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WP6

ICT Platform to enhance TSO/DSO coordination

TSO/DSO visualization tools

D6.3



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AUTHOR(S)	Clara Bagnasco, Christian Biasuzzi, Davide Longo, Massimo Ferraro, Lara Pinato
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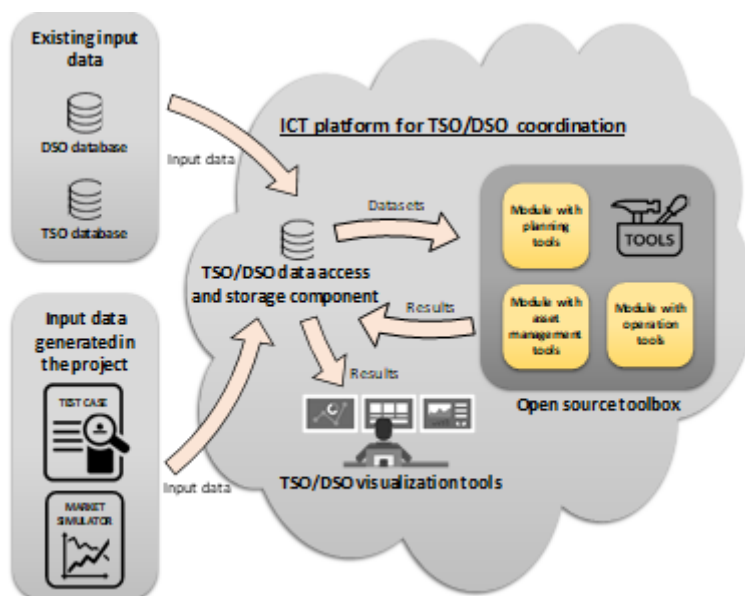
Abbreviations and Acronyms

<i>API</i>	Application Programming Interface
<i>CSS</i>	Cascading Style Sheets
<i>GUI</i>	Graphical User Interface
<i>HTML</i>	HyperText Markup Language
<i>ICT</i>	Information and Communication Technologies
<i>JS</i>	JavaScript
<i>PWA</i>	Progressive Web App
<i>REST</i>	Representational State Transfer
<i>SLD</i>	Single Line Diagram
<i>SPA</i>	Single Page Application
<i>SVG</i>	Scalable Vector Graphics
<i>UI</i>	User Interface

1. Introduction

The results of ATTEST project include an opensource toolbox: a set of tools for supporting TSOs and DSOs during asset management and coordinated network planning and operation.

An ICT platform, depicted in the picture below, integrates the toolbox, and includes (1) a common data access layer enabling data integration, (2) an orchestration layer allowing the use of the tools and (3) an interface layer for accessing data and functionalities.



The interface layer, inside the ICT platform, provides a set of interactive visualization tools (graphical user interfaces) tailored according to the purpose and requirements of components in the toolbox, with the goal of enabling and enhancing the collaboration between operators and facilitating their network operation, maintenance and planning tasks.

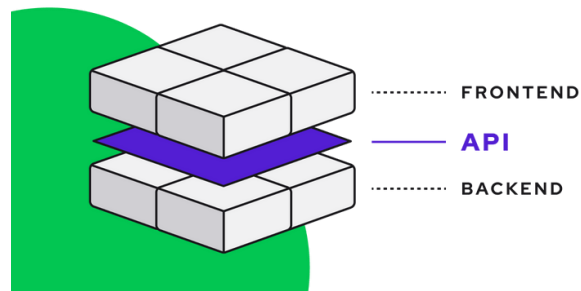
This report accompanies the release of the software implementing the interface layer, and provides the following information:

- Section 2 describes the ICT GUI implemented and the framework used for integrating the visualization components.
- Section 3 lists and provides information about the different visualization components implemented.

For the installation guide of the ICT platform, including the interface layer, please refer to the appendix of deliverable D6.1 "TSO/DSO data access and storage component".

2. ICT GUI

The ATTEST ICT platform has been designed and implemented using a headless approach, separating the presentation layer and the User Interface (frontend) from the business logic and data layer (backend). The communication between frontend and backend takes place through API (see picture below).



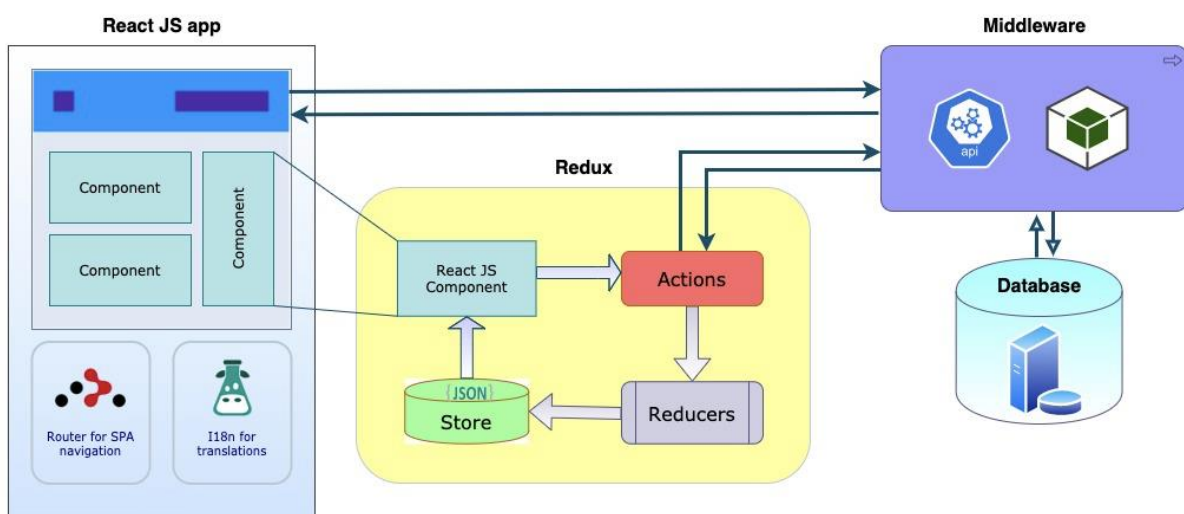
This approach enhances the flexibility, making the platform modular and so more easily extendable and integrable with other systems.

In ATTEST the backend is the data access and storage component (please see deliverable D6.1 for details), while the frontend is described in this report. The API layer is implemented using REST Web Services, provided by the access and storage component, and used by the interface layer for accessing data and functionalities.

The interface layer has been implemented as a Progressive Web App (PWA), a type of application software delivered through the web, built using common web technologies including HTML, CSS, JavaScript, and WebAssembly. It is designed to be responsive, intended to optimize the user experience and to work on any platform with a standards-compliant browser, including desktop and mobile devices.

We developed the PWA as a SPA (Single Page Application), i.e. a web application that interacts with the user by dynamically rewriting the current web page with new data from the web server, instead of the default method of a web browser loading entire new pages. The advantages of this approach are a quick loading time and a seamless user experience, making also easier to add advanced features to the web application.

The technology used to implement the PWA is React, a free and open-source front-end JavaScript library for building user interfaces based on UI components.



React uses a Component Based Architecture, a method for encapsulating individual pieces of a larger user interface (aka components) into self-sustaining, independent micro-systems.

A component is a small feature that makes up a piece of the user interface. These components exist within the same space, yet interact independently from one another. Components encapsulate well-defined functionalities, have their own structure, their own methods and their own APIs. Components are also reusable and can be “pasted” into interfaces at will. The independent nature of components allows for developers to create a UI with many different moving parts.

The different React visualization components developed during the project and integrated and used in the ICT interface layer are described in the following section.

The access to all the functionalities provided by the interface requires authentication. Parts of the interface are also customized, and some functionalities made available, according to the user role. The interface layer uses the services and integrates pages provided by the identity manager included in the ICT platform (please see deliverable D6.1 for details) for handling user authentication and getting user’s data and roles.

3. Visualization components

The list of visualization components developed during ATTEST project, and integrated in the ICT platform interface layer (see section 2) are included in 2 main categories:

- Network management components, for loading networks and auxiliary data, and for networks and network elements visualizations.
- Tools management, to select, configure, run and monitor tools, and to visualize analysis results.

The different components available are reported in the following sections.

3.1. Network management

3.1.1. Data loading

These components are used to load into the system networks and all the necessary auxiliary data, i.e. profiles. The components allow both to input/select some network and profile parameters and to

upload the proper data files.

The screenshot shows the 'Create or edit a Network' form in the Attest application. The form includes the following fields and controls:

- Name:** A text input field.
- Mpc Name:** A text input field.
- Country:** A dropdown menu with the placeholder text 'Select the country...'. A small downward arrow is visible on the right.
- Type:** A dropdown menu with the placeholder text 'Select the type...'. A small downward arrow is visible on the right.
- Description:** A text input field.
- Is Deleted:** A checkbox.
- Network Date:** A date-time input field showing '24/11/2022 00:00' with a calendar icon on the right.
- Version:** A text input field.
- Creation Date Time:** A date-time input field showing '24/11/2022 00:00' with a calendar icon on the right.
- Update Date Time:** A date-time input field showing '24/11/2022 00:00' with a calendar icon on the right.
- Buttons:** 'Back' and 'Save' buttons at the bottom left.

FIGURE 1 - NETWORK CREATION

The screenshot shows the 'Upload data for network PT_DX_01_2020' form in the Attest application. The form includes the following elements:

- Header:** 'Upload data for network PT_DX_01_2020'.
- Upload a Network file:** A section containing a file selection input field with the placeholder text 'Scogli file' and 'Nessun file selezionato', an 'Upload' button, and a 'Remove Filters' link.
- Navigation:** A 'Back' button at the bottom left.

FIGURE 2 - NETWORK UPLOAD

The screenshot shows the 'Upload data for network PT_DX_01_2020' form in the Attest application, displaying the results of profile loading. The form includes the following sections:

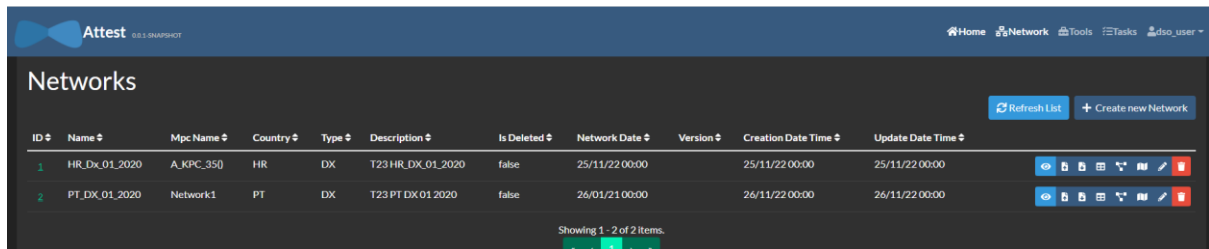
- Network file uploaded:** A box showing 'Distribution_Network_PT1.m'.
- Generator Profile:** A section with fields for Profile Date, Season, Typical Day, and Mode, and a file selection input field. An 'Upload' button and 'Remove Filters' link are present.
- Load Profile:** A table with columns for Season, Typical Day, Mode, Time Interval, Name, and Delete. The table contains one row: Autumn, Business Day, Business day for a season, 15 minutes, Network1_A_Bd.xlsx, and a delete icon. A 'Files Uploaded' button is at the top right.
- Flex Profile:** A section with fields for Profile Date, Season, Typical Day, and Mode, and a file selection input field. An 'Upload' button and 'Remove Filters' link are present.

FIGURE 3 - PROFILES LOADING

3.1.2. Network visualization

These components are meant to visualize network and network elements.

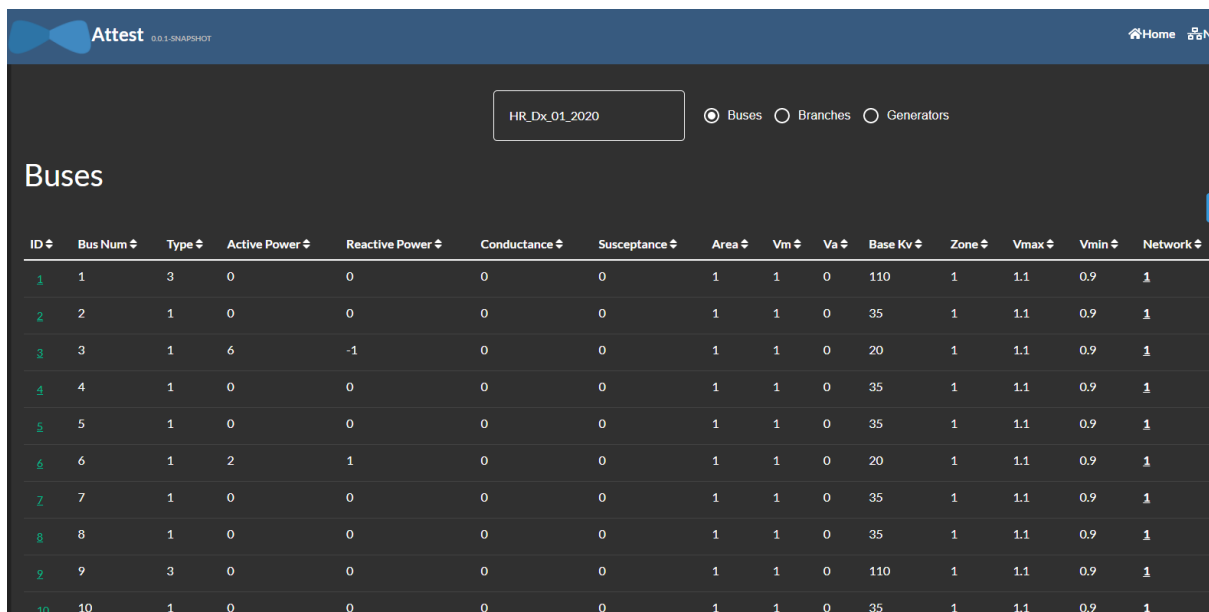
A visualization component lists all the networks loaded into the platform, showing also some information about them (country, distribution vs. transmission type, etc.) and providing access to some operations (e.g. single line diagram – SLD – visualization). The component uses a table representation, with the table lines (networks) sortable according to the different columns (network data).



ID	Name	Mpc Name	Country	Type	Description	Is Deleted	Network Date	Version	Creation Date Time	Update Date Time
1	HR_Dx_01_2020	A_KPC_350	HR	DX	T23 HR_DX_01_2020	false	25/11/22 00:00		25/11/22 00:00	25/11/22 00:00
2	PT_DX_01_2020	Network1	PT	DX	T23 PT_DX_01_2020	false	26/01/21 00:00		26/11/22 00:00	26/11/22 00:00

FIGURE 4 - NETWORKS LIST

Some visualization components allow to visualize data (e.g. voltage, active and reactive power) of the different elements of a network: buses, branches, etc. The components use a table representation of the data, allowing the user to sort the tables lines (network elements, e.g. buses) according to the different columns (elements data, e.g. active or reactive power).



ID	Bus Num	Type	Active Power	Reactive Power	Conductance	Susceptance	Area	Vm	Va	Base Kv	Zone	Vmax	Vmin	Network
1	1	3	0	0	0	0	1	1	0	110	1	1.1	0.9	1
2	2	1	0	0	0	0	1	1	0	35	1	1.1	0.9	1
3	3	1	6	-1	0	0	1	1	0	20	1	1.1	0.9	1
4	4	1	0	0	0	0	1	1	0	35	1	1.1	0.9	1
5	5	1	0	0	0	0	1	1	0	35	1	1.1	0.9	1
6	6	1	2	1	0	0	1	1	0	20	1	1.1	0.9	1
7	7	1	0	0	0	0	1	1	0	35	1	1.1	0.9	1
8	8	1	0	0	0	0	1	1	0	35	1	1.1	0.9	1
9	9	3	0	0	0	0	1	1	0	110	1	1.1	0.9	1
10	10	1	0	0	0	0	1	1	0	35	1	1.1	0.9	1

FIGURE 5 - BUSES DATA

A component has also been developed to provide a single line diagram (SLD) visualization of the network. The component can show both a network level and a substation level representation of the SLD.

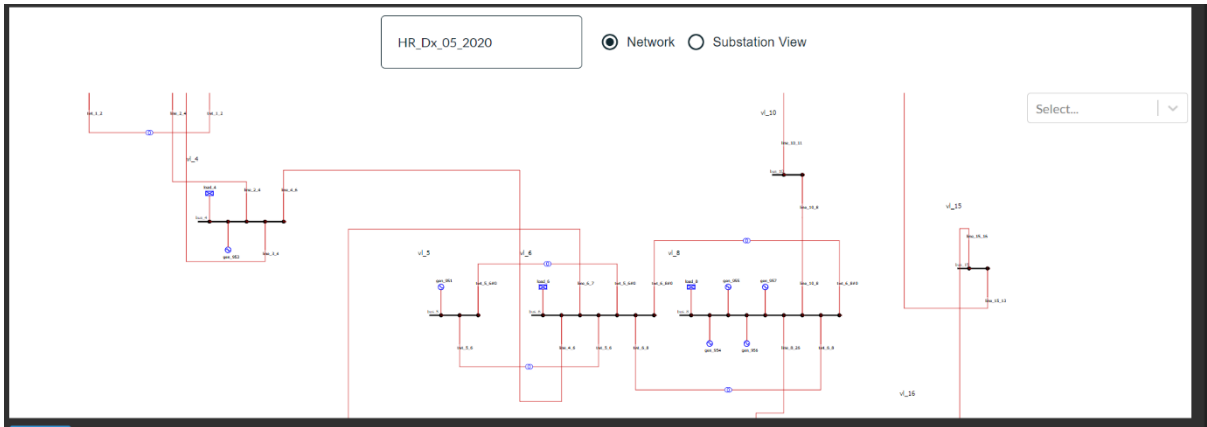


FIGURE 6 - SINGLE LINE DIAGRAM - NETWORK VIEW

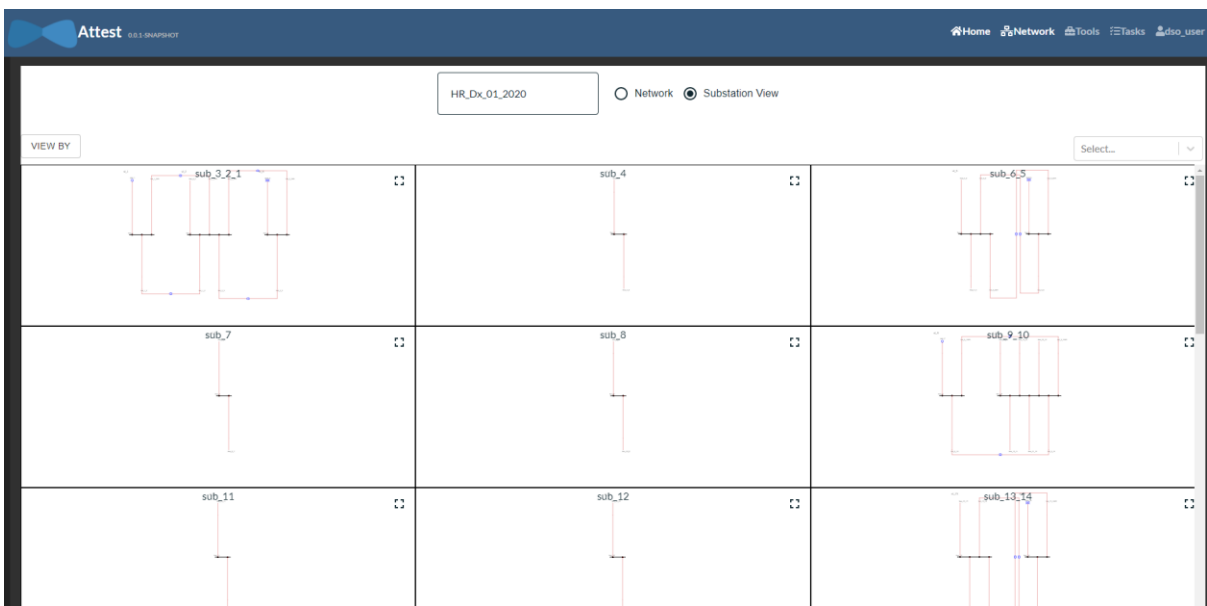


FIGURE 7 - SINGLE LINE DIAGRAM - SUBSTATIONS VIEW

The SLD is rendered in SVG format, an open standard XML-based vector image format for defining two-dimensional graphics, supporting interactivity and animation. The SVG file is provided by a Web Service made available by the data access and storage component, while the SLD interface component, besides visualizing the diagram, adds interactivity to it, allowing, for example, to zoom in a substation view, or navigate between substations, or to visualize data related to a network element (e.g. a chart of the profile of a generator or a load).

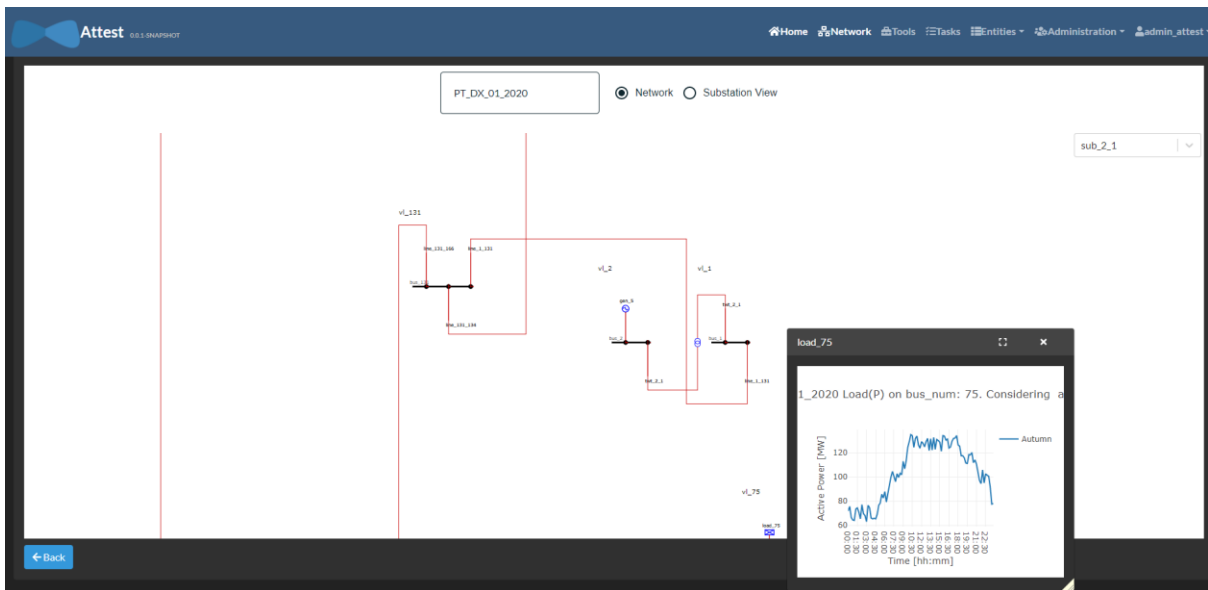


FIGURE 8 - SINGLE LINE DIAGRAM - LOAD PROFILE CHART

3.2. Tools management

These components are used to manage the whole execution process of a tool: selection of the tool to run, configuration and setting of the input parameters, execution and monitoring of the process. The GUI layer provides also interface components to visualize the results: the tools output.

3.2.1. Selection

This component supports the user in the selection of the tools to be run. The component has been designed with a carousel (a web component for displaying text, graphics and images in one interactive “sliding” block) for choosing the Work Package the tool the user would like to run belongs to, and some boxes for selecting a specific WP tool. Supporting the first step of the tool execution, the component also includes an element for choosing, using some search fields, the test case (network) the tool will analyze.

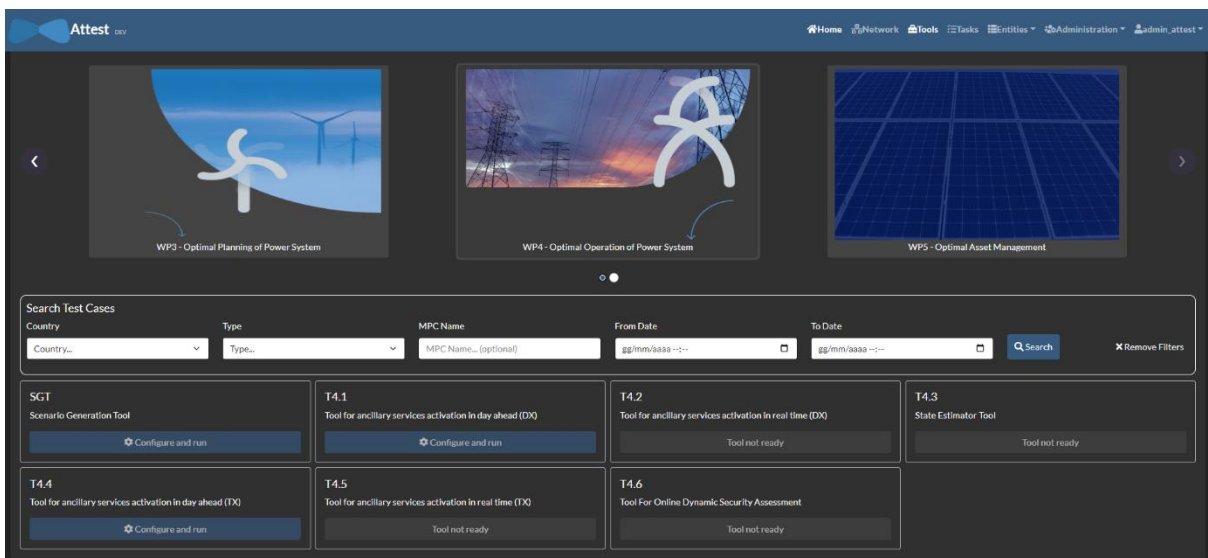


FIGURE 9 - TOOLS SELECTION

3.2.2. Configuration and execution

These visualization components allow the user to configure the tools before running them. The components are designed according to the input of the different tools, supporting the users in the definition and selection of all the necessary parameters. The components use text, dropdown and checkbox input fields, modeling the different type of tools paraments. Where needed, the components support also the upload of files, if used as input by the tool.

These GUIs also permit the user to start the execution of the tools

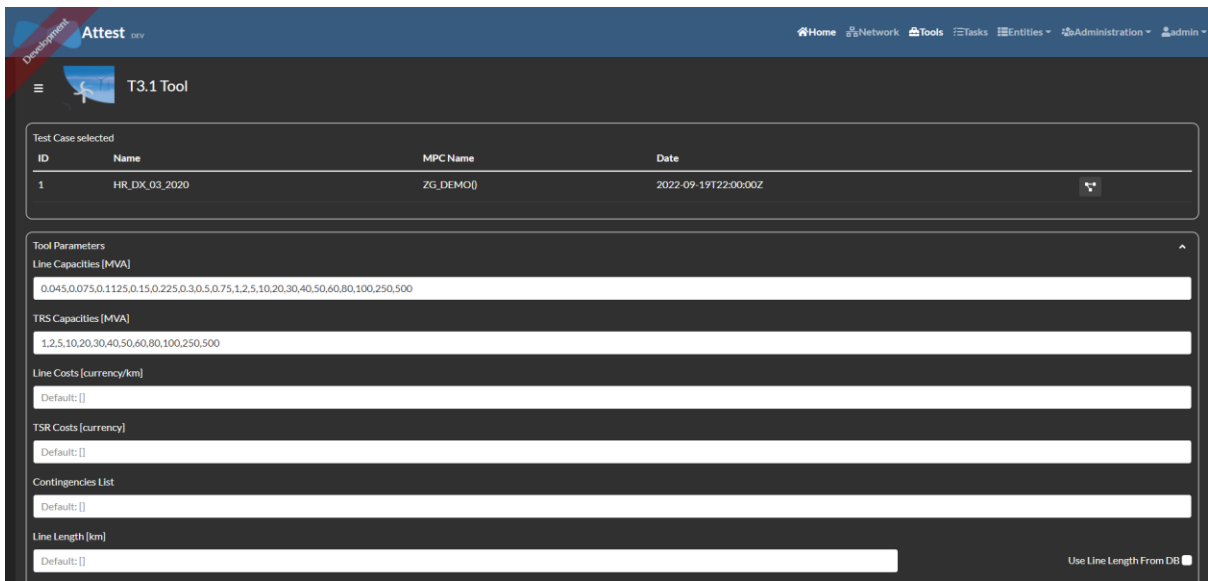


FIGURE 10 - TOOLS CONFIGURATION

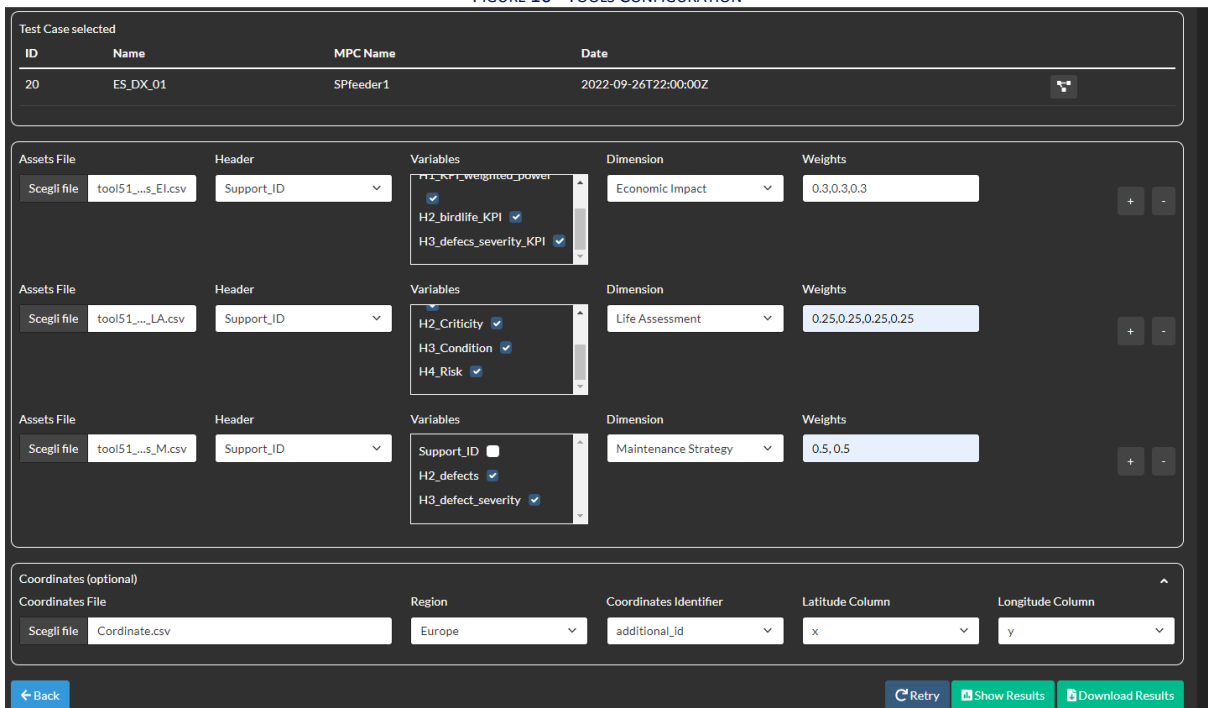


FIGURE 11 - TOOLS CONFIGURATION

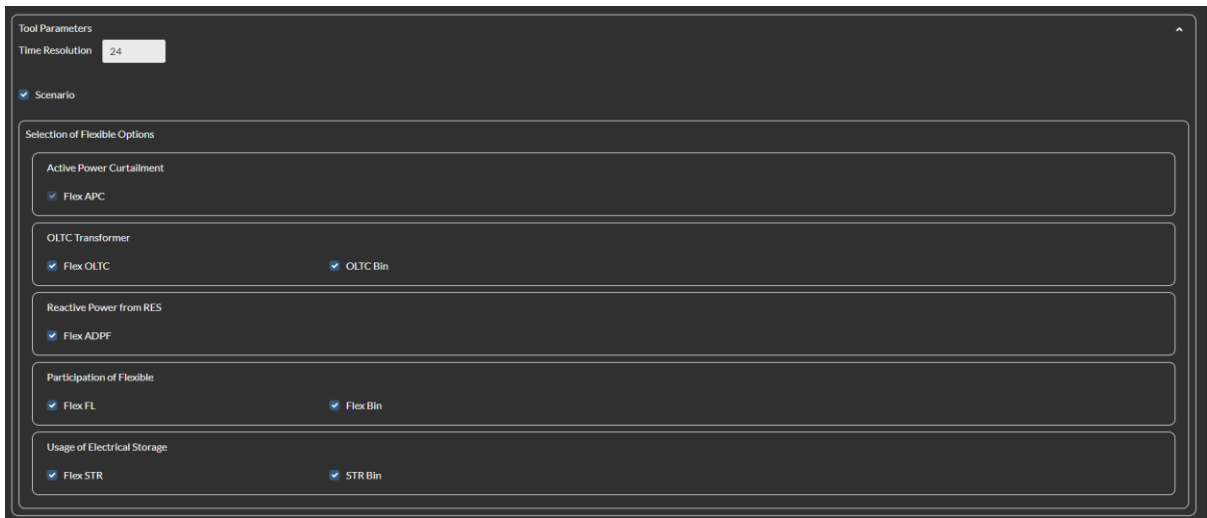


FIGURE 12 - TOOL CONFIGURATION

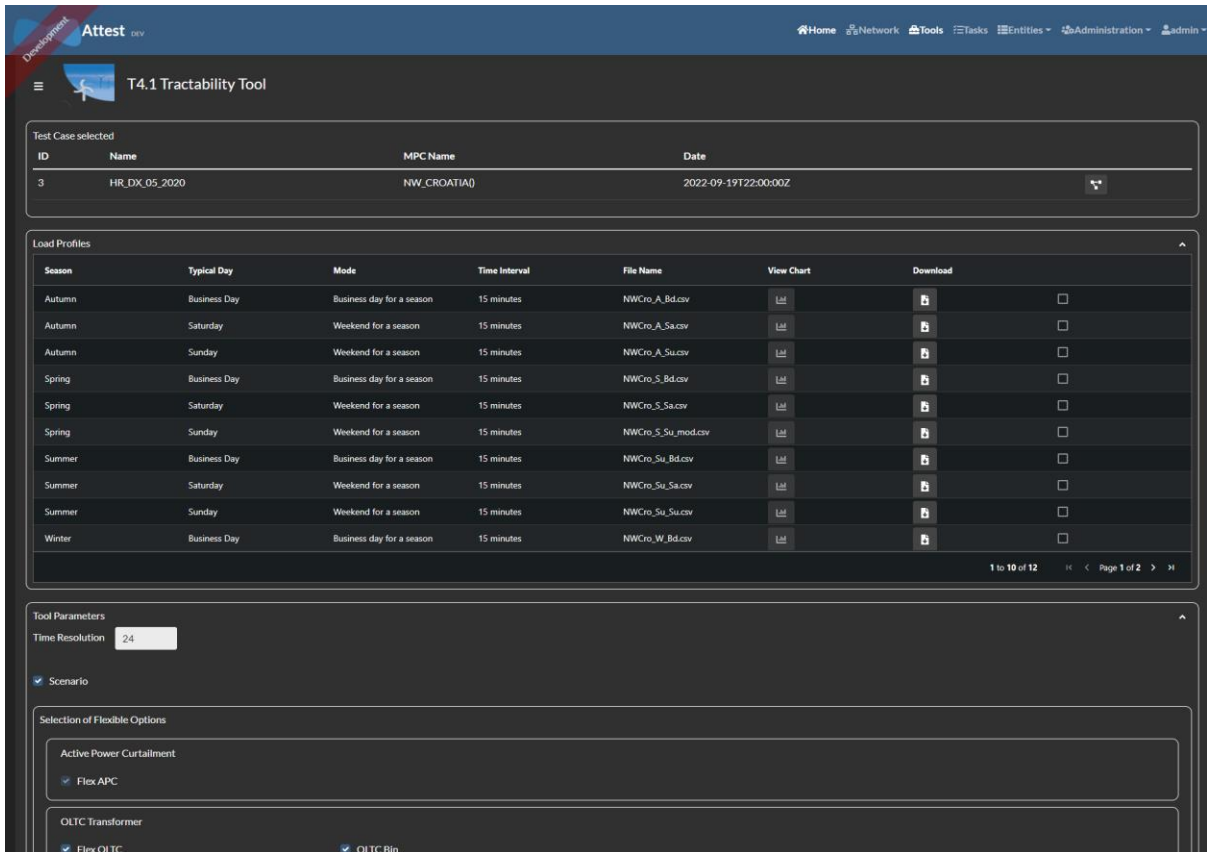


FIGURE 13 - TOOLS CONFIGURATION

Some configuration pages, when allowing to load ODS/XLS files, also integrates an editor component for viewing and editing inline the content of the files. The configuration pages contain a “View/Edit” button that open the component for editing the file.

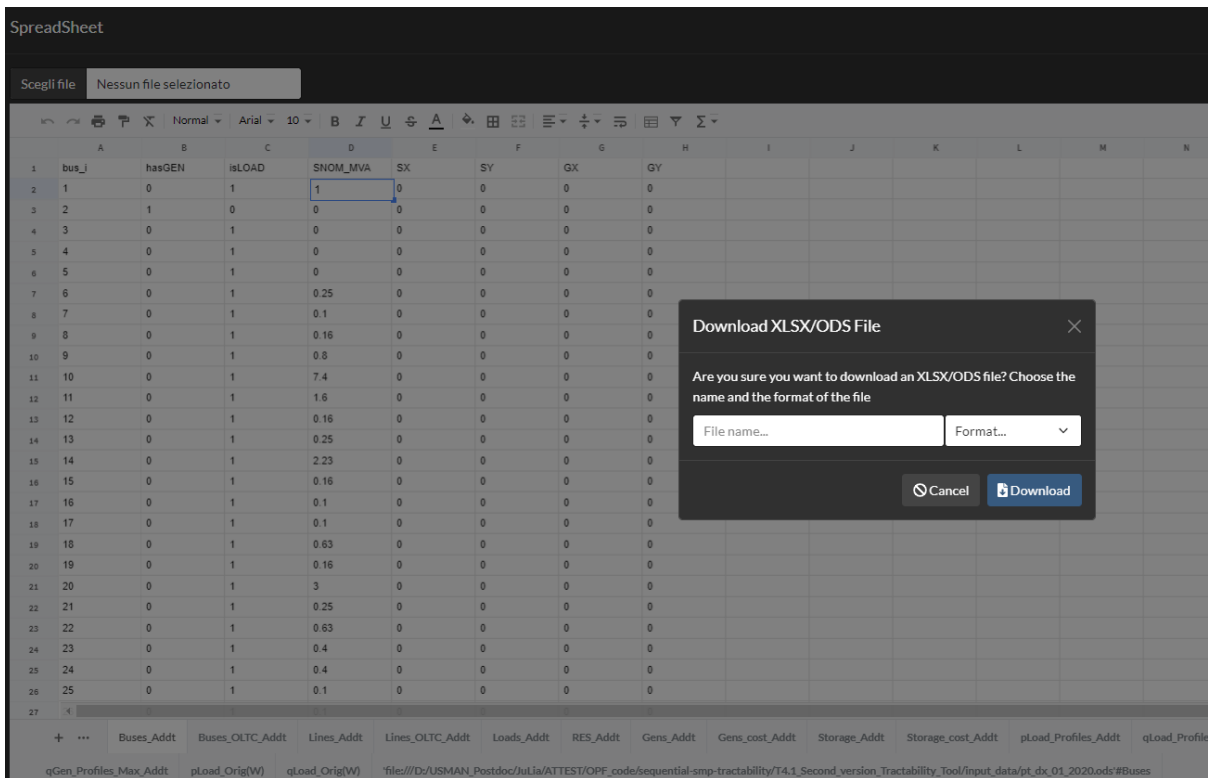


FIGURE 16 - INLINE EDITOR COMPONENT

3.2.3. Monitoring

This visualization component is used to monitor the execution of the tools run by the users. The component list all the run performed, with some information about the processing (e.g. status, start and end), allowing to download the log file and view and download the analysis results. The component uses a table representation of the data, allowing the user to sort the tables lines according to the different columns.

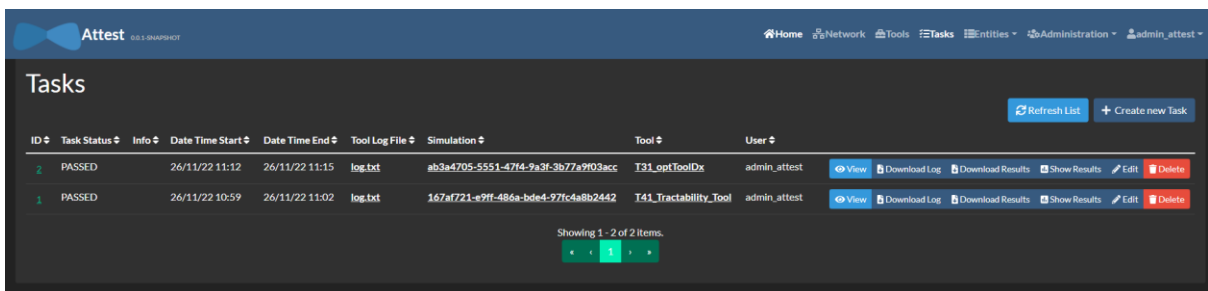


FIGURE 17 - TOOLS MONITORING

3.2.4. Results visualization

These components allow to visualize the results of the tools analysis.

The components are designed to show the results using different visualization elements, mainly tables and charts. The elements are interactive, allowing the users, for examples, to filter the data shown in charts.

Also the SLD component described in section 3.1.2 could possibly be used to visualize some tools output, highlighting some information in the diagram for a better and quicker identification of some phenomena.

The results interface components also use visualization elements provided directly by some tools (namely WP5 tools) as output, integrating them in the interface layer and making them available to the platform users. These elements include also a geographical representation of assets data, visualizing information on a map.



FIGURE 18 - RESULTS IN TABLES

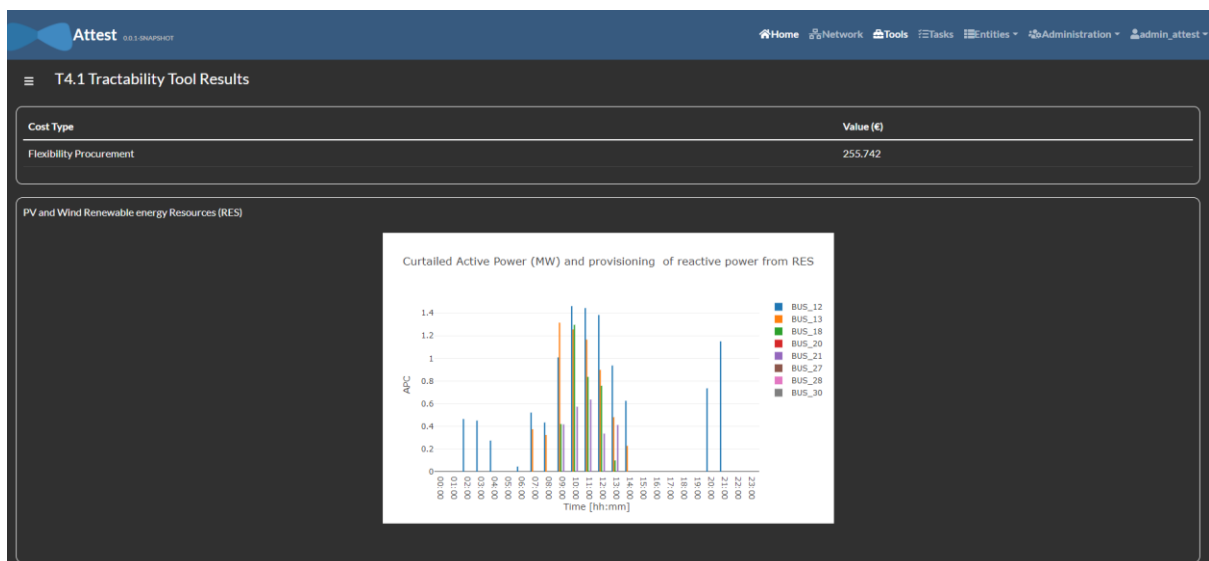


FIGURE 19 - RESULTS IN TABLES AND CHARTS

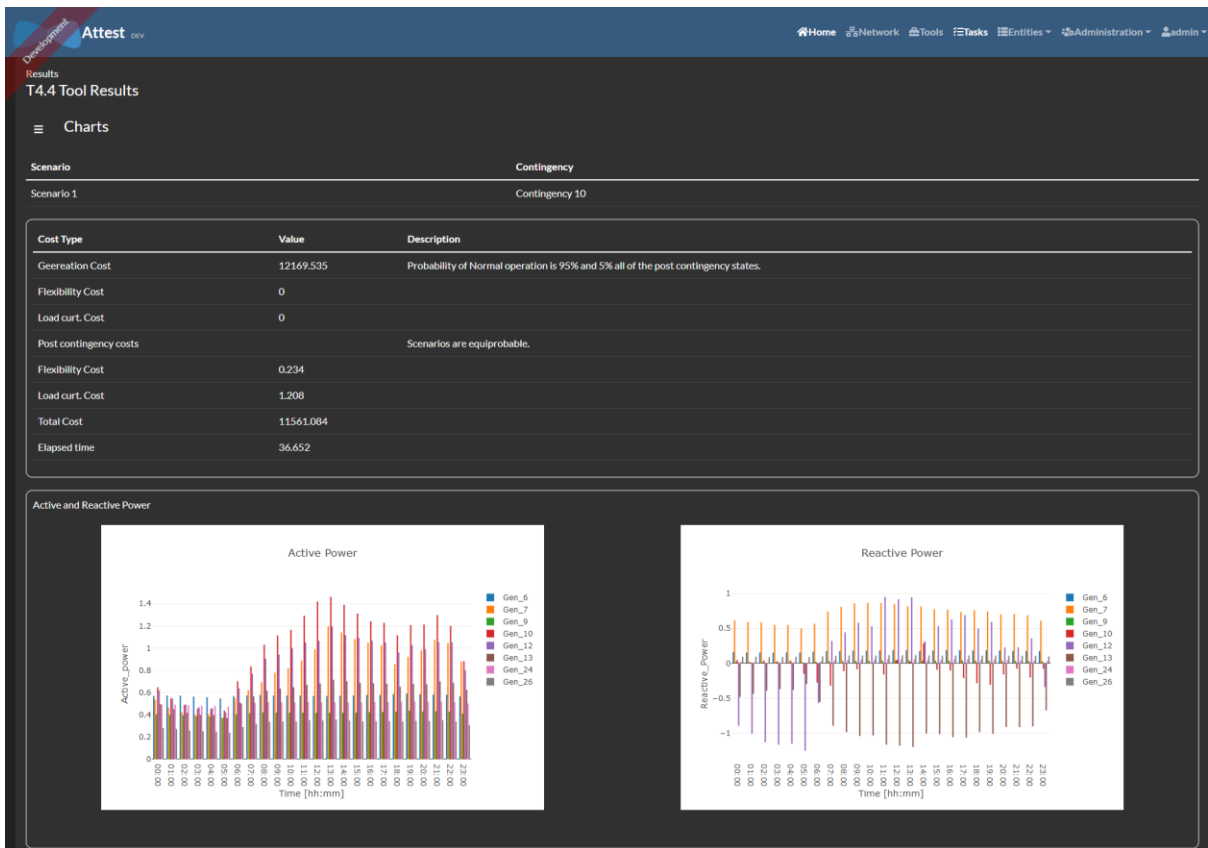


FIGURE 20 - RESULTS IN TABLES AND CHARTS

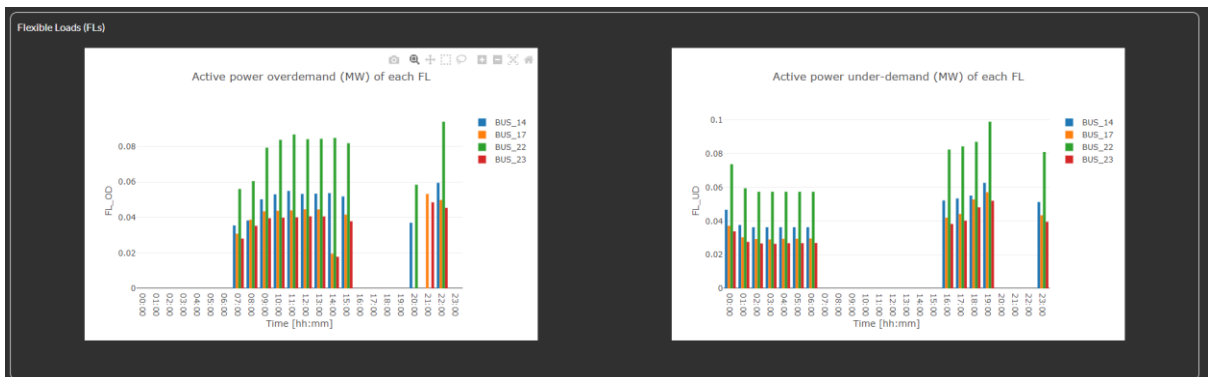


FIGURE 21 - RESULTS IN CHARTS



FIGURE 22 - RESULTS IN CHARTS

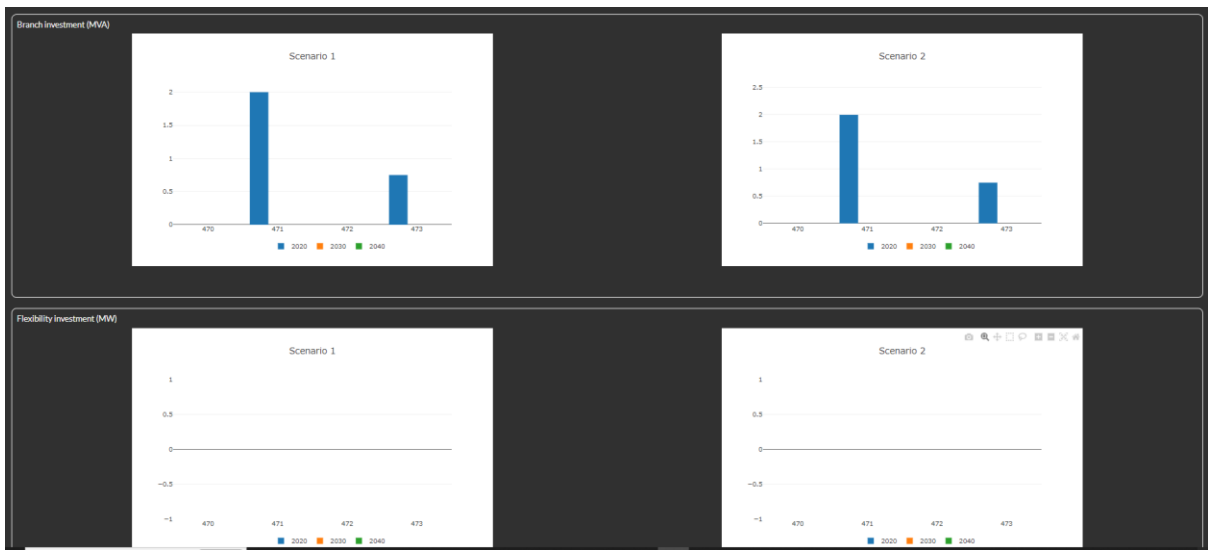


FIGURE 23 - RESULTS IN CHARTS

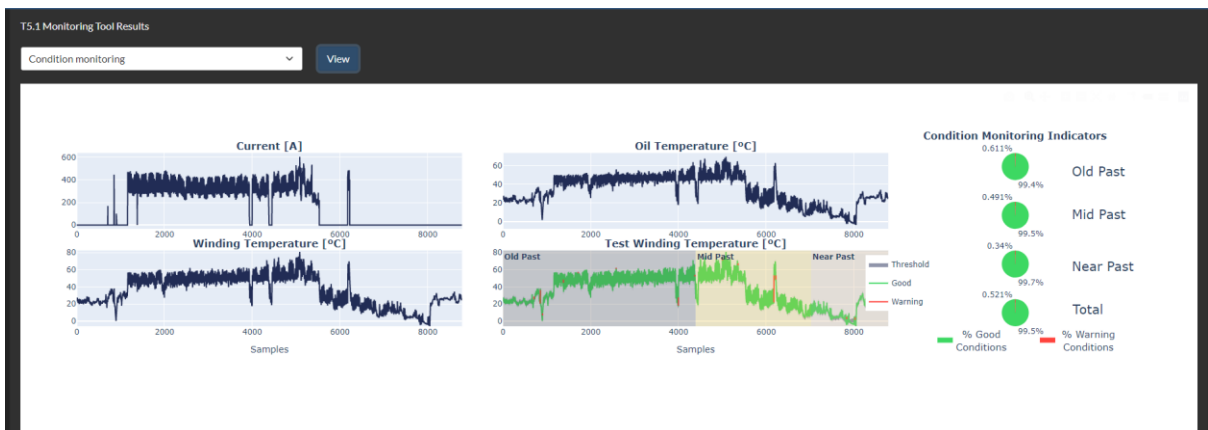


FIGURE 24 - WPS RESULTS

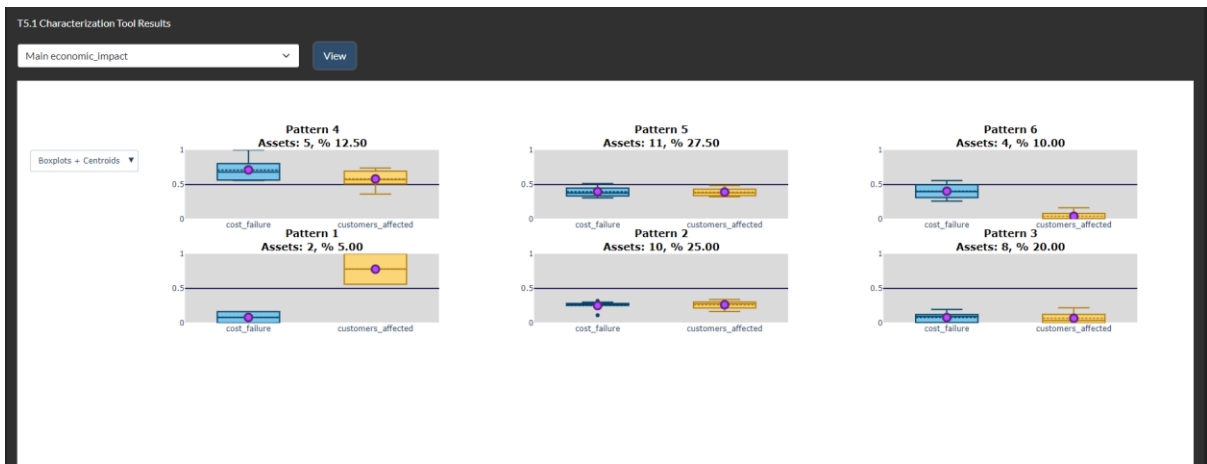


FIGURE 25 - WP5 RESULTS

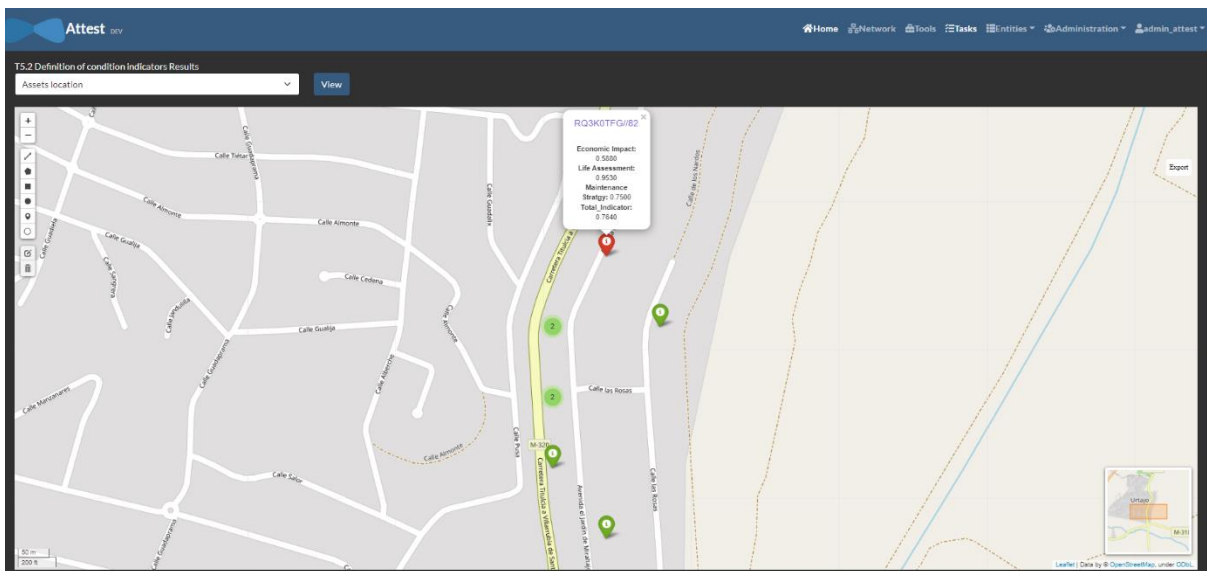


FIGURE 26 - WP5 RESULTS

Assets

NAME	ECONOMIC IMPACT	LIFE ASSESSMENT	MAINTENANCE STRATGY	TOTAL_INDICATOR
RQ8UCGAG//74-33-4	0.719	0.737	1.0	0.819
RQ9W9OJR//74-32	0.804	0.897	0.75	0.817
RQAUFPTH//74-33-2	0.719	0.737	0.875	0.777
RQ3K0TFG//82	0.588	0.953	0.75	0.764
SAM60AF0//D59-70	0.833	0.926	0.458	0.739
RQBQDFTA//74-33	0.684	0.768	0.75	0.734
RQA9HCG7//74-33-3	0.719	0.737	0.625	0.694
RR0BE8R1//59-17	0.504	0.796	0.75	0.683
RQ37A8RE//74-28	0.654	0.742	0.625	0.674
RQ61SCFJ//74-30	0.564	0.665	0.75	0.659
RQE5WQGE//74-34	0.534	0.665	0.625	0.608
RQFQK18DI//74-35	0.534	0.665	0.625	0.608

FIGURE 27 - WP5 RESULTS