplete or not valid, as well as in the cases of pending pipelines that are scheduled to be executed in the future, while successful and failed executions are highlighted with appropriate icons. Finally, a data asset provider may select to configure or remove a pipeline, to view the results of the pipeline in the pipeline results view (as described in Section 4.4), and view the pipeline execution log, from the Actions column.

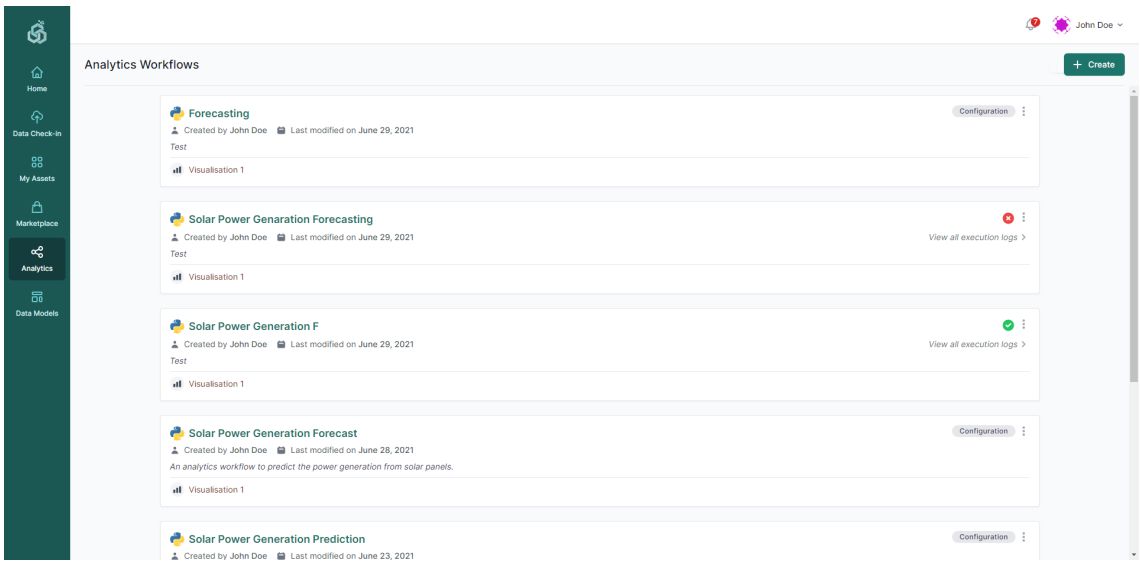

Figure 76: View all Analytics Pipelines

5.2 Create an Analytics Pipeline

A data asset provider may create a new analytics pipeline through the Data Analytics view by selecting the Create button, as shown in Figure 76. Initially, the view for creating a new Workflow

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appears as depicted in Figure 77, where the data asset provider needs to insert some basic details such as a title, and a short description that essentially provides an overview of this data analytics pipeline job. Then, the data asset provider needs to select the execution framework of their analytics pipeline, that is the framework (i.e., Apache Spark engine, or Python environment) that will be used for the data processing tasks included in the pipeline. In addition, the location where the analytics pipeline job will be executed (i.e., Cloud Execution, or On-Premise Execution), needs to be defined as well. It needs to be noted that, running the analytics pipeline on the Cloud Execution is the only available option if the data asset consumer selects the Apache Spark framework for running the analytics pipeline. In contrast, the data asset consumer is able to run the analytics pipeline on all the available execution locations (i.e., Cloud Execution, On-Premise Execution) using a Python environment. It needs to be noted that local execution can run analytics only over data that are stored locally at the moment (since no transfer of data from the cloud to the On-Premise Environment is allowed in this release). By clicking on the Save button, the Analytics Workbench page loads accordingly as described in the subsequent section.

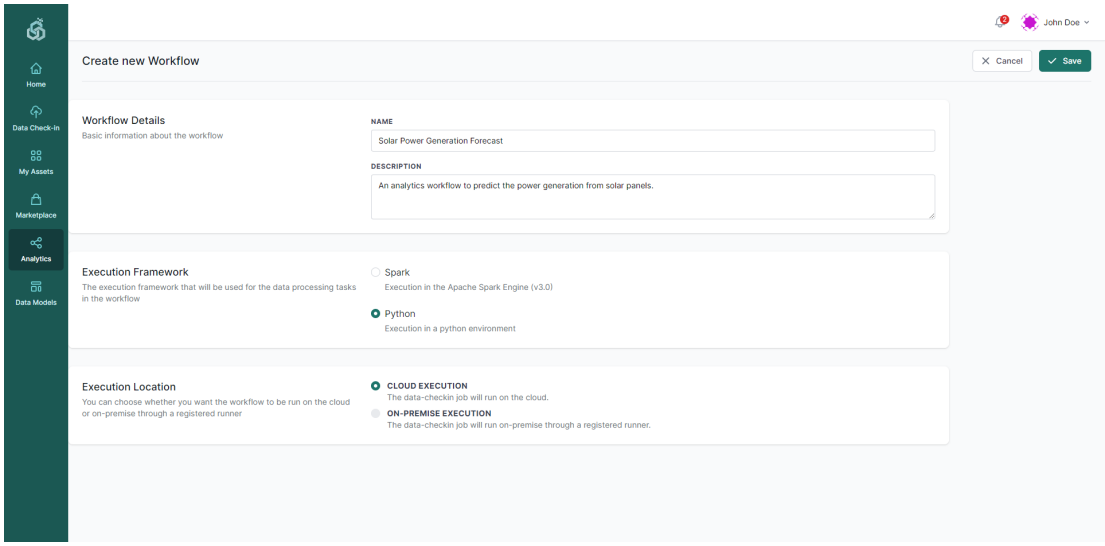

Figure 77: Create a new Analytics Pipeline

5.3 Configure an Analytics Pipeline

Through the Analytics Workbench, data asset providers are able to appropriately configure a complete analytics pipeline, by defining the necessary input data (input blocks), the data manipulation functions (data preparation), the machine learning (ML) algorithms that are to be applied on the data, and the output data (output block) for storing the results of an analytics pipeline.

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This configuration is done by connecting these different pipes/function blocks such that the whole analytics pipeline is designed in a visual manner, in the form of easily configurable blocks that are appropriately connected to form the final data analysis pipeline. Towards the design of a complete data analytics pipeline, three main views are available to support visually the configuration, the validation of changes on the data sample after each function block, and the configuration for visualising the results.

5.3.1 Graph View

The Graph view of the Analytics Workbench allows users to design (in a visual way) an analytics pipeline as shown in Figure 78.

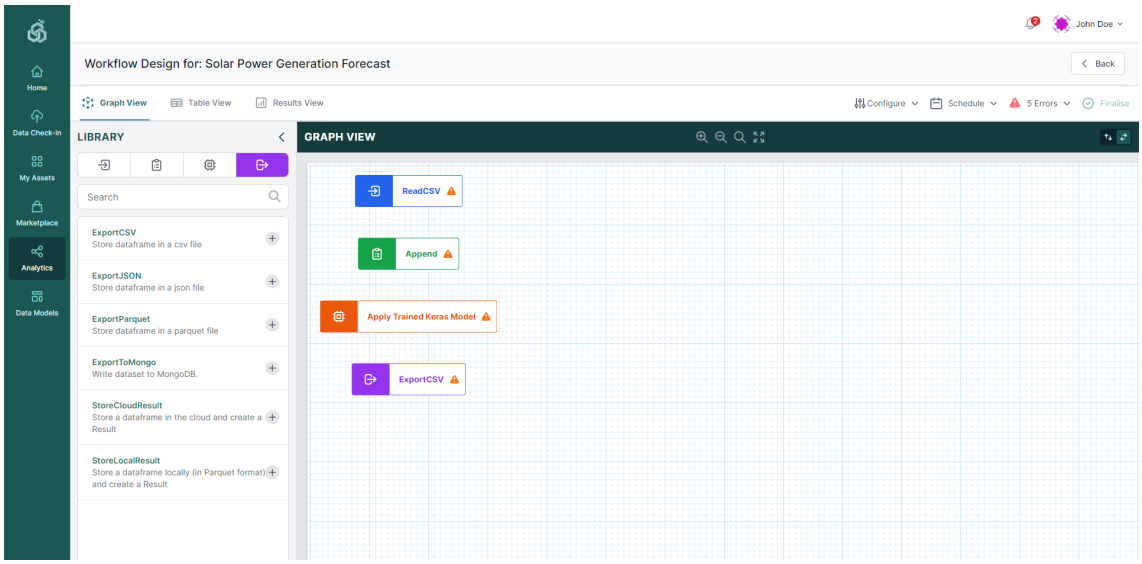

Figure 78: Configure an Analytics Pipeline – Graph View

By searching, browsing and filtering in the Library located at the left side of the view, the data asset providers may find the relevant blocks for their pipeline, i.e. input blocks, data preparation blocks, machine learning (ML) blocks, and output blocks. Upon locating a relevant block needed for the analytics pipeline in the Library, the data asset provider can add them in the main Graph View by selecting the add button (cross icon). Adding a function results in a block that appears in the main Graph View without any connections (directed arrows between blocks), since the connection between the added blocks, is added when the data asset provider configures the block connections in the right slideover. Indicatively the data asset provider should define the method for reading the input data, by adding a particular input block (e.g., Read Dataset which reads a stored data asset, and Read Result which reads an existing result from another data analysis pipeline that has been already

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executed), and inserting its associated parameters accordingly in the right slideover revealed after the block selection, as shown in Figure 79.

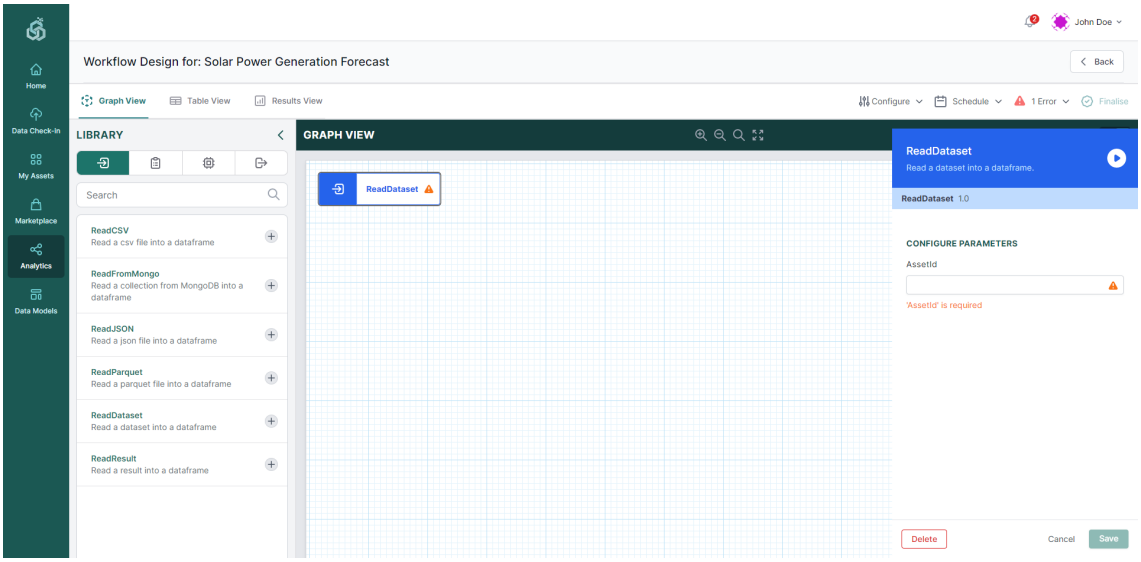

Figure 79: Analytics Pipeline - Input Blocks

Following, the data asset provider may define data preparation rules by adding different processing functions (e.g., sort, drop null values, etc.), that are to be executed before the actual analytics functions, as shown in Figure 80.

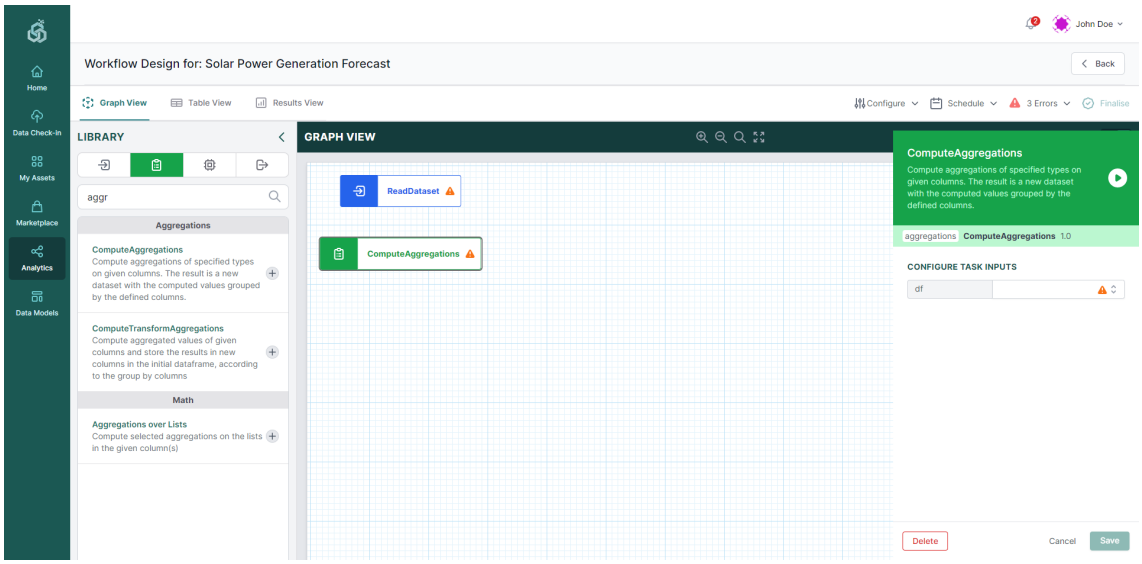

Figure 80: Analytics Pipeline – Data Preparation Blocks

Once the data asset provider has added the input and data preparation blocks, the appropriate machine learning block should be selected depending on the actual analysis that is intended to be done, as shown in Figure 81. The various machine learning blocks are classified into three categories

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based on their use (e.g. evaluate, train, or apply), while the available machine learning algorithms (e.g., Binary Classification, Regression, Clustering, etc.) are allocated accordingly to these categories.

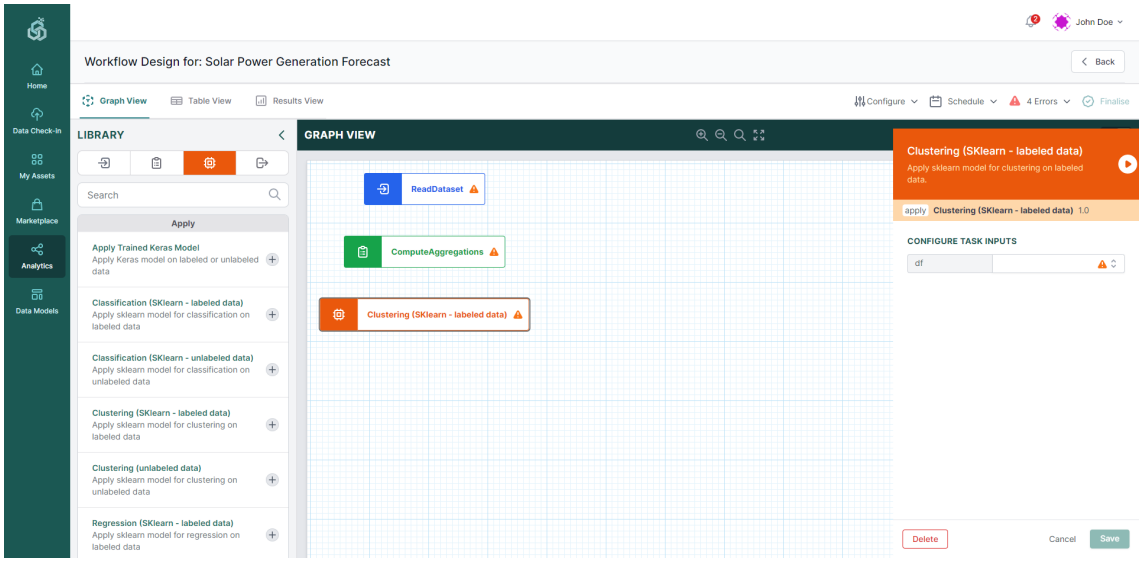

Figure 81: Analytics Pipeline - Machine Learning Blocks

Finally, the data asset provider should define the output block that denotes the way the data will be stored, or obtained from other mechanisms to create a result (e.g., through visualization, through the SYNERGY Platform's APIs, etc.), as shown in Figure 82.

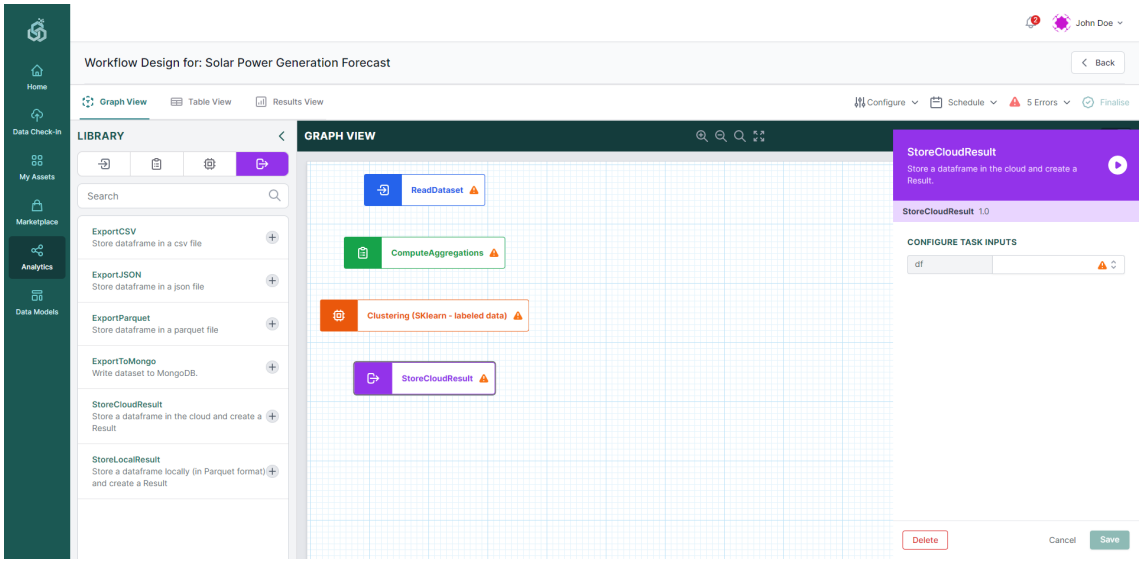

Figure 82: Analytics Pipeline - Output Blocks

Practically, in the Library View, by selecting a block, the data asset provider may view and change the description of that block, see the type and version of the block, define the connections of the block (i.e., upstream tasks, downstream tasks), and define the parameters depending on the block type. By

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selecting the Save button, a quick run over the sample will be executed for the configured block in order to propagate the data structure to next block and a relevant status icon will appear in the right side of the block in the Graph View. Once the blocks are configured correctly, a Valid icon will appear at the top bar of the Analytics Pipeline View. Additionally, the data asset provider may change the name or the description of the Analytics Pipeline by selecting the Configure button.

The available actions in the blocks include: (a) test run in order to execute the pipeline up to the specific block for a small data sample, (b) settings in order to edit or delete a block from the pipeline. In case there are any validation errors in the pipeline, they will be displayed in the appropriate blocks, and a summary of the validation results will be displayed in the Validation Results as shown in Figure 83. The data asset provider may proceed to view the results of the test run by selecting the Table View (Section 5.3.2) from the Workflow Designer top bar, and follow the workflow as described in the subsequent section.

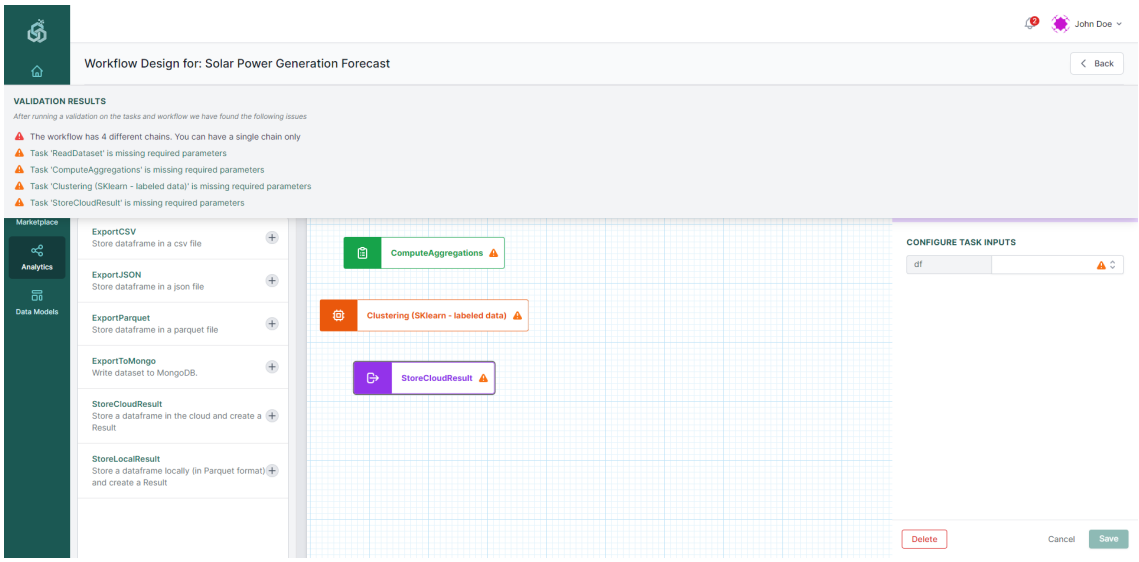

Figure 83: Analytics Pipeline - Validation Results

5.3.2 Table View

In the Table view, depicted in Figure 84, data asset providers obtain an overview of a data sample, and how data change each time they are processed according to the function blocks defined in the previous step. In particular, the data asset provider may view the blocks that constitute the pipeline in the left slideover, while by selecting a particular block the corresponding workflow is highlighted, and the results of the test run appear in the main Table View. Additionally, by selecting a particular block, the data asset provider may change the settings that were defined previously in the Graph

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View. In the main Table View, the data asset consumer may view the different columns of the outcomes and may sort them, search for a specific value or resize them.

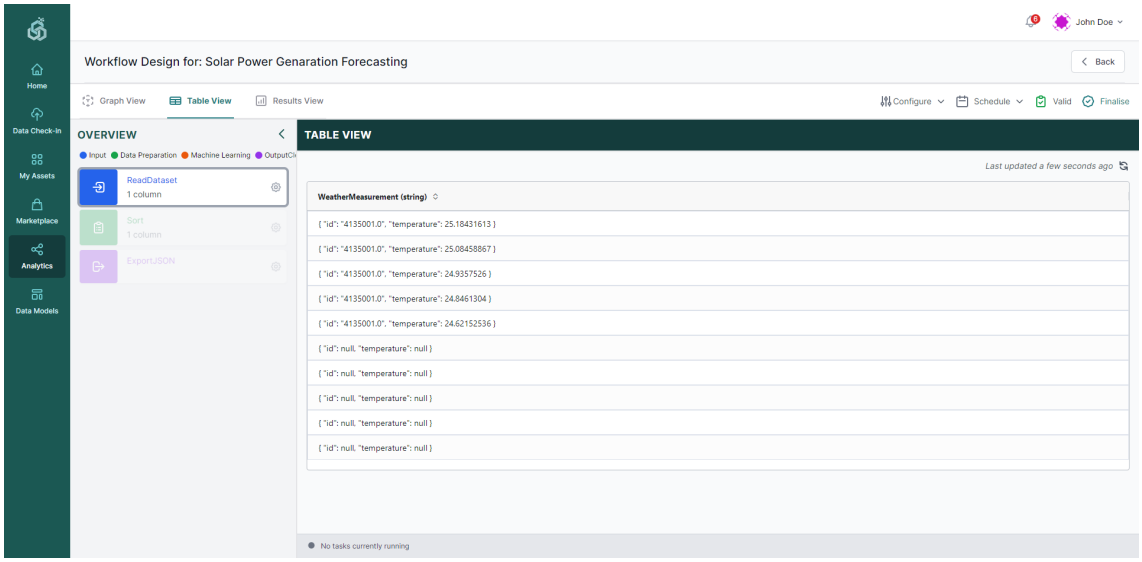

Figure 84: Configure an Analytics Pipeline – Table View

5.3.3 Results View

Once the data asset provider is satisfied with the defined and configured data analytics pipeline, he/she may configure the desired output / visualization of the results from the Results View as shown in Figure 85. In particular, the data asset provider may select the output block that he/she is interested to visualize, and then the type of diagram that needs to be visualized from the left slideover menu that includes all the available visualization types. This menu provides several types of diagrams for visualization such as line graph, scatter plot, and bar chart. Following that, the data asset provider needs to select the appropriate output blocks in order configure the parameters that are to be visualized, from the Configuration right slideover menu. The parameter selection needs to be done for each axis according to the type of the diagram, and the needs of the data asset provider with regards to what is to be visualized. In addition, the data asset provider may add a title for the diagram, legends for the data, axes labels for the diagram, as well as to select among various other options such as to add grids, and tooltip to the diagram.

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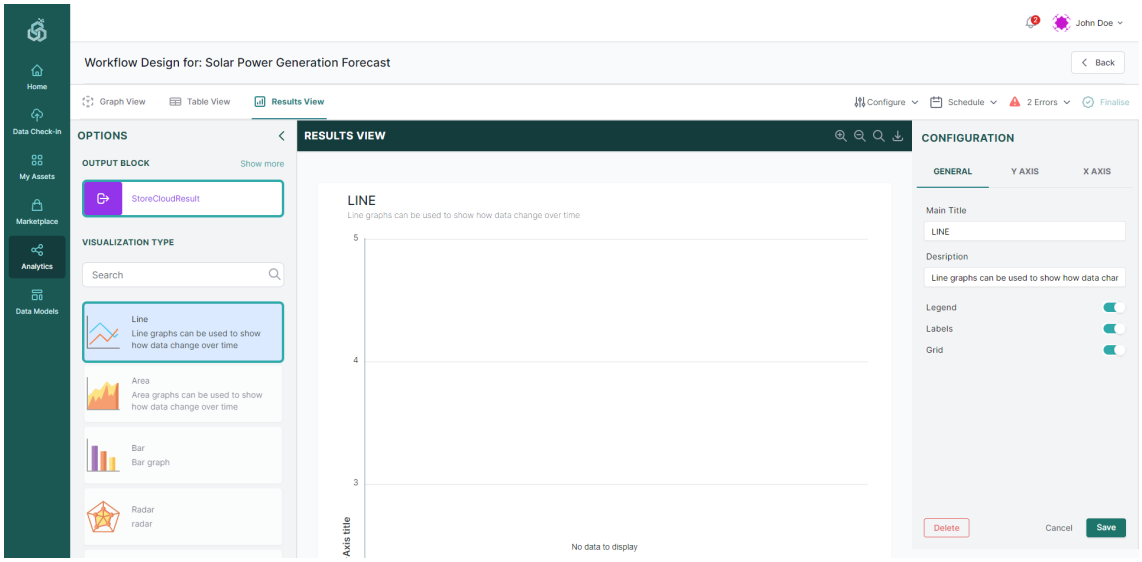

Figure 85: Configure an Analytics Pipeline – Results View

5.3.4 Schedule Execution

Apart from the configuration of the different input, processing, analytics and output blocks that need to be added in a complete analytics pipeline, the data asset provider may also configure the scheduling of the pipeline execution, by selecting the Schedule option from the Analytics Workbench bar, as shown in Figure 86. A top slideover to define a schedule (or multiple schedules) is displayed allowing the data asset provider to select the execution period (i.e., start date, end date), the frequency of the execution (i.e., hourly, daily, weekly, monthly), and the exact time of execution depending on the frequency.

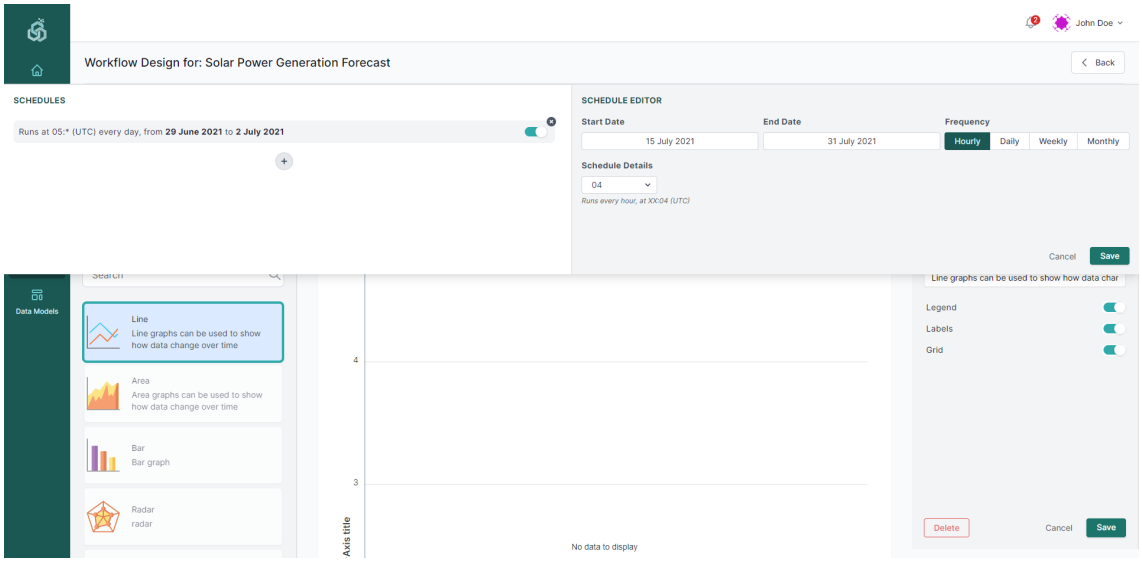

Figure 86: Configure an Analytics Pipeline – Schedule Execution

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5.3.5 Execution History

By selecting the Execution History option for a particular Analytics Pipeline, from the Analytics Workbench bar, a new screen including the execution logs will appear as shown in Figure 87. Within this view, the data asset provider can see the execution summary information such as the number of total executions, the number of successful executions, the number of failed executions, and the average execution time. Below these, the data asset provider may view more details regarding each execution including its timestamp, status, and available actions. When an execution is queued, there is only one available option that is to cancel the next execution as the schedule shall continue (skipping the next execution only). When an execution has successfully been completed or failed, the available options are: a) to view the details which opens a table that includes the task details, b) to delete the execution including the accompanied results and log files, and c) to visualize the results in the Results View. It needs to be noted that the execution logs are organized in a listed view that can be sorted by the date of execution or status accordingly.

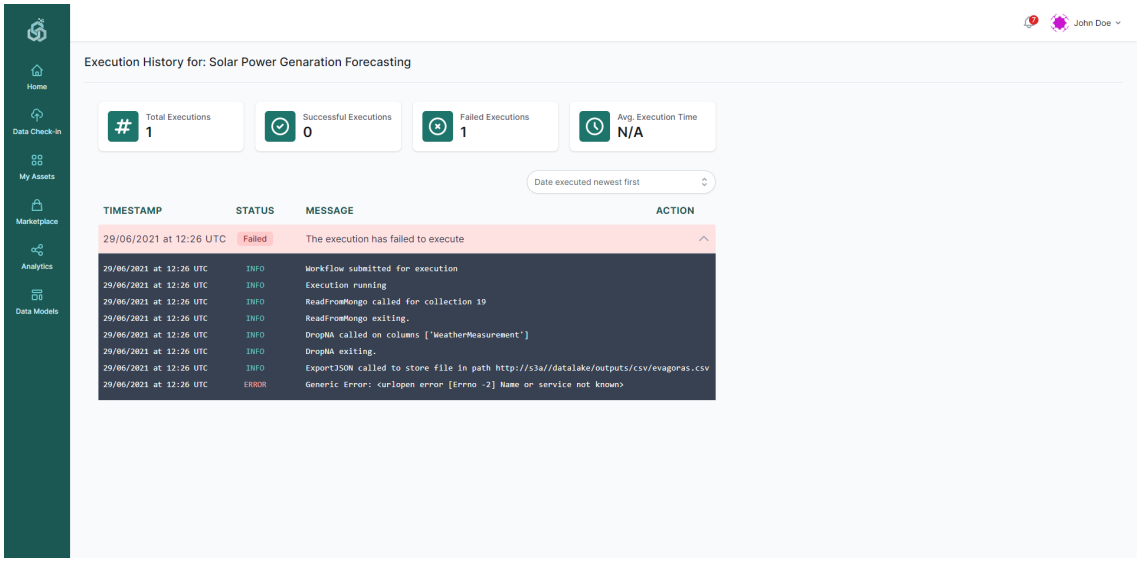

Figure 87: Analytics Pipeline - Execution History

5.4 Visualization Results of an Analytics Pipeline

Once an analytics pipeline has been finalised and has been successfully executed, the data asset consumer may view the results as shown in Figure 88. The results are adapted based on the configuration of the visualization, as defined in the Results View page described in Section 4.3.3. Moreover, the user is able to download the results locally, or to send the results to an API.

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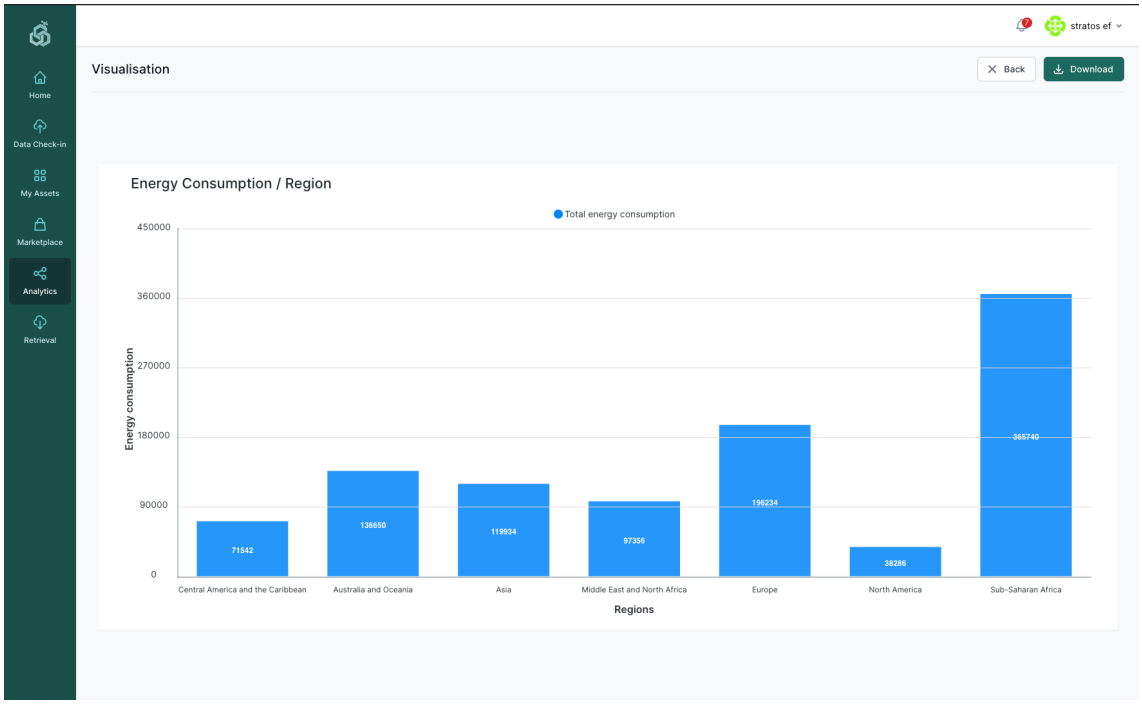

Figure 88: Analytics Pipeline – View Results of an Analytics Pipeline

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6 Additional Platform Functionalities

In addition to the functionalities that were described in the former sections, the SYNERGY Platform provides some additional functionalities to different types of users (i.e., platform's administrators, data asset consumers, data asset providers, and others) enabling platform support functions. Such support functionalities include: (a) Common Information Model Lifecycle Management for the CIM administrators, (b) Edit Organization Profile, (c) Edit User Profile, and (d) Wallet Management.

6.1 Common Information Model (CIM) Manager

The Platform's administrators are allowed to create, edit, update and deprecate data models representing data that are exchanged between the stakeholders of the energy data value chain, in accordance with the CIM lifecycle management approach that was defined in the SYNERGY Deliverable D3.1. This functionality is offered by the CIM Manager component, and can be accessed through the Models view.

Within the CIM Manager, depicted in Figure 89, the CIM manager is able to view: (a) the list of concepts that are included in the data model at the left side of the page, (b) the fields/concepts that are included (or linked) in the selected concept at the middle of the page, and (c) more details about the selected field such as its description, its mapping to standards, and its related terms, at the right side of the page.

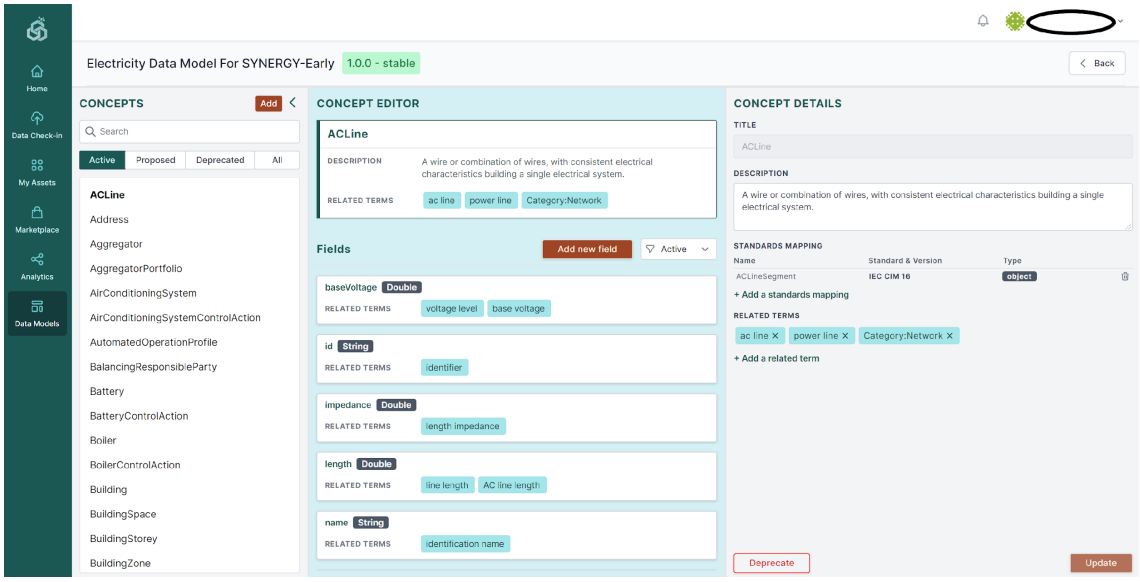

Figure 89: Common Information Model (CIM) Manager – Concepts/Fields View

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In this page the CIM manager may add, edit, or delete existing concepts or fields according to its needs. In order to maintain the CIM up-to-date according to the latest needs of the data asset providers in the SYNERGY Platform, the CIM manager is able to edit the concepts and fields of the selected data model, which generates a new major or minor version of the CIM (depending on the evolution rules that are triggered under the hood) and makes the new data model and its associated concepts/fields available in the Mapping configuration stage. It is worth mentioning that any proposed concepts by the data asset providers are also visible in the CIM Manager, allowing the CIM manager to take appropriate actions.

In particular, the CIM manager may add a concept to the model by selecting the Add button in the Concepts section to enable the right Concept Creator section where he/she needs to insert the title, the description, the mapping to a particular standard (if any), as well as to add related terms for the concept. Additionally, the CIM manager can select to import an existing concept from another data model by selecting the Import from another Data Model option (e.g. from a deprecated CIM version) as shown in Figure 90. Finally, the concept is created by selecting the Create button which enables the Concept Editor section in order for the CIM manager to provide the fields to be included in the concept.

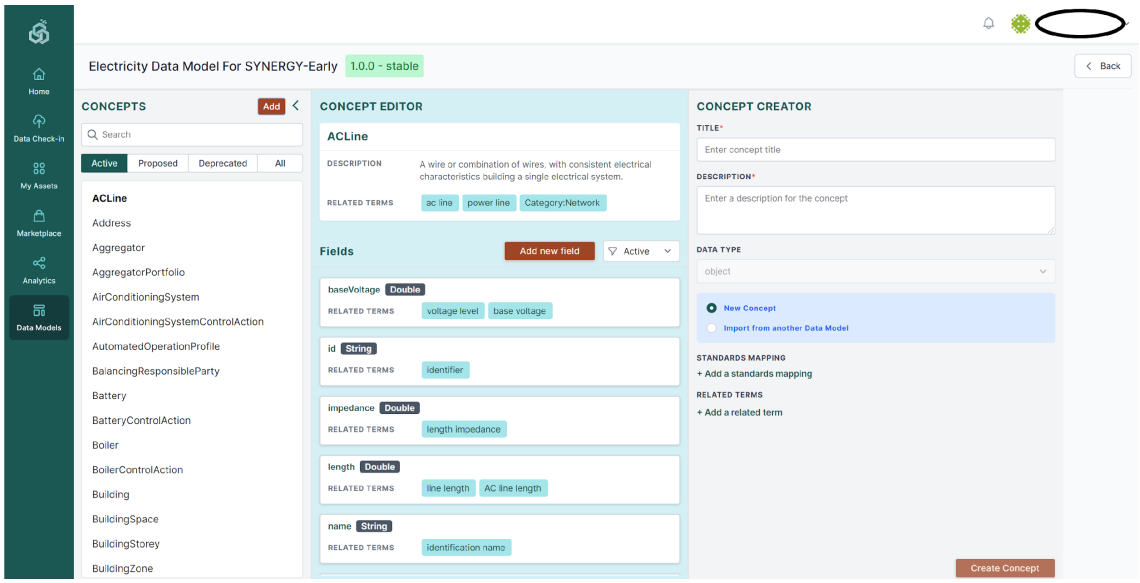

Figure 90: Common Information Model (CIM) Manager – Concept Creator

Once the concept is created, the CIM manager can add the fields or sub-concepts, by selecting the "Add new Fields" option in the Concept Editor section, which will enable the Field Creator section at the right side of the page as Figure 91 depicts. In this section, the CIM manager can provide the title and description for the field, select its data type (e.g. string, double, integer, object, etc), add a

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standard mapping (referring to the fields of certain standards), add related terms, and add metadata to the field. Appropriate metadata can be added to the field depending on the data type and including information regarding different aspects of the data that could be potentially uploaded to the particular field. Indicative metadata options are: (a) Allow multiple occurrences of this field; (b) Order of multiple occurrences is important; (c) Allow indexing of this field; (d) Denoting if the data can be customized (for object data type); (e) Denoting the temporal coverage of the data (for date, time, and datetime data type); (f) Measurement Type and Unit (for double and integer data types).

Finally, the CIM manager can create the field by selecting the Create Field button at the bottom of the page.

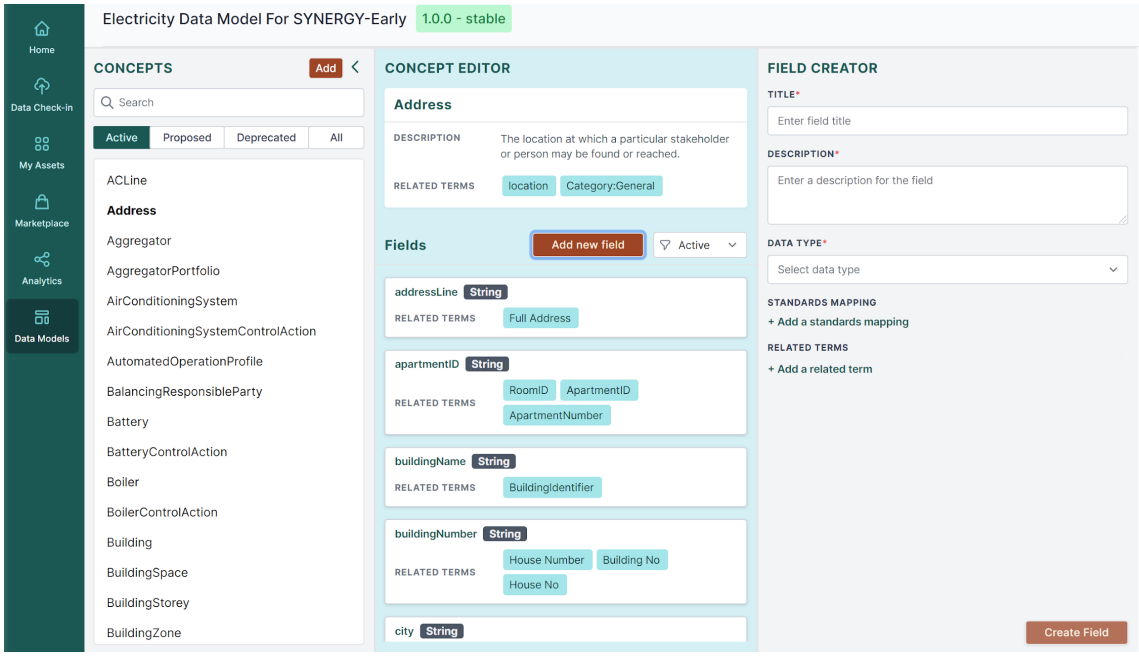

Figure 91: Common Information Model (CIM) Manager – Field Creator

6.2 Edit Organisation Profile

The organisation's manager (who is also the organisation's legal representative, eligible to sign any data asset contracts in the SYNERGY Platform) may edit the organisation's profile, by navigating to the Edit Organisation Profile page as shown in Figure 92. The organisation's manager may edit the organisation's business name, by which it is typically identified. In addition, the manager can add a cover photo, and a description that provides a brief overview regarding the organisation's activities. The organisation type that distinguishes the organisation within the electricity data value chain, needs to be selected as well (even though this functionality may be deactivated upon the initial

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organization registration to avoid potential misuse). The organisation's manager may add, edit, or remove a department (including its name, address, city, and country) to the Departments List as well.

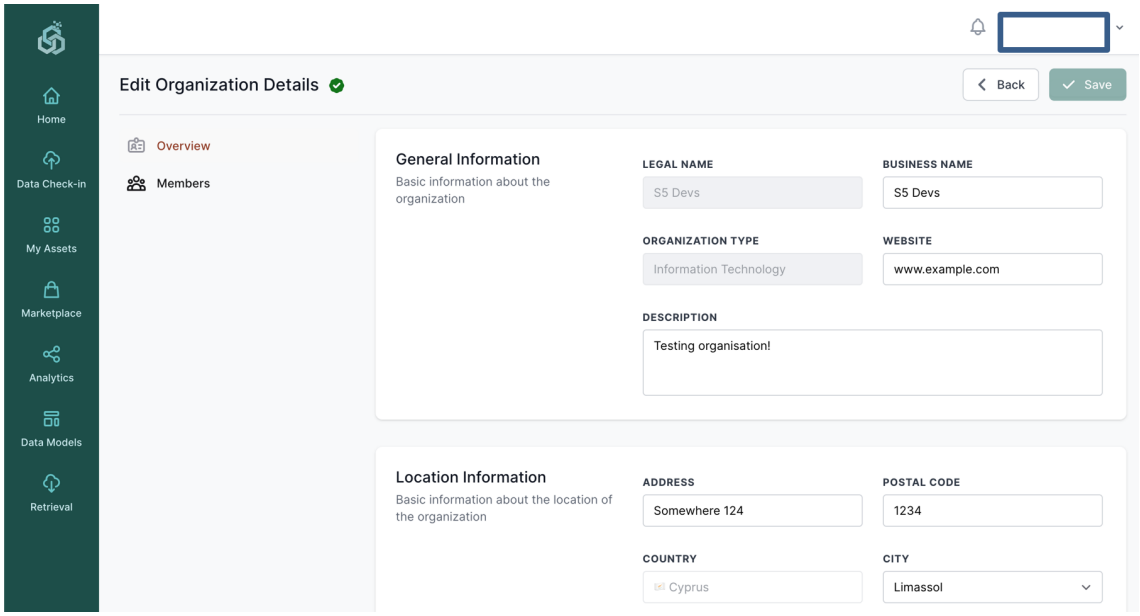

Figure 92: Edit Organisation Profile - Overview

In addition, users can be added in the Users List by defining the department they work, their role in the organisation, and their status (i.e., Active, Invited, Blocked), while a user can be activated (if Blocked) or deactivated (if Invited or Active) by the manager by selecting the corresponding buttons, as depicted in Figure 93.

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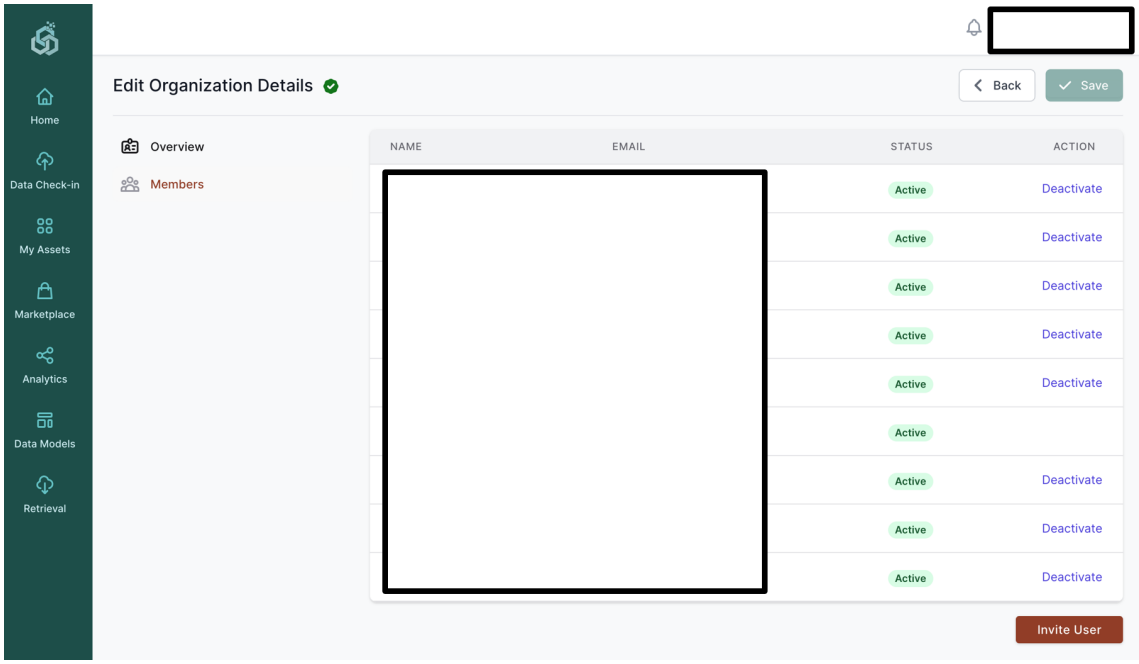

Figure 93: Edit Organisation Profile - Users List

6.3 Edit User Profile

Users may edit their individual user profiles, by navigating to the Personal Profile page that is loaded by selecting the name of the user at the top right side of the SYNERGY Platform. As depicted in Figure 94, the user may update basic information such as the first and last name, as well as to change their current password to a new one, by filling the corresponding text boxes.

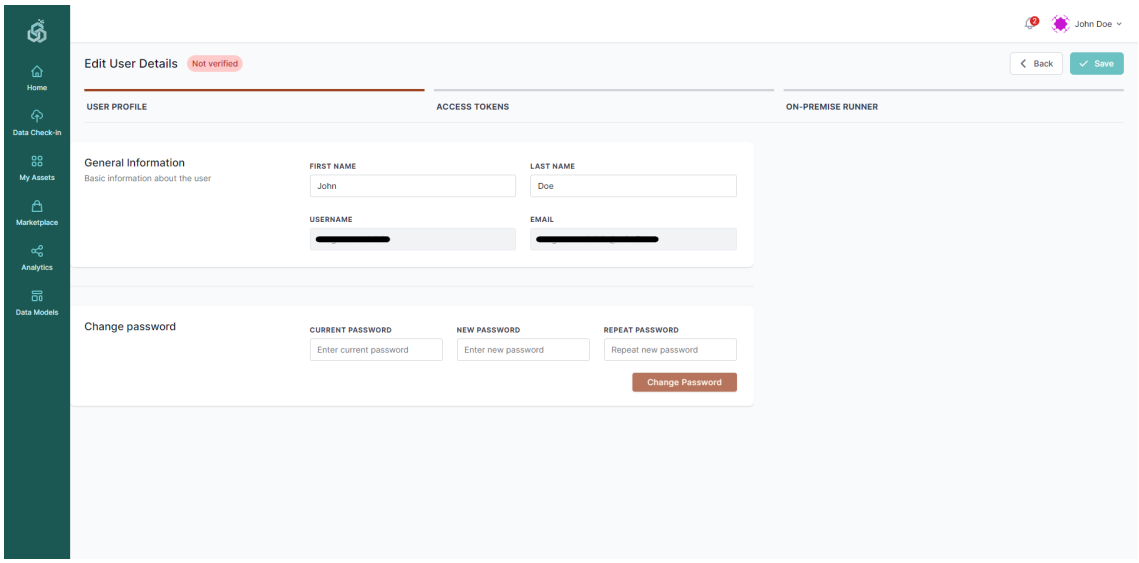

Figure 94: Edit User Profile – Overview

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6.3.1 Generate Access Tokens

By selecting the Access Tokens tab, the users are able to view their tokens (for retrieving or uploading data to the SYNERGY Platform through the SYNERGY APIs). By selecting the Generate new token, the user is asked to provide a name for the token that is to be generated and select the scope of the intended use that is to retrieve data from the platform's API, or to upload data to the platform's API, or both. Finally, the user is able to delete generated personal access tokens by selecting the Delete button located at the right side of each access token in the Access Tokens tab, as depicted in Figure 95.

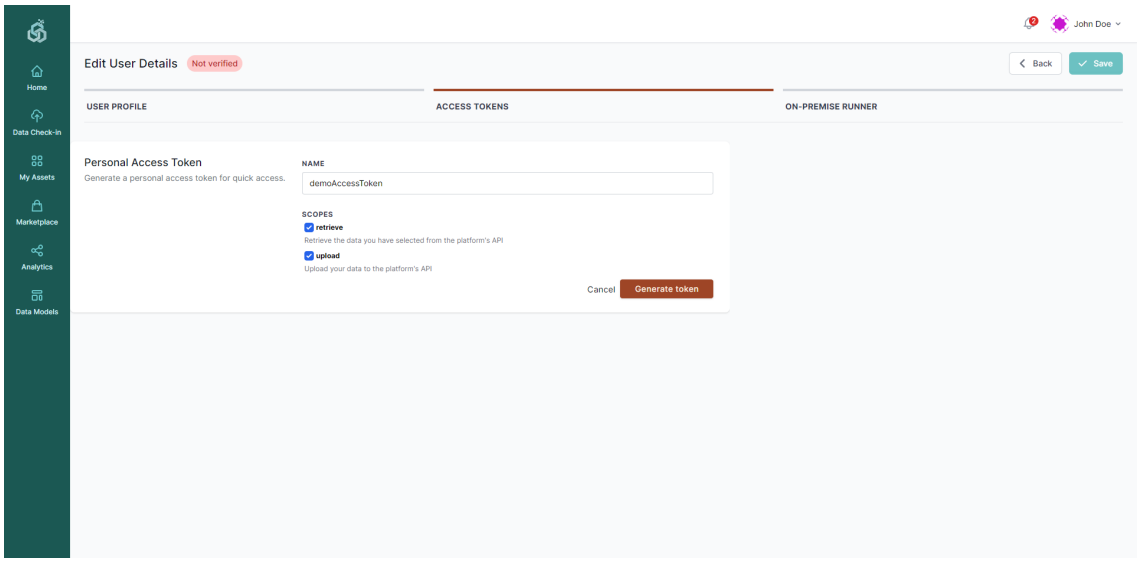

Figure 95: Edit User Profile - Access Tokens – Generate Token

6.3.2 Register an On-Premise Execution Environment

The user may download the On-Premise Execution Environment tab as shown in Figure 96. In particular, the user needs to select the operating system of his/her physical machine in order to start downloading the appropriate version of the On-Premise Environment for Windows, MacOS, Linux.

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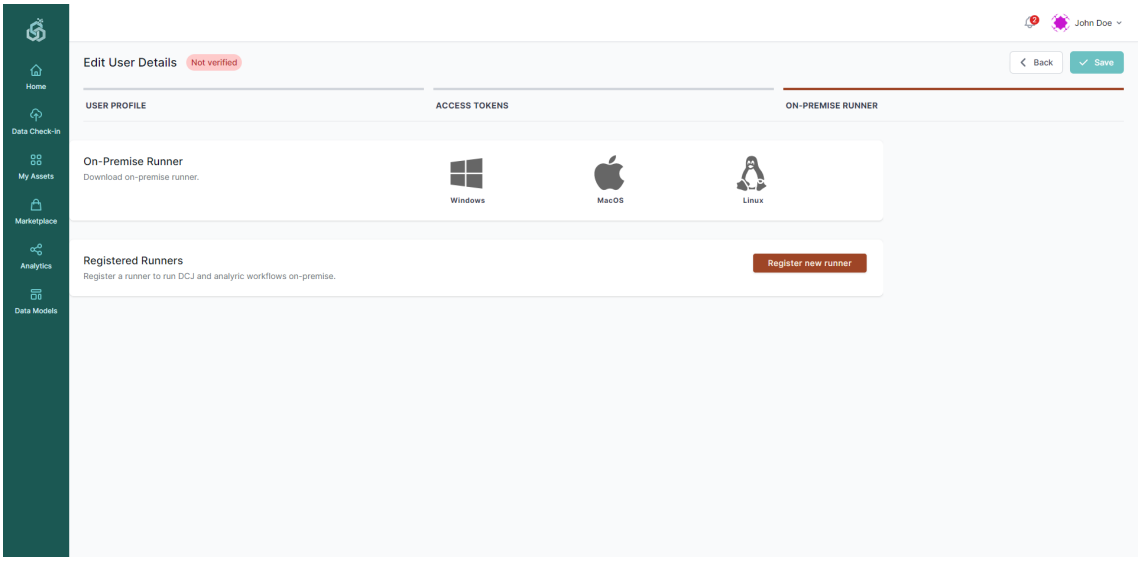

Figure 96: Edit User Profile - On-Premise Execution Environment

However, a prerequisite step to execute the On-Premise Execution Environment is to register it by selecting the "Register a new runner" button which then enables a text box asking to provide a name for the Execution Environment. As soon as the name is inserted correctly, the corresponding URL and code for the registered On-Premise Execution Environment will appear allowing the execution of the On-Premise Execution Environment, as shown in Figure 97. The generated URL and code need to be inserted during the installation phase on the On-Premise Execution Environment on the user's physical machine.

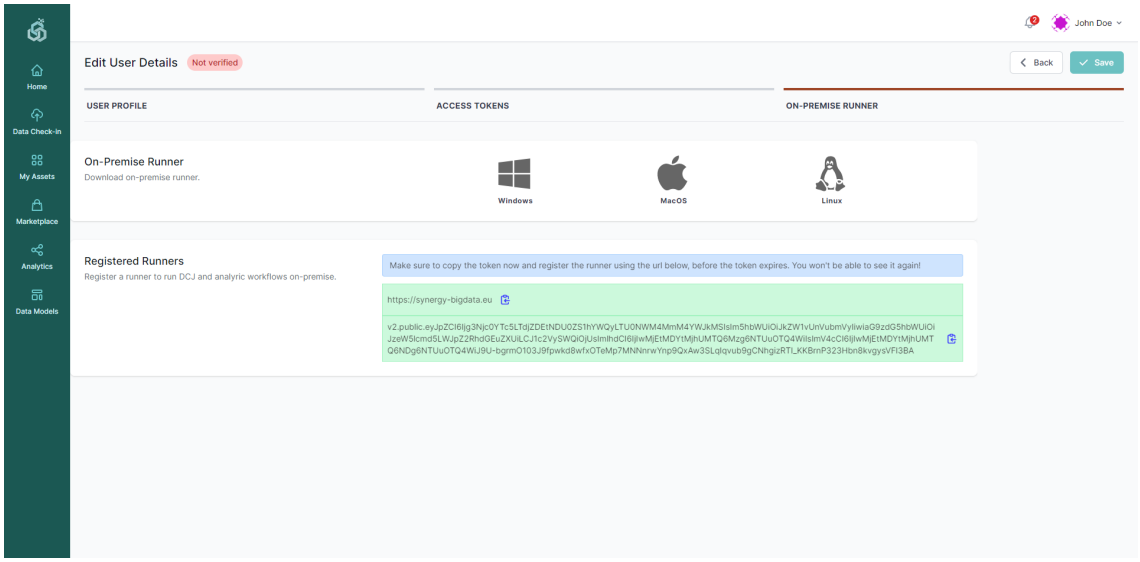

Figure 97: Edit User Profile - On-Premise Execution Environment - Register a New Runner

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6.4 Wallet Manager

An organization's manager may view the contracts of his/her organization by navigating to the Contracts view of the Marketplace, as shown in Figure 98. In the case that the organization does not have a linked wallet, the manager may import an existing wallet, or create a new one as described in the subsequent sections (Section 6.4.1 and Section 6.4.2, respectively). It needs to be noted that, if data asset providers have already initiated requests for data assets (that do not belong to their organization) but the organization manager has not set up a wallet yet, they will not be able to proceed in buying a data asset, until a wallet is generated in the Contracts tab.

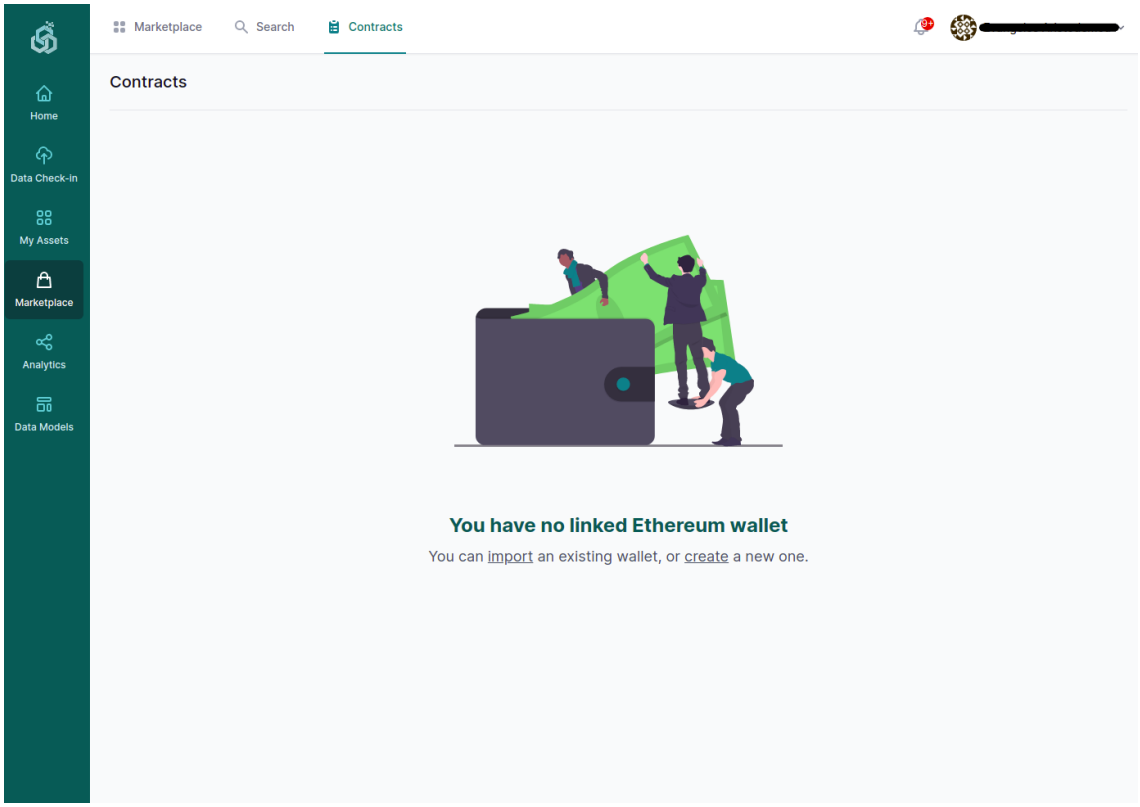

Figure 98: Contracts List

6.4.1 Import an Existing Wallet

The organization's manager may import an existing wallet by entering the private key and the wallet password, as depicted in Figure 99.

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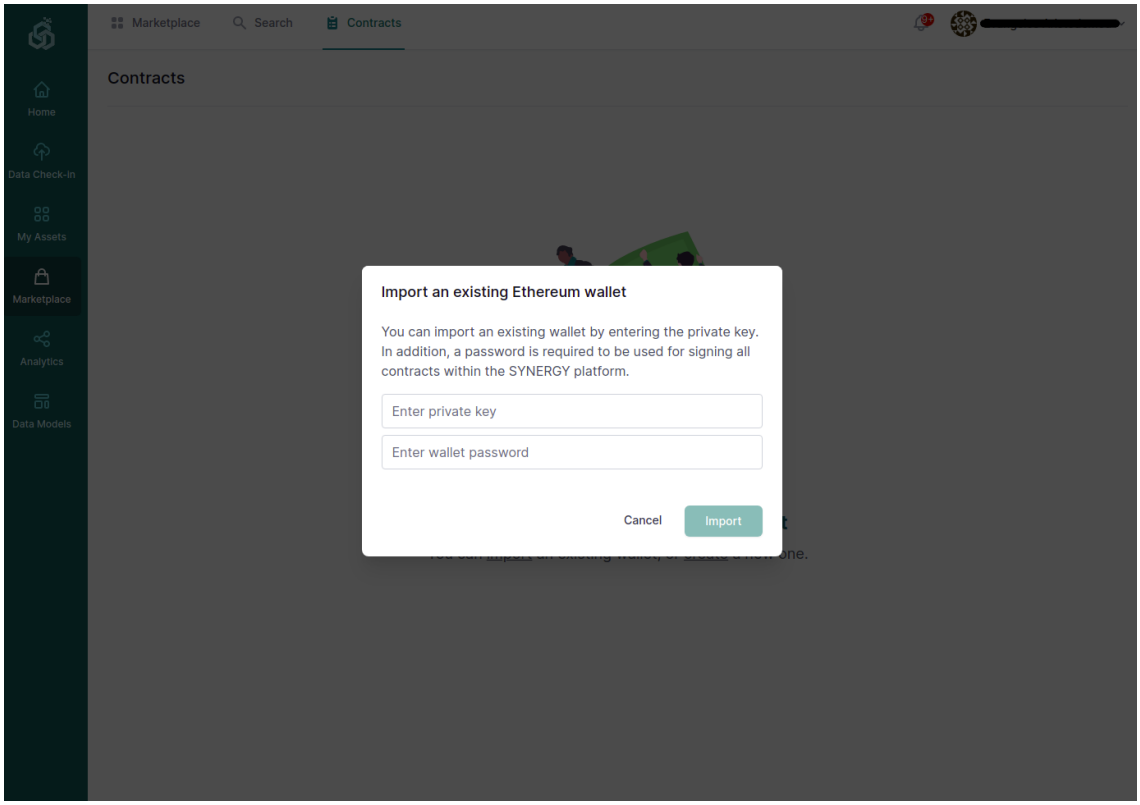

Figure 99: Import an Existing Wallet

6.4.2 Create a New Wallet

An organization that does not have a wallet can create one by selecting the import link in the Contracts view of the Marketplace, as shown in Figure 98. A wallet password needs to be entered accordingly to encrypt the organization's wallet, as Figure 100 depicts. It needs to be noted that this password will be used for signing all contracts within the SYNERGY Platform. By selecting the Create button, the platform starts generating and encrypting the wallet as Figure 101 shows.

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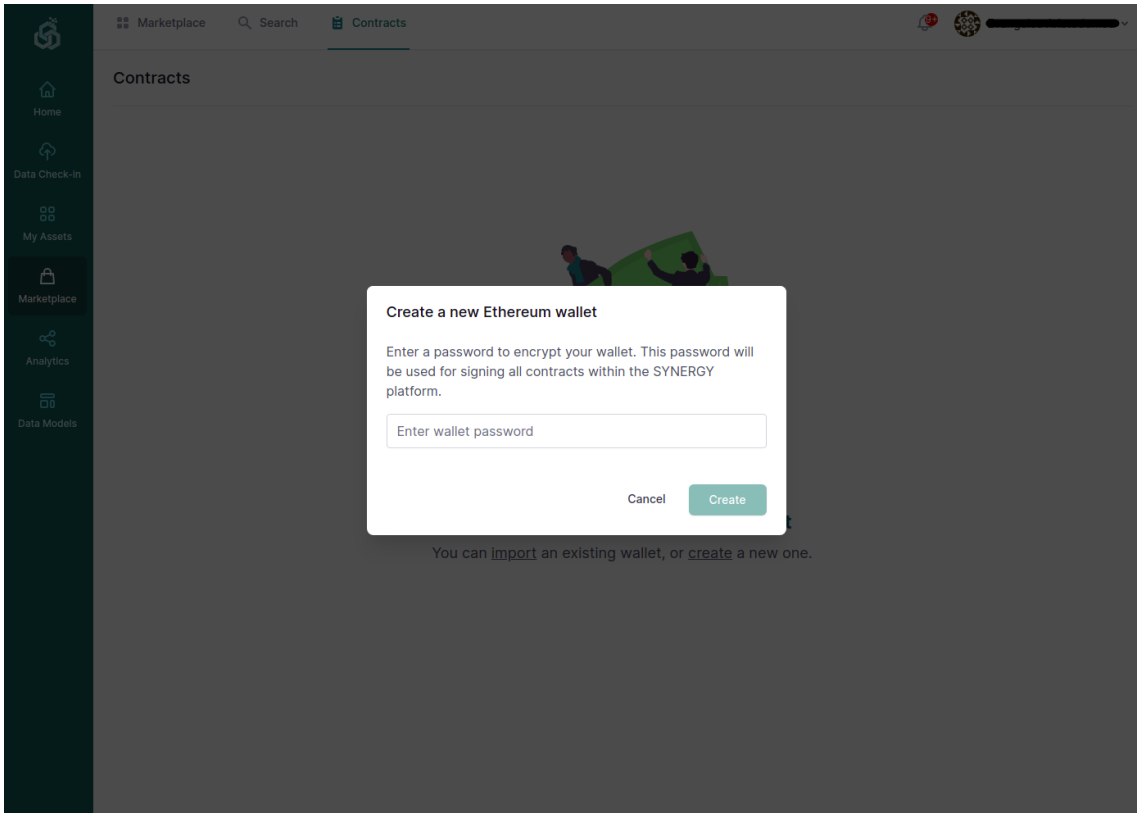

Figure 100: Create a New Wallet

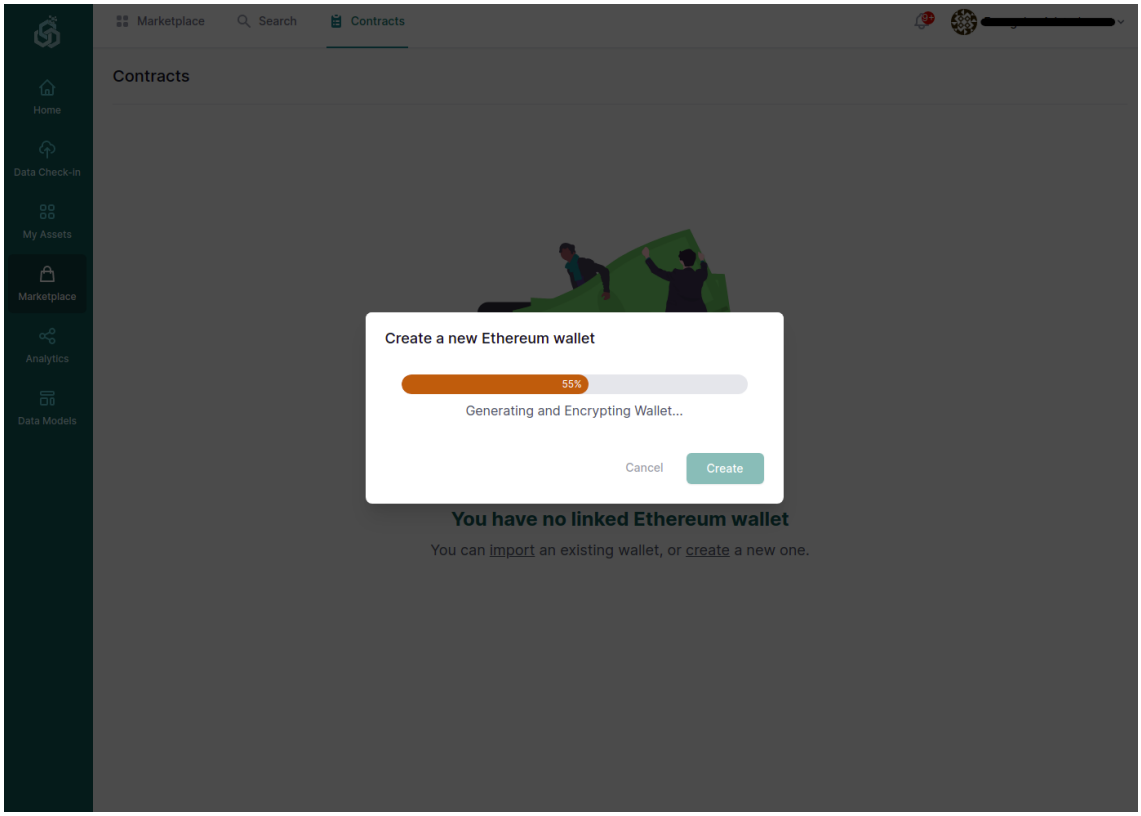

Figure 101: Create a New Wallet - Generating and Encrypting Wallet

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7 Platform Integration and Support Activities

This section focuses on the integration approach followed by the technical partners to deliver the beta release of the SYNERGY Integrated Platform, as well as on the support channels that are in place to acquaint the overall SYNERGY consortium with the platform functionalities.

7.1 Integration Approach

As described in Section 2, the SYNERGY Platform brings together an extensive number of components, services and technologies that have been integrated at the Cloud deployment and the Server On-Premise Environments in accordance with the SYNERGY architecture (described in the SYNERGY Deliverable D2.6) and the integration plan (defined in the SYNERGY Deliverable D3.3). In order to proactively meet the software delivery challenges that a complex project as SYNERGY brings, an agile integration approach based on DevOps and GitOps has been put into place:

I. **Release design and planning** that bring together the involved development teams, the WP3 and WP4 leaders, and the Technical Coordinator to discuss the priorities, the identification of dependencies and the main milestones per development cycle.

II. **Collaborative software development and testing** with each development cycle (for new features) typically lasting 3 weeks and providing a new minor release of the SYNERGY Platform. It involves the involved development teams in: (a) coding, (b) running unit tests, (c) committing code to the respective component repo, (d) reviewing the code changes and providing comments to the pull requests, (e) merging the new features and fixes included in the code, (f) running appropriate integration tests.

III. **Deployment in staging environment** that ensures that any minor release of the SYNERGY Platform is tested by the involved development teams before it is shipped to production. Depending on its criticality, any error or bug noticed may be prioritised to be immediately fixed or put in the backlog for the next minor release in (II).

IV. **Deployment in production environment** that occurs per major release (i.e. on M18 for the beta release, on M24 for Release 1.00 and on M36 for Release 2.00) and on selected minor releases (for bug fixes or for prioritised features that need to be shipped earlier than the next major release). Experimentation on the production environment is available to all SYNERGY partners.

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In this context, the integration activities of the SYNERGY Platform rely on a set of state-of-the art techniques and open-source tools to ensure collaborative and continuous planning, development and deployment cycles for each release as depicted in the following table.

Table 4: SYNERGY Integration Tools

Integration-related Activity	Tool
Source code versioning and issue tracking	Github
Automated build and testing	Github Actions
Error Tracking	Sentry
Deployment	Docker, Kubernetes
GitOps	Flux

Taking into consideration the current status of the beta release of the SYNERGY Platform and the components interrelations, the integration plan that shall be followed for M24 is depicted in the following figures.

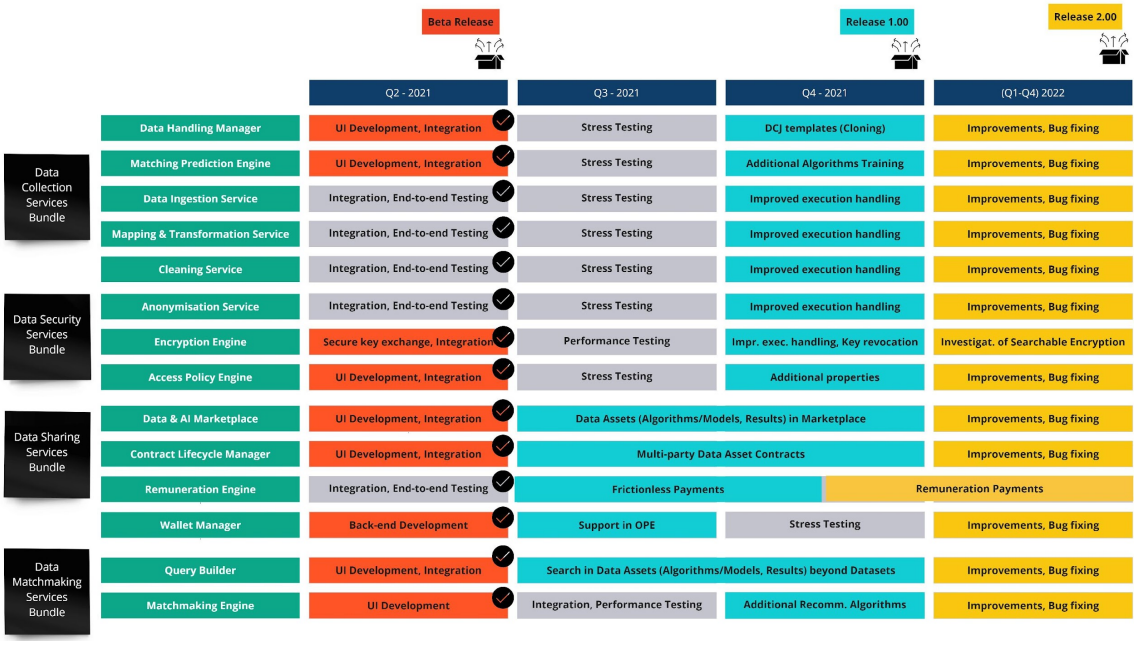

Figure 102: SYNERGY Integration Plan on M18-Part I

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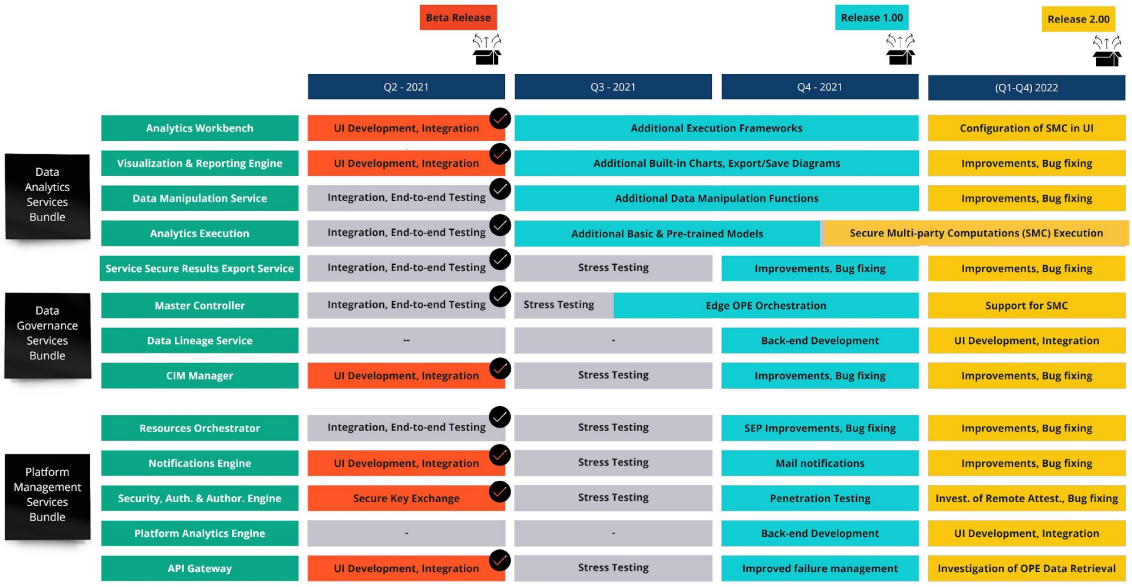

Figure 103: SYNERGY Integration Plan on M18-Part II

7.2 Platform Availability

The SYNERGY Platform is deployed in its production environment at:

https://www.synergy-bigdata.eu/

Since the SYNERGY Platform allows organisation-based access, the organisation manager needs to register his/her personal profile and then register the organisation. Taking into consideration that the SYNERGY Platform is addressed to stakeholders of the electricity data value chain, the platform administrator moderates the organisation's registration and may grant or deny access to the platform. If an organisation is approved, then the organisation's manager can invite additional members to join the organisation, which receive an invitation code via email.

Demo accounts may become available upon request at: admin@synergy-bigdata.eu

7.3 Platform Support Mechanisms

The beta release of the SYNERGY Integration Platform has been deployed and is available to the SYNERGY consortium for experimentation and testing. In order to provide efficient support to the demo partners in WP8 and the energy application developers in WP5-WP7, the following support mechanisms shall be leveraged:

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- **Online training sessions** aiming at providing walkthroughs and guidance of the SYNERGY Platform functionalities to the demo partners and the application developers. The first platform demo event is scheduled for July 7th, 2021 in which the SYNERGY Platform will be launched to the whole SYNERGY Consortium.
- **Direct support channel in Slack** under a "SYNERGY-Support" workspace in which dedicated channels have been created:
    - *#platform-app-support* intended for the energy apps developers to request support and guidance on the use of SYNERGY Platform by the technical team.
    - *#platform-demo-support* intended for the demo partners to request support and guidance on the use of SYNERGY Platform by the technical team.
    - *#platform-deployment* intended for the technical team to announce maintenance times and any redeployments that occur on the SYNERGY Platform, to the SYNERGY Consortium.
- **Issue tracking in Github** under a dedicated organization entitled "SYNERGY Project". A "*platform-support*" private repo has been created and includes pre-defined templates: (a) Bug report to collect all the bug information that will help the technical team to reproduce and solve the issue encountered (as depicted in the following figure); (b) Feature report to collect any enhancements and ideas that can improve the user experience and can be considered by the technical team for the next releases of the Platform. In order to properly manage, prioritise and track any problems/issues until they have been successfully resolved, all partners will be invited to join the SYNERGY Project in Github. It needs to be noted that issue reporting via email will not be allowed.

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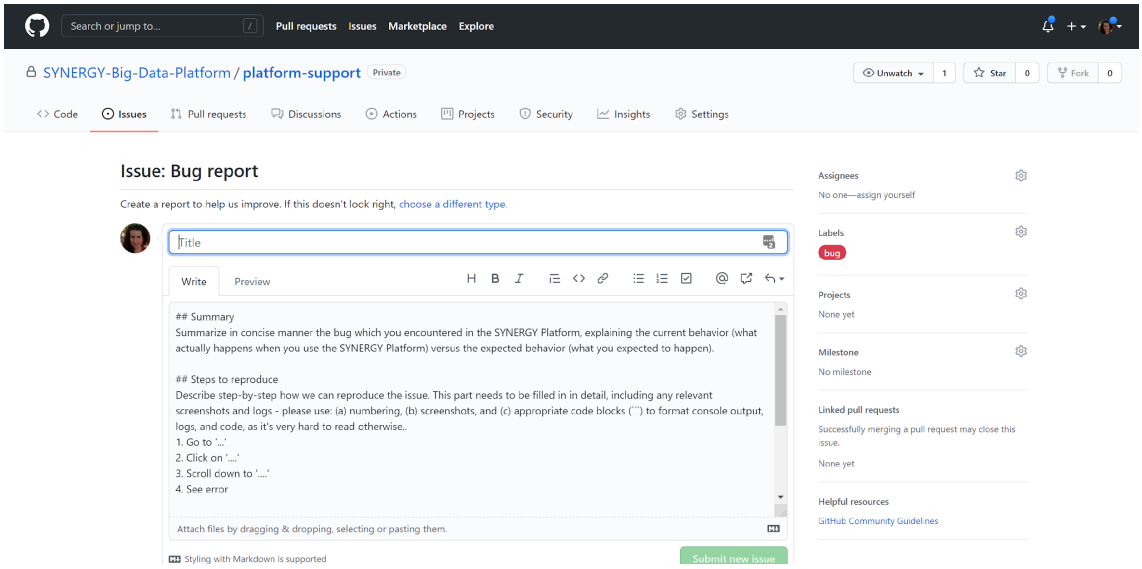

Figure 104: Bug report in Github

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8 Conclusions & Next Steps

In this deliverable, D3.4 "SYNERGY Integrated Platform – Beta Release", a thorough description of the different functionalities offered by the SYNERGY Platform, is provided. In particular, the different workflows of the core platform functionalities (i.e., data check-in, data search and acquisition, data analytics) and the additional platform functionalities (CIM manager, edit organisation profile, edit user profile, wallet management) that are supported by the SYNERGY Platform, are described thoroughly as user journeys for data asset providers and consumers.

Towards this end, this deliverable documented the beta release of the SYNERGY Platform, including an overall description of the SYNERGY Platform described in Section 2, as well as all the supported functionalities that were developed under WP3 and WP4 towards the delivery of this beta release. In particular, the main user journeys of the developed functionalities include:

- The Data Check-in User Journey which describes thoroughly the steps from the data check-in job creation to its configuration and execution (including data harvester, mapper, cleaner, anonymiser, and encryption), and additionally the profiling of the resulting data assets.
- The Data Search and Acquisition User Journey which describes the functionalities that allow users (both data asset providers and consumers) to browse data assets (i.e. datasets for this release) within the SYNERGY Marketplace, and prepare data contracts between data asset providers and consumers in order to retrieve such assets from the SYNERGY Platform, according to their preferences.
- The Data Analytics User Journey which describes the functionalities for designing, configuring, executing data analytics pipelines, such that the platform's users gain valuable insights for their own and acquired data (by visualizing the appropriate results or retrieving them according to their terms).
- The additional functionalities available in the SYNERGY Platform (i.e., CIM manager, the organisation profiles, the user profiles, and the wallet manager).

This document not only provides the aforementioned user journeys for the supported data services bundles and the exposed APIs, but it also provides updates on the previous release (D3.3 "SYNERGY Integrated Platform, Alpha mock-up Release") including certain considerations, assumptions, and restrictions that occurred during the development.

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The integration plan (as defined in D3.3 “SYNERGY Integrated Platform – Alpha, Mock-ups Release”) remains valid, driving two major back-end development releases (to be reported on M22 in D3.5 “Data Collection, Security, Storage, Governance & Management Services Bundles – Release 1.00”, D4.3 “SYNERGY Data Analytics, Sharing & Matchmaking Services Bundles – Release 1.00”), and the next integrated platform release (to be reported on M24 with D3.6 “SYNERGY Integrated Platform & Open APIs – Release 1.00”).

The deployment of the different components and services included in the current release followed a solid integration plan to ensure that their interrelations and dependencies are properly reflected and their integration is appropriately prioritised in order to provide the most added value possible to the electricity data value chain stakeholders through quick-wins. The components and services that fall under the context of the current release were deployed in the SYNERGY Cloud Platform and its Secure Experimentation Playgrounds (SEP), and the On-Premise Environments (OPE), as described in detail in D2.6 “SYNERGY Framework Architecture including functional, technical and communication specifications v1”. Finally, the secure transfer of data across the platform’s different layers (i.e., Cloud, SEP, OPE) is deployed as mentioned in the previous integration plan (defined in D3.3 “SYNERGY Integrated Platform – Alpha, Mock-ups Release”).

The current version of the SYNERGY Integrated Platform will be available to SYNERGY stakeholders in the beginning of M19 for early assessment and feedback that will be collected during the development activities of the various SYNERGY energy apps in WP5-WP7, the demonstration activities in WP8, and the living lab activities in WP9. Based on these, necessary enhancements and updates will be taken into consideration and potentially introduced in the upcoming versions of the platform.

This project has received funding from the European Union’s Horizon 2020 Research and Innovation programme under Grant Agreement No 872734.

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