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Deliverable D4.6
frESCO Integrated Platform – Beta Release

Deliverable number	D4.6
Deliverable name	frESCO Integrated Platform – Beta Release
Lead beneficiary	Suite5
Description	The deliverable will update D4.4 and will provide the Beta version of the frESCO Integrated Platform.
WP	WP4
Related task(s)	Task 4.3. Core Big Data Ingestion, Curation and Management Services Task 4.4. Personal and Enterprise Big Data and Edge Analytics Algorithms Definition as a baseline for advanced energy service bundles Task 4.5. Data Assets Security, Encryption and Privacy Mechanisms
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Main author	Georgios Zafeiris, Alexandros Tsaloukidis
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Final deliverable submission	28.02.2022	Format	CIRCE

ABBREVIATIONS

Abbreviation	Name
A/C	Air Conditioning
API	Application Programming Interface
CA	Consortium Agreement
CIM	Common Information Model
CSV	Comma Separated Values
D	Deliverable
DER	Distributed Energy Resources
DMP	Data Management Platform
EC	European Commission
ESCO	Energy Service Company
HVAC	Heating, Ventilation and Air Conditioning
ICT	Information and Communication Technology
GA	Grant Agreement
H2020	Horizon 2020 The EU Framework Programme for Research and Innovation
JSON	JavaScript Object Notation
PDF	Portable Document Format
PubSub	Publish-Subscribe
SASL	Simple Authentication and Security Layer
URL	Uniform Resource Locator
XML	Extensible Markup Language
WP	Work package

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EXECUTIVE SUMMARY

Deliverable 4.6 presents the Beta Release of the frESCO Integrated Platform, outlining also the modules that comprise the platform (Data Collection, Data Security and Storage, Data Analytics, Data Search, Platform Governance). Using as a basis the frESCO conceptual architecture, as presented in D2.5 [1], in this document, all modules and their respective features are described to such an extent, in order to depict in detail, the range of features that the frESCO Platform users are enabled with.

D4.6 builds upon the analysis conducted in D4.4 [2], which provided a detailed description of the frESCO Platform user flows for configuring and executing the core platform functionalities, such as data collection, harmonization and curation, data search and retrieval and data analytics, as well as different supplementary functionalities, including User Profile Management and Notification Alerts. To this purpose, appropriate screenshots of the frESCO Integrated Platform are provided, in order to depict the features that are part of the beta release of the Big Data Management Platform. The most crucial features are presented and described thoroughly, and they are accompanied by indicative guidelines, so that the frESCO Platform users can have a clear picture of what is offered to them.

In addition, this deliverable enriches the analytics catalogue, as offered in D4.5 [3], by supplementing the list of Personal and Industrial Analytics with Heating, Ventilation and Air Conditioning (HVAC) Flexibility Analytics.

The final release of the frESCO Integrated Platform (due in M32) will be based on the results of this deliverable and will focus on: a) enriching the existing features and functionalities of the frESCO Big Data Management Platform, and b) laying the groundwork for the potential introduction of new features and functionalities, if they are deemed necessary.

1 INTRODUCTION

1.1 Purpose and target group

Deliverable 4.6 constitutes the beta release of the frESCO Integrated Platform, offering the current implementation status of the modules that constitute the platform, namely the Data Collection, Data Security and Storage, Data Analytics, Data Search and Platform Governance modules. This deliverable is the updated version of D4.4 "frESCO Integrated Platform - Alpha, Mock-ups Release", presenting the extent of the functionalities that the frESCO Platform users are able to access, by describing all modules and their associated features.

Utilizing intuitive and comprehensive screenshots, user flows for configuring and performing the fundamental platform functions are offered. These include data collection, harmonization and curation steps, data search and retrieval actions, and data analytics results verification, as well as various supplementary functionalities for user profile management and user notification alerts.

1.2 Scope of the document

Deliverable D4.6 "frESCO Integrated Platform – Beta Release" provides the implementation status of the frESCO Big Data Management Platform, outlining the current functionalities available to its intended users. In this beta release, core user flows for the performance of fundamental platform functionalities, alongside the different features implemented are offered. To this end, an end-to-end usage overview, with step-by-step instructions and screenshots are included.

Moreover, in this deliverable, HVAC Flexibility Analytics are introduced and analysed, in order to enrich the frESCO analytics catalogue, as introduced in the corresponding deliverable D4.5.

1.3 Structure of the document

The structure of the document is organized as follows:

Section 2 offers a brief introduction of the modules, that constitute the frESCO Big Data Management Platform (Data Collection, Data Security and Storage, Data Analytics, Data Search and Platform Governance). The inclusion of HVAC Flexibility Analytics to the analytics

catalogue, as well as the state-of-the-art analysis and implementation details, are also presented in this section, under Data Analytics Module.

Section 3 outlines the functionality of the frESCO Platform and provides appropriate screenshots of the various user flows in order to advise and inform frESCO Platform users on the available features of the frESCO Big Data Management Platform.

Section 4 concludes this deliverable D4.6 “frESCO Integrated Platform – Beta Release”, providing a brief summary of what has been presented in the different sections of the deliverable.

2 BIG DATA MANAGEMENT PLATFORM AND MODULES OVERVIEW

The Big Data Management Platform serves as the backbone for all integration efforts in the frESCO project, providing a fundamental ICT framework for interoperable and secure data collecting and processing, enabling the introduction of novel energy services. The platform facilitates the granular communication and data interchange between a variety of sources, including buildings, DER management systems, weather data sources, and wholesale energy pricing, as well as the efficient mass ingestion and storage of large volumes of the corresponding data assets. To ensure high performance and flexibility to respond to the requirements and demands of the different stakeholders, appropriate procedures and methodologies for data importing, curation, and semantic harmonization are used. Furthermore, the Big Data Platform includes a big data analytics module that enables the development and execution of analytics algorithms, as well as the reporting of the findings, using a catalogue of pre-trained analytics models to provide fresh insights and knowledge for all frESCO stakeholders. The Big Data Platform comprises the core modules listed below, graphically illustrated in Figure 1, which will be discussed more in the following segments.

- Data Collection Module
- Data Security and Storage Module
- Data Analytics Module
- Data Search & Retrieval Module
- Platform Governance Module

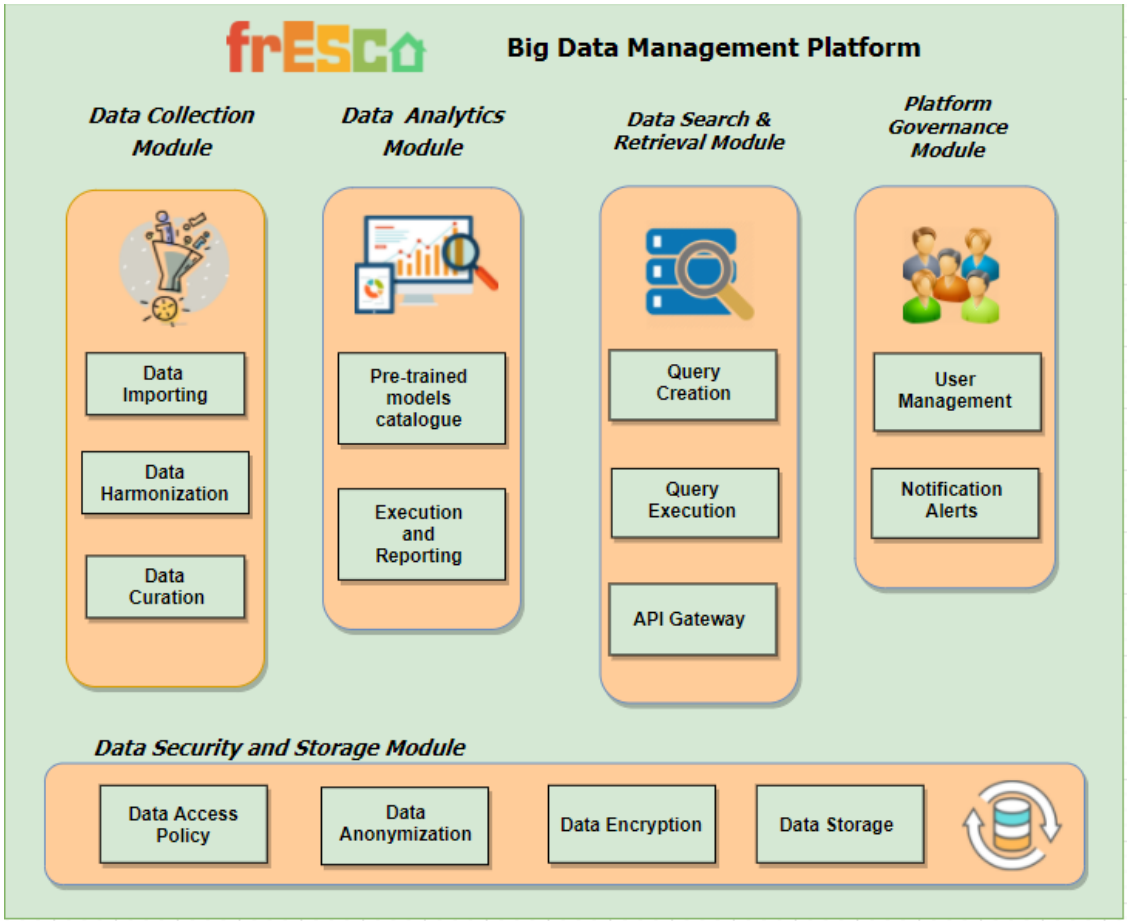


Figure 1 frESCO Big Data Management Platform and Modules Overview

2.1 Data Collection Module Overview

Data importing, which entails establishing proper procedures and methodologies for data import into the frESCO Platform, and data harmonization, which allows imported data assets to be harmonized to the frESCO CIM, are two functions included in the frESCO Data Collection Module that assist data collection. The data ingestion process settings configuration, which encompasses the needs and preferences about how the data will be integrated into the platform, was one of the most important aspects of the Data Collection Module's development. Any frESCO Platform user can use secure and reliable processes to upload data to the frESCO Big Data Management Platform infrastructure, either by direct file uploading or through APIs. Furthermore, since any result of a data collection job is preserved as a data asset in the frESCO Big Data Management Platform, platform users have the option of assigning a title and metadata to a data asset and explaining what is contained within it.

The frESCO UI is designed appropriately, in order to provide suitable guidance to platform users so that they can harmonize all of the attributes of imported data based on the frESCO Common Information Model (CIM). The harmonization of the imported data to the frESCO CIM ensures that the data attributes match the CIM entity names, and the data values match the CIM measurement units and the required data types.

Also, during the curation configuration process, the user sets the constraints and limitations that the data ingested into the module may have, as well as the precise actions that must be taken if any of these constraints are violated. The data curation feature ensures that the data imported is of high quality and value. A curation rule is produced by combining a validation option with a corrective action for a specific attribute, and all curation rules are applied to the converted data (coming from the semantic harmonization process to the Common Information Model), yielding curated data.

2.2 Data Security and Storage Module Overview

The Data Security and Storage module was created to help users build confidence in the frESCO Data Management Platform by allowing them to create simple and flexible access rules that govern access requests to their data on the platform. To maximize effectiveness, access policies can be designed for each data asset. When a request to access data imported into the frESCO Data Management Platform (DMP) is made, the access policies set up are used to determine whether access is authorized. A graphical user interface allows users to create advanced access policy rules for their data assets. The rules are saved, and the data asset provider can instantly adjust them using the given interface.

Diverse storage and indexing capabilities are designed to meet different needs depending on the type of information maintained in the frESCO Platform and how it is accessed when it comes to data storage. All storage and indexing tools utilized in frESCO are taken into account, and they are used to store a variety of data (e.g., data assets, analytics models, and analytics results). At the same time, appropriate metadata is recorded in order to make it accessible to all frESCO platform modules and features. The module also holds log-related information for the frESCO Data Management platform's operation and usage, such as users and any administrative data required to keep the frESCO Platform running properly.

2.3 Data Analytics Module Overview and Analytics Catalogue Enrichment

The Data Analytics Module allows users in the frESCO platform Infrastructure to run analytics over their own data. It provides a catalogue of pre-trained analytics models that can be selected based on the user needs and leverage the added value that data analytics can bring through the offerings of the frESCO models by executing and visualizing their results. The Data Analytics Module contains a simple mechanism that allows frESCO platform users to visually get insights into the execution of pre-trained models. In more detail, the Analytics Execution and Reporting mechanism, introduced by the module, includes predefined charts for various analytics processes that are fed with data, leading to the creation of useful visualisations. Also, the module enables saving and exporting visualisations and reports, as all assets created with the Analytics Reporting mechanism are saved as static objects (i.e., image).

In deliverable D4.5, the project's system and end-user analytics needs were covered by a complete list of Personal and Industrial Analytics, comprising the analytics catalogue of the frESCO Big Data Platform. Following a similar approach, in section 2.3.1, the HVAC Flexibility Analytics are introduced along with the state-of-the-art analysis and implementation details, as part of the overall frESCO analytics catalogue, supplementing the baseline analytics of generation forecasting, devices profiling and comfort analytics.

2.3.1 Enrichment of the analytics catalogue with HVAC Flexibility Analytics

2.3.1.1 Introduction

Consumer acceptance in Demand Response programmes is a key factor towards maximizing flexibility utilization in the energy system with a view to achieving ambitious decarbonization goals and ensuring the resilient operation of the system under increased uncertainty introduced by the volatile output of Renewable Energy Sources. Residential flexibility introduction to energy markets and demand response strategies, requires non-intrusive solutions that do not compromise human comfort and wellbeing in the built environment. In this context, quantification and extraction of residential flexible assets' flexibility shall not only rely on the energy use and performance data of such assets but needs to take into account and properly balance the comfort requirements and wellbeing constraints imposed by the occupants of buildings. This will allow the fine-grained analysis and forecasting of the available flexibility at asset level (demand side) and facilitate the definition of human-centric demand

response strategies from aggregators. Thus, we gain further acceptance by consumers and reduction of the risks of opting out and overriding demand response control signals that may lead to undesirable financial penalties and losses for non-compliance to contractual obligations.

The introduction of high acceptance, non-intrusive, human-centric flexibility management strategies (that properly balance flexibility provision with the comfort of building occupants and do not compromise the latter) points to the need for the proper and detailed understanding of the context-aware flexibility that can be extracted by comfort-relevant flexible assets (e.g., HVAC). Such flexibility analytics will constitute valuable input for aggregators in their function of creating viable, accepted and high-performance Virtual Power Plants to effectively address evolving requirements of system operators through Human-Centric Demand Response Programmes.

This is the focal point for frESCO, which aims to introduce demand (especially aggregated volumes of residential energy consumers) as an active market entity that offers a viable and cost-efficient product/ commodity to flexibility markets and overlay power grids capacity, balancing and ancillary services markets, while also enabling the realization of energy efficiency strategies by ESCOs and Energy Retailers.

To this end, frESCO builds upon comfort/discomfort analytics that allow the understanding of the real-time comfort parameters (thermal, visual) in the built environment. It combines them with associated energy metrics and analytics for the quantification of the anticipated performance of comfort-relevant flexible assets under varying ambience contexts and, subsequently, calculates demand flexibility profiles towards optimizing energy management at the building level, without compromising comfort of building occupants.

The extraction of flexibility profiles at device level enables the integrated and coordinated utilization of major building loads towards the deployment of highly effective flexibility management strategies under various scopes and goals. Flexibility control in frESCO is gaining further importance, since demand flexibility modelling and profiling will provide the base information for optimizing local device control, enabling the provision of high value services from ESCOs and Aggregators to DSOs and TSOs. On the other hand, such flexibility profiles will comprise in the fundamental means for increasing consumers' understanding and awareness on flexibility and their potential to get effectively and risk-aversely involved in flexibility

transactions and smart contracts, by offering and committing to evident and temporally specified quantities of flexibility made available by distributed flexible assets in the built environment.

2.3.1.2 State of the art

The introduction of renewable energy resources to the power grid, such as wind and solar energy, is rapidly evolving bringing along benefits such as the reduction of fossil fuel dependency. However, in combination with the increasing energy demand, it causes imbalances between energy supply and demand. Demand response programs aim to overcome this problem and ensure that the power grid will always stay in balance. One of the most important aspects of a successful demand response program is the accurate prediction of the demand side flexibility, that a consumer can offer to the system, which can be realized through the precise controls in demand response programs. Thus, a lot of attention has been given to the accurate estimation of the flexibility that different sectors can offer, with the residential sector being one of the most important ones, as it is responsible for a big portion of the overall energy consumption (Merce, R. A., et.al., 2020) [4].

The approaches used for the flexibility quantification task can be grouped in 2 categories: the data driven approaches, that rely mostly on historical consumption data and the physically based approaches, which rely on physical characteristics of a building, the occupants' behavior and require complex calculations [4]. Che, Y.,et.al. (2019) [5] focused their research on Air Condition (A/C) flexibility, as ACs are considered suitable for demand response programs with the potential of providing considerable flexibility to the grid. They formulated mathematical relationships to describe the AC operation, the thermodynamic characteristics of the buildings, as well as the load reduction procedure based on different set temperatures. The flexibility was estimated as the difference of the AC consumption, that occurs due to the different operation frequencies of the AC compressor, when the AC operates for different set temperatures. In addition, the authors introduced restrictions to prevent the indoor temperature reaching unacceptable levels in terms of consumers' comfort, which were also taken into consideration when estimating the potential AC flexibility. A similar approach was followed by Alic, O., & Filik, Ü. B. (2020) [6]. They built an electrical model representation of an AC by combining the AC energy consumption, the indoor and outdoor temperatures, and

the AC operational time. After the model formulation, they designed an energy management scheme, to be able to control the AC set temperatures, based on consumers' comfort profiles (i.e., acceptable temperature ranges), outdoor temperatures and electricity unit prices. Thus, they managed to reduce the energy consumption during peak pricing periods and estimate the flexibility as the difference of baseline consumption and the consumption that occurred after the modification of the AC operation according to the suggested energy management scheme. Chen, Y., et.al., (2019) [7] formulated theoretical models to estimate the potential flexibility that different resources of a building can offer. They considered the flexibility that can be obtained through consumers' behavior (willingness to change their preferable indoor temperatures), the characteristics of the building (thermal mass) and the HVAC system. They reached the conclusion that the HVAC performance was largely influenced by the consumers' behavior and the building characteristics during the peak hours, promising important flexibility potential. Yin, R., et.al. (2016) [8] suggested a different approach. They proposed a simpler model to directly estimate the HVAC flexibility. They claimed, based on previous research, that the flexibility potential correlates with the outside temperature. Thus, they trained linear models with the outside temperature as the only predictor and used different linear models for different ranges of temperatures to estimate the flexibility. They also built detailed physical models to estimate the AC flexibility and compared the 2 approaches, which were found to mostly agree on the results.

2.3.1.3 Implementation

The dataset selected for the suggested solution is obtained from the "Indian Dataset for Ambient Water and Energy" (IAWE) project [9] . It comprises electricity consumption data of different appliances, as well as water, ambient and weather-related data. These data were collected, with a frequency of 1 sample per second, by 33 sensors that were placed for a period of 4 months (May-August 2013) in a three-storey house in New Delhi. After an initial processing of the data (data cleaning, missing data imputation) the dataset included 5,098,699 samples that correspond to a period of 3 months (June-August 2013). For the presented approach, whose purpose is to estimate the potential flexibility of an AC, the AC consumption data were used, as well as weather and ambient related data.

According to the suggested solution for the AC flexibility estimation, two models were implemented. The first model (thermal model) predicts the indoor temperature change for the next time interval and the second model (state predictor) predicts the next AC state (ON-OFF) based on the thermal model's output and the desired temperature (set temperature). Using the predictions for the AC states and the rated AC power, one can estimate the AC consumption for a specific duration and set temperature. The flexibility can be obtained as the difference between two AC consumptions, that occurred for two different set temperatures.

After the first phase of data preprocessing, the data needed to be prepared for the models' training. In order to be able to capture the small indoor temperature differences, that occurred every few minutes due to the AC functioning, the data needed to be down-sampled i.e., the frequency needed to be decreased from 1 second to 2 minutes. The next step was to keep only the data that corresponds to time intervals during which the AC was activated. This step ensures that only valuable information was fed to the models during the training, excluding the periods while the A/C was OFF, which could add noise and worsen the model training.

Having kept only informative time intervals, the actual features required for the training had to be extracted. Thus, indoor and outdoor temperature features, AC consumption and state features, as well as the combination of these, were created to be used for the training and normalized to reduce the negative effect of scale difference among the feature values.

The features were then split to training and test sets (80%-20%) to train and evaluate the models. A linear regressor was trained to predict the indoor temperature change (thermal model) and a Random Forest classifier was trained to predict the next AC state (state predictor).

The trained models were later combined to estimate the AC consumption for a certain duration and a certain set temperature, which were used as inputs to the procedure. The thermal model was employed to estimate the indoor temperature change for the next time interval. Following, the state predictor outputted the next AC state based on the thermal model's output and the selected set temperature. These steps were repeated until the AC states were extracted for the desired time interval. Next, the AC consumption was estimated using the predicted AC activation states and the rated power of the AC. As a final step, the

flexibility for the selected time interval was calculated as the difference of the AC consumption estimated for 2 different set temperatures of interest, which are obtained through the user's thermal comfort profile. Thus, the final output of the model corresponds to the predicted flexibility for the defined duration and time-steps. Figure 3 shows an indicative example of prediction results that correspond to the predicted flexibility for the upcoming three hours at a 15-minute interval (12 steps in total).

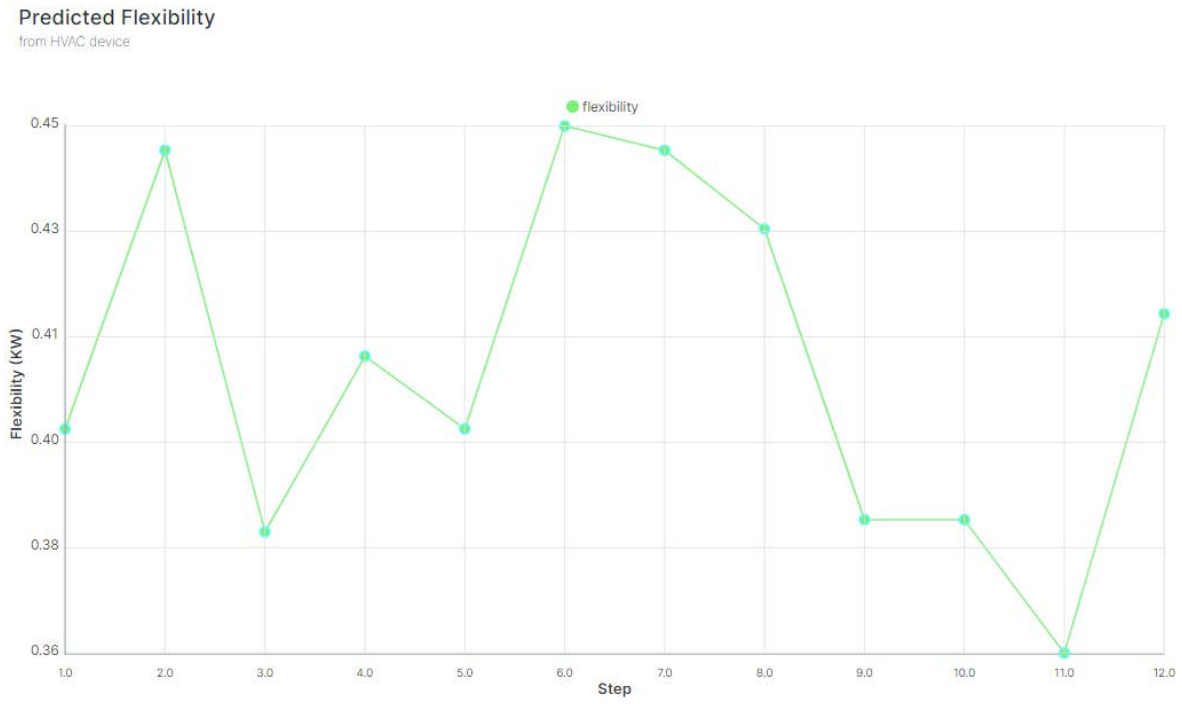


Figure 2 3-hour ahead flexibility prediction for AC device

2.4 Data Search Module Overview

The Data Search Module constitutes an essential part in the Big Data Management Platform of frESCO, enabling the users of the platform to search and discover data that can be proven useful, determine and define which of these available data are of importance and eventually, have a clear and thorough view on the provided results. The Query Creation feature allows users to generate queries utilizing both a flexible free-text search and filtering on the data assets' information, providing them more options in how they find and search for data by introducing a user-friendly data search that allows for keyword and metadata searches. The users of the platform get value from this feature by using it to search for data assets based on their metadata and content.

When a query creation is finished, the Query Execution feature converts the data creator's query settings into a query that the platform can execute efficiently, and the results that match the query are delivered, processed, and presented to the user. Regarding the configuration of APIs for data retrieval, authorized apps will be able to use the frESCO Open APIs to configure data retrieval from a single dataset or from analytics findings. For fine-tuning the returned results, filters, which will be represented by API request parameters, and the selection of certain data attributes are used. The API Gateway generates a unique identifier, provides endpoint usage instructions and includes a test API for a quick results review.

2.5 Platform Governance Module Overview

The Platform Governance Module in the platform of frESCO is of crucial importance, as it establishes the means and processes for secure and reliable registration of the users to the platform. Through appropriate authentication and safeguarding processes, the users are granted access to the data they are eligible to use, and they are offered the capability to receive analytics results, as well. The User Management feature simulates the responsibilities of an identity provider, such as creating and managing identification information for people who are authorized to access the frESCO platform, as well as providing authentication and authorization services to limit access to authorized users.

Furthermore, with the Notification Alerts feature, platform users are provided with timely information on the status of a data import job's execution (successful or unsuccessful) and the status of a data analysis job's execution (successful or failed). They can also investigate and respond to various notifications, as well as delete them if necessary. Finally, the users of the frESCO platform can also customize which notifications they get, based on their personal preferences.

3 PLATFORM FUNCTIONALITY AND USER FLOWS

This deliverable includes the implementation of the frESCO Big Data Management Platform, which can be found at https://fresco.s5labs.eu/.

The landing page welcomes users to the frESCO Big Data Management Platform and allows them to register or log in utilizing existing accounts, as depicted in Figure 3.

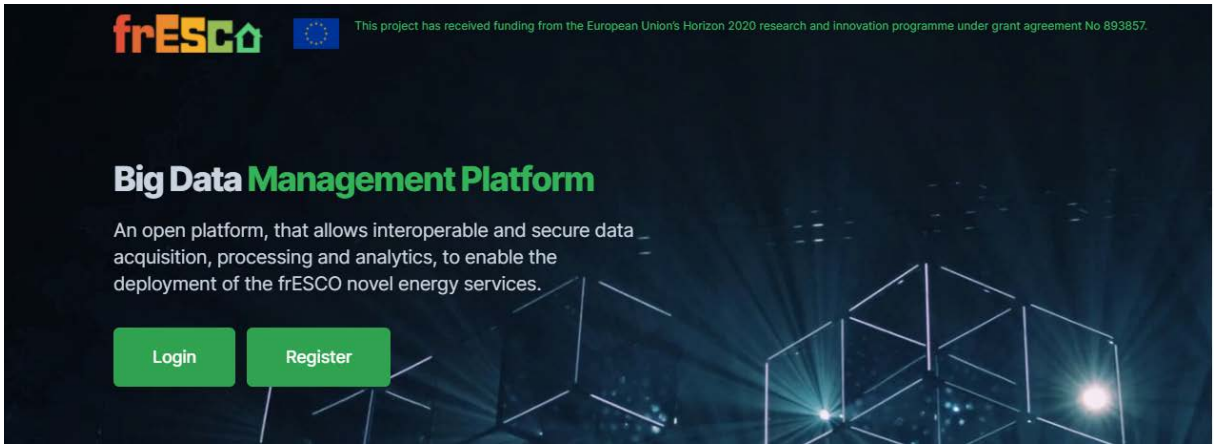


Figure 3 frESCO Big Data Management Platform landing page

Users of the frESCO Platform can start the process of registering a new user by entering their first and last name, a username, an e-mail address, and a password that must meet certain restrictions and be provided twice, as shown in Figure 4.

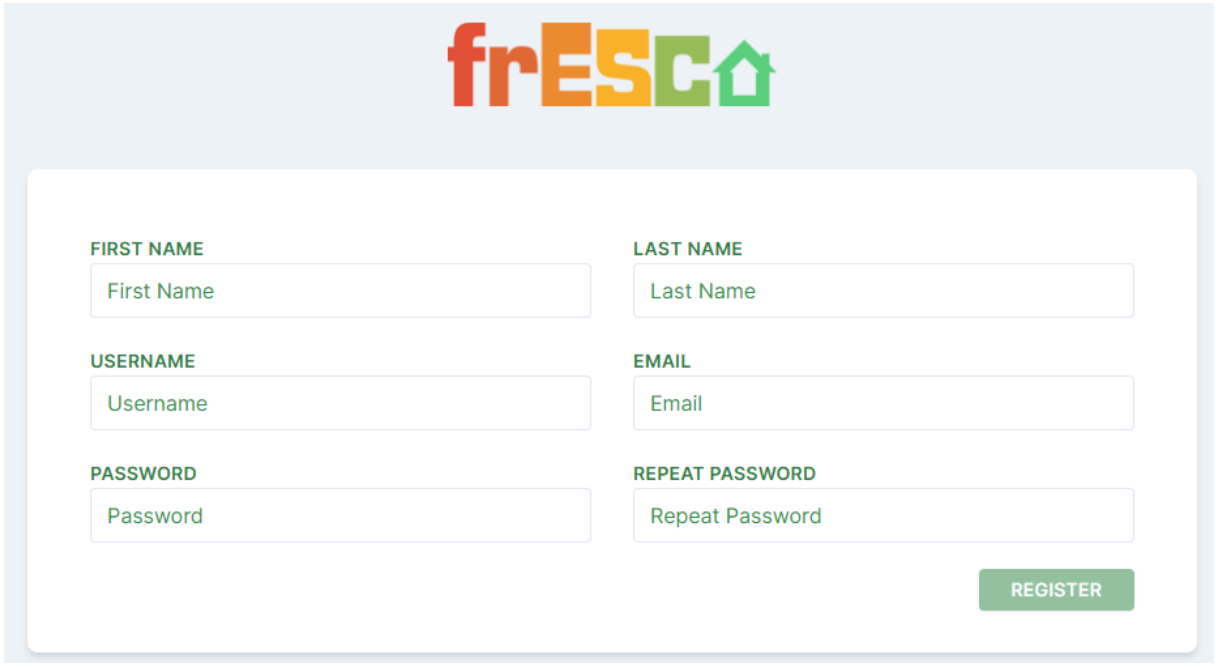


Figure 4 Registration of a new frESCO Platform user

Users are redirected to the login page after finishing the registration process, as illustrated in Figure 5, in order to give their credentials and log in to the frESCO Big Data Management Platform.

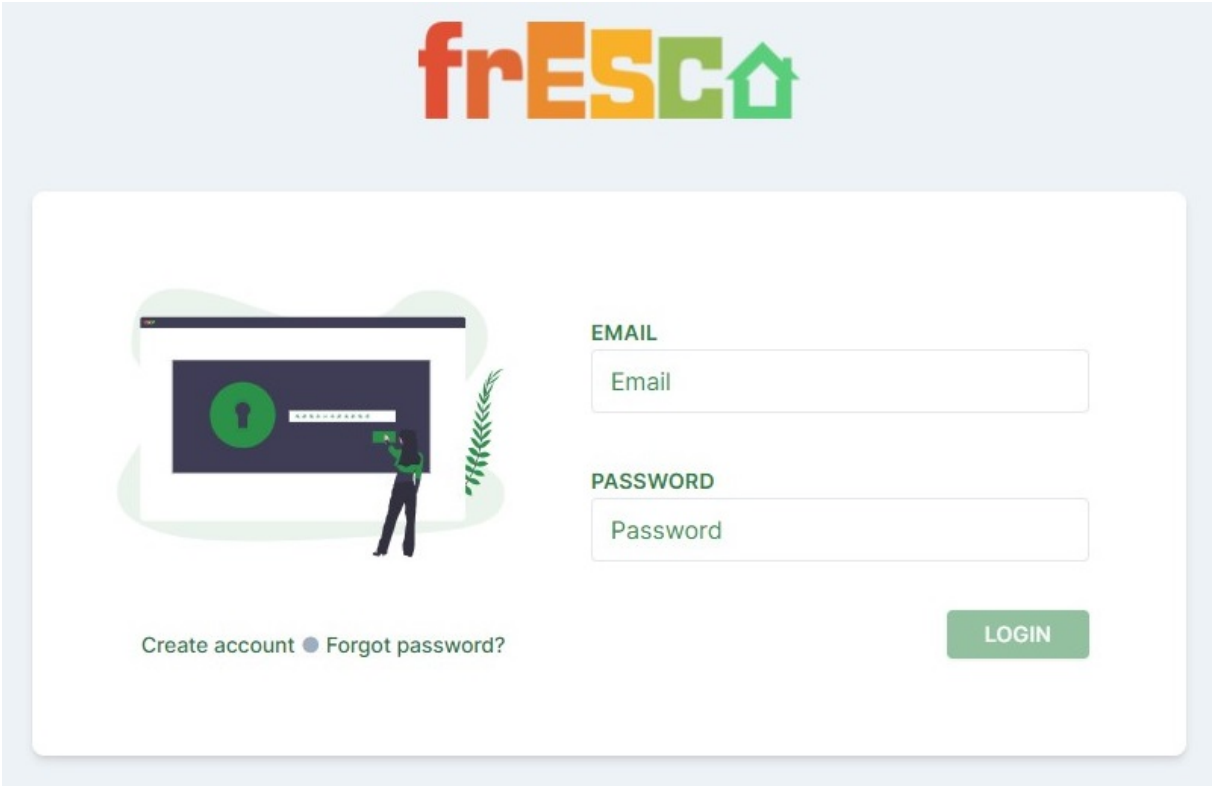


Figure 5 Logging in the frESCO Platform

The core user flows of the frESCO Big Data Management Platform are detailed in the sections that follow. The data ingestion, storage, and search and retrieval processes are all described in depth with appropriate screenshots. The user-friendly interface environment built in the context of this deliverable, as defined in section 2.1, allows users to understand and smoothly complete the important activities, tailored to their specific needs.

3.1 Data Collection User Flow

When entering the platform, the user is presented with the Data Collection page. The data collection job creation is initiated after selecting the Create button on the top navigation bar. Furthermore, the platform user is requested to provide the data collection job parameters and choose the preferred processing rules.

3.1.1 Data Collection Job Creation

The data collection workflow starts with the creation of a new data collection job and with the provision of specific processing rules, as presented in Figure 6. The data asset provider is requested to fill in some initial information about the data collection job, such as title and a

brief description of the data asset that is going to be imported, defining also appropriate processing rules. The processing rules of collector, harmonization and data storage are preselected; however, the platform user can decide whether to curate or not the data asset, since the curation rule is optional.

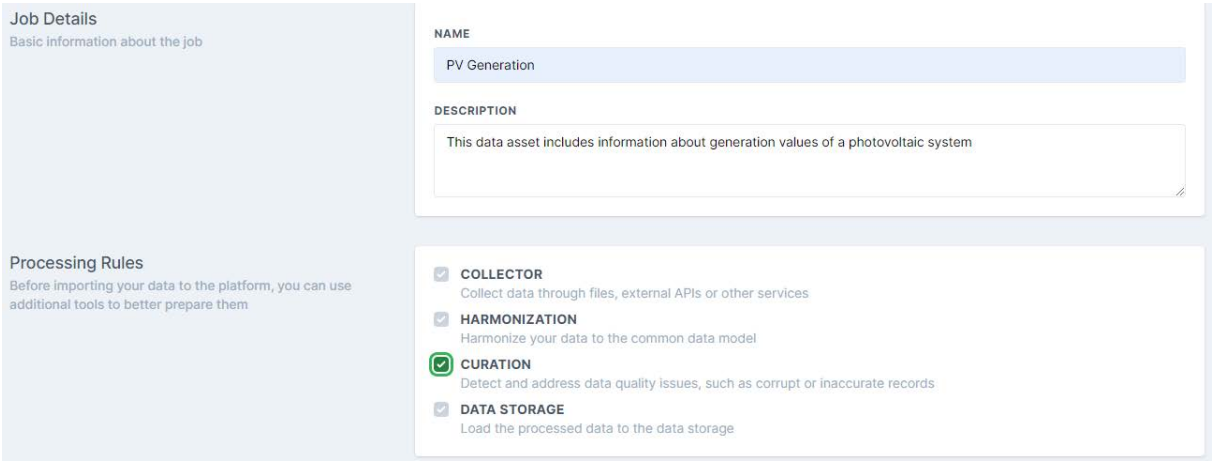


Figure 6 Parameters of new data collection job

The data collection job is saved once the users click on the “Create” button, at the right top corner of the screen. The job is created and listed in the data collection jobs list after the required information is provided. When the data collection job name is clicked, steps to be configured are displayed based on the user's preferences during the creation, as presented in Figure 7.

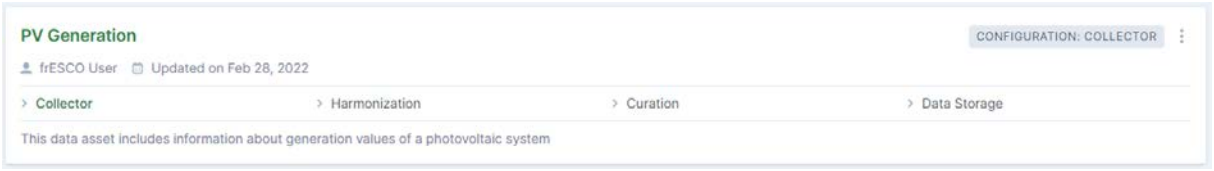


Figure 7 Display of the created data collection job and user preferences for processing

3.1.1.1 Collector

When the platform user selects the Collector on a new data collection job, the user can pick from the different data import options, which include direct file uploading and data collection via APIs, as depicted in Figure 8.

Figure 8 Uploading files in the frESCO Platform

File formats such as .csv and JSON can be selected in the file uploading configuration. This phase is completed by providing a sample and the actual file to be uploaded, as depicted in Figure 9.

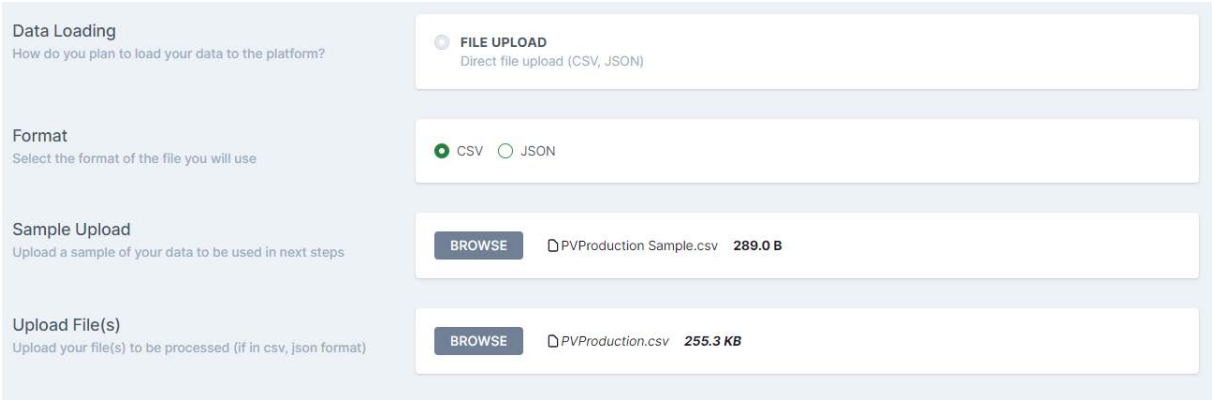
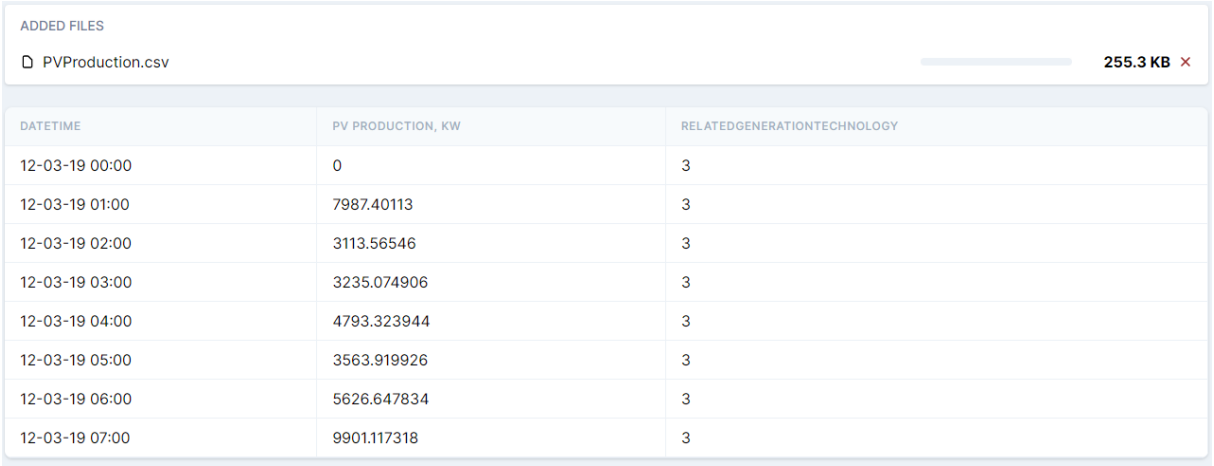


Figure 9 Uploading files Configuration

When the necessary information is provided, the platform users are presented with a summary of the sample file they selected and then, they can Save and Finalize the configuration, as depicted in Figure 10.



DATETIME	PV PRODUCTION, KW	RELATEDGENERATIONTECHNOLOGY
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12-03-19 01:00	7987.40113	3
12-03-19 02:00	3113.56546	3
12-03-19 03:00	3235.074906	3
12-03-19 04:00	4793.323944	3
12-03-19 05:00	3563.919926	3
12-03-19 06:00	5626.647834	3
12-03-19 07:00	9901.117318	3

Figure 10 Sampling of the uploaded files

Also, platform users who keep data in their organization systems and expose it through APIs can utilize the frESCO platform's API retrieval feature [10]. A configuration page is provided to them, as shown in Figure 11, in order to initiate the process to import their data. The platform user selects the type of authentication, and then the user is requested to provide the entire API URL, as well as the method to be utilized (e.g., GET) and, if necessary, the request's query body.

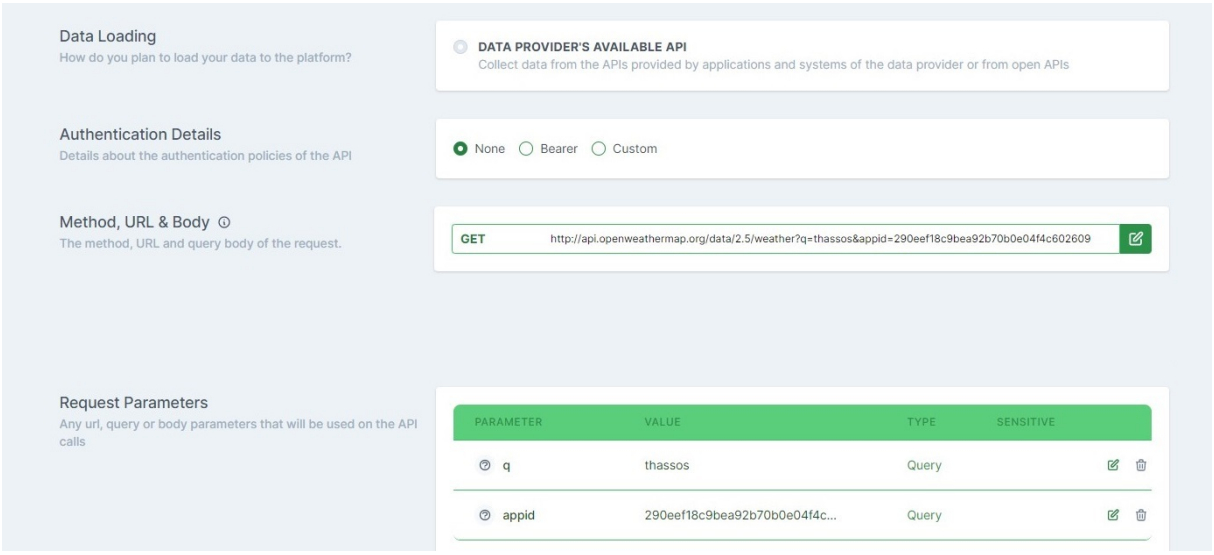

Figure 11 Data Collection via API Configuration

Additionally, the platform users are requested to define how often they prefer to retrieve data through the API and set appropriate scheduling intervals. The user is given a summary of the structure that is stored, together with selected entities, in order to rapidly examine the data that will be stored on the platform, as depicted in Figure 12.

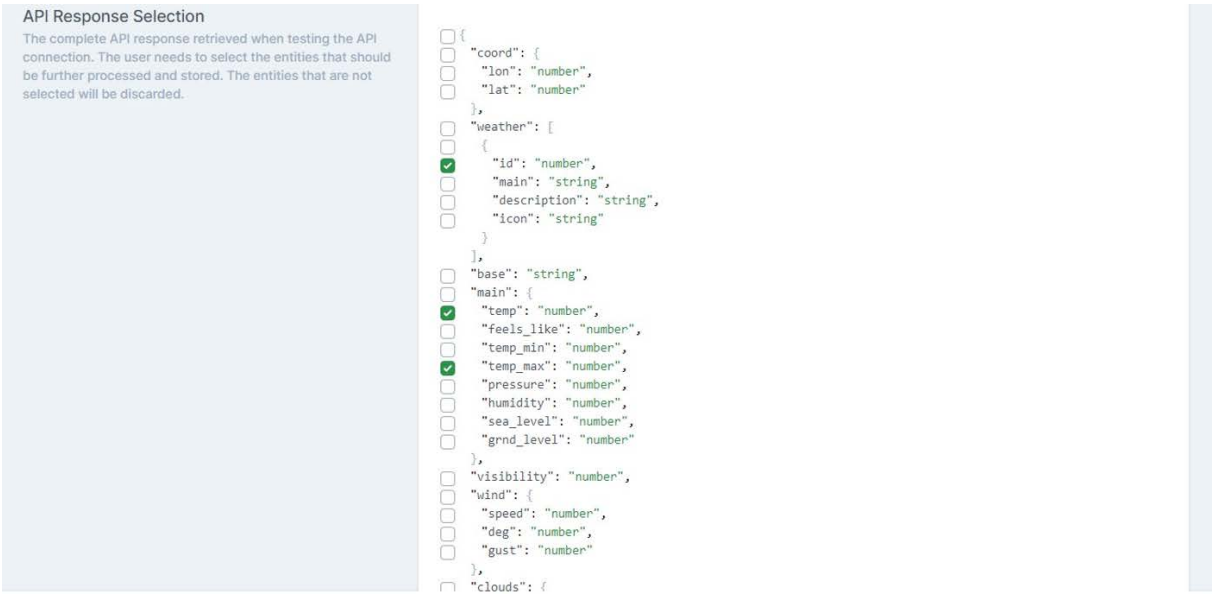

Figure 12 API Retrieval Configuration

3.1.1.2 Harmonization

Selecting the Configure Harmonization option button, the process to match the imported data to the frESCO CIM defined entities in D4.1 [11] is initiated. During step 1, the platform displays the name of the model, several standards considered in the development of the frESCO Common Information Model, that can be selected if the user knows the corresponding standard the imported data adheres to, and the list of the frESCO CIM entities defined in order to select the entry point of the harmonization process.

After concluding Step 1, the frESCO Platform users are redirected to the harmonization playground in Step 2, where they can harmonize the imported data with the frESCO CIM's entities and attributes, as depicted in Figure 13.

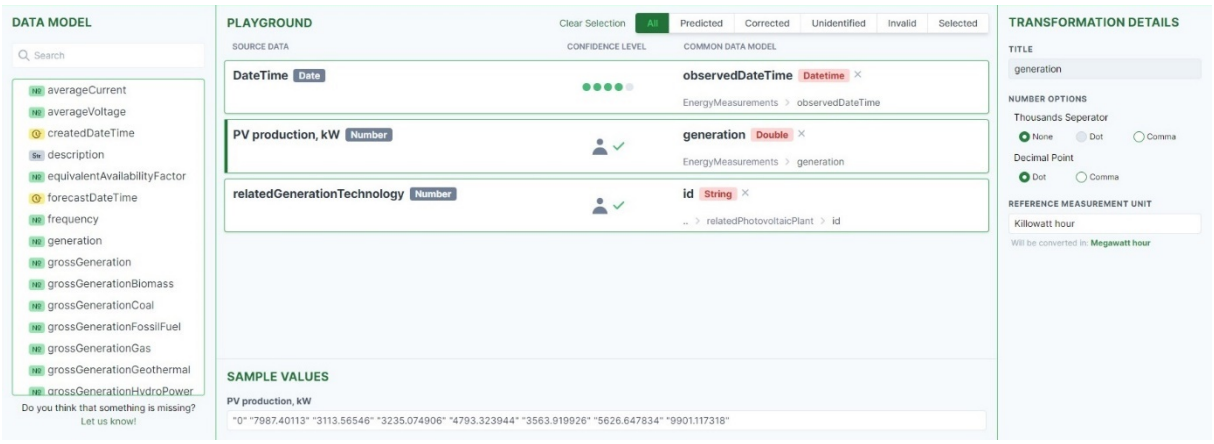

Figure 13 Harmonization Playground Configuration

The users of the frESCO Platform can search through the frESCO CIM and discover the list of attributes for the entity selected in the previous phase, on the left side of the harmonization playground page. Also, the user can see the data imported into the platform in the middle of the page and can define the harmonization details of each attribute selected, on the left side of the page. In order to facilitate the execution of the harmonization process, the user will receive suitable guidance and appropriate harmonization recommendations, as well as relevant confidence levels, search and drag-and-drop functionality, explanations of attributes, and data sample display, as stated in section 2.1. The user is also provided with a validation option that informs on whether the harmonization performed is correct, allowing for any necessary changes and completions.

In Step 3, the users are offered with an overview of the matched entities and attributes, they are notified whether the harmonization actions are correct, and they can select to Save and Finalize the process, as presented in Figure 14.

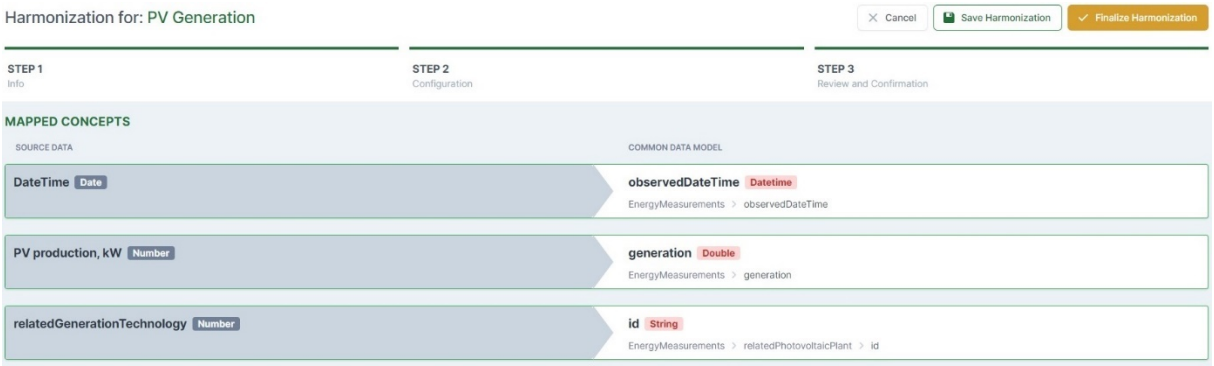

Figure 14 Harmonization Overview

3.1.1.3 Curation

After the harmonization process is completed, the users are redirected to the curation configuration page, where they can apply curation rules to the imported data, as shown in Figure 15.

Figure 15 Curation Configuration

The users are presented with the capability to establish one or more curation rules and restrictions, as well as the respective outliers' rules, for each of the data attributes, in order to eliminate erroneous values before they are eventually stored in the platform, as depicted in Figure 16.

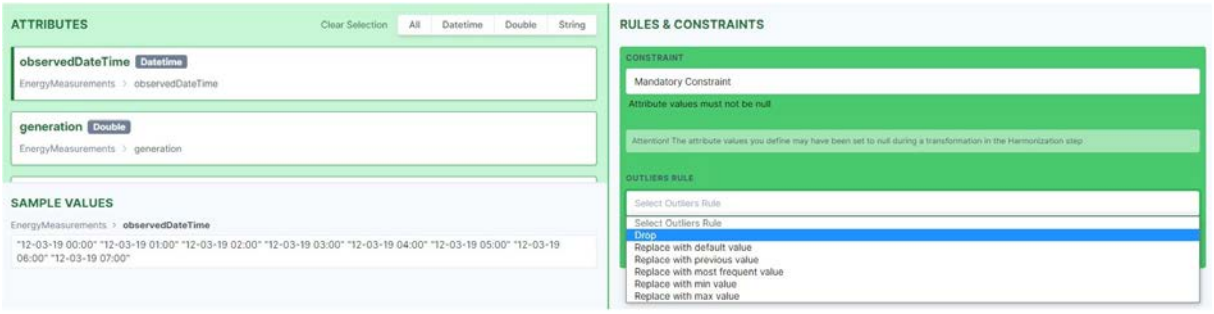

Figure 16 Establishing curation rules and constraints

After the curation configuration is completed, the users are able to overview the curation rules and constraints for each and every one of the data attributes and then finalize the curation process, as presented in Figure 17.

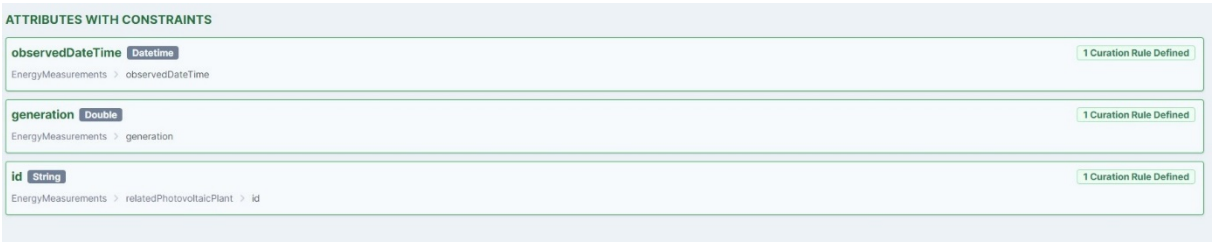

Figure 17 Curation Overview

3.1.1.4 Data Storage

The final stage for the successful completion of a data collection job is Data Storage. At this stage, the frESCO Platform users need to define a name for the data asset that is to be stored

in the platform, along with a brief description of the data that the data asset contains, as depicted in Figure 18.

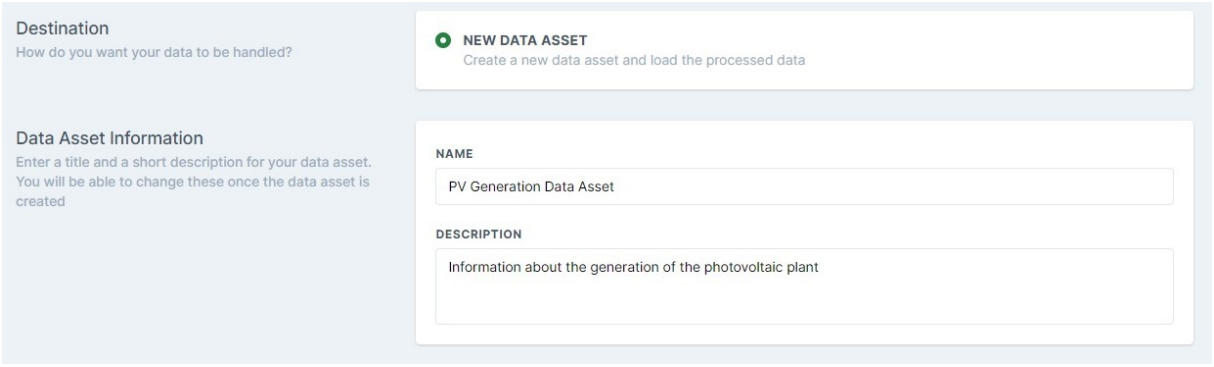

Figure 18 Data Storage Configuration

After providing all the necessary information about the data asset that is to be stored in the frESCO Big Data Management Platform, the frESCO Platform users are notified that the data collection job is completed and they are redirected to data collection job page, as depicted in Figure 19, where they are able to find all the data collection jobs initiated along with their respective completion status.

Figure 19 Data Collection Jobs page, once a data collection job is completed

3.1.1.5 Data Asset Profile Definition

Any result of a data collection job is saved as a data asset in the frESCO Big Data Management Platform, so data providers must define a complete profile of the data asset. After going to the Data Assets tab on the side navigation bar, platform users are requested to provide a title for the data asset and a description of what it contains, as shown in Figure 20.

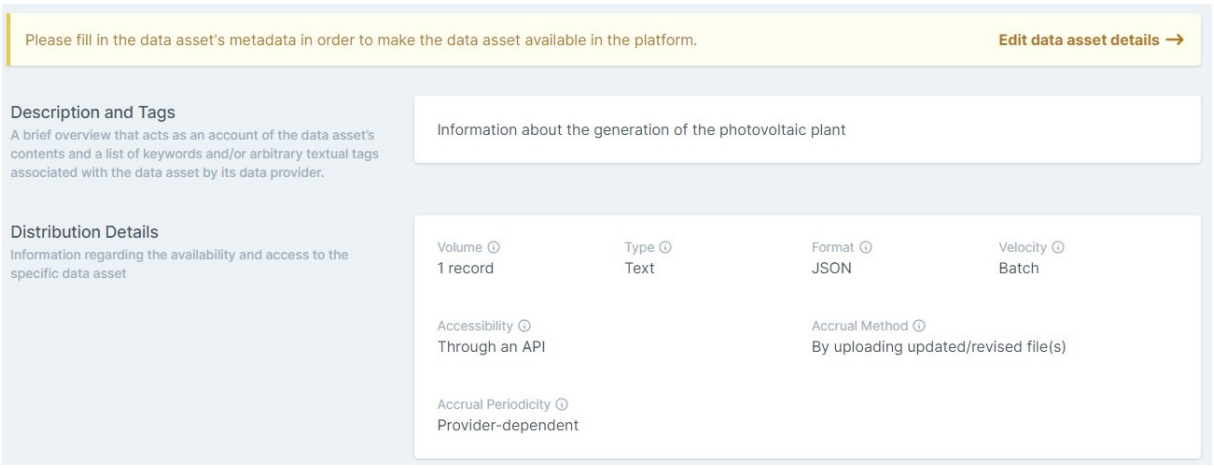

Figure 20 Definition of the data asset profile

Applicable tags should also be defined when completing the data asset profile. Information about the data asset's coverage and granularity, as depicted in Figure 21, in order to delineate the type of the data asset, the format of the data asset to which the data are available, the language of the data asset, as well as specifics about the temporal coverage, spatial coverage, temporal resolution, and spatial resolution units of the data.

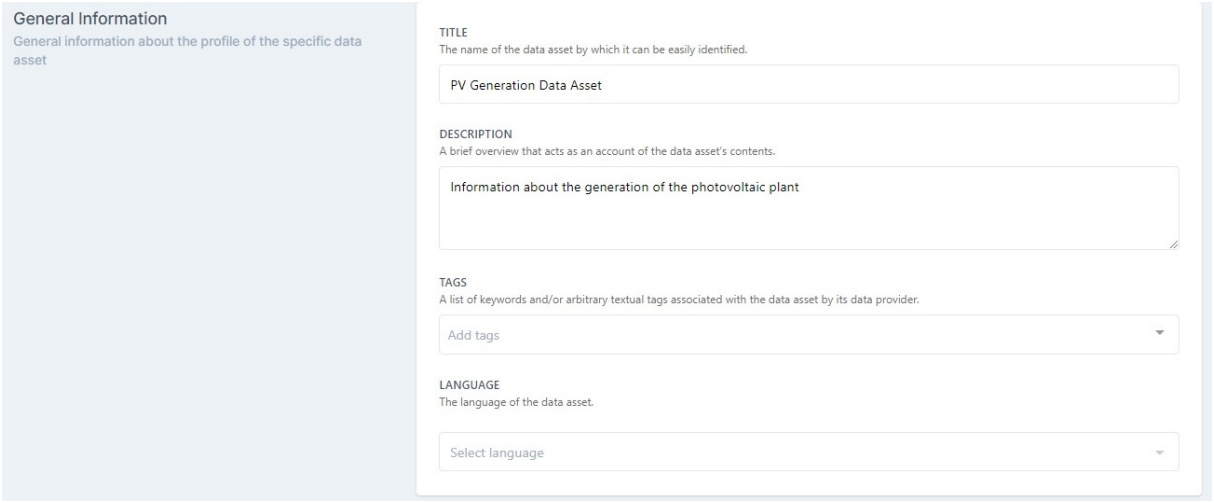

Figure 21 General information provision for a data asset

Users of the frESCO platform can configure the visibility levels as well as the access policies for the corresponding data assets. The data asset provider can choose whether the data asset is for: i) Exclusive access (access to the data asset is allowed only if access policies are met) or ii) Universal access by setting visibility levels (Free access to the data asset, no requirement for access policies to be met). If the access level is set to Exclusive, the applicable access policies, as well as the relevant approach (Allow-all) and the inclusion of specific exceptions, must be

defined. A data asset provider must choose a user parameter, a condition (such as equal, not equal etc.,), and the value of the parameter to add exceptions, as shown in Figure 22.

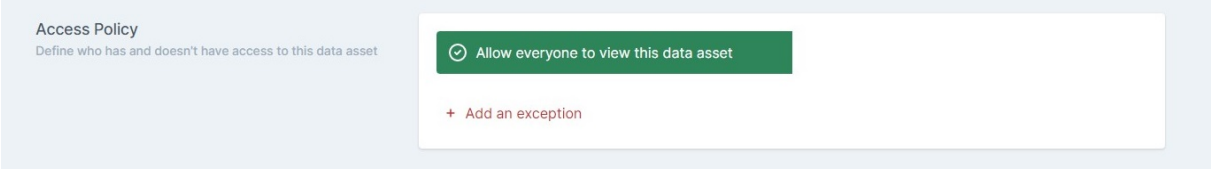

Figure 22 Access policies definition

3.2 Data Analytics User Flow

The Data Analytics Module includes a simple mechanism that allows frESCO platform users to see how pre-trained models are executed visually. More specifically, the module's Analytics Execution and Reporting mechanism comprises predefined charts for various analytics processes that are fed with data, resulting in the generation of relevant visualizations, that in the beta release of the frESCO Platform are visible to the Platform administrator, as illustrated in Figure 23.

Thus, the results of the analytics algorithms execution will be made available through the search and retrieve functionality to all platform users.

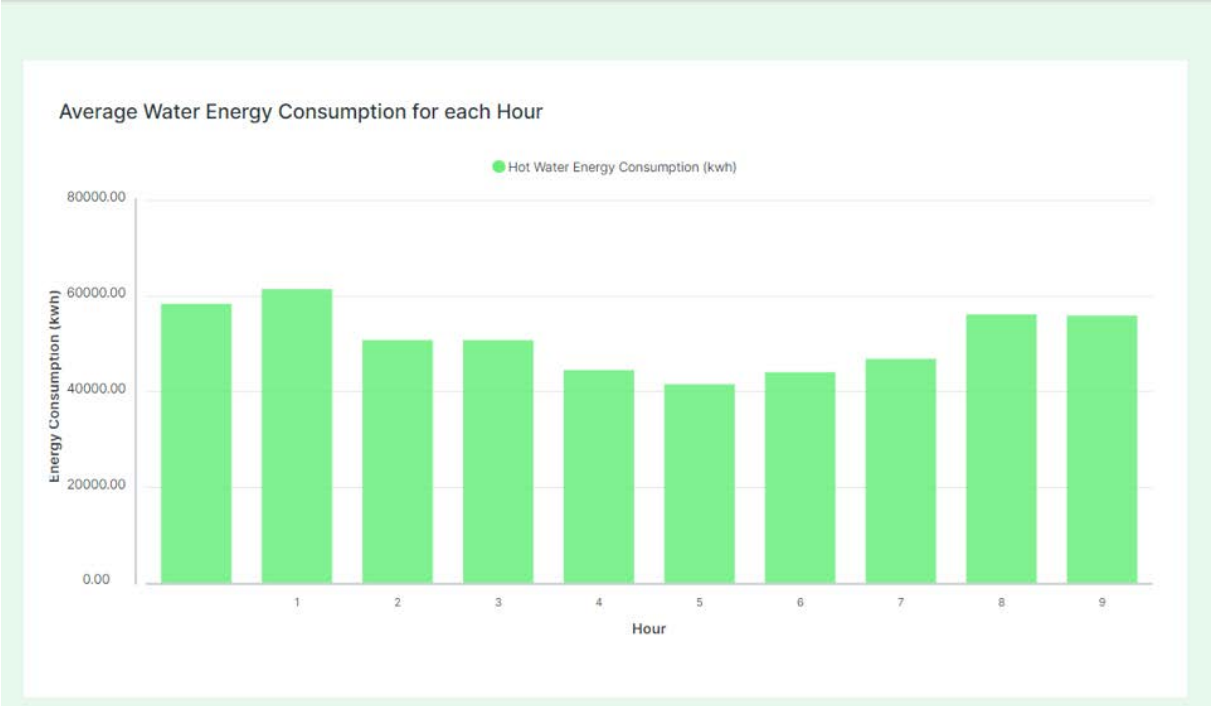

Figure 23 Algorithmic Model execution Results over Energy Consumption

3.3 Data Search and Retrieval User Flow

The Data Search Module is essential for the frESCO's Big Data Management Platform, allowing users to search for and discover useful data, determine and define which of these available data are important, and finally, have a clear and comprehensive view of the provided results.

Users of the frESCO Platform can see a list of the data assets they own after navigating and clicking in the appropriate tab at the platform's side navigation bar. They are provided with appropriate filtering tools, so that they can filter the data assets based on their data type. It is worth mentioning, that the platform users are able to select data assets either uploaded from them or from other users, as depicted in Figure 24.

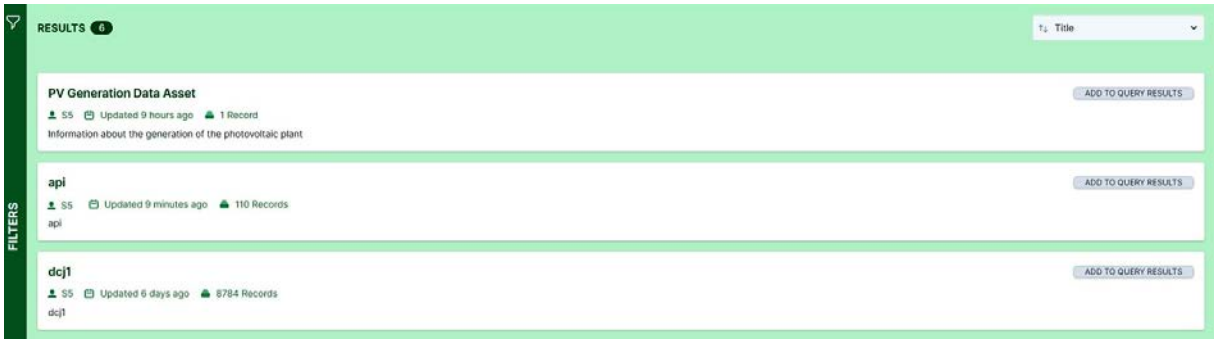

Figure 24 Search Query Overview

Additionally, users can create queries using both a flexible free-text search and filtering on the data assets' information, as indicated in section 2.4, giving them more options in how they find and search for data within the frESCO Platform.

Query Creation is a major feature of the Data Search Module that gives data asset providers the resources they need for data retrieval and exploration, allowing them to conduct data sharing operations. Users of the platform can search for data that is relevant to their needs, browse through the results, and dig further into the data to select viable candidates for retrieval. The Retrieval Settings must be provided by API in the Retrieval Configuration page by selecting the entities that a user wishes to obtain from each data asset. In addition, the entities used as query parameters to filter the query results must be declared, as depicted in Figure 25.

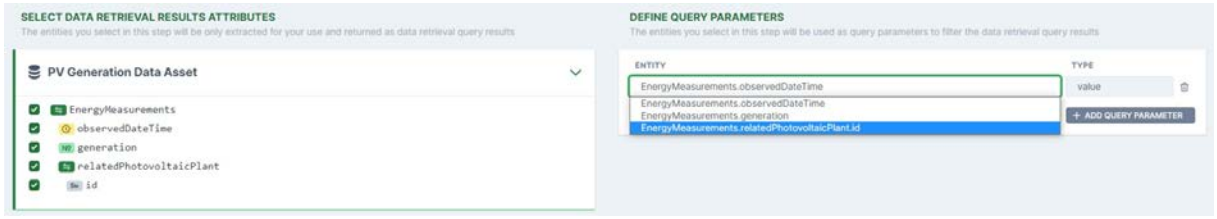

Figure 25 Query Configuration

The retrieval configuration concludes with instructions on how to use the frESCO APIs to acquire the retrieval results. To that aim, authentication instructions are included alongside the endpoints (i.e., for GET and POST methods), as well as the entire API paths, as depicted in Figure 26.

Figure 26 Finalization of the Retrieval Configuration

3.4 Supplementary Platform Functionalities

Additional features on the frESCO Platform are available to different types of users (platform administrators, data asset consumers, data asset suppliers, and others), such as editing user profiles and receiving notification alerts on the status of data import jobs (successful or unsuccessful), as well as the functionalities to handle them appropriately.

The users of the frESCO platform have the option of receiving appropriate notification alerts regarding the progress of their data import jobs and their current status, as depicted in Figure 27.

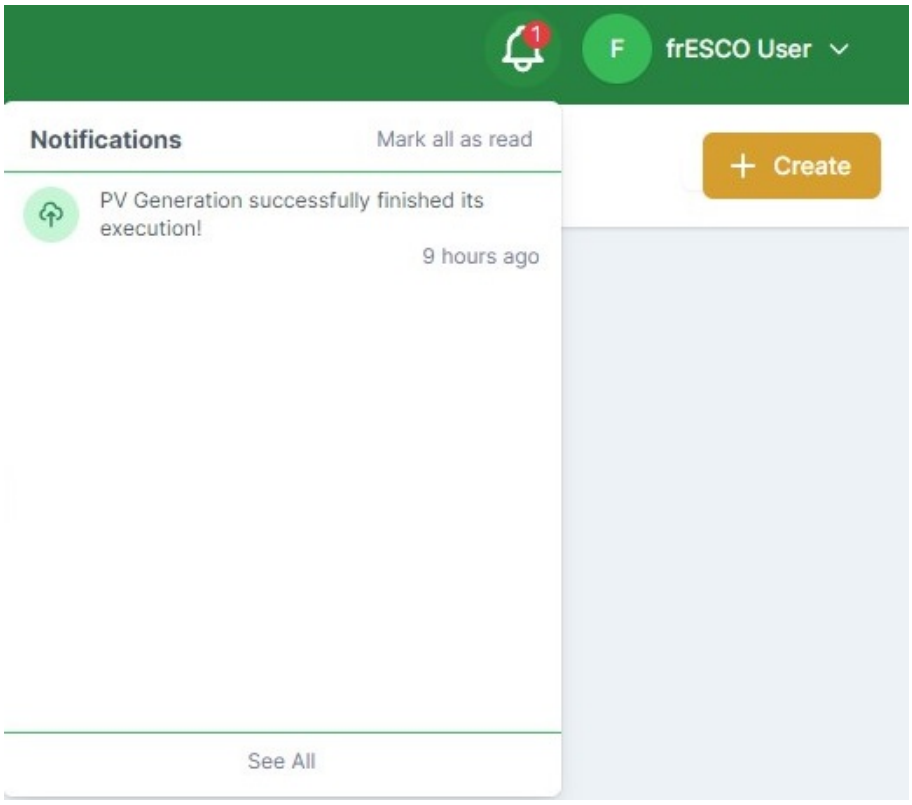

Figure 27 Notification Alerts

4 CONCLUSIONS

Deliverable 4.6 describes the frESCO Integrated Platform's Beta Release, as well as the modules that make up the platform (Data Collection, Data Security and Storage, Data Analytics, Data Search, Platform Governance). The current implementation status of the platform's modules and the extent of the features available to frESCO Platform users are also analyzed. In particular, this deliverable describes extensively:

- The data collection user flow which demonstrates how the platform users can create Data Collection jobs using direct file uploading and APIs. The platform's data import process, how attributes are harmonized with the frESCO CIM, and how appropriate data processing rules are established are also explained.
- The data analytics user flow, in order to deliver useful insights to the frESCO Platform users. HVAC Flexibility Analytics are also introduced and analysed, as part of the overall frESCO analytics catalogue, supplementing the baseline analytics of generation forecasting, devices profiling and comfort analytics.
- The Search and Retrieval User Flow, with which platform users can search for data that they are allowed to use based on the access policies that have been established. The users are enabled with appropriate options for filtering the available results, from which they can choose the ones that match their preferences, in order to include them in the creation of a retrieval query and finally, retrieve them.
- Supplementary functionalities included in the frESCO Platform. The users of the frESCO Platform have the ability to edit and change their personal profile information, as well as update their current password to a new one. Also, they can take advantage of the Notification Alerts feature, which provides information on the success or failure of a data collection job, whilst being able to modify this feature by determining how often they want to receive notifications based on their particular preferences.

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