



DELIVERABLE

D4.3 Digital Twin CS data integration and prototype 2

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List of Abbreviations

Abbreviation	Definition
AR	Augmented Reality
API	Application Programming Interface
CS	Citizen Science
CRUD	Create, Read, Update, Delete
CSV	Comma Separated Values
CO2 Dashboard	Carbon Footprint Simulation Dashboard
CS	Citizen Science
DEVA	Dynamic Exposure Visualisation App
Fig	Figure
GUI	Graphical User Interface
GPS	Global Positioning System
ID	Identification
MS	Milestone
M	Month
PMD	Policy Monitoring Dashboard
OGC	Open Geospatial Consortium
PO	Product Owner
REST	Representation State Transfer
UI	User Interface
URL	Uniform Resource Locator
WP	Work Package
3D	Three Dimensi

Executive Summary

This document describes the open beta release of the **COMPAIR** prototype. This is the second working version of the prototype that offers a set of the expected functionalities, and acts as the test-bed for the **COMPAIR** stakeholders to test the **COMPAIR** prototype and its functionalities, and assess the concepts and knowledge conveyed by the project.

The components comprising the open beta release of the **COMPAIR** prototype are the following: 1) The Policy Monitoring Dashboard (PMD); 2) the Carbon Footprint Simulation Dashboard (CO2); and 3) the Dynamic Exposure Visualisation App (DEVA).

The open beta release has been built via Sprint iterations taking into account the list of epics as defined by the Pilot partners in cooperation with the POs.

The deliverable provides an overview of the current functionalities in the form of a user guide. The scope of this document is to act as an appendix to the current version of the **COMPAIR** open beta release.

1. Introduction

This deliverable aims to provide an overview of the open beta release of the **COMPAIR** prototype. To this end, the report describes the current functionality which is explained in the form of a user guide.

Following the implementation of the individual tools in WP3 (Sensor Development and Technical Innovation), this WP delivers the open beta release of the **COMPAIR** prototype to act as the test-bed for setting the **COMPAIR** pilots in WP5 (Pilot CS Experiments & Co-Innovation). The content presented in this deliverable is subject to refinements and modifications, based on the progress of the technical work packages, as well as during the validation and evaluation phases of the project.

Taking into account the prioritisation of the requirements and the Pilots' needs based on the Agile principles¹ we are following, we focus our work on the implementation of the second versions of the Policy Monitoring Dashboard (PMD), the Carbon Footprint Simulation Dashboard (CO2 dashboard) and the Dynamic Exposure Visualisation App (DEVA). The Digital Twin dashboard (as indicated in the title of the report) will be analysed during the forthcoming period. The result of this process, as well as any updates of the **COMPAIR** tools, will be part of the D4.5: Digital Twin CS data integration and prototype 3/M30.

This document reports on the activities and effort placed in the implementation of the various technologies and tools provided by the WP3 towards delivering the second release of a functional **COMPAIR** prototype. The integration effort is guided by the Agile Software Development methodology, aiming to progress the development work in parallel teams and regularly integrating their output, based on a well-defined design.

The scope of this document is to act as an appendix to the current version of the **COMPAIR** open beta release and it is structured as follows:

- Section 2 provides an overview of the development aspects of the **COMPAIR** prototype;
- Section 3 presents a user guide with the main functionality of the PMD;
- Section 4 presents a user guide with the main functionality of the CO2 dashboard;
- Section 5 presents a user guide with the main functionality of the DEVA;
- Section 6 concludes this report and presents the next steps for the final release of the **COMPAIR** prototype.

¹ https://en.wikipedia.org/wiki/Agile_software_development

2. Development of the COMPAIR open beta release

The **COMPAIR** open beta release has been implemented via Sprint iterations following the agile process, as described below, in concrete steps:

- The Pilot Users along with the assigned Product Owners (POs) agreed on specific epics (described in Table 1);
- The selected epics were broken down in Stories / Tasks by the POs and the technical team;
- The Prioritized Stories became available in **COMPAIR** Jira from the POs;
- The technical **COMPAIR** team organized bi-weekly Sprints (sprint planning meetings) where team members came together in order to lay out the components for the upcoming round of work;
- The POs reviewed the finished user stories and provided early and constructive feedback;
- Monthly Sprint Reviews were organized with the rest of the Consortium partners with the aim to present the working software to the Pilots;
- Pilot partners tested the provided functionalities and provided their feedback;
- POs translated the feedback provided into Jira stories / tasks.

Taking into account the list of epics as defined by the Pilot partners in cooperation with the POs, the list of epics for the open beta release (taking into account the comments/ feedback provided during the first evaluation phase / Closed Testing) as refined and given in the technical team is presented in table 1.

Table 1: List of epics identified and used for the open beta release

ID	EPICS
AllUMa	User Management
	Story: As a logged in citizen I want to be able to reset my password
AllExp	Export Data
	Story: As a citizen, I want to be able to export the elements of the dashboard (e.g. to png), so I can share the information via mail, social media etc
	Story: As a citizen, I want be able to export the data of the Carbon Footprint Simulation Dashboard (e.g. to csv), so I can share the information via mail, social media
AllL&f	Look and Feel
	Story: As a citizen, I see a footer, header, logos on the Carbon Footprint Simulation Dashboard, so I get some general information about COMPAIR
	Story: As a visitor, I can switch the language of the PMD to my language
	Story: As a visitor, I can switch the language of DEVA to my language
	Story: As a visitor, I can switch the language of the CO2 dashboard to my language
	Story: As a citizen, I can open a project dashboard in a new window outside the container
	Story: As a citizen I can read an explanation of each graph of the PMD, so I

ID	EPICS
	understand what they mean
AllSha	As a User I can copy the current state of the tool or dashboard, so results of my analysis can be communicated
	Story: As a user of the PMD, I can copy a URL that allows recreating the complete status of the PMD so I can share that in reports, emails
BackCAL	Calibration Engine for Air pollution sensors
	Story: As a developer, I can ingest sensor observations from SODAQ Air so that I can develop a component that sends OGC-formatted data to the Data Manager.
	Story: As a developer, I can send the output of calibration data to ATC according to the agreements stated in integration document
PMDproj	As a citizen I can use a dashboard created for a certain project, so I can assess impact of policy changes
	Story: As a citizen, I can go to a specific project dashboard so I can inspect policy impact
	Story: As a citizen, I can indicate 2 periods to take into account for the graphs
	Story: As a citizen, I see a QuickScan box, with the dates of the 2 periods in blue and yellow
	Story: As a citizen, I see graphs depicting the daily average of the different measurements
	Story: As a citizen, I see graphs depicting the total values of the different measurements
	Story: As a citizen, I can add and remove a box to contain advanced graphs
	Story: As a citizen, I can see the detailed traffic counts in a graph
	Story: As a citizen, I can see detailed air pollution in a graph
	Story: As a citizen, I also see air pollution data coming from the IMEC calibration engine in the quickscan box
	Story: As a citizen, I can see bcmeter in the project dashboards
	Story: As a citizen, I get meaningful names for the traffic sensors, so I can more easily relate them to the map
	Story: As a citizen, the dates of the project dashboards are filled in, so I do not need to worry about it
	Story: As a visitor, I am not confused by unused selection boxes
	Story: As a citizen, I know the graphs are using only the period the schoolstreet is blocked and not when it is open so I have a good view of the impact of the closure
	Story: Allow to show relative differences for air and traffic measurements
	Story: As an admin, I want to enable measuring for full days in my project
	Story: As a citizen, I also see air pollution data coming from the IMEC calibration engine in the advanced graph box
PMDMan	Dashboard Management
	Story: As an admin, I can create a project dashboard so citizens can assess the impact of policy changes
	Story: As an admin, I can delete a project dashboard
PMDAir	Air in PMD
	Story: As a citizen, I can see and access the BCMeter sensors, so I know about black carbon air quality
PMDTra	Traffic in PMD
	Story: Telraam to send more granular data (every 15 minutes)

ID	EPICS
	Story: As a citizen, I can get extra information about the Telraam sensor through the dashboard so I can inspect
PMDMap	Map in PMD
	Story: As a citizen, I type in the name of a street to position the map to that location
	Story: As a visitor, I can select the source together with the parameter to be used in the browse mode so I can decide to see sensor.community data, SODAQ, etc.
Co2Cal	Carbon Footprint Calculator
	Story: As a citizen, I can keep a history of my previous calculator results, so I can see how my carbon footprint changes over time
	Story: As a citizen I can read explanations about the Carbon Domains, so I can better understand how to use the calculator.
	Story: As a citizen, I can see only my calculator results in my Profile, after I have logged in.
Co2Sce	Scenario Simulation
	Story: As a citizen, I can keep a history of my previously submitted scenarios, so I can see how my understanding of how emissions can be reduced changes
	Story: As a citizen, I can see only my scenarios in my Profile, after I have logged in.
	Story: As a citizen, I can read explanations about the Scenario Simulation, so I can better understand how to use it.
Co2Man	Management
	Story: As an admin, I can read explanations about the Admin Page, so I can better understand how to use it.
	Story: As an admin, I want my input to be validated, so it is easier for me to create new scenarios, actions, and recommendations.
DEVAViz	Visualize data in 3D Space
	Story: As a citizen, I want to be able to tilt the angle to display data all around
DEVAAnn	Annotate Measurements
	Story: As a citizen, I want to measure the type of mode of transportation
	Story: As a citizen, I can share information about my daily commuting
DEVAMan	Management
	Story: As a researcher, I want sensitive data to be identified
	Story: As a researcher, I can monitor whether a device is measuring effectively during the experiment by getting a signal when the device is on, but not measuring data
DEVAUI	User Interface
	Story: As a citizen, I want frequently used functions to be displayed on my toolbar
	Story: As a citizen, I want to switch the user interface to different design and level of complexity
DEVAREa	Real-time communication and information visualisation
	Story: As a citizen, I want to be connected to COMPAIR's database
DEVAGam	Gamification
	As a parent, I want the app to display information to raise consciousness about air pollution, especially for children
HrdwImp	Hardware Improvements
	Story: As a researcher, I want to rely on the accuracy of the SODAQ Air PM sensor to meet the indicative requirement of VMM.

The components comprising the open beta release of the **COMPAIR** prototype are the following: the Policy Monitoring Dashboard (PMD), the Carbon Footprint Simulation Dashboard (CO2) and the Dynamic Exposure Visualisation App (DEVA).

Screenshots of the main pages of the Open beta release are presented in the following subsections and describe the platform's main functionalities. By opening a web browser and entering the platform's Uniform Resource Locator (URL) <https://monitoring.wecompair.eu/>, the user gets into the Homepage of the **COMPAIR** Prototype.

3. Policy Monitoring Dashboard (PMD)

The Policy Monitoring Dashboard (PMD) helps users to understand and compare how environmental situations change under different actions. By collecting a large amount of Citizen Science (CS) information in a particular setting, the Dashboard will be able to simulate future impacts for different variables.

List of epics implemented for the PMD open beta release

The following table presents the list of epics implemented for the open beta release.

Table 2: List of epics implemented for the open beta release of the PMD

ID	EPICS
PMDproj	As a citizen, I can use a dashboard created for a certain project, so I can assess impact of policy changes
	Story: As a citizen, I can go to a specific project dashboard so I can inspect policy impact
	Story: As a citizen, I can indicate 2 periods to take into account for the graphs
	Story: As a citizen, I see a QuickScan box, with the dates of the 2 periods in blue and yellow
	Story: As a citizen, I see graphs depicting the daily average of the different measurements
	Story: As a citizen, I see graphs depicting the total values of the different measurements
	Story: As a citizen, I can add and remove a box to contain advanced graphs
	Story: As a citizen, I can see the detailed traffic counts in a graph
	Story: As a citizen, I can see detailed air pollution in a graph
	Story: As a citizen, I also see air pollution data coming from the IMEC calibration engine in the quickscan box
	Story: As a citizen, I can see BCMeter in the project dashboards
	Story: As a citizen, I get meaningful names for the traffic sensors, so I can more easily relate them to the map
	Story: As a citizen, the dates of the project dashboards are filled in, so I do not need to worry about it
	Story: As a visitor, I am not confused by unused selection boxes
	Story: As a citizen, I know the graphs are using only the period the schoolstreet is blocked and not when it is open so I have a good view of the impact of the closure
	Story: Allow to show relative differences for air and traffic measurements
	Story: As an admin, I want to enable measuring for full days in my project
	Story: As a citizen, I also see air pollution data coming from the IMEC calibration engine in the advanced graph box
PMDMan	Dashboard Management
	Story: As an admin, I can create a project dashboard so citizens can assess the impact of policy changes
	Story: As an admin, I can delete a project dashboard
PMDAir	Air in PMD

ID	EPICS
	Story: As a citizen, I can see and access the BCMeter sensors, so I know about black carbon air quality
PMDTra	Traffic in PMD
	Story: Telraam to send more granular data (every 15 minutes)
	Story: As a citizen, I can get extra information about the Telraam sensor through the dashboard so I can inspect
PMDMap	Map in PMD
	Story: As a citizen, I type in the name of a street to position the map to that location
	Story: As a visitor, I can select the source together with the parameter to be used in the browse mode so I can decide to see sensor.community data, SODAQ.

User Guide

The following section presents a User Guide for the second release (Open beta release) of the Policy Monitoring Dashboard. The **COMPAIR** consortium has acquired the following url for accessing the dashboard: <https://pmd.wecompair.eu/>.

Screenshots of the main views of the PMD are presented in the following sub-sections, which describe the PMD's functionalities implemented for the second release.

Browse mode - Parameters and sources

On the homepage/browse mode (figure 1) <https://monitoring.wecompair.eu/>, the user can now select and view air and traffic sensor data based on the selected sensor type (parameter) and data source. These latest observation values are depicted as hexagons on the map, in which the user can zoom in, zoom out, pan and view more information about them from the sensor menu popover option.

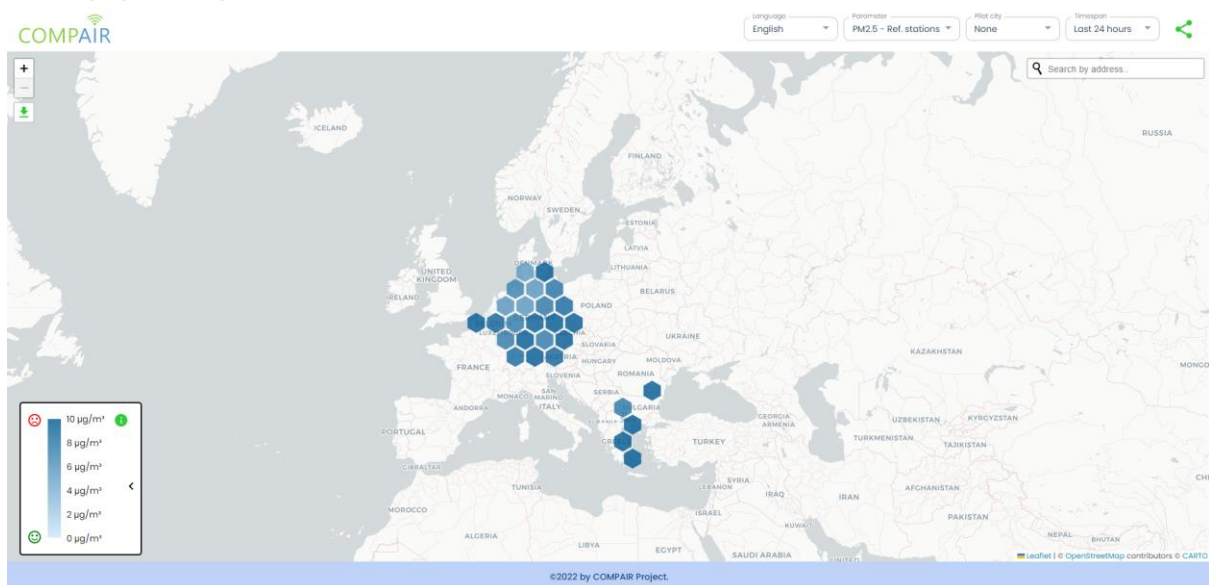


Figure 1: Browse mode (map view)

As displayed in figure 2 the user can select a parameter from the list (PM2.5, PM10, NO2, BC, Pedestrian, Bike, Car and Heavy vehicle) that is also linked with a source that is displayed next to each parameter (Reference Stations, SODAQ, Sensor.community, Telraam).

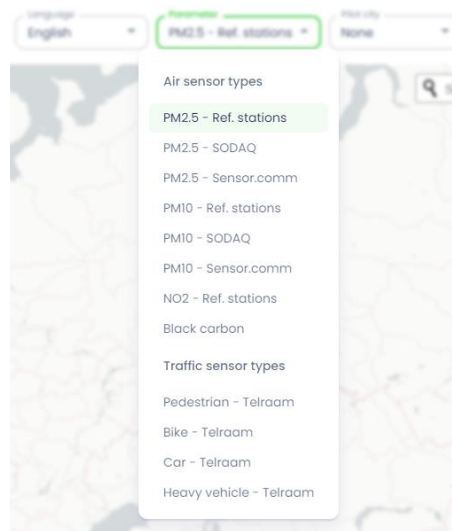


Figure 2: Parameter and source dropdown selection

Map - Search address

Aside from panning and zooming in/out the map to browse for sensors, the user is able to search a specific location to fly to on this map. This search bar is located on the top right corner inside the map container. When a user searches a street name, a list will appear where they can select the most relevant result (figure 3).

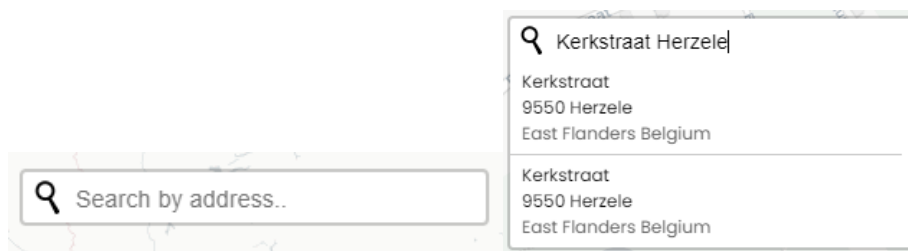


Figure 3: Search by address bar

Upon clicking a result, the user will navigate to that location and a marker will be placed on the map (figure 4) with a popover showing more information about that location/marker.

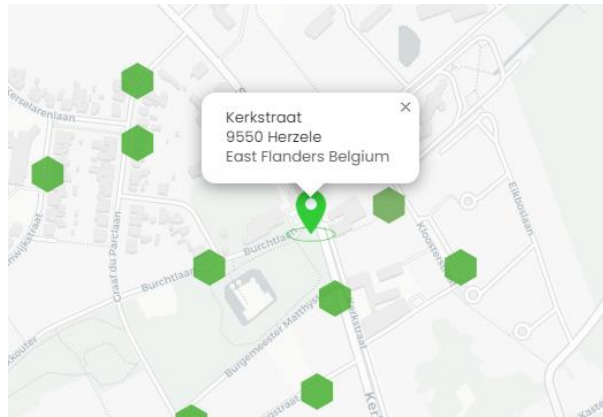


Figure 4: Address result on map

Browse mode - Additional sensor information

The user can now view more information about the sensors on the sensor menu list by clicking the expand icon located in the beginning of each item row. They can now view the sensor id, sensor type, source, the parameters the sensor is measuring, when the sensor data was last updated, the location of the sensor, the availability of the sensor data as well as sensor value distributions (figure 5).

Sensor menu



SENSOR ID	PM2.5 ($\mu\text{g}/\text{m}^3$)	GROUP
	50.876179	6.873818
Availability		
Distributions	View histogram	
^ DENW212	7.41	None
Sensor ID	DENW212	
Sensor type	Unknown	
Source	Discomap	
Measuring	NO2, PM10, PM2.5	
Last updated	2023-05-28T22:00:00.000Z	
Location	LATITUDE	LONGITUDE
	50.947268	6.957649
Availability		
Distributions	View histogram	

Figure 5: Expandable additional sensor information

The distributions are accessed by clicking on the view histogram text button, where the user can view all histograms per measuring parameter (figure 6). The histogram view allows a quick overview of the range of measured values in the selected period.

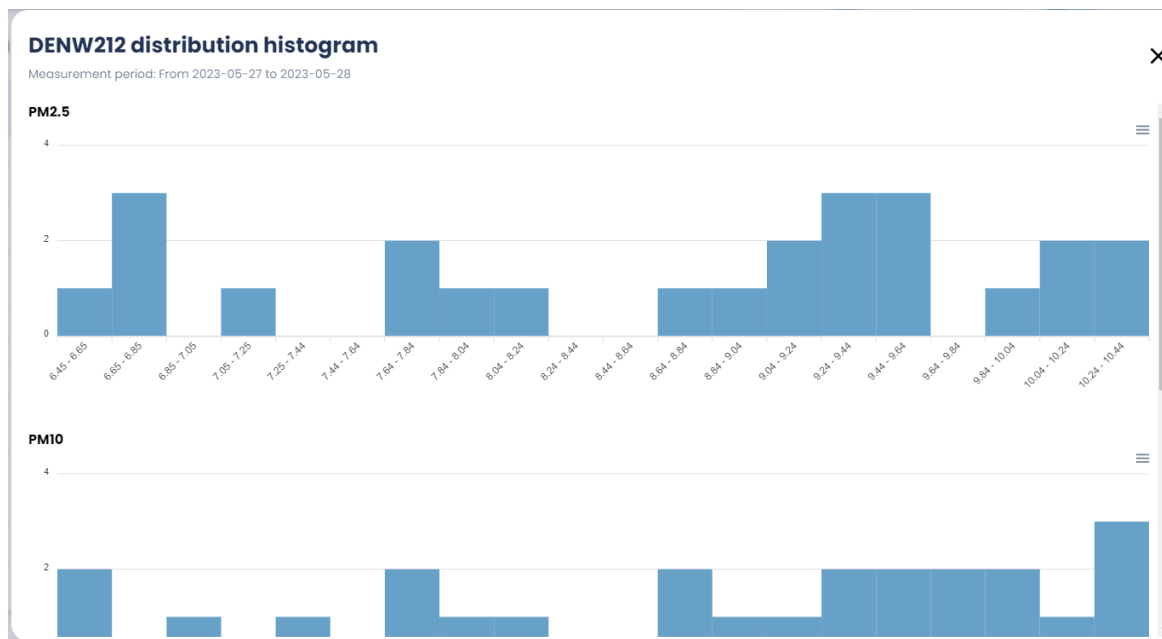


Figure 6: Distribution of sensor data (histograms)

Project dashboards - View

In the sidebar of the monitoring (<https://monitoring.wecompair.eu/>) application the user can view a list of project dashboards as shown in figure 7.

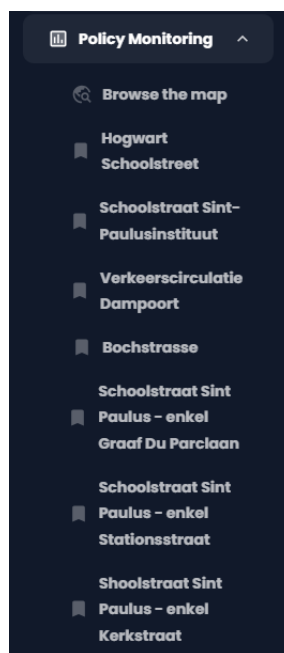


Figure 7: Project dashboards list in monitoring sidebar

These dashboards are being created by the admins of the platform and their aim is to provide users the ability to assess the air and traffic impact in certain areas. The process of creating and updating such dashboards will be thoroughly explained in the next section.

The dashboards, apart from the project title and a quick description of the project, are consisted of two user defined groups (e.g. Neighborhood and School Street) that have some sensors assigned to them. These sensors are also depicted on the map on the left side and the sensor list on the right side (figure 8). On the sensor list, the user can also view the name of the street the sensor is located at, the sensor type as well as the group it belongs to.



Figure 8: Project sensors on map and sensor list

When the user selects a sensor from the list, the sensor is highlighted with a black stroke around the hexagon it belongs to. Likewise, when the user clicks on a hexagon the sensors that belong to that hexagon are highlighted with a light green background on the sensor list (figure 9).

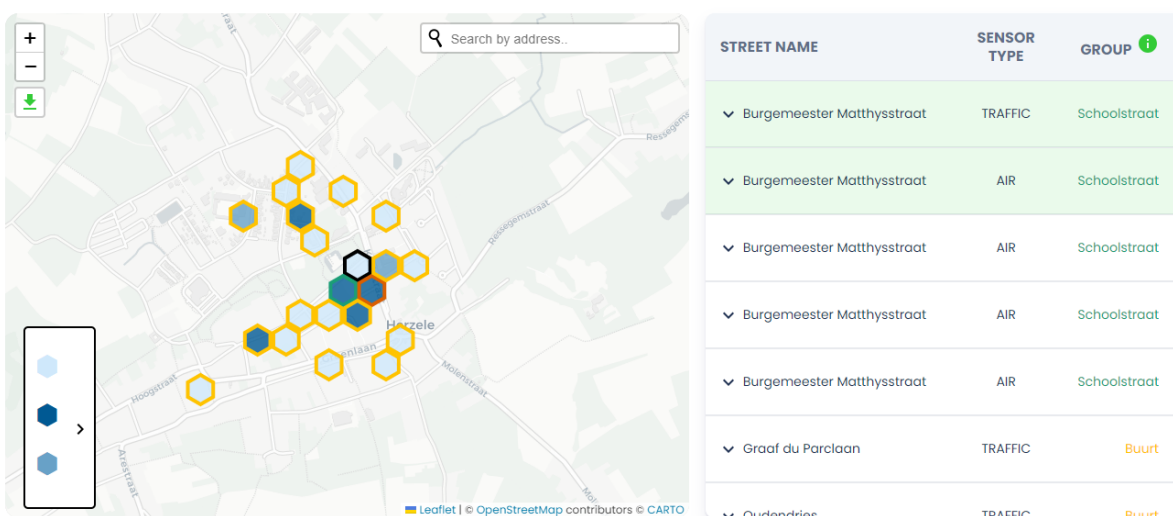


Figure 9: Selected hexagon showing selected sensors on the list

Below this section, the user can view some graphs (quickscan and advanced) with data coming from the IMEC calibration engine, BCmeter² and Telraam³ that are based on two period dates (figures 10 and 11). These dates are either automatically generated based on the project start of measurement and policy change date, or either specified by the admin of the project explicitly in the admin/create dashboard page.

In the quickscan graphs, the user is presented by default with the deltas of each group and has the ability to show and hide other options as well (before/after of each group). In the quickscan box, the user can quickly investigate traffic and air quality data before and after introducing a policy measure for both the target and neighbourhood zones (figure 10).



Figure 10: Quickscan graphs

By clicking on the “Show advanced graphs” button, the user is provided with more advanced graphs, where they can visually compare two vertically aligned graphs combining air/traffic data of the two groups (figure 11).

² <https://bcmeter.org/>

³ <https://telraam.net/>



Figure 11: Advanced (deep dive) graphs

The user, by hovering their mouse pointer over one plot, can reveal detailed information for both graphs at that date, allowing thorough inspection (figure 12).

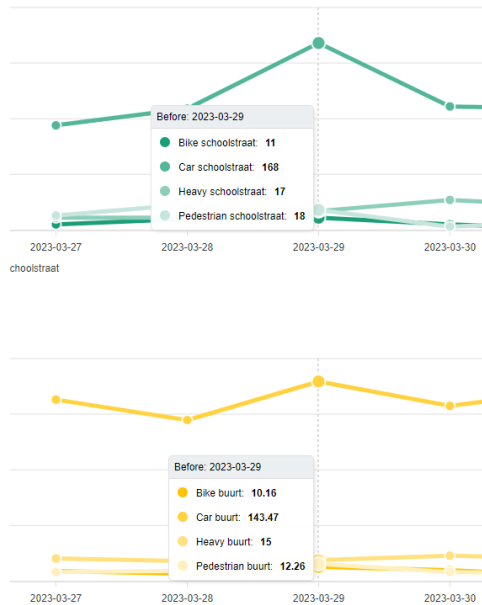


Figure 12: Advanced graphs comparison on hover

Additionally, the user can select different options and parameters that affect the data shown in the charts (figure 13). The user can select the visualisation (before, after, delta), the sensor type and the group to display in each graph.

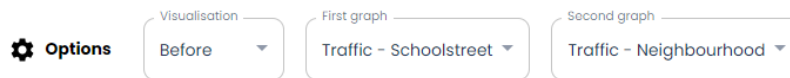


Figure 13: Advanced graphs options

Project dashboards - Create

Inside the container UI, the admin can create the previously mentioned project dashboards and also update existing ones.

In the first part of the form (figure 14), the admin can specify a unique title for the project, the project start and policy change date, the native language, the descriptions and the project homepage (if any).

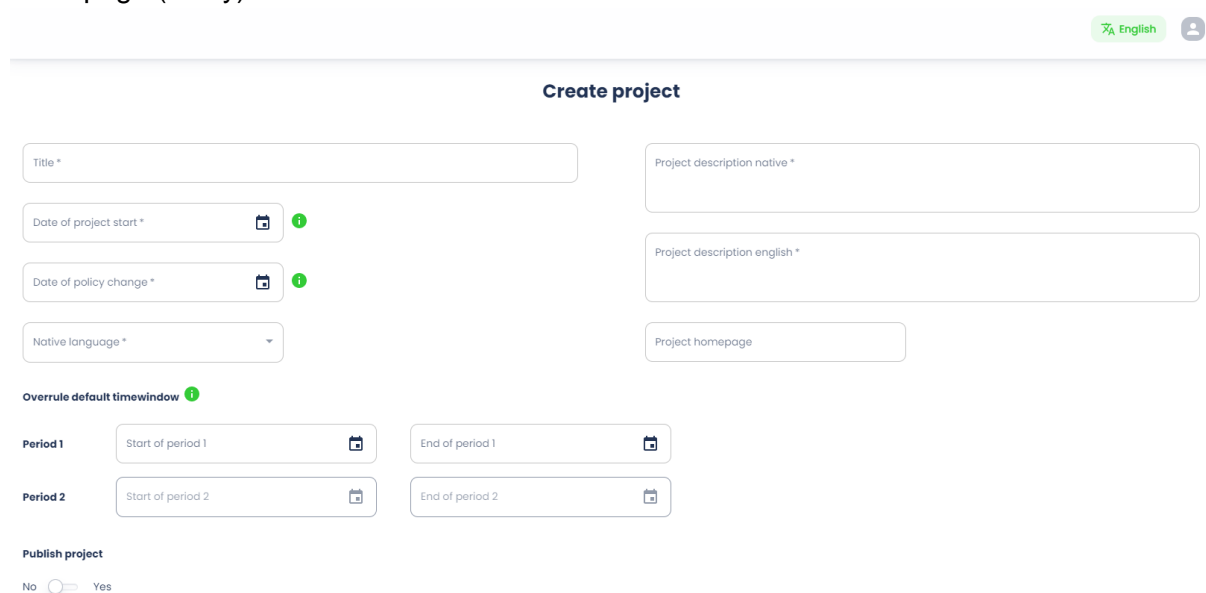


Figure 14: Create project form - Basic info

The admin can also override the default period dates calculation mentioned previously and define two equal in length and starting on the same day of the week periods. Additionally, they have the option to publish the dashboard that they have just created. If the dashboard is set to be published, then the dashboard will be accessible by everyone and will also get placed in the sidebar of the container application.

In the second step of the form, the admin can view all sensors on the map and add some of them to the project (figure 15).

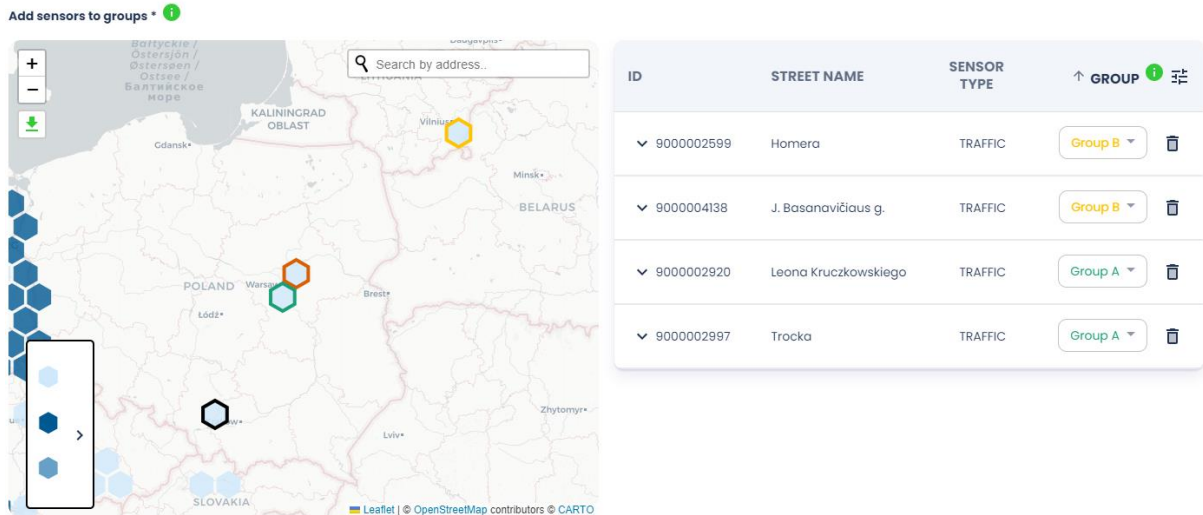


Figure 15: Create project form - Sensors selection

Upon clicking a hexagon, the sensors inside that hexagon get added to the list. Here the admin can create two groups, just like in the browse mode, and add some sensors in these two groups from the drop down list in each list item. Additionally, the current location and zoom of the map will be saved and used in the view mode of this project dashboard.

In the final step, the admin can configure the measurement time windows for each day of the week (figure 16).

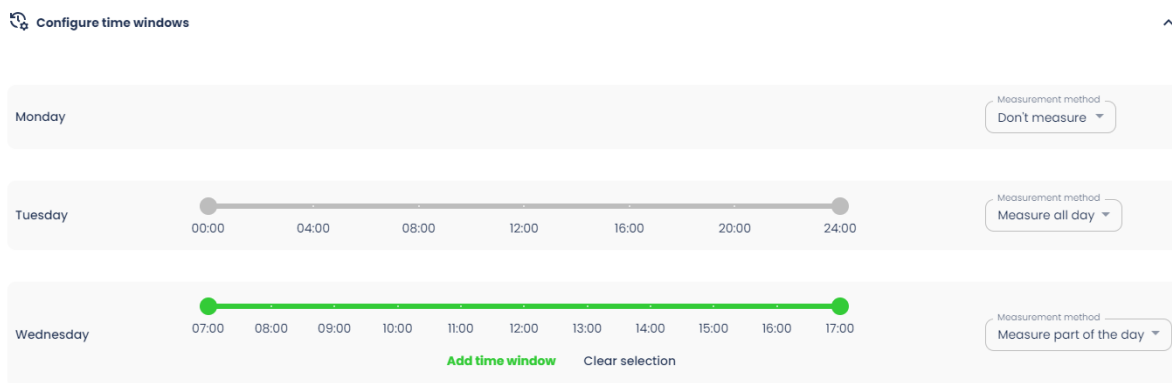


Figure 16: Project time windows - Measurement methods

The admin is presented with three options for each day to choose from. The admin can either select not to measure during a specific day of the week at all, measure all hours of the day or partially measure that day (figure 17). In the latter case, the admin can add more windows/sliders in the day, can delete an added window by clicking on the discard icon and clear all selections for that day and reset to the default time window (7:00 to 17:00).

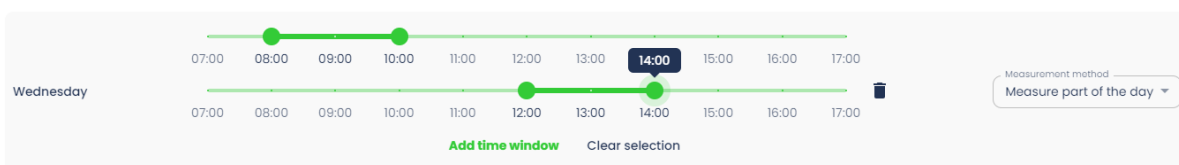


Figure 17: Project time windows - Day range adjustments

After clicking on the create project button on the bottom of the screen, and if all form fields are valid, the admin gets redirected to the created project page (figure 18). From there, the admin can navigate to the project created or navigate to the container homepage.

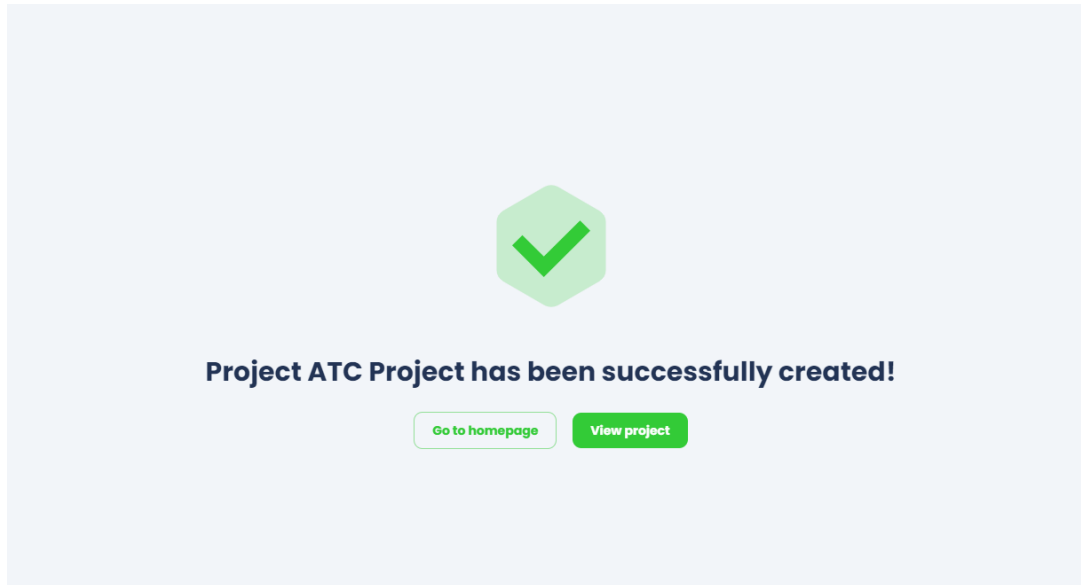


Figure 18: Successful project creation page

Project dashboards - Update

After creating and visiting a project, the admin can choose to update the existing details and sensors of this project by clicking on the pencil button (figure 19).

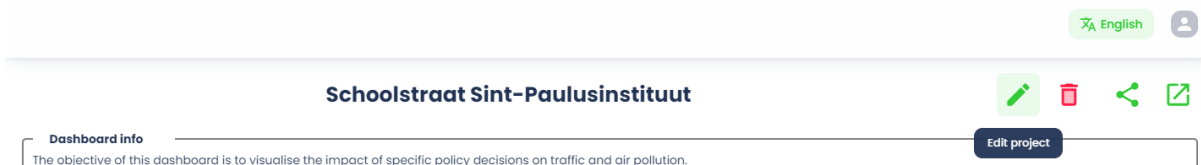


Figure 19: Project dashboard options - Update

The admin will get navigated to the previous form with all the data filled in, thus can easily edit them and update the corresponding project (figure 20).

Update project

Title *
Schoolstraat Sint-Paulusinstituut

Date of project start *
28/03/2023

Date of policy change *
17/04/2023

Native language *
Nederlands

Project description native *
In de Burgemeester Matthyssstraat in Herzele is van 17 april tot 16 juni 2023 een proefinstallatie van een schoolstraat gepland. Burgerwetenschappers meten samen met 3 scholen het effect van deze ingreep op het verkeer, in deze straat en de omliggende straten. Binnenkort wordt ook het effect op de luchtkwaliteit gemeten.

Project description english *
In the Burgemeester Matthyssstraat in Herzele, a test installation of a school street is planned from April 17 until June 16, 2023. Citizen Scientist together with 3 school monitor the effect of this measure on traffic in this street and the surrounding streets, with a Telraam. The effect on Air quality will soon be measured also.

Project homepage
<https://www.wecompair.eu/flanders>

Overrule default timewindow

Period 1 Start of period 1: 20/03/2023 End of period 1: 31/03/2023

Period 2 Start of period 2: 08/05/2023 End of period 2: 19/05/2023

Publish project

No Yes

Add sensors to groups

ID ↑	STREET NAME	SENSOR TYPE	GROUP
9000004782	Graaf du Parclaan	TRAFFIC	Buurt
9000004783	Burgemeester Matthyssstraat	TRAFFIC	Schoolstraat
9000004784	Oudendries	TRAFFIC	Buurt
9000004786	Kloosterstraat	TRAFFIC	Buurt
9000004787	Kerkstraat	TRAFFIC	Buurt
9000004788	Kloosterstraat	TRAFFIC	Buurt

Configure time windows

Update project

Figure 20: Update project dashboard page

Project dashboards - Delete

When the admin visits a created dashboard, they can permanently delete the dashboard by clicking on the red delete icon. After clicking on it, a dialog will appear with a confirmation message and a button to delete the project (figure 21).

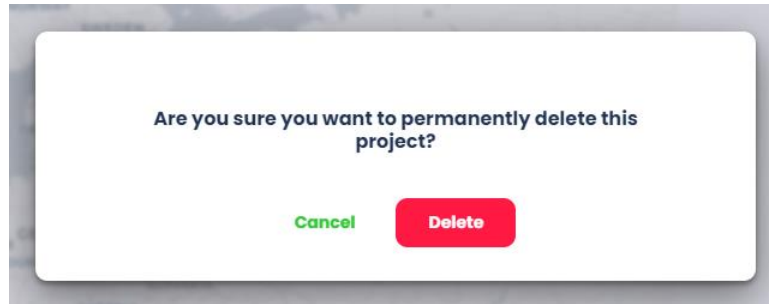


Figure 21: Project deletion confirmation dialog

After a successful deletion, the admin will get redirected to the homepage and the project will get removed from the container sidebar project list.

Sharing dashboard view

Both in the project mode and the browse mode, the user has the option to share the current dashboard view by clicking on the share icon that is located on the top right corner of the screen (figure 22).

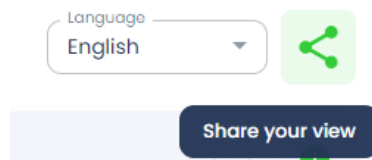


Figure 22: Share dashboard view button

This action will open a popover dialog with a unique URL that includes all of the settings of the application at the current state (figure 23).

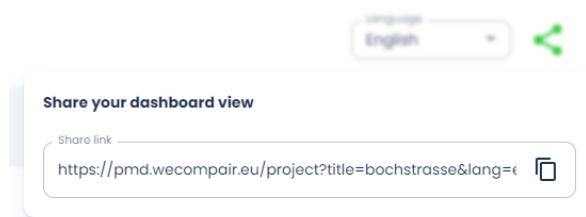


Figure 23: Share dashboard view link clipboard

Such settings may include: the map zoom level and location, a list of selected sensors, sensor groups, active map parameter, the current language, the pilot city, the timespan, the active zoom, legends and options of the graphs, etc. Thus, by sharing this link with other users/policy makers, all the settings will be applied to the UI when they open the URL in their browser and reflect the initial view of the shared UI. This way, citizens can share their exact view with other citizens which will help when evaluating effectiveness of policy changes.

Open in a new tab

When the user visits the browse mode or a project dashboard from the container app, an icon button is presented, that when clicked, opens the dashboard in a new tab (figure 24). As with the sharing dashboard functionality all user settings at that time are shared and applied on the isolated PMD view that is opened in the new tab.

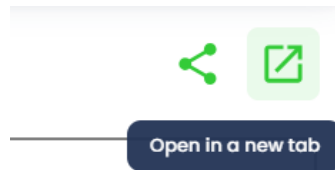


Figure 24: Open in new tab button

Explanations

Across the UI some explanations about the specific sections of the PMD are provided for a better user experience. This is being done with a different set of elements. One explanation element is a green info button located usually next to texts and headings. When the user clicks on this button, a popover appears with more information about that section (figure 25).

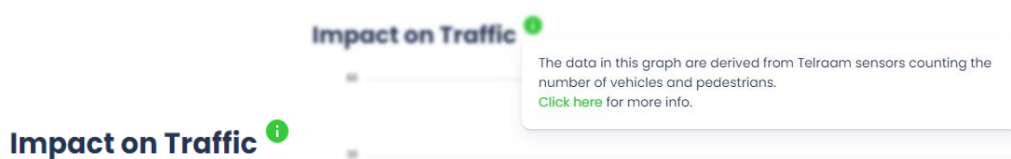


Figure 25: Icon button explanation popover

When a project dashboard of the PMD is accessed from the container dashboard, the user can get more information about the purpose of these dashboards in general as well as information about that specific project in such boxes shown in figure 26.

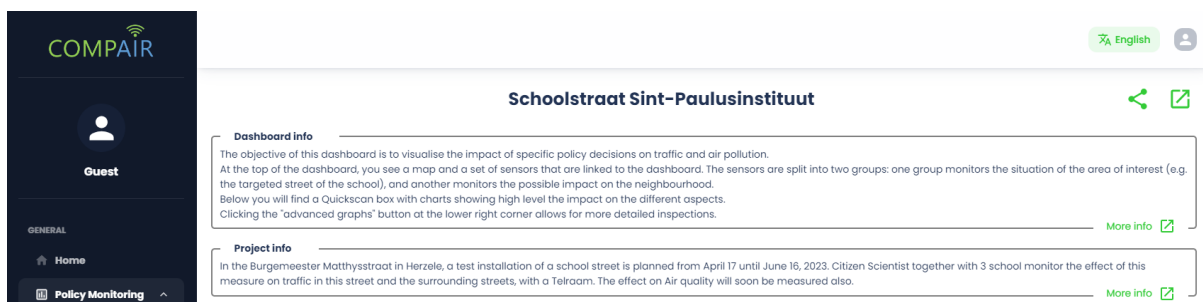


Figure 26: Dashboard explanation boxes inside the container app

The user can also open informational links provided by the project admins by clicking on the ‘more info’ text.

Lastly, the user can find more information about the quickscan and deep dive graphs by expanding the boxes as shown in figure 27.

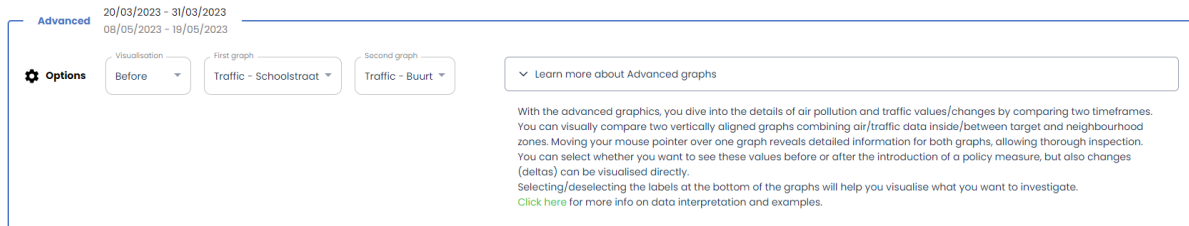


Figure 27: Explanation boxes inside quickscan and advanced graphs

Translations

The PMD has also been translated in each of the pilot’s languages (English, Greek, German, Bulgarian and Dutch). The user can change the language either from inside the container dashboard (figure 28), or by selecting the language from the dropdown inside the PMD itself when in isolation (figure 29). Both language switchers are located on the top right corner of each page.

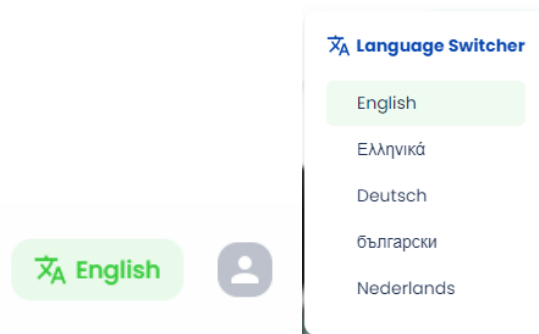


Figure 28: Container language switcher and options

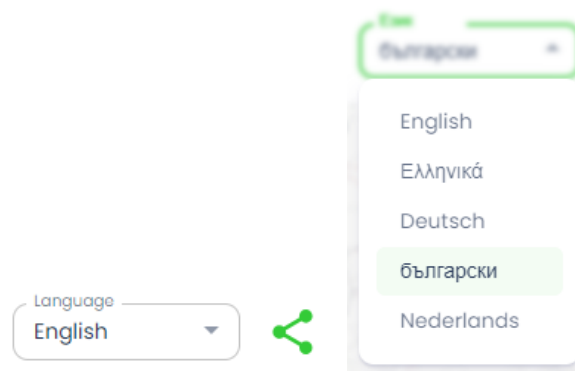


Figure 29 :PMD language switcher and options

An example of what the page will look like when the user visits a project dashboard and changes the language to Dutch can be found in figure 30.

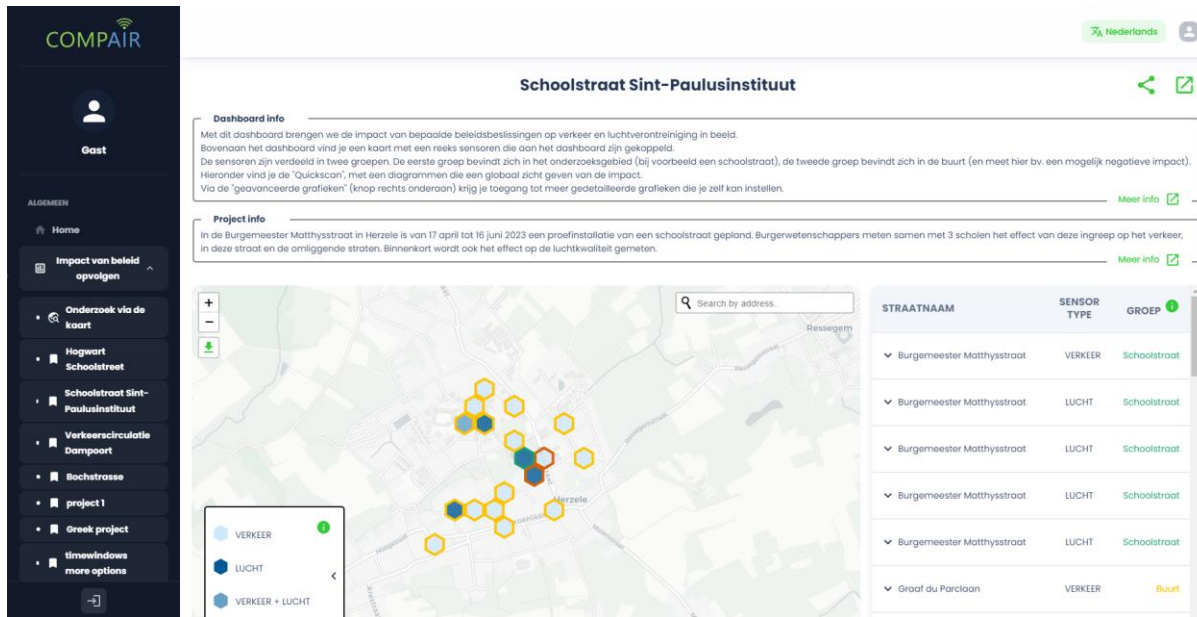


Figure 30: Translated project dashboard in Dutch language

4. CO2 Dashboard

The purpose of the Carbon Footprint Simulation Dashboard (CO2) is to guide users to improve their behaviours through more environmentally friendly choices, regarding their carbon footprint.

List of epics implemented for the CO2 open beta release

The following table presents the list of epics implemented for the open beta release of the CO2 Dashboard.

Table 3: List of epics implemented for the Open beta release of the Carbon Footprint Simulation Dashboard

ID	EPICS
CO2Cal	Carbon Footprint Calculator
	Story: As a citizen, I can keep a history of my previous calculator results, so I can see how my carbon footprint changes over time
	Story: As a citizen, I can see only my calculator results in my Profile, after I have logged in.
	Story: As a citizen, I can read explanations about the Carbon Domains, so I can better understand how to use the calculator.
	Story: As a citizen, I want my input to be validated, so it is easier for me to fill in the fields of the calculator.
	Story: As a citizen, I can include the energy efficiency of my appliances in the calculation of my carbon footprint
CO2RRe	Carbon Footprint Reduction Recommendations
	As a citizen, I want to get links to information sources for each recommendation, so that I understand how I can adopt a recommendation
CO2Man	Dashboard Management
	Story: As an admin, I want my input to be validated, so it is easier for me to create new scenarios, actions, and recommendations.
	Story: As an admin, I can read explanations about the Admin Page, so I can better understand how to use it.
	Story: As an admin, I can have access to the Admin Page of the CO2 Dashboard
	Story: As an admin, I can add links to information sources for each recommendation I create, so users can get informed on how to apply those recommendations
CO2Sce	Scenario Simulation
	Story: As a citizen, I can see only my scenarios in my Profile, after I have logged in.
	Story: As a citizen, I can keep a history of my previously submitted scenarios, so I can see how my understanding of how emissions can be reduced changes
	Story: As a citizen, I can read explanations about the Scenario Simulation, so I can better understand how to use it.

User Guide

The following section presents a User Guide for the second release (Open Beta version) of the Carbon Footprint Simulation Dashboard. The Dashboard can currently be accessed on the following URL: <https://co2.wecompair.eu>

By entering the URL for the Carbon Footprint Simulation Dashboard, the user is led to the homepage of the Dashboard (Figure 31). It contains information regarding the **COMPAIR** project, as well as information about the Dashboard itself.

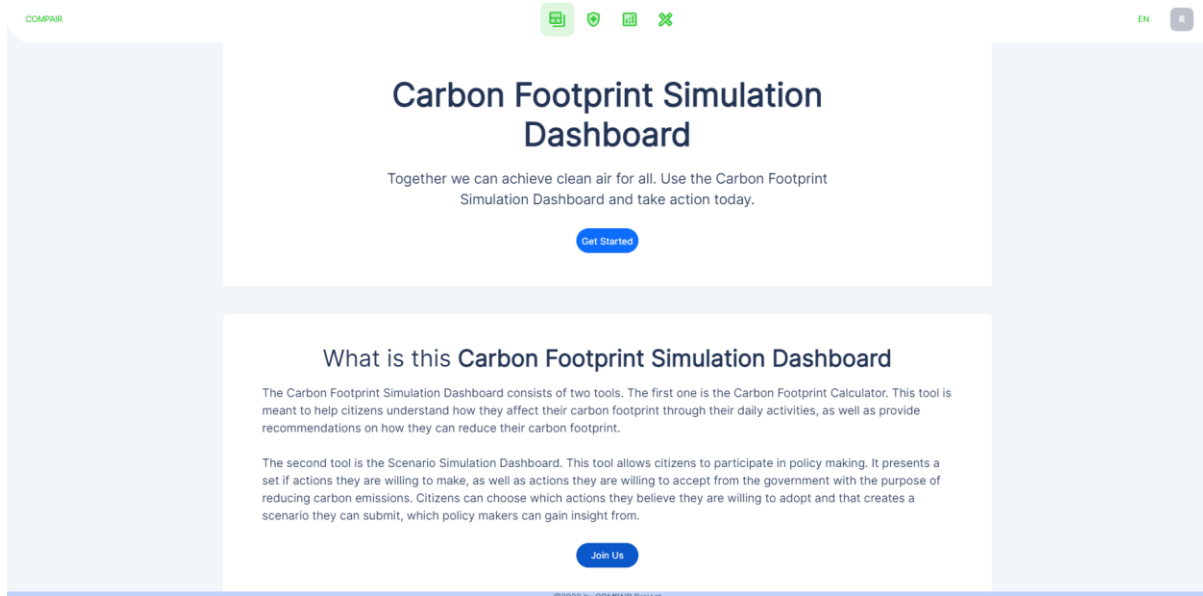


Figure 31: Carbon Footprint Simulation Dashboard home page

At the top of the page, a menu is available which is how the user can navigate through the various pages of the Dashboard (Figure 32). The first option on the menu leads to the homepage. The second option leads to the Carbon Footprint Calculator, which is the first tool available on the Dashboard. The third option leads to the Scenario Simulation, which is the second available tool on the Dashboard. The fourth option leads to the user's Profile Page that is specifically about the Carbon Footprint Simulation Dashboard. Finally, the fifth option leads to the dashboard's Admin Page with features that will be available to administrators of the Dashboard. The first three options are visible and available to anyone, regardless of whether they have created a user account or not. The Profile Page is available to users who have created an account and have logged into the dashboard. Finally, the Admin Page is available only to users who have created an account, have logged in, and have the administrator role.



Figure 32: Navigation menu of the Dashboard

Translations

The Carbon Footprint Simulation Dashboard has currently been translated to English, Greek, and Bulgarian and will soon also be translated to German and Dutch, covering each of the pilot's languages. The user can change the Dashboard's language by using the dropdown menu that is available on the top right corner of the screen (Figure 33).

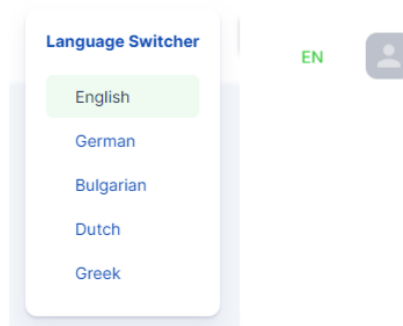


Figure 33: The dropdown language menu

Carbon Footprint Calculator

Choosing the second option on the navigation menu, the user is led to the Carbon Footprint Calculator, which allows the user to calculate their carbon footprint (Figure 34). This page consists of various tabs, each with different questions the user has to answer. Currently, there are eight tabs and from left to right they are named: Welcome, Demographic, Cars, Flights, Trains, Buildings, Waste Management, and Results. The questions of each tab may change based on additional feedback from users.

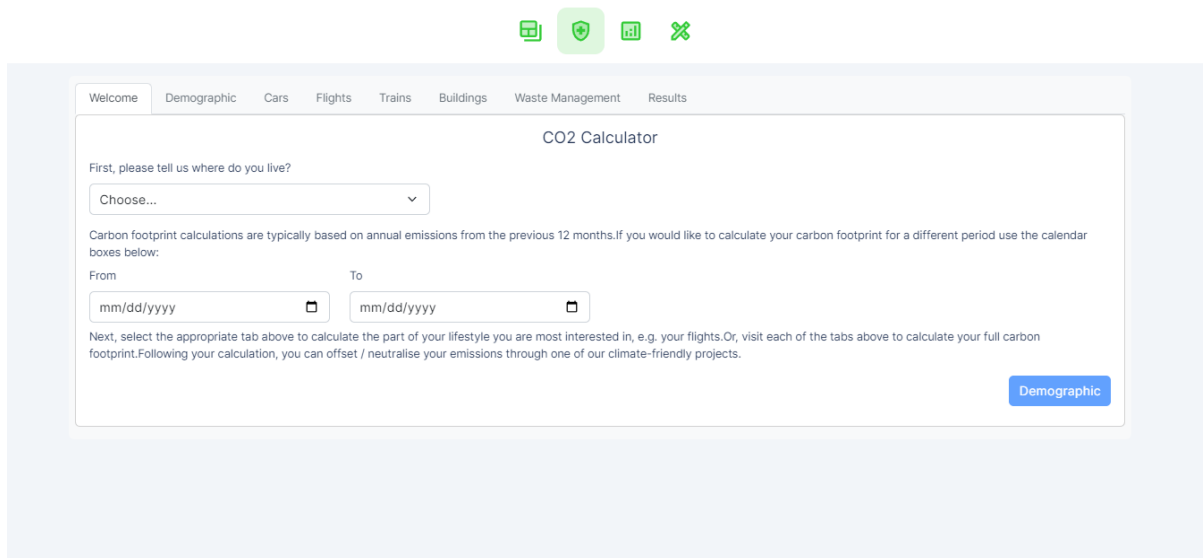


Figure 34: Carbon Footprint Calculator - Welcome tab

When first visiting the page, only the first tab (the Welcome tab) can be browsed. The rest of them, except for the Results tab, can be accessed once the user has selected the country they are living in. The user's country is required because it is used for the calculation of their carbon footprint, as well as the presentation of data relevant to them at the Results tab. The Results tab becomes accessible only when all the questions on the rest of the tabs have been answered, since those questions are crucial for the calculation of the user's carbon footprint. On the Welcome tab, the user can also choose the period for which they are going to calculate their carbon footprint. This is not mandatory since carbon footprint is typically calculated on an annual basis.

The second tab, Demographic (Figure 35), contains questions about the user that are not related to their carbon footprint. They are not mandatory, but they can help with the calculation of the carbon footprint, as well as the presentation of the results.

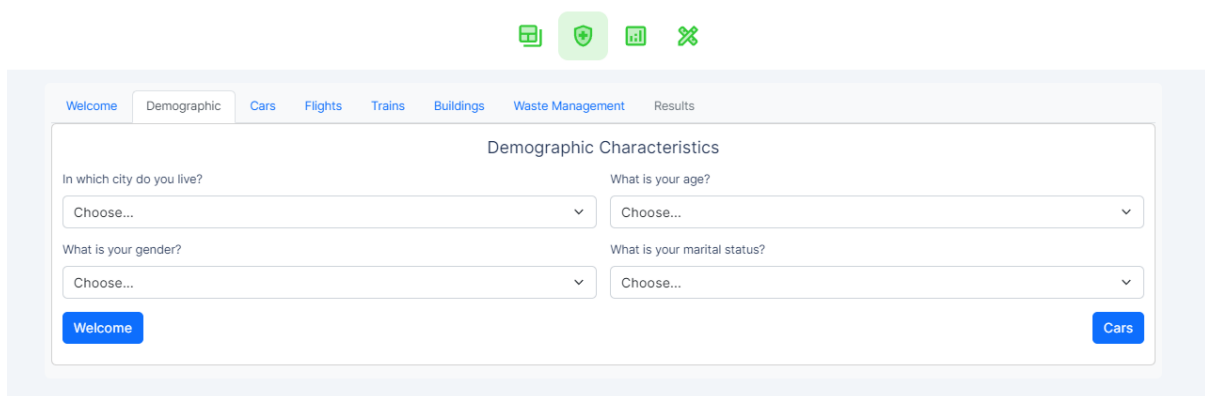


Figure 35: Carbon Footprint Calculator - Demographic tab

On the Cars tab (Figure 36), the user fills in information regarding the usage of their car(s). The information required is the distance they have travelled the previous year (or in the time period they have designated in the Welcome tab), the consumption of their car(s), as well as the type of fuel the car(s) uses. Furthermore, there are two checkboxes that represent whether the user is making use of public transport, and if the car is an electric one. If any of the two is true, the user can check the corresponding checkbox so that the calculation of the carbon footprint changes accordingly.

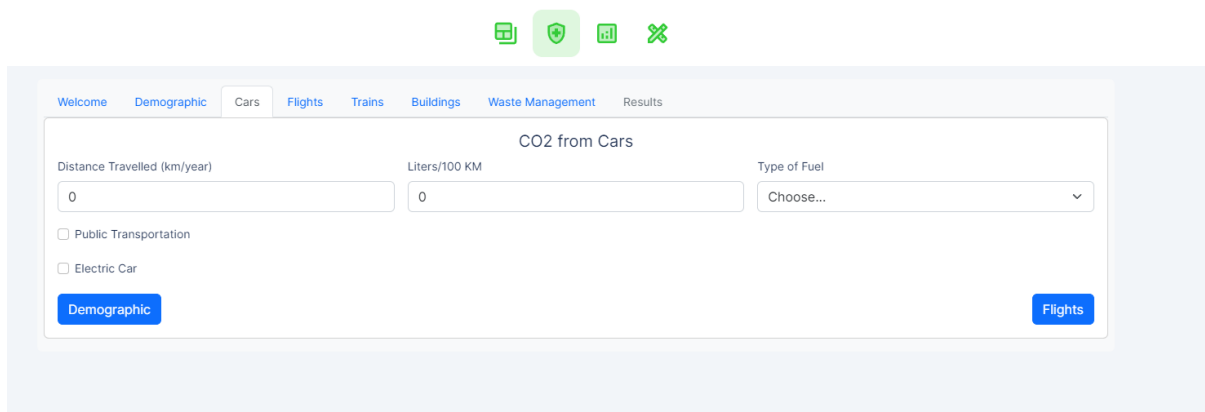


Figure 36: Carbon Footprint Calculator - Cars tab

The next tab is the Flights tab (Figure 37), in which the user fills in information regarding their flights. There are four types of flights presented here, based on their duration and average distance. The user needs to fill in how many flights of each type they have had during the designated time period, which is the one the user has provided in the Welcome tab.

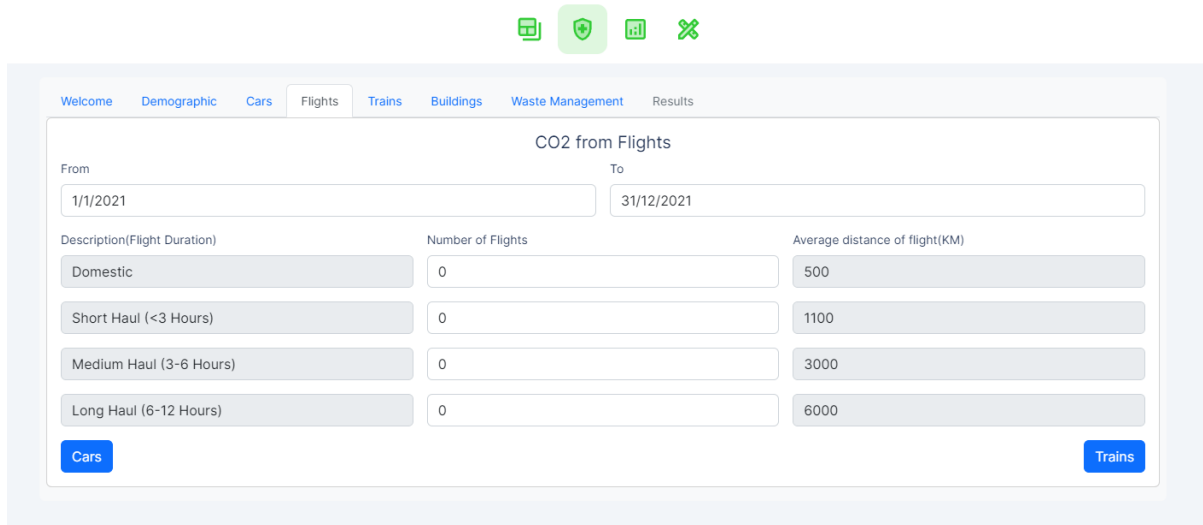


Figure 37: Carbon Footprint Calculator - Flights tab

The next tab is the Trains tab (Figure 38). The user can fill in information regarding the use of trains. What the user needs to provide is the number of trips they have taken and the average distance of the trips. The time period is pre-filled with the one provided in the Welcome tab.

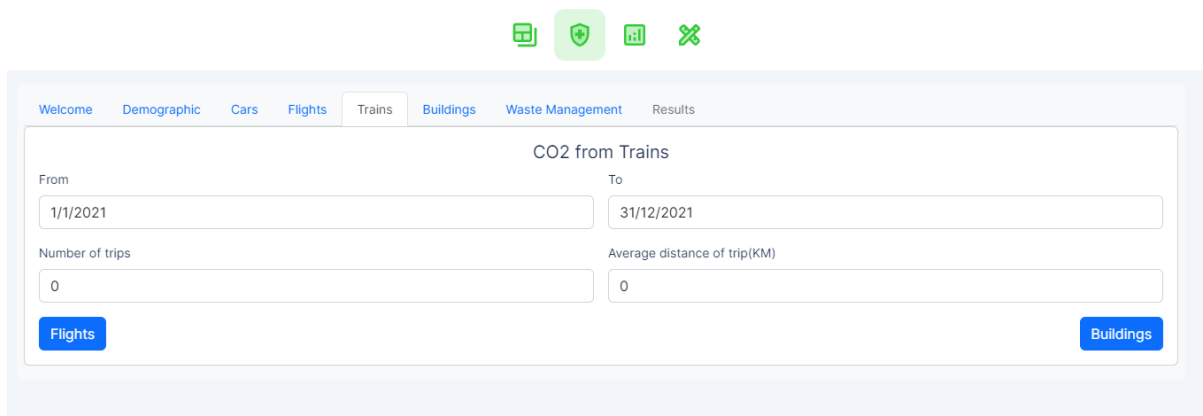


Figure 38: Carbon Footprint Calculator - Trains tab

The Buildings tab (Figure 39) is next, and the user has to fill in information regarding the use of energy in their home. The user has to provide the amount and type of fuel they have used, the amount of electricity they have used, and which grid type their house belongs to. Moreover, there are two checkboxes that represent the use of solar thermal energy and the use of a heat pump, which the user can check if they use any of the two. Next, there are four questions regarding the energy efficiency of appliances the user may have in their home, which are a refrigerator, a washing machine, a dishwasher, and an oven. The user can choose the level of energy efficiency of each appliance. The options are No, Semi-efficient, and Yes. Each of these options also correspond to specific energy efficiency levels that can be found on the

appliance’s EU Energy Label. Finally, if the user does not know the level of energy efficiency of the appliance or does not own such an appliance, they can choose the last option.

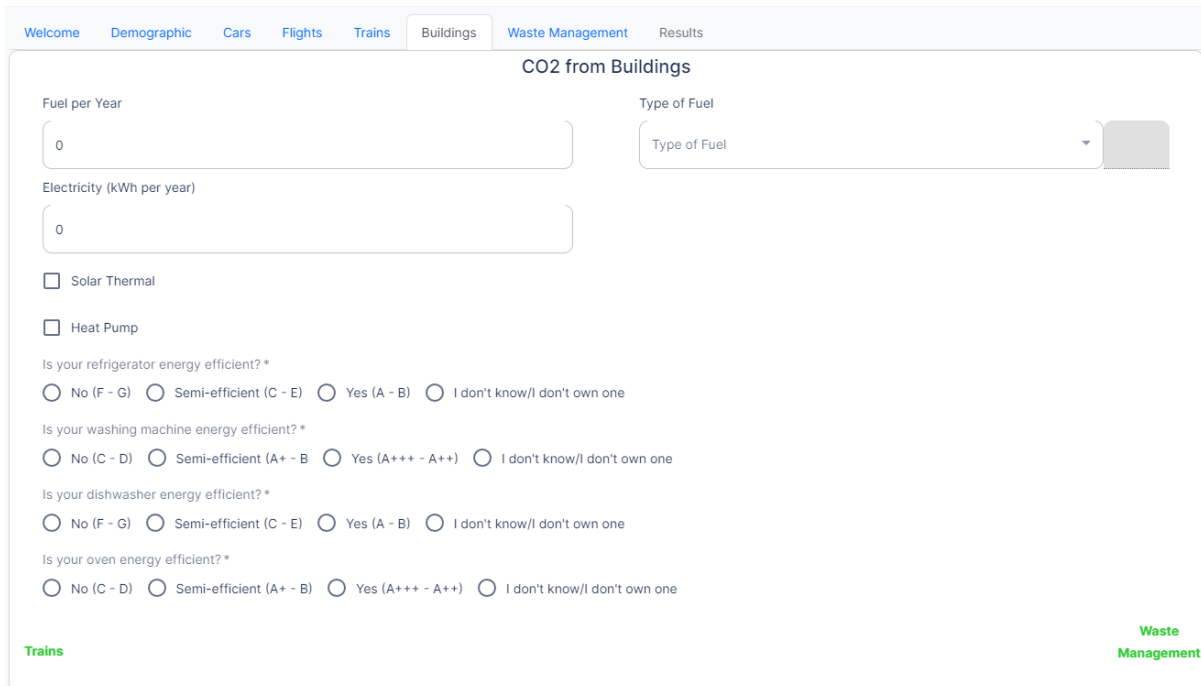


Figure 39: Carbon Footprint Calculator - Buildings tab

The final tab, in which the user has to provide input, is the Waste Management tab (Figure 39). The user is presented with the amount of recycling and composting done by the average citizen of their country. Then, through two dropdown menus, they can choose whether they recycle and compost more, the same, or less than the average. There is also the option of not recycling or composting at all.

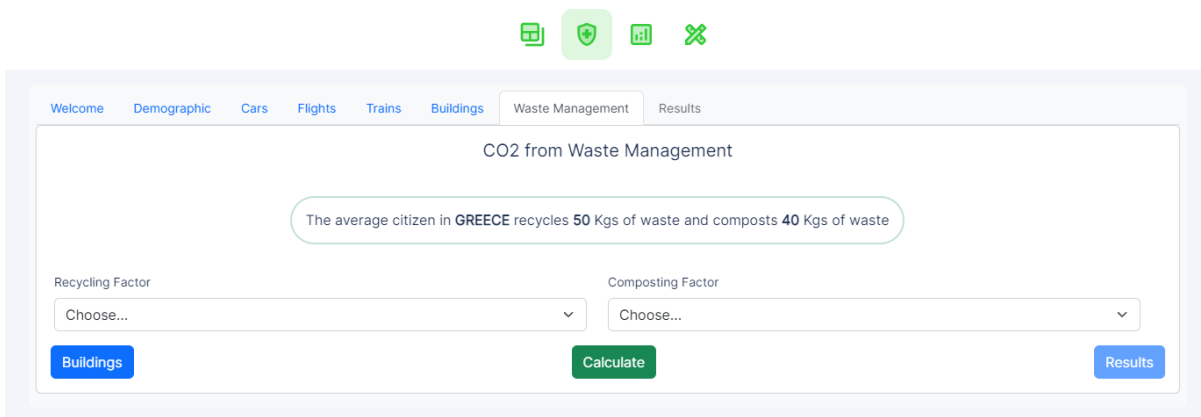


Figure 40: Carbon Footprint Calculator - Waste Management tab

If the user presses the Calculate button without filling in all the required fields, an error message will appear informing them that they have missed some fields (Figure 41). If they have filled in all the fields, then they are informed that they can proceed to the Results tab (Figure 42).

Figure 41: Error informing some fields have not been filled in

Figure 42: Calculation Successful

On the Results tab, the user receives information regarding their carbon footprint. At the top of the tab, there are three bars (Figure 43). The topmost bar provides the user’s carbon footprint. The middle one provides the average carbon footprint of the user’s country. The bottom one provides the EU carbon footprint average. This allows the user to compare their results with various averages, so they can understand where there may be room for improvement for them.

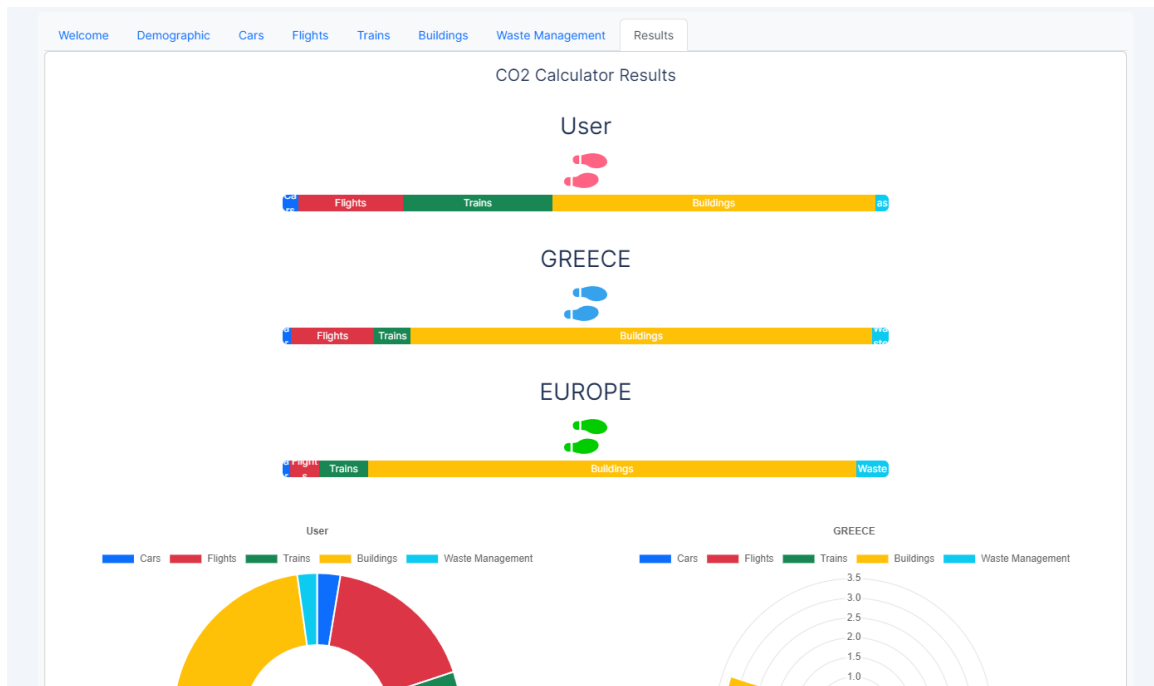


Figure 43: User's results comparison

Furthermore, each colour on the bars represents a different carbon footprint domain, which corresponds to one of the tabs they have previously visited. By clicking on a domain (Figure 44), a message appears that shows the user how much that domain takes up from their total carbon footprint. If they click on the domain again, the message disappears.

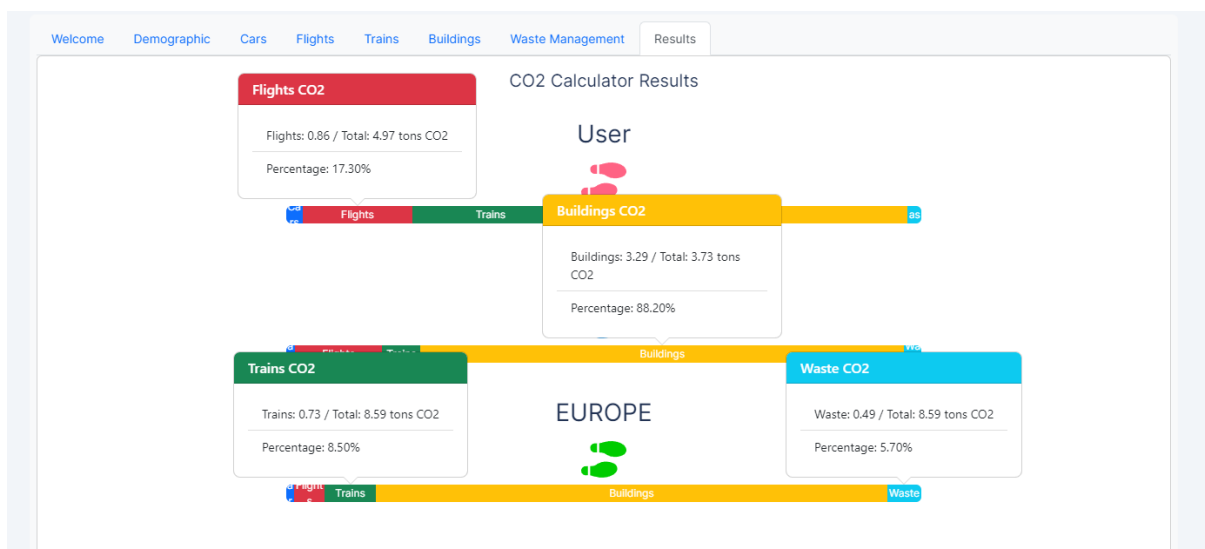


Figure 44.: Information about each carbon footprint domain

Right below the bars, there are various graphs (Figure 45) that provide visualisations that help the user understand their carbon footprint. Not all of the graphs that are currently present in this area will remain, once feedback is received regarding which the users prefer the most.

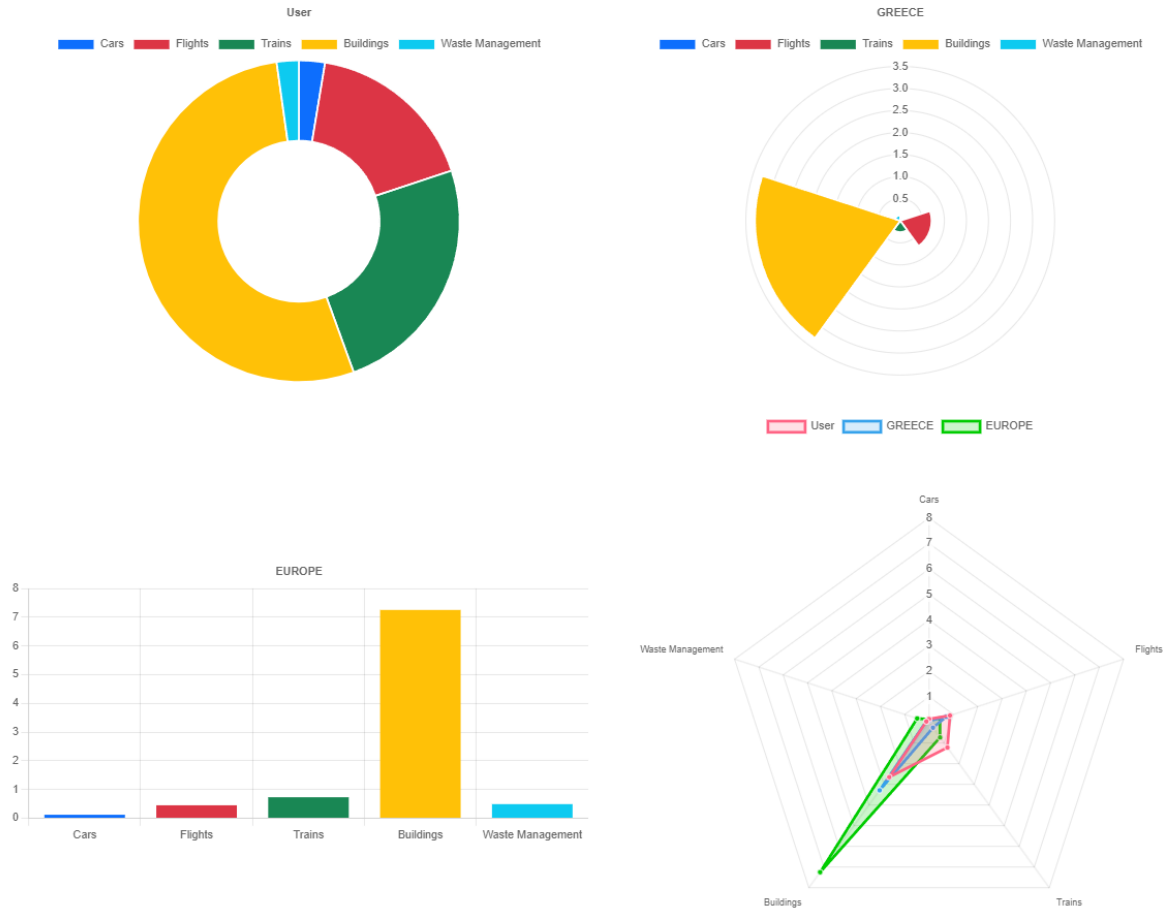


Figure 45: Visualisation options

At the bottom of the tab, the user also has access to recommendations on how they can reduce their carbon footprint (Figure 46). There is one recommendation category for each domain. The recommendations that appear here depend on what answers the user has provided in the previous tabs.

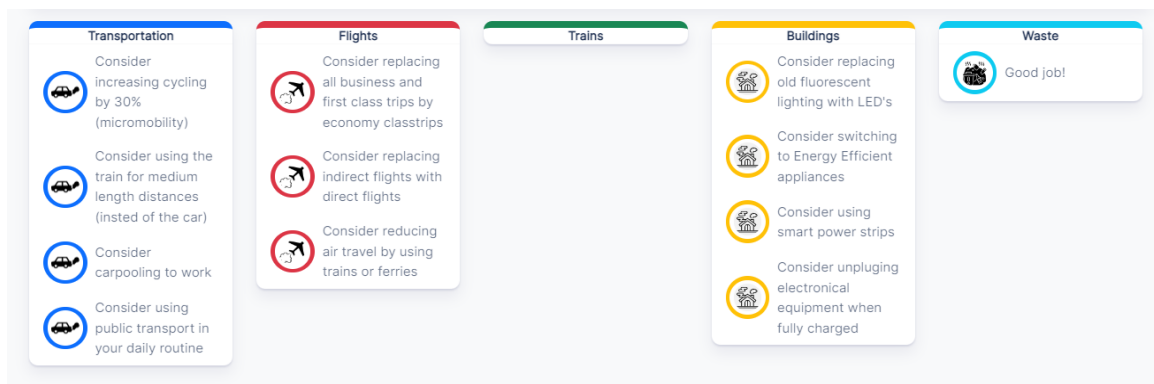


Figure 46: Recommendations by domain based on user's results

By clicking a recommendation, the user is presented with information links (Figure 47) that can provide additional insight regarding that recommendation and how they can begin adopting it. These links are country-based so the user will receive links that are relevant to the country they have chosen on the Welcome Tab of the calculator.

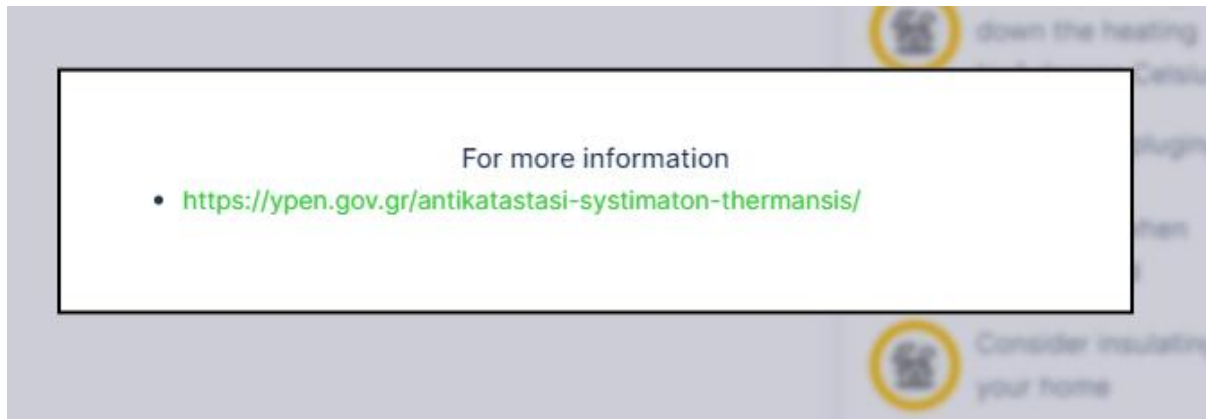


Figure 47: Information link related to a specific recommendation the user clicks on

Scenario Simulation

Choosing the third option on the navigation menu, the user is led to the Scenario Simulation (Figure 48). The Scenario Simulation allows the user to submit their opinion in the form of scenarios regarding a specific quantified environmental goal. For example, a goal can be the European Commission's target of a 55% net reduction in greenhouse gas emissions by 2030. The goal is visible on the top of the page. The purpose of the tool is to allow the users to see how various actions can affect their carbon footprint. Moreover, summaries of these scenarios will be later available to policy-makers, giving them insight on the opinions of the citizens that will allow them to take them into consideration when making decisions.

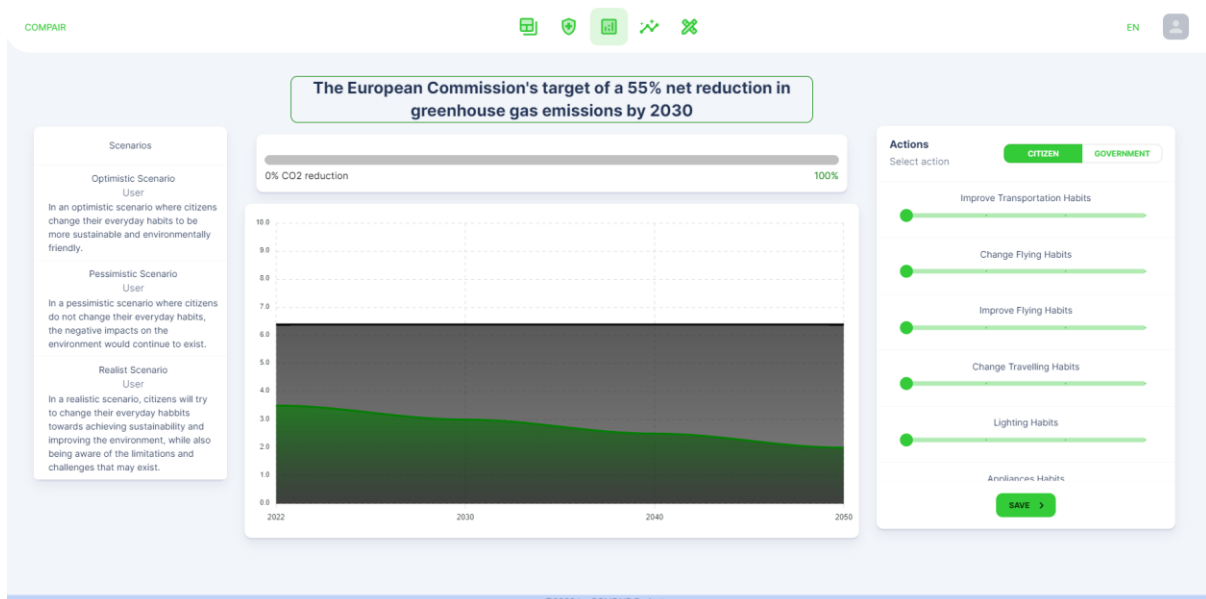


Figure 48: Scenario Simulation

Below the goal there is a progress bar and a graph. The progress bar shows the emissions reduction caused by the actions chosen by the user. The graph shows the current and the target emissions.

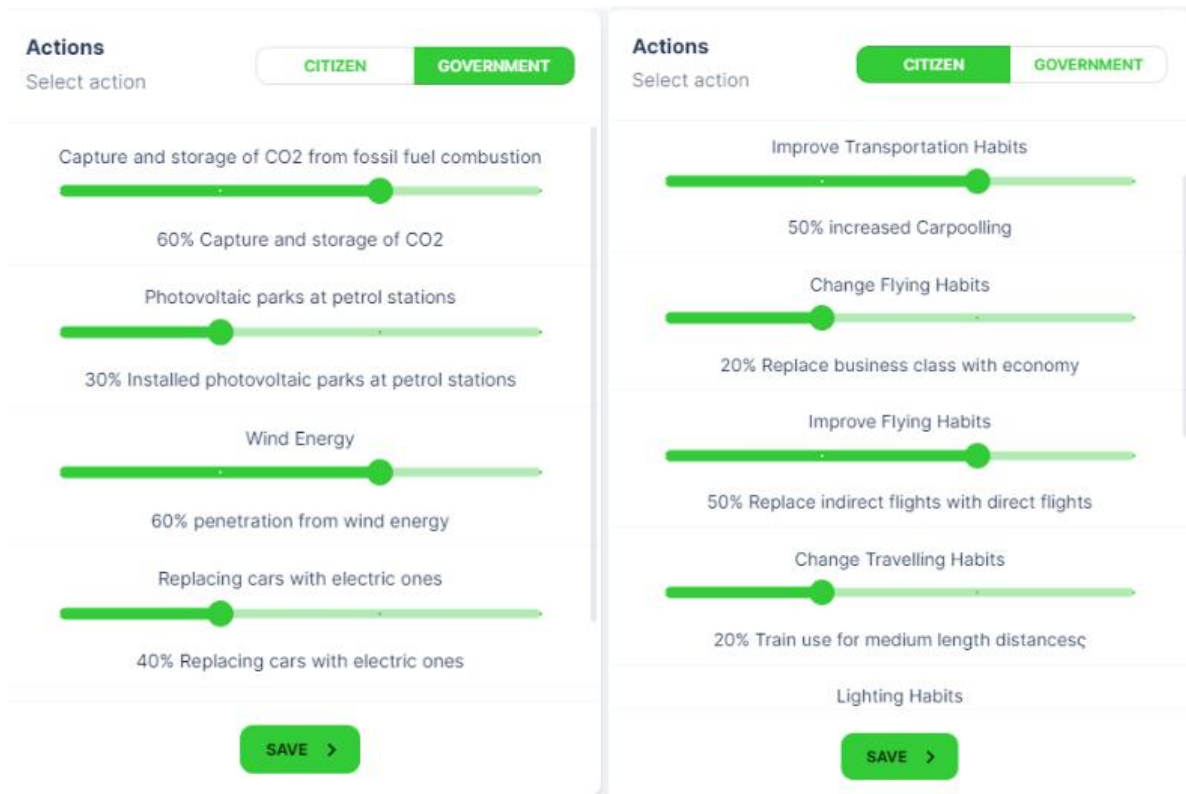


Figure 49: Action sliders

To create scenarios, the user can choose between two types of actions (Figure 49). These actions can be found on the right side of the page and they are actions they can adopt and actions they are willing to accept from the government. Each action has four available levels, which corresponds to a different level of adoption. The user can choose the level they want by moving the slider of the action. Moreover, an explanation of each level is provided when the user chooses it. When a user's scenario reaches the set goal, the user can submit their scenario.

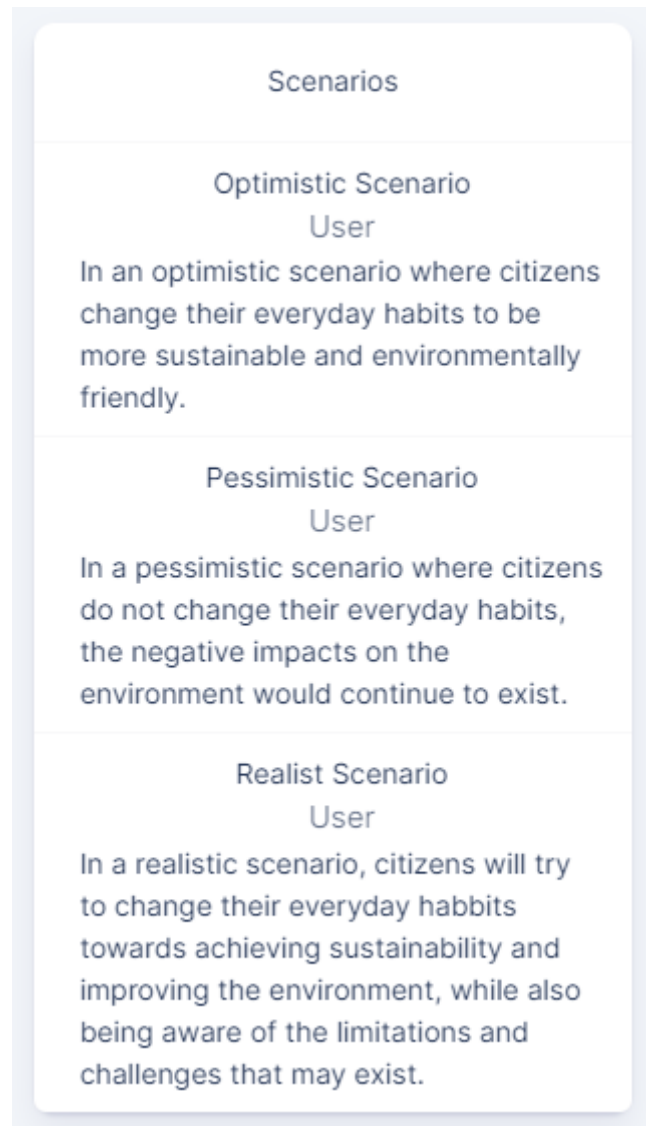



Figure 50: Example Scenarios

Moreover, on the left side of the page, there are example scenarios (Figure 50). These can be viewed by the users so that they can get a better idea on how various actions affect carbon footprint and what strategies governing bodies are considering in order to reach the set goal.

Profile Page

Choosing the fourth option on the navigation menu, the user is led to their Profile Page (Figure 51). This profile page is dedicated only to the Carbon Footprint Simulation Dashboard and provides the user with the history of their results on the Carbon Footprint Calculator and submitted results of the Scenario Simulation.





Calculations Export

Full Name:

e-mail:

Calculator Results:

Buildings

Fuel per Year:

Type of Fuel:

Electricity (kWh per year):

Solar Thermal:

Heat Pump:

Energy Efficient Refrigerator:

Energy Efficient Washing Machine:

Energy Efficient Dishwasher:

Energy Efficient Oven:

Cars

Kilometers / Year:

Liters/100 KM:

Type of Fuel:

Public Transportation:

Electric Car:

Flights

Domestic:

Short Haul:

Medium Haul:

Long Haul:

Waste Management

Recycling:

Composting:

Trains

Number of Trips:

Average Distance of Trip (km):

(tons CO2 per domain)

Cars 0 tons CO2

Flights 0 tons CO2

Trains 0 tons CO2

Buildings 0 tons CO2

Waste Management 0 tons CO2

(tons CO2 per domain)

Cars 0 tons CO2

Flights 0 tons CO2

Trains 0 tons CO2

Buildings 0 tons CO2

Waste Management 0 tons CO2

Europe (tons CO2 per domain)

Cars 0 tons CO2

Flights 0 tons CO2 tons CO2

Trains 0 tons CO2 tons CO2

Buildings 0 tons tons CO2

Waste Management 0 tons CO2

Scenario

Download Data

Figure 51 :Profile Page

The user can choose which calculation they want to browse from the dropdown menu that is available (Figure 52) on the top left part of the screen. This dropdown menu will present only calculations of the user. The identifier for each calculation is the date and time that the calculation took place.

Sun Apr 09 2023 22:45:42 GMT+0300 (Eastern European Summer Time)

Sun Apr 09 2023 22:45:48 GMT+0300 (Eastern European Summer Time)

Sun Apr 09 2023 23:24:00 GMT+0300 (Eastern European Summer Time)

Sun Apr 09 2023 23:24:01 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 16:29:56 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 16:29:56 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 17:51:31 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 17:52:23 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:09:24 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:14:50 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:18:39 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:19:25 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:22:07 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:23:08 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:34:56 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:56:16 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 19:58:46 GMT+0300 (Eastern European Summer Time)

Mon Apr 10 2023 20:08:07 GMT+0300 (Eastern European Summer Time)

Mon Apr 24 2023 17:51:05 GMT+0300 (Eastern European Summer Time)

Mon Apr 24 2023 17:51:06 GMT+0300 (Eastern European Summer Time)

Mon Apr 24 2023 19:13:28 GMT+0300 (Eastern European Summer Time)

Mon Apr 24 2023 19:13:29 GMT+0300 (Eastern European Summer Time)

Mon Apr 24 2023 19:15:50 GMT+0300 (Eastern European Summer Time)

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Mon Apr 24 2023 19:30:01 GMT+0300 (Eastern European Summer Time)

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Mon Apr 24 2023 22:36:12 GMT+0300 (Eastern European Summer Time)

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Mon Apr 24 2023 23:30:43 GMT+0300 (Eastern European Summer Time)

Mon Apr 24 2023 23:30:43 GMT+0300 (Eastern European Summer Time)

Mon Apr 24 2023 23:34:36 GMT+0300 (Eastern European Summer Time)

Figure 52: Calculations dropdown menu

Once the user chooses which calculation they want to browse, the data is presented on the rest of the screen and is distributed appropriately (Figure 53). There is a box for each of the calculation's carbon domains that shows how the user has replied to each of the answers. Apart from the answers, the user can also see the distribution of their carbon footprint just like on the results tab of the Carbon Footprint Calculator, as well as the comparison with the carbon footprint average of their country and the EU.

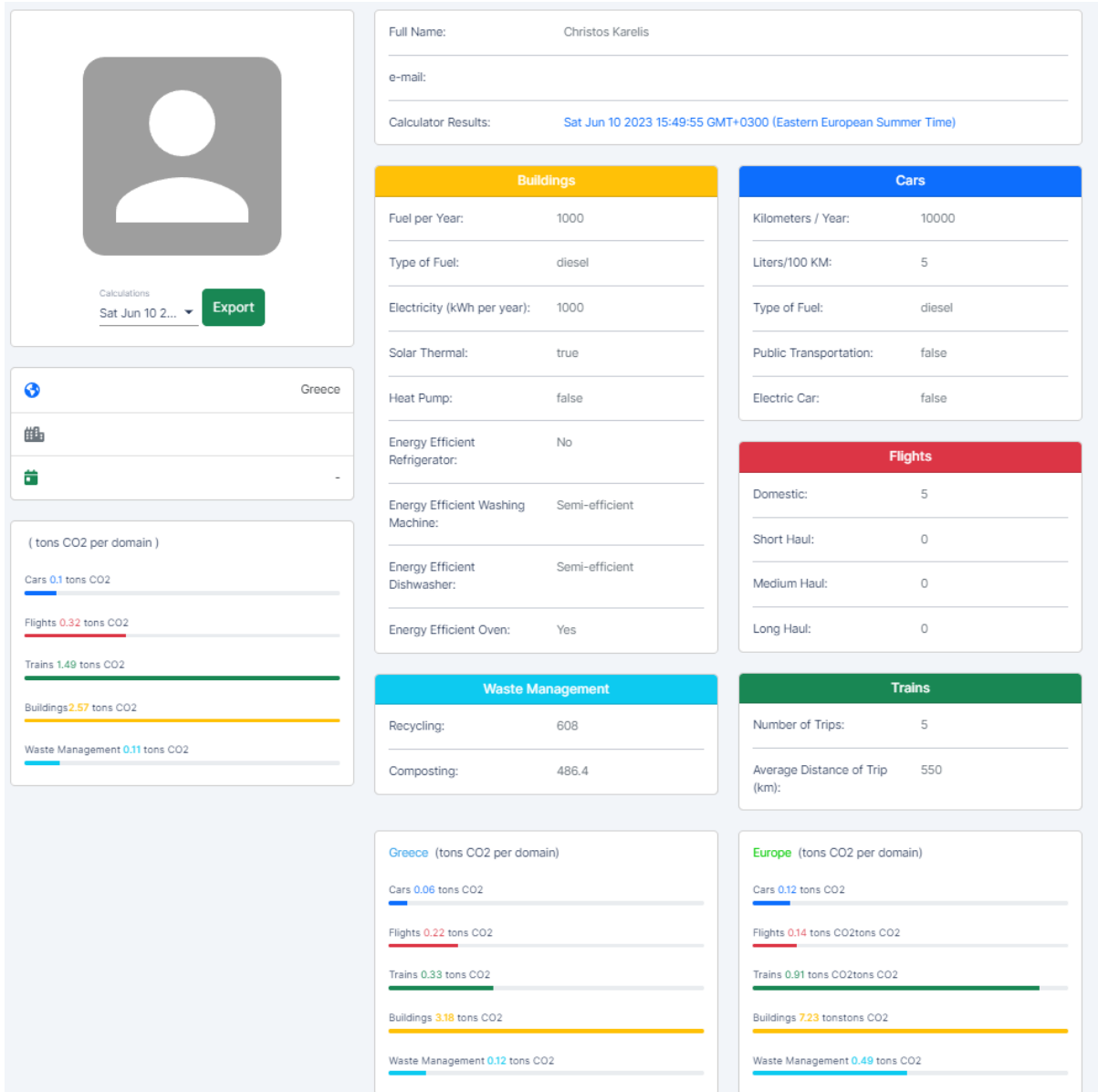


Figure 53: Browsing a calculation on the profile page

Below the Carbon Footprint Calculator results, the user can also browse the scenarios they have created on the Scenario Simulation. Similarly with how they can browse the Carbon Footprint Calculator results, there is a dropdown window that shows them their created scenarios (Figure 54).

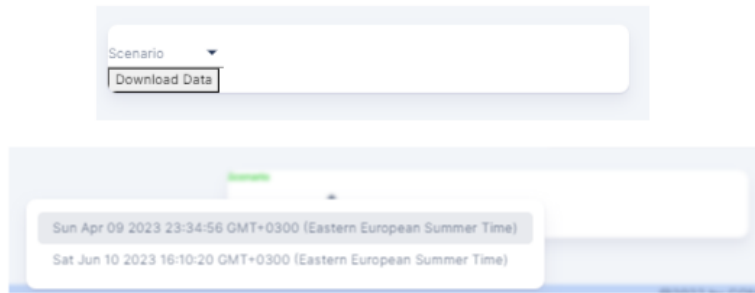


Figure 54: Scenarios dropdown menu

Once the user picks which scenario they want to browse, a list appears with the actions of the scenario set at the level the user has chosen (Figure 55). The actions cannot be edited here, since the scenario has been submitted and this is a feature that allows the user to see a previously submitted scenario. If they want to make a change, they have to create a new scenario on the Scenario Simulation and submit it again.

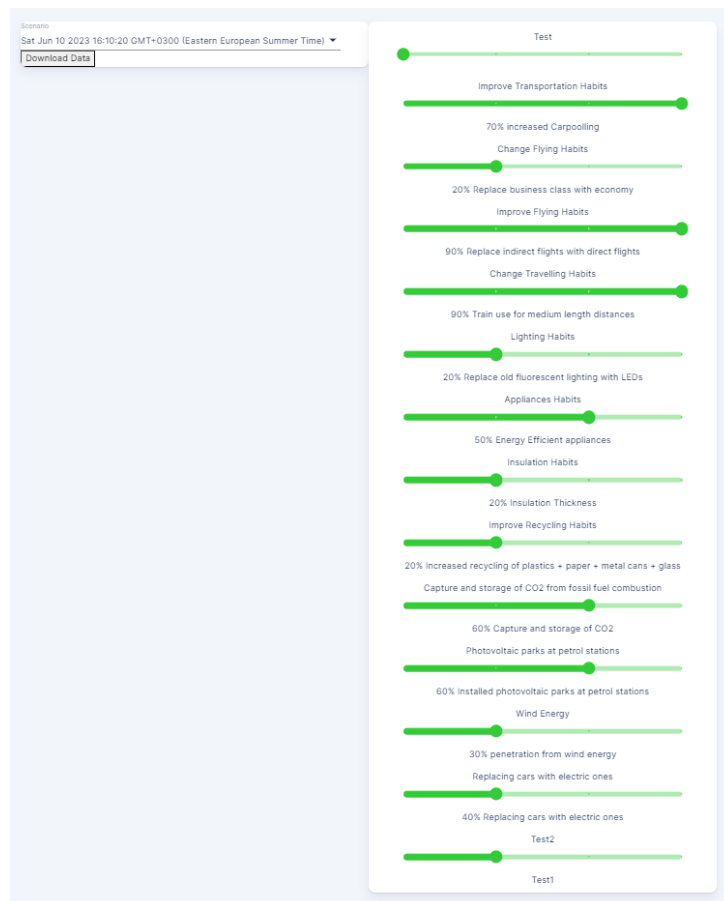


Figure 55: Browsing a scenario on the profile page

Administrator Page

Choosing the fifth option on the navigation menu, the user (if an administrator) is led to the administrator page (Figure 56) which provides various tools to the administrators of the Dashboard. Administrators are meant to be policy-makers and city officials that are going to gain insight on citizens' opinions on what actions they are willing to perform towards the achievement of a policy target and the probability of achievement. The Admin Page is under development so only the currently available features are presented below.

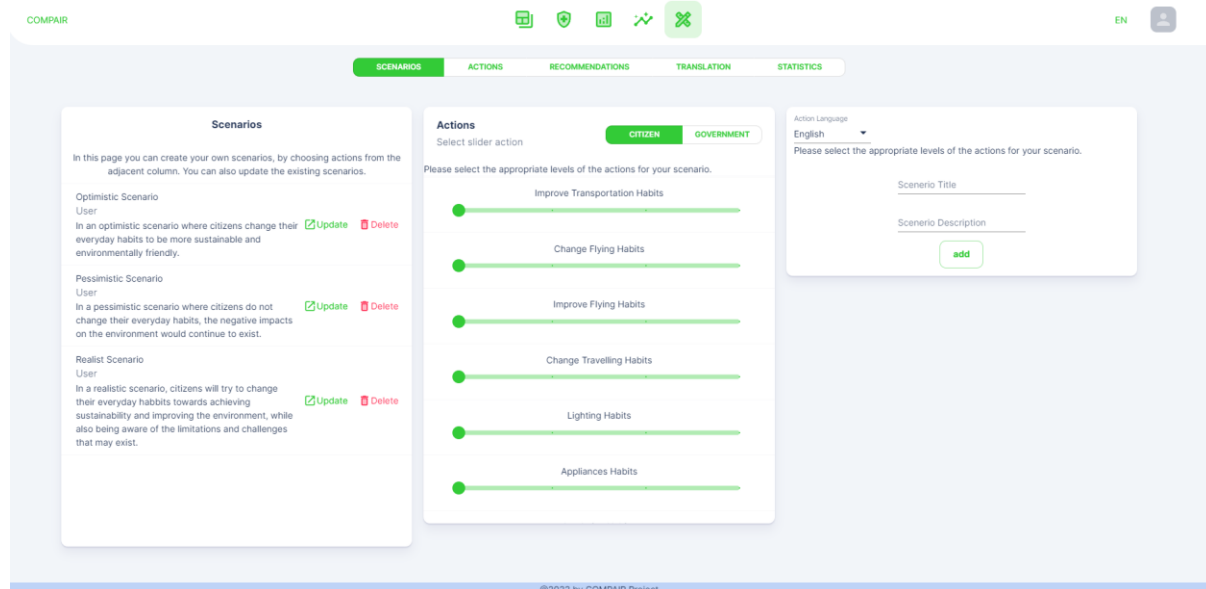


Figure 56: Admin Page

The admin page has its own navigation menu below the main navigation menu. There are currently three options in the menu. The first option leads to the scenario creation page. In this page, an administrator can create, update, and delete example scenarios for the Scenario Simulation. On the left part of the screen, there is a list of example scenarios that are currently available. From there, the administrator can update or delete an example scenario.

In order to create a scenario, an administrator has to choose the level of each action for the scenario. This can be done from the list of actions that are available, which is located in the middle of the screen. Then they have to enter the scenario's name and description on the right part of the page (Figure 57). Finally, they can press the "add" button and their scenario is created.

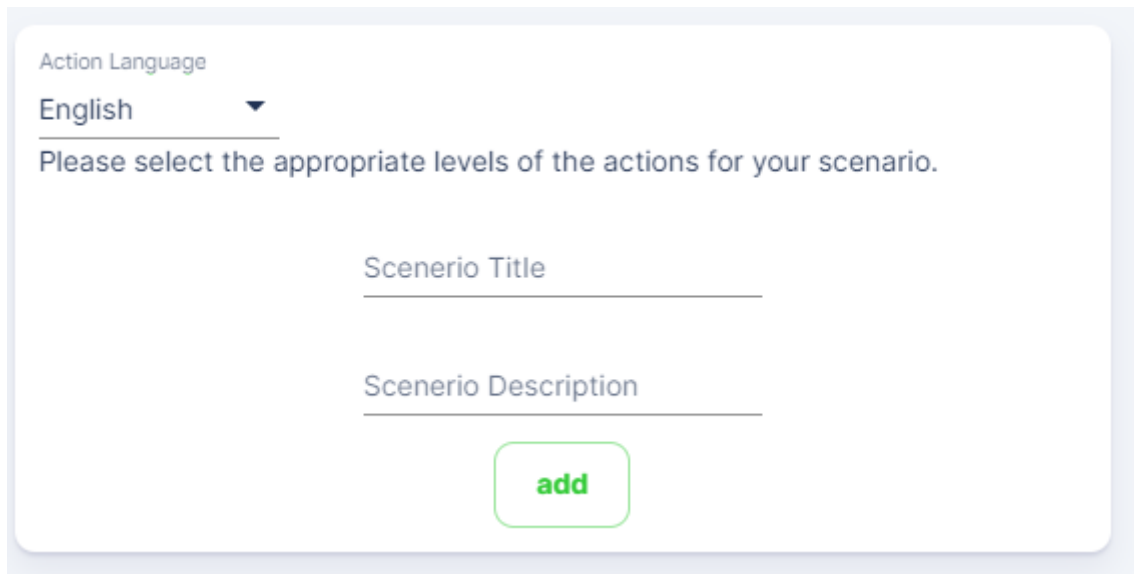


Figure 57: Add the title and the description of the new scenerio

The second option in the admin page navigation menu leads to the actions page (Figure 58). This allows the administrator to create, update, and delete actions that are available in the Scenario Simulation. On the left part of the screen there is a list of the actions that are currently available. From there, the administrator can update or delete an action. They can switch between the citizen and government lists by pressing the “citizen” or “government” button.

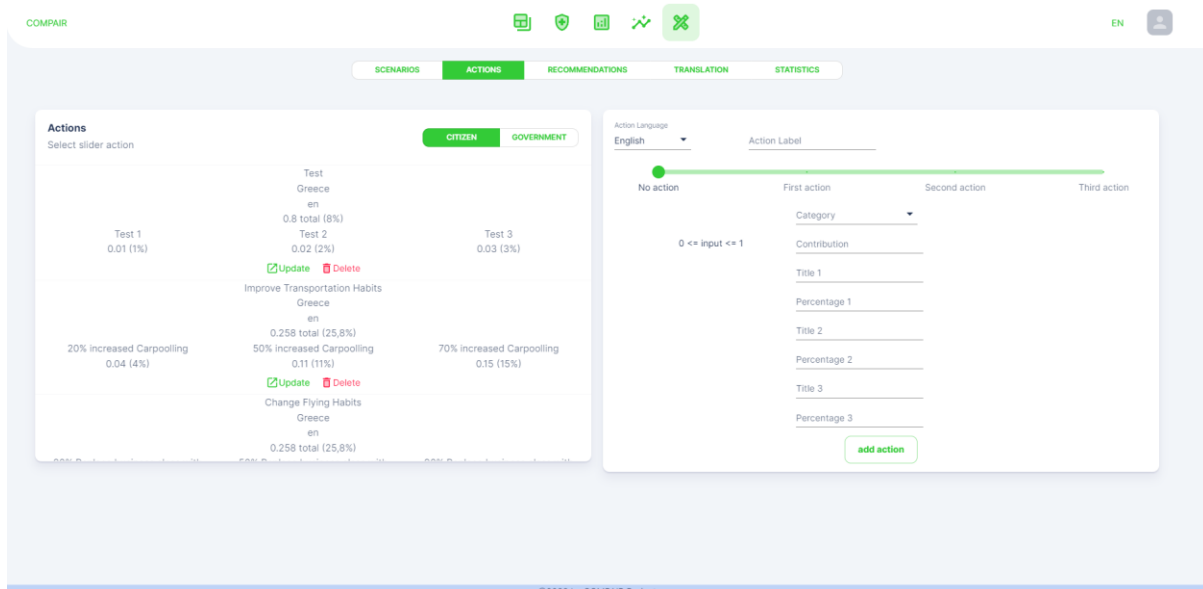


Figure 58: Admin page - actions

In order to create an action, first, the administrator has to give it a name by filling in the “Action Label” field. Then, they can choose whether the action is a citizen or a government action from the “Contribution Category” dropdown menu. The “Contribution” field allows the administrator to choose the percentage of emission reduction this action provides. Finally, they have to add a title and the percentage of contribution for each level of the action.

The third option in the admin page navigation menu leads to the recommendations page (Figure 59). This allows the administrator to create, update, and delete recommendations that are available in the Carbon Footprint Calculator. On the left part of the screen, there is a list of the recommendations that are currently available. From there, the administrator can update or delete a recommendation.

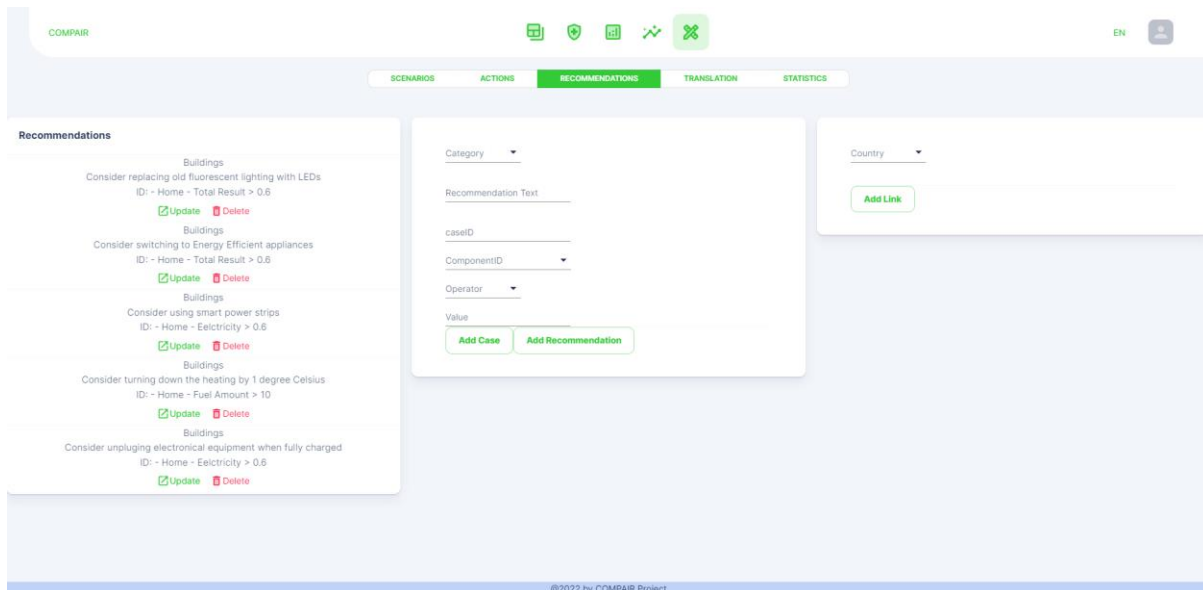


Figure 59: Admin page - recommendations

In order to create a recommendation, first, the administrator has to choose its Category. The categories available correspond to the carbon footprint domains from the Carbon Footprint Calculator. Then, they have to enter the text for the recommendation, which is the text the user will see. The caseID allows the administrator to add an identifier for their recommendation.

Finally, they have to provide the conditions for the recommendation to appear. The ComponentID dropdown menu contains a list of all the fields in the Carbon Footprint Calculator a user can fill in. The administrator can choose a field, an operator, and a value. A comparison between the chosen field's value set by the administrator and the value provided by the user, based on the operator that has been chosen, takes place. If the comparison is true, the recommendation will appear to the user. If the administrator needs to add more comparison cases for their recommendation, they can press the "Add Case" button and an additional set of fields appears (Figure 60).

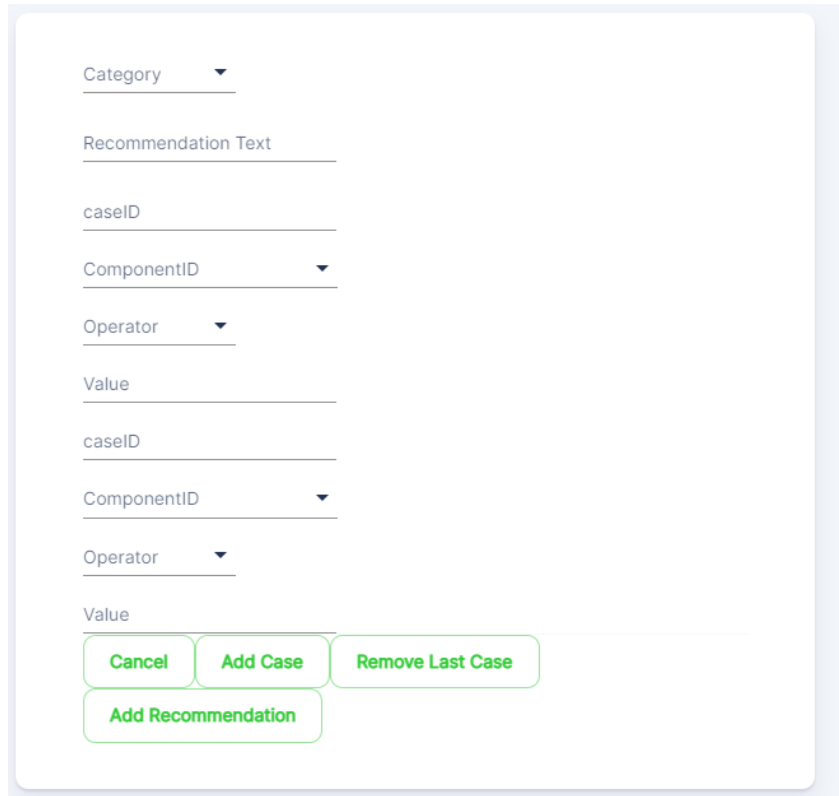


Figure 60: Adding more cases to a recommendation

Furthermore, if the administrator has information links they want to provide along with the recommendation, they can do it on the right part of the screen (Figure 61). They can choose for which country they want to add a link and can add multiple ones if there is a need to do so.

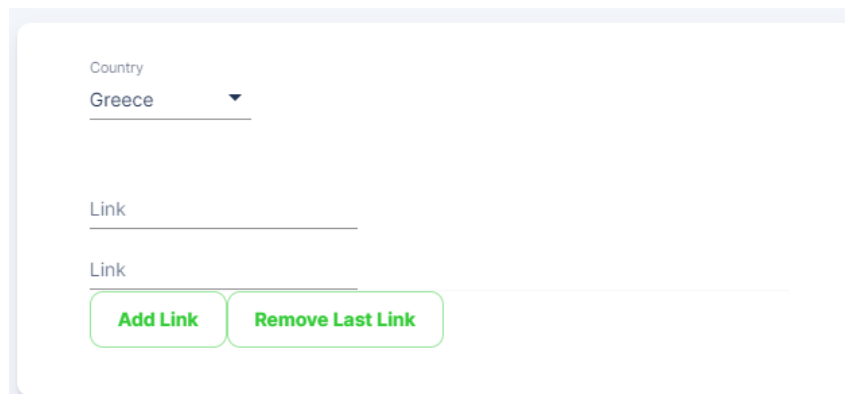
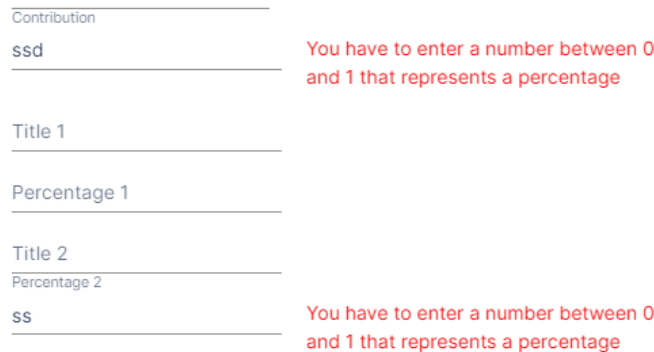


Figure 61: Adding information links to a recommendation

Data Validation

In order to help users and administrators, we have implemented a feature that does not allow them to input the wrong type of data that would result in the Carbon Footprint Simulation Dashboard working incorrectly. When a user tries to enter a wrong type of data in a field, they won't be able to do so and may get an error message with directions on what they are supposed to input (Figure 62). This feature will continue getting updated as new components are added, and others are removed or changed.

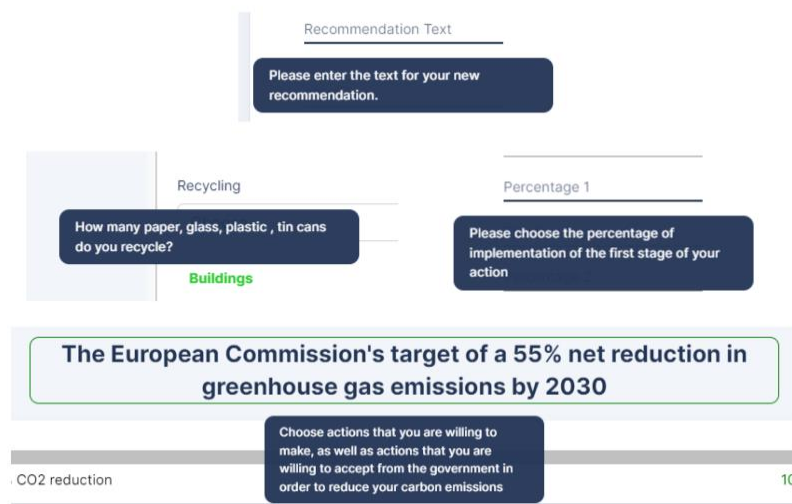


The screenshot shows a form with several input fields. Two fields, 'Contribution' and 'Percentage 2', contain the text 'ssd'. Red error messages are displayed next to these fields: 'You have to enter a number between 0 and 1 that represents a percentage'. Other fields include 'Title 1', 'Percentage 1', 'Title 2', and 'ss'.

Figure 62: Error message when trying to add text in a number field

Data Validation

In order to help users and administrators understand what they need to enter in each field, explanations have been added throughout the Carbon Footprint Simulation Dashboard. These explanations come in the form of text that is either immediately visible or in the form of tooltips that appear when a user moves their mouse over the relevant component on the screen (Figure 63).



The screenshot shows a dashboard with several components and explanatory tooltips. At the top, a 'Recommendation Text' tooltip says 'Please enter the text for your new recommendation.' Below this, there are two input fields: 'Recycling' with a tooltip 'How many paper, glass, plastic, tin cans do you recycle?' and 'Percentage 1' with a tooltip 'Please choose the percentage of implementation of the first stage of your action'. A central banner reads 'The European Commission's target of a 55% net reduction in greenhouse gas emissions by 2030'. Below the banner, a tooltip says 'Choose actions that you are willing to make, as well as actions that you are willing to accept from the government in order to reduce your carbon emissions'. At the bottom, a progress bar for 'CO2 reduction' is shown, with a value of '10'.

Figure 63: Explanations throughout the Carbon Footprint Simulation Dashboard

5. Dynamic Exposure Visualisation App (DEVA)

The Dynamic Exposure Visualisation Application (**DEVA**) is to enable citizens to explore their surroundings via their smartphone or tablet camera, so they see a visual overlay of environmental information such as air quality or traffic information.

List of epics implemented for the DEVA open beta release

The following table presents the list of epics implemented for the DEVA open beta release.

Table 4: List of epics implemented for the open beta release of DEVA

ID	EPICS
DEVEViz	Visualise data in 3D Space
	Story: As a citizen, I want to be able to tilt the angle to display data all around
DEVAAnn	Annotate Measurements
	Story: As a citizen, I want to measure the type of mode of transportation
	Story: As a citizen, I can share information about my daily commuting
DEVAMan	Management
	Story: As a researcher, I want sensitive data to be identified
	Story: As a researcher, I can monitor whether a device is measuring effectively during the experiment by getting a signal when the device is on, but not measuring data
DEVAUI	User Interface
	Story: As a citizen, I want frequently used functions to be displayed on my toolbar
	Story: As a citizen, I want to switch the user interface to different design and level of complexity
DEVAREa	Real-time communication and information visualisation
	Story: As a citizen, I want to be connected to COMPAIR's database
DEVAGam	Gamification
	Story: As a parent, I want the app to display information to raise consciousness about air pollution, especially for children
AILL&f	Look and Feel
	Story: As a visitor, I can switch the language of DEVA to my language

In the following sections, the updates and developments since 1st December 2022 are described. In the first part, we revisit all the updates and new features that have been implemented in the **DEVA** on a general level. After that, we describe the achievements for each epic that was defined by the end users through short user-stories (see table 4).

General updates and features

The design and the graphical elements have been modified towards a modern and more appealing outlook. In Figure 64, the different screens are presented when the app is started.

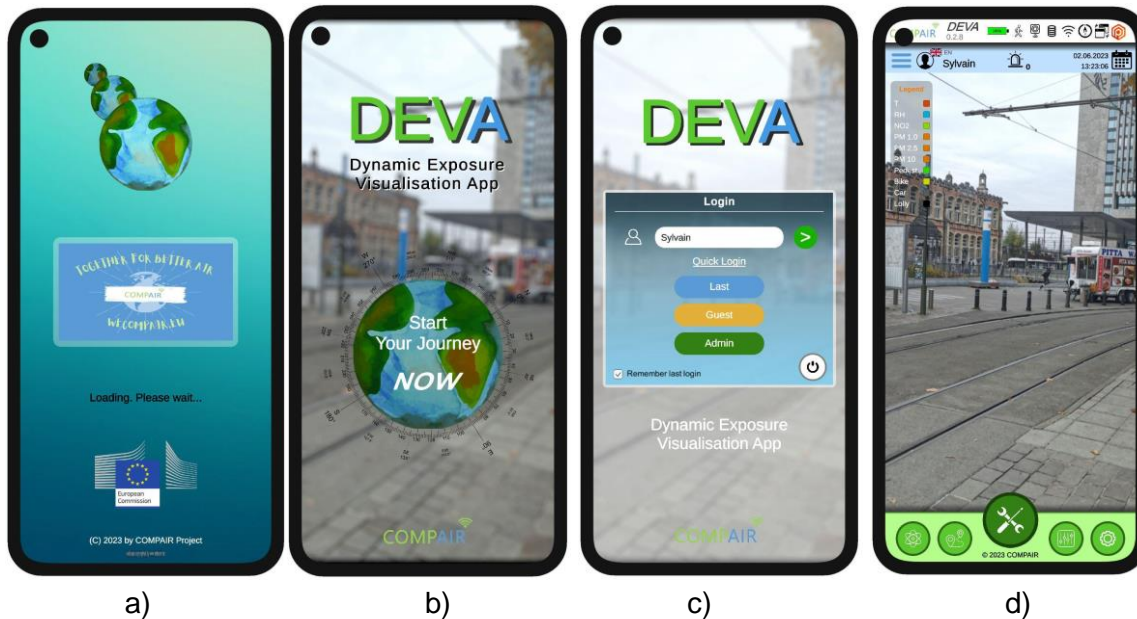





Figure 64: a) Splash screen, b) start screen, c) login screen and d) main screen.

An important update in the login procedure is the possibility to set an option for an automatic login (see Figure 64c, checkbox “Remember last login”). If the checkbox is checked, **DEVA** takes the next time the last username and password, and directly shows the main screen (Fig. 39d) after the start screen (Fig. 64b). To disable this function, the user has to logout via the Hamburger menu and disable the checkbox.

Significant changes in the main user interface have been performed in order to provide a professional design and coherent outlook among all the different graphical elements. In the top bar (Figure 65a), some new elements have been added to access information quickly. This is the full screen mode icon  (second from the right), the transportation mode icon  (at the right of the battery symbol) and the favourite tools icon (right most). The wheel for the setting ( in the old app) has been removed as it is now part of the toolbox.

The Hamburger menu (see Figure 65b) has been extended and different menu items were grouped and visualised in different colours. The toolbox has been extended by various helpful tools such as direct selection of different data representations like original/ dome/ theatre representation and data selection or filtering (see Figure 65c). A Revolver button-wheel was implemented to quickly access preferred functionalities related to the understanding of the AR environment and offers the possibility to activate some helpful geometry information (see Figure 65d, red buttons).



Figure 65: a) New top bar, b) revised Hamburger menu, c) new toolbox and d) new implementation of favourite tools

New settings windows for the AR Settings, GUI Settings and the User Profile Settings were added with an updated list of parameters (see Figure 66). A major change in the save logic was done:

- The user can now quit a setting window with the “OK” button without saving the changes, so the user can experiment with the changes before deciding to save them.
- If the user wants to permanently change the setting, the user has to click on the new “Save” button Save.
- The “Cancel” button closes the window ignoring the changes. All settings remain unchanged.



Figure 66: AR Settings window (left) GUI Settings window (middle) and User Profile settings (right)

In order to test the implemented functionalities during development and the correct workflow during interaction, a set of debug tools were additionally integrated:

Simulation tool (see Figure 67a)

It is essential to create sensor data without having access to real data. The lack of real data occurs if network connectivity is not available or if there are problems on the server side at the Data Manager. The capability of creating random test data helps to test the different kinds of visualisations and many more.

Data Manager and server test (see Figure 67b)

It is also essential to set up the connectivity to the Data Manager as well as test the server. This functionality is provided in a separate window, where the URL and port number to the REST server as well as the web socket can be defined. The server test window allows testing various commands and server requests, using a REST Http or WebSocket connectivity.

GPS location (see Figure 68c)

In this window, the functioning of the GPS sensor of the mobile device can be tested. A button on the top right allows visualizing the current location on Google maps. Additionally, the user can define 3 favourite locations (Fav 1 to 3) to experiment with the positioning and accuracy of GPS data in the AR environment. In these positions, COMPAIR 3D cubes are placed, floating 1m from the ground.

Data Manager transport protocol test (see Figure 67d)

Finally, a separate debug window for the testing of the OpenAPI protocol with the Data Manager based on a special COMPAIR definition file for DEVA (yaml file format) has been implemented. It allows sending dedicated REST calls (GET) to the Data Manager. It further provides response times for various kinds of server requests.

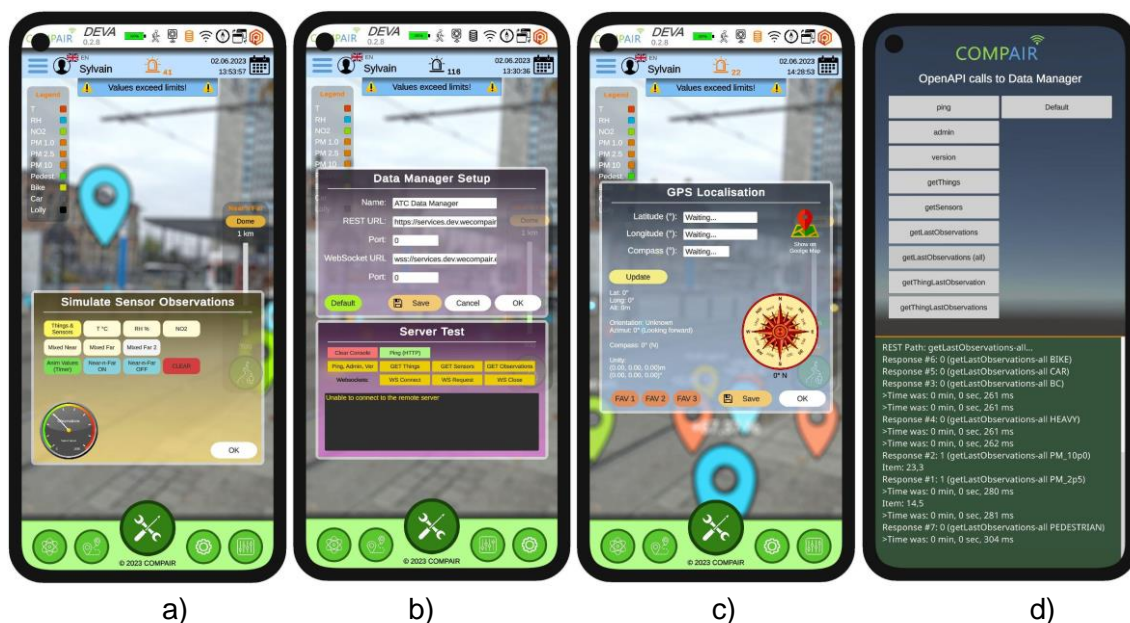


Figure 67: a) Simulation tool, b) datamanager and server test c) GPS test d) debug window

Implementation according to the list of epics for the open beta release

As presented in Table 4, a list of epics have been defined in order to further complement the development of **DEVA**. In this section, we present the realisation of the implementation for each of the defined and completed epics.



DEVAViz Visualise data in 3D Space

Story: As a citizen, I want to be able to tilt the angle to display data all around

The inertial sensor is used to detect the orientation of the mobile device. As soon as the user tilts the device towards horizontal direction, a new visualisation, the “Radar View”, is presented (see Figure 68). This visualisation offers the user a complete overview on all the available sensor data in the surrounding.

Figure 68: Radar view



DEVAAnn Annotate Measurements

Story: As a citizen, I want to measure the type of mode of transportation

Story: As a citizen, I can share information about my daily commuting

In the next period, it is planned to measure the exposed pollution during a trip. Therefore, the current position and time stamp are transferred to the Data Manager for further evaluation. In order to support this functionality from **DEVA** side, a special interface has already been implemented to allow the user to

- Select the mode of transportation
- Choose the purpose of the trip
- Start, stop and pause the acquisition of measurements

In Figure 69, the interface is presented.

Figure 69: GUI for transportation



DEVAMan Management

Story: As a researcher, I want sensitive data to be identified

Story: As a researcher, I can monitor whether a device is measuring effectively during the experiment by getting a signal when the device is on, but not measuring data

In order to provide the user with the necessary information about individual sensors in the surrounding, a dedicated interface and GUI has been implemented. In the window “Sensor Information” (Figure 70), the current measurements of a particular sensor can be retrieved. All the available data such as the type of the sensor, the unit, the current value and positional information are provided. A notification box in the bottom provides the state of the current sensor, the alarm state if some limits are exceeded and the state of calibration. Red and green colours of the symbols indicate the state. Sensible data are only shown for users with a “Researcher” or “Admin” role

Figure 70: Monitoring window for sensor data

To activate this window, the user has to select an observation from the AR space. Data near the user are more suitable for selection. The user can switch in the window between the following three tabs for Observations, Sensors and Things (Figure 70, top of the information window: **1 Observation 2 Sensor 3 Thing**) and get access to the metadata of the individual sensors and their devices from the metadata provided within the OGC SensorThingsAPI data model.

DEVAUI User Interface

Story: As a citizen, I want frequently used functions to be displayed on my toolbar

Due to the large number of functionalities in the app, the user might want to configure the app according to their preferences. Hence, a customizable toolbar is implemented to accommodate this functionality. In Figure 71a, the current set of functionalities is presented after opening the toolbox from which the user can select six functions (see Figure 71b).



To edit the toolbox, the user clicks the small edit button  changing to red . Now, the user can click the tools, where four of them are main functions and two are secondary level functions (for landscape mode). The selected functions are immediately presented in the toolbar at the bottom, saved in the user’s profile, and the user can then quickly access the functions. In the landscape mode, the second level buttons are also displayed (see Figure 71c).



Figure 71: a) Complete overview of tools, b) toolbar items settings interface, c) landscape mode

DEVAUI User Interface

Story: As a citizen, I want to switch the user interface to a different design and level of complexity

This epic refers to one of the major developments of DEVA. To the best of our knowledge, there are no AR apps available that allow visualisation of air pollution data. An overview of the current state of the art is presented in “D3.3 AR Design”. Hence, the challenge is to create and develop new ways for visualisation of various kinds of pollution data that allow the user to quickly capture the condition at the current position.

New different ways for visualisation of sensor data are available to offer different levels of complexity according to the user preferences. In Figure 72a, the “Display” view is presented that gives detailed information about various measurements in the surrounding area. A legend box on the top left, provides the colour codes used for the different panels. In the “Cloud” view (see Figure 72b), a much less complex visualisation is offered to the user. The measurements are displayed via clouds and the type of pollution is colour coded. This dust representation would be developed in the future to a cloud system, aggregating observations together in bigger clouds.

New status elements representing the state of a sensor can now be made visible directly on top of the data (see also “Sensor Information” window in the sub chapter DEVAMan Management). For this, the user has to have a “Researcher” or “Admin” role and to activate the checkbox “Show States” in the AR settings window. Figure 47c shows the intermediate type of visualisation “Pin” in the extended fashion. When a sensor is active but not sending data, the activity symbol will change to yellow and blink.

Finally, a separate interface, the “Data Equaliser” (see Figure 72d) allows to select

- the different types of pollution or environmental data by a given check box

- or choose the level of importance with a slider for each type of pollution or environmental data. The position of the slider determines the amount of the value to be displayed. The less important the value chosen, the larger the measurement must be to be displayed. If the Near-n-Far mode is active, the equaliser configures both areas automatically so that more important data is always best visible in the near region of the user.

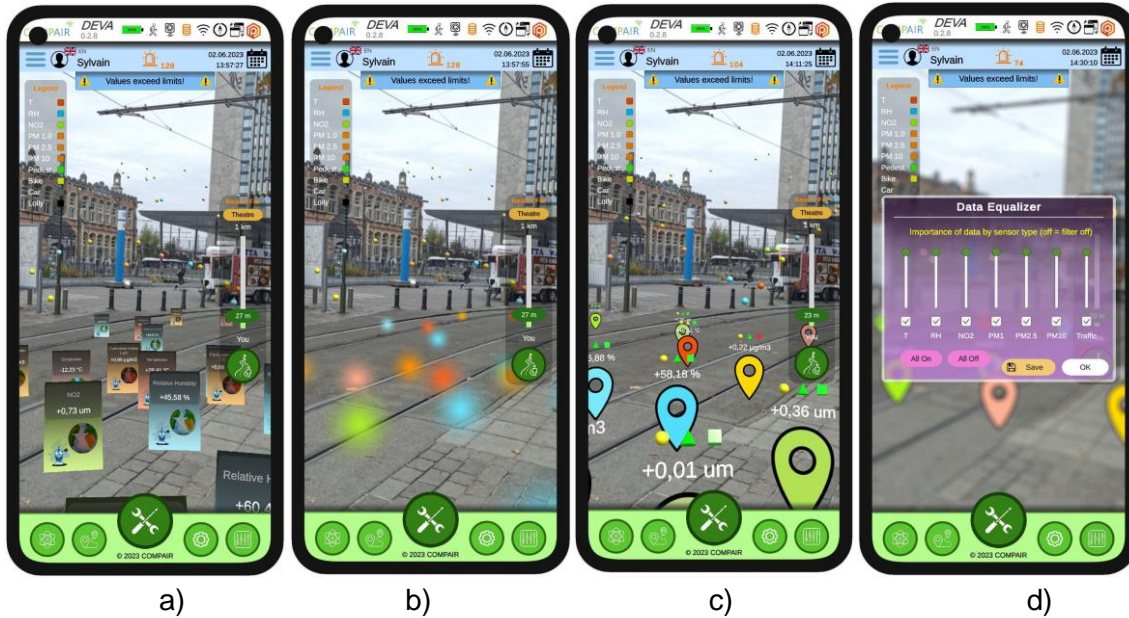


Figure 72: a) Panel view, b) cloud view, c) pin view, d) data equaliser

Depending on the presence of sensors and pollution measurements in the surrounding area, the augmentation should be adopted in order to determine the preferred number of measurements on the screen. Hence, a slider is implemented (see Figure 73a), which allows the user to select the radius in metres around the current position for measurements to be displayed using the Near-n-Far techniques already introduced in DEVA.

Beside the requested customisation of the UI, an additional functionality is implemented to offer a wider field of view by the so-called full screen mode (see Figure 73b). By selecting the full screen logo in the top bar, the UI switches to the full screen mode and the top bar and toolbar is set invisible.

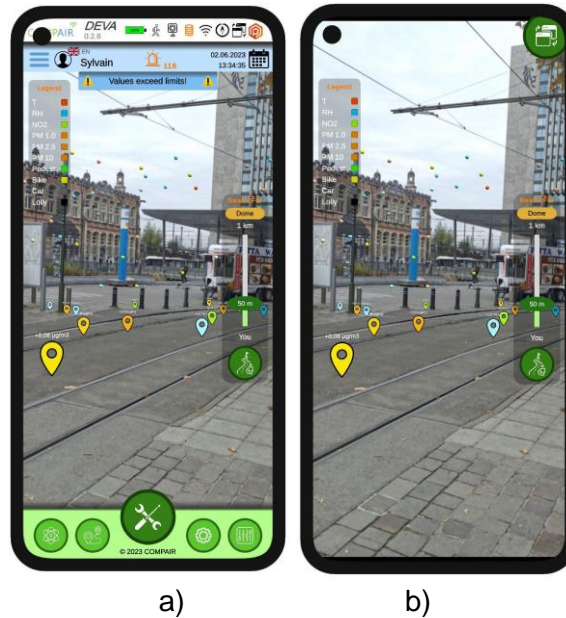


Figure 73: a) Slider to customise the observed area, b) full screen mode



DEVARea Real-time communication and information visualisation

Story: As a citizen, I want to be connected to **COMPAIR**'s database

As already mentioned in the context of debug tools, it is possible to define the connection and test the communication with the Data Manager, which serves the **COMPAIR** database.

At the time of writing the deliverable (June 2023), the access to **COMPAIR**'s database via the data manager is working. Various kinds of measurements can now be retrieved from the data manager via a dedicated OpenAPI interface. In the next period, the API will be further complemented by implementing dedicated server requests to fulfil the needs of **DEVA**.

Figure 74: Interface to connect and test the communication with the Data Manager

One important aspect is to reduce the data transfer between the mobile device and the Data Manager. Users may have a limited amount of data budget and therefore would not be willing to use an application that consumes much of their available budget. Hence, only the relevant measurements at the current position in the surrounding area of the user should be displayed. Depending on the positional change of the user, only novel measurements should be transferred to the mobile device. In order to implement smart data management, further algorithm development on client and server side is necessary.



DEVAGam Gamification

Story: As a parent, I want the app to display information to raise consciousness about air pollution, especially for children

In order to fulfil this user requirement, a set of information windows are implemented to give more detailed information about various aspects and the vision of **COMPAIR**, the goals as well as detailed information on environmental facts.

Figure 75: Information windows to provide additional information

The window can be accessed directly via the Hamburger menu “Notification” item, or will be shown automatically if some air pollution values exceed their ranges. The function can be deactivated in the GUI Settings window (checkbox “Show Notifications”).

Remark: The specific content will be further developed in the next period.

AiL&f Look and Feel

Story: As a visitor, I can switch the language of **DEVA** to my language

In order to support accessibility and usability of **DEVA**, support of different languages is key. A flexible and modular scheme has been developed to support different languages for all kinds of text elements in the UI. This relates to menu items, text boxes, text of buttons, warnings and many more. The DEVA offers five different languages, which are English (EN), German (DE), Greek (GR), Bulgarian (BG) and Dutch (DU). The selection of languages is caused by the involved pilot partners, which are Berlin, Flanders, Athens and Sofia and Plovdiv. The language can be set up in the “User Profile” window (see Figure 76). A “Reset” button allows the user to switch back to english i.a. if something goes wrong.



Figure 76: Language selection

In Figure 77, an example for the “About”-info box in all five languages is presented.

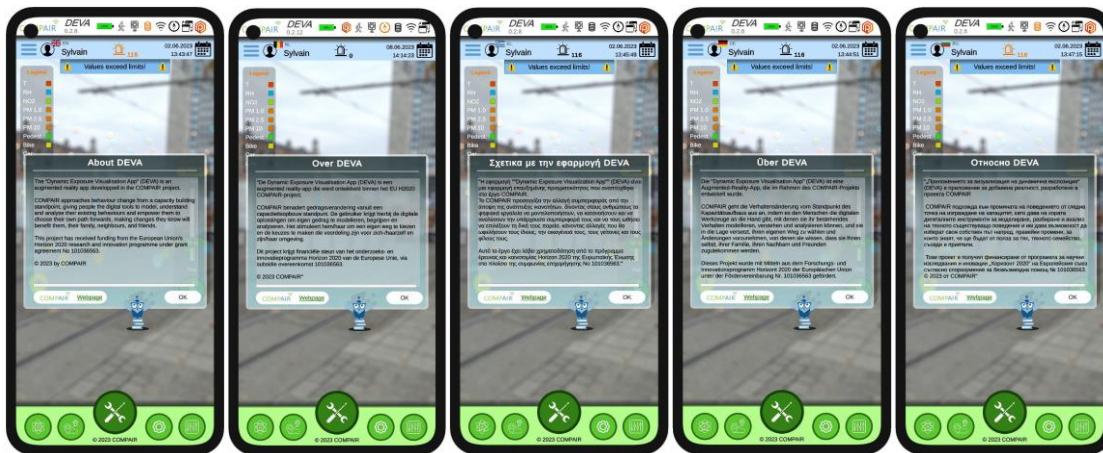


Figure 77: Multi-language example of the “About”-info box for EN, DU, GR, DE and BU

In Figure 78, an example for the Hamburger menu is presented.



Figure 78: Multi-language example of the Hamburger menu for EN and GR

6. Conclusion

This document describes the open beta release of the **COMPAIR** prototypes: the Policy Monitoring Dashboard (PMD), the CO2 footprint dashboard and the Dynamic Exposure Visualisation Application (DEVA). This report represents the second working version of the prototype, offering a set of functionalities supporting the epics defined by the Pilots. The current developments will be used as a testbed for the **COMPAIR** stakeholders to improve the **COMPAIR** prototype and its functionalities and assess the concepts and knowledge conveyed by the project.

The implementation and integration is not limited to the current level. Most **COMPAIR** modules, as well as the platform itself are designed to be flexible and easily customisable. The overall architecture of the system facilitates modifications and makes platform improvements easy to implement, at any point. The next development cycle will concentrate on enhancing platform capabilities, improving stability, improving sophistication and efficiency for target end users by plugging additional functionalities and calibrating existing ones.

The next versions of the prototypes will be enriched with more functionalities to support the **COMPAIR** pilots so that the planned evaluation iteration will be performed in the next period. The results of this evaluation cycle, along with the already scheduled work in this and the other technical WPs, will lead to another prototype release of the prototypes by M30 (March 2024).

7. References

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- [7] COMPAIR Consortium, “D5.2: Closed Resting Report_v1”, October 2022