



## DELIVERABLE

# D4.2 Digital Twin CS data integration and prototype 1

Project Acronym:	<b>COMPAIR</b>	
Project title:	Community Observation Measurement & Participation in AIR Science	
Grant Agreement No.	101036563	
Website:	<a href="http://www.wecompair.eu">www.wecompair.eu</a>	
Version:	1.0	
Date:	31 October 2022	
Responsible Partner:	ATC	
Contributing Partners:	HHI, UAEG	
Reviewers:	All technical partners External: Gitte Kragh, Andrew Stott, Karel Jedlicka, Joep Crompvoets	
Dissemination Level:	Public	X
	Confidential, only for members of the consortium (including the Commission Services)	

## Revision History

Version	Date	Author	Organisation	Description
0.1	28.06.2022	Athanasios Dalianis, Marina Klitsi	ATC	Draft ToC
0.2	10.10.2022	Marina Klitsi Haris Argyropoulos	ATC	Input in Section 1 and Section2
0.3	17.10.2022	Sylvain Renault Oliver Schreer	HHI	Input in Section 5
0.4	17.10.2022	Christos Karelis	UAEG	Input in Section 4
0.5	19.10.2022	Marina Klitsi Athanasios Dalianis	ATC	Input in Section 2 Final edits
0.6	20.10.2022	Marina Klitsi Athanasios Dalianis Sylvain Renault Christos Karelis	ATC  HHI UAEG	Ready for internal review
0.7	20.10.2022 - 26.10.2022	Gitte Kragh, Andrew Stott, Karel Jedlicka, Joep Crompvoets  All technical partners	External experts  IMEC, TELR, SODA, DV	Internal review
0.8	27.10.2022	Marina Klitsi Chris Karelis Sylvain Renault	ATC UAEG HHI	Final edits taking into account reviewers comments
1.0	31.10.2022	Marina Klitsi	ATC	Final version

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## List of Abbreviations

Abbreviation	Definition
CS	Citizen Science
CSV	Comma Separated Values
CO2	Carbon Footprint Simulation Dashboard
DEVA	Dynamic Exposure Visualisation App
Fig	Figure
MS	Milestone
PMD	Policy Monitoring Dashboard
PO	Product Owner
UI	User Interface
URL	Uniform Resource Locator
WP	Work Package

# Executive Summary

This document describes the closed alpha release of the **COMPAIR** prototype. This is a first working version of the prototype that offers an initial set of the expected functionalities, and acts as the test-bed for the **COMPAIR** stakeholders to experience with this initial set of **COMPAIR** provisions and assess the concepts and knowledge conveyed by the project.

The deliverable provides an overview of the current functionalities in the form of a user guide, exposing every available feature so far. The scope of this document is to act as an appendix to the current version of the **COMPAIR** alpha release.

# 1. Introduction

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

The WP4 (Development and Technical Integration) aims at providing the implementation aspects for the delivery of the **COMPAIR** prototype. The design of the **COMPAIR** prototype is driven from the user requirements definition and the technical specifications as delivered by WP2 (Stakeholder Engagement and Framework Design) and WP4 (Development and Technical Integration, respectively).

Following the implementation of the individual tools in WP3 (Sensor Development and Technical Innovation), this WP delivers the closed alpha 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 principles<sup>1</sup> we are following, we focus our work during the first year of the project on the implementation of the initial 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 second year of the project. The result of this process, as well as any updates of the **COMPAIR** tools, will be part of the D4.3: Digital Twin CS data integration and prototype 2/M20.

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 first 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** alpha 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 second release of the **COMPAIR** prototype.

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<sup>1</sup> [https://en.wikipedia.org/wiki/Agile\\_software\\_development](https://en.wikipedia.org/wiki/Agile_software_development)

## 2. Development of the COMPAIR alpha release

The **COMPAIR** closed alpha 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 Prioritised Stories became available in **COMPAIR** Jira from the POs.
- The technical **COMPAIR** team organised 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 organised 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 closed alpha release as refined and given in the technical team is presented in table 1.

**Table 1:List of epics identified and used for closed alpha release**

ID	EPICS
Allnf01	As a citizen, I want to use fast and efficient dashboards, so I can analyse situations well
AllExp	As a citizen, I want to be able to export the data from the dashboards in a number of formats, so I can share and work on the data outside the <b>COMPAIR</b> tools
AllL&f	As a citizen, I want to use pleasing, clear, consistent dashboards, so I can analyse situations well
AllDis	As a citizen, I can access information about air quality, best practices, ... from the <b>COMPAIR</b> tools and dashboards
AllUMa	As a citizen, I can login to the tools, so my settings and personal info is used
PMDCom	As a citizen, I want to compare the output from different projects using the policy monitoring dashboard against each other
PMDAir	As a citizen, I want to see real time and historical information about air pollution, so I can assess the impact of policy decisions
PMDCon	As a citizen, I want to see context data like weather, roadworks, so I can take this context into account when assessing the impact of policy decisions
PMDMap	As a citizen, I can use a map interface to see the location of sensors so I have an understanding where measurements are done
PMDTra	As a citizen, i want to see realtime and historical information about traffic, So I can assess the impact of policy decisions
PMDGam	As a Pilot admin, I can trigger behaviour using the dashboard by using gamification

ID	EPICS
	techniques, so I can increase take up of the dashboard
PMDMan	As a Pilot admin, I can manage dashboards during the lifecycle of projects so people can use the dashboards to assess impact of policy decisions
PMDUI	As a citizen, I get a user friendly, pleasing, intuitive UI, so I know how to use the dashboard and I'm motivated to use it
Co2Cal	As a citizen, I want to know the current and historic contribution of my different activities to my Carbon Footprint, so I can maximise the impact of changes to my behaviour
Co2RRe	As a citizen, I want to get a list of recommendations on how to reduce my contribution to CO2 emissions
Co2Man	As an admin, I want to manage the dashboards I am responsible for, so I can help my users be efficient
Co2Sce	As a citizen, I want to be able to create scenarios of citizen and government actions that show me how emissions can be reduced to a certain target
DEVARea	As a citizen, I want to get realtime information about trips so I can assess the exposure
DEVAUI	As a citizen, I want to use pleasing, clear, consistent dynamic exposure visualisation app, so I can analyse situations well

The components comprising the closed alpha release of the **COMPAIR** prototype are the following:

- Policy Monitoring Dashboard (PMD)
- Carbon Footprint Simulation Dashboard (CO2)
- Dynamic Exposure Visualisation App (DEVA)

Detailed descriptions of the **COMPAIR** components in terms of functionality and technology are provided in separate deliverables such as D3.3: AR design, and D3.4: Dashboards Design. The alpha release was developed based on the architecture design presented in D4.1: Solution architecture report.

Screenshots of the main pages of the alpha 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 Home page of the **COMPAIR** Prototype.

Via the landing page (Figure 1), the user is able to access information about the **COMPAIR** offerings. General information about the offerings as well as access to the dashboards is provided. It has to be noted that the tools act as standalone components as well.

COMPAIR

Admin Admin  
Admin

GENERAL

- Home
- Dashboards

MANAGEMENT

- Users

Welcome, Admin Admin!  
Use COMPAIR tools and take action today

## Together we can achieve clean air for all

Join COMPAIR and participate in measuring and reviewing air quality against other city data sources.

[Learn more](#)

### What We Offer

- Easy to understand Interactive Dashboards** - A cool new way to visualise and explore potential (urban) solutions quickly and effectively
- Dynamic Exposure Visualisation Application** - A better understanding of the local issues in order to be more collaborative and creative in coming up with solutions



### Try COMPAIR Tools

Making Data More Accessible, click through our offerings and try them for free.

- Policy Monitoring**  
Understand and compare how environmental situations change under different actions
- Carbon Footprint**  
See how you can affect your carbon footprint through your daily activities and learn how you can reduce your carbon footprint.
- DEV Application**  
Explore your surroundings via your smartphone or tablet camera, so you can see a visual overlay of environmental information



### Lets Be More Aware of Individual Actions and Behaviours

- Use our dashboards and learn what needs to be done at a personal, local and city-wide level to improve air quality
- Explore results via an easy app and generate ideas for change
- Raise awareness about local issues in your community and take part in our experiments

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036563. This website represents the views of the COMPAIR project only. Read our [Terms & Conditions](#).

Figure 1: The COMPAIR Landing Page

### 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 closed alpha release

The following table presents the list of epics implemented for the closed alpha release.

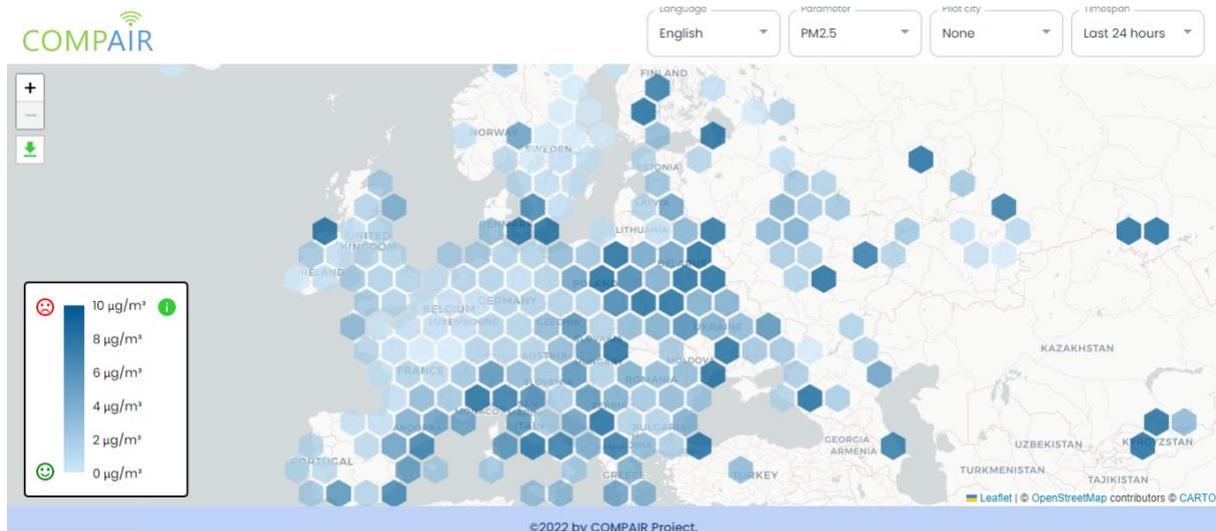
**Table 2: List of epics implemented for the closed alpha release of the PMD**

ID	EPICS
<b>PMDAir</b>	<b>Air quality in PMD</b>
	Story: As a citizen, I see the air pollution reflected in the colour of the hexagon
	Story: As a citizen, I can see a graph of the different groups of air quality sensors
	Story: As a citizen, the graphs for the groups represent all cells and not just the cell selected
	Story: As a citizen, I can assign air quality sensors to a group so I can show graphs for a group of air quality sensors
<b>PMDMap</b>	<b>Map in PMD</b>
	Story: As a citizen, I can zoom in and out on the map
	Story: As a citizen, I can pan on the map, so I can inspect other locations
	Story: As a citizen, I see a map in the dashboard that allows me to orient where things are
	Story: As a citizen, I see a grayscale map, so the hexagons are better visible
<b>PMDTra</b>	<b>Traffic in PMD</b>
	Story: As a citizen, I see the density of traffic reflected in the color of the hexagon
	Story: As a citizen, I see a map with hexagons showing the locations of traffic sensors
<b>PMDUI</b>	<b>User Interface</b>
	Story: As a citizen, I can switch to the pilot locations, so I can quickly analyse the area of the pilot

#### User Guide

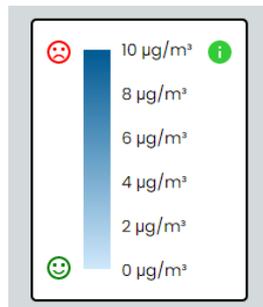
The following section presents a User Guide for the first release (Alpha release) of the Policy Monitoring Dashboard. The **COMPAIR** consortium has acquired the following url for accessing the dashboard: <https://pmd.wecompair.eu/>.

Screenshots of the main views of the PMD are presented in the following sub-sections, which describe the PMD’s main functionalities. By opening a web browser and entering PMD’s url, the user gets into the Home page (Figure 2). This is the browse mode of the Policy Monitoring Dashboard.



**Figure 2: Home page (map)**

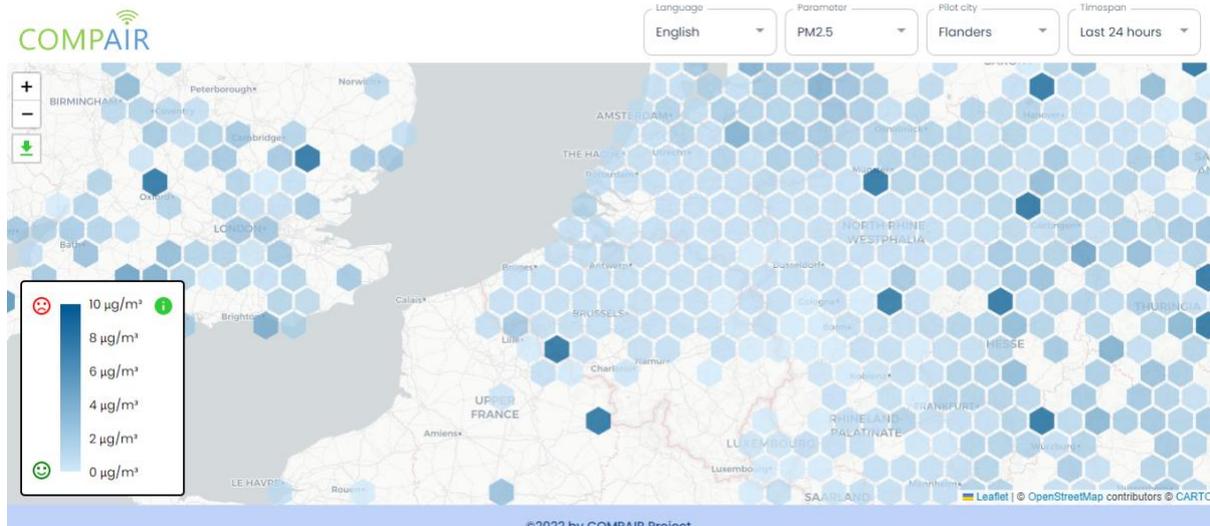
On the Home page (figure 2), the user can view air and traffic sensor data<sup>2</sup> based on a specific parameter. The locations of the sensors are grouped and visualized as hexagons placed as an overlay on top of a map. The fill colour of an individual hexagon represents the median value of all the sensors that are included in this hexagon and is based on a gradient scale of the active parameter layer (figure 3).



**Figure 3: Hexagon value gradient scale for air quality**

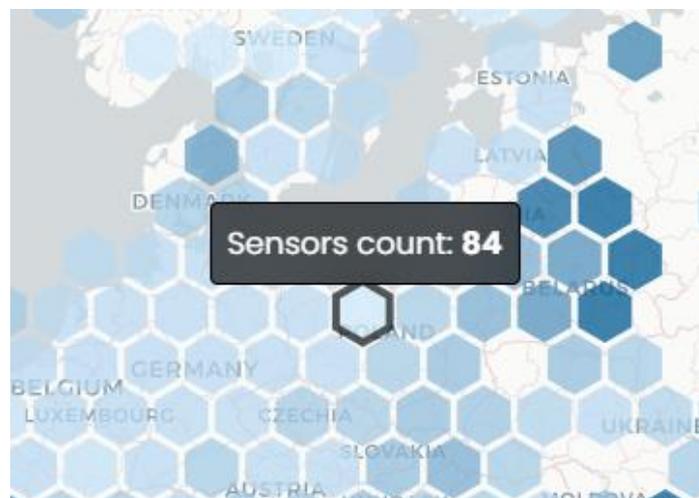
The user can interact with the map by zooming in and out, by using the plus '+' and minus '-' icon respectively (placed on the top left corner of the map), by using the mouse wheel or by 'pinching' the screen on tablets/mobiles. While zooming in, the initial hexagons are broken down into smaller hexagons that include fewer sensors than the previous zoom level (as shown in figure 4).

<sup>2</sup> The current version visualises data received from sensors.community.



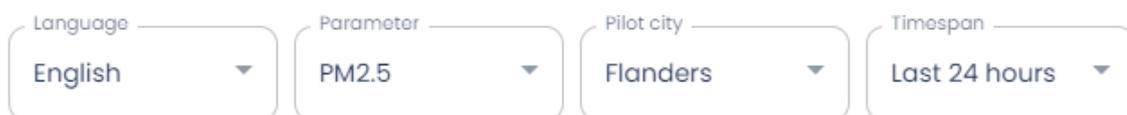
**Figure 4: Zoomed-in map with a more granular view**

When the user hovers over a hexagon, information on the amount of sensors that are present in this specific hexagon is displayed (figure 5).



**Figure 5: Hexagon sensors count**

At the top of the screen, the user can find a list of dropdown options. A selection of the language<sup>3</sup>, the parameter, the location and a timespan<sup>4</sup> is available. Additionally, the user is allowed to download the PMD hexagon data for the selected parameter in a Comma-Separated Values (CSV) format by clicking the download button



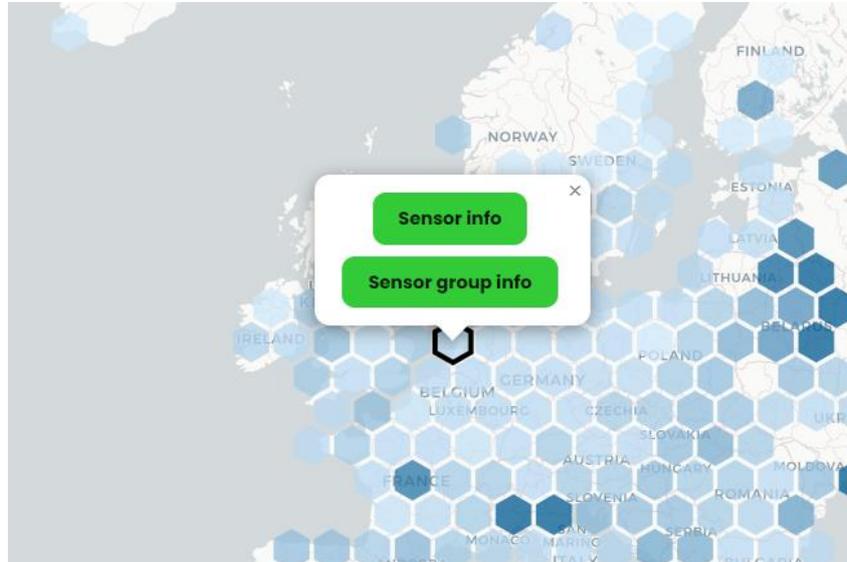
**Figure 6: Map header/dropdown options for users**

<sup>3</sup> The current version is only available in English. The plan is to add the Pilots language - this option will be part of the next release.

<sup>4</sup> The timespan will be available in the next release.

## Sensor info

To view more information about the individual sensors that are present in a hexagon, the user can click on a hexagon, where a popup context menu will appear (figure 7).



**Figure 7: Hexagon popup/context menu**

After selecting 'Sensor info' from the popup, a sensor menu modal appears on the screen (figure 8). On the left side of this panel, the user can see a list of all the sensors that are included in this hexagon. For each sensor the user can see its 'id' (identifier), current value of the sensor, as well as the group which it is assigned to (if any). Upon clicking a sensor from the list, on the right side of the panel a graph will appear displaying the fluctuation of the parameter value for this sensor in a selected period of time e.g. last 24 hours (figure 8).

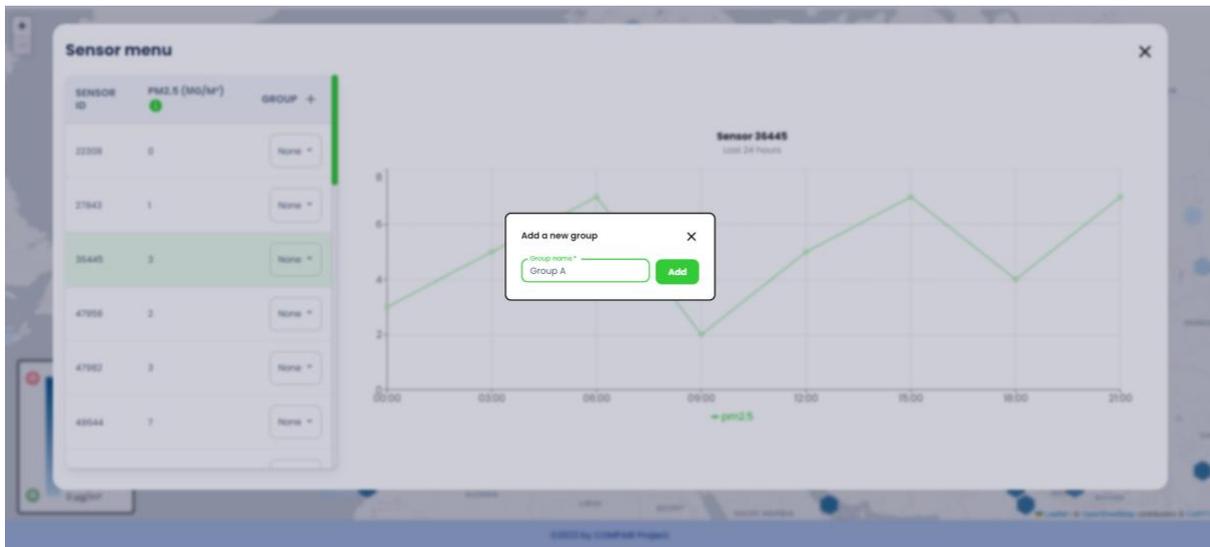


**Figure 8: Sensor info menu**

## Sensor groups

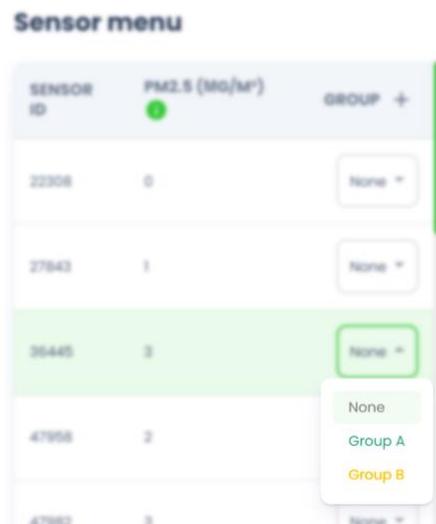
Each sensor can be assigned to user-defined groups for the user to visually distinguish those sensors on the map and to compare sensor data from different groups (this functionality will be thoroughly explained later on).

To create a new group, the user should click on the plus (+) icon next to the `Group` column on the sensor list table. After that, a new modal appears where the user can define a unique name for this new group (figure 9). Note here that each newly created group will be assigned a predefined colour (green, yellow) and maximum two groups per parameter layer can be created.



**Figure 9: Create new sensor group**

After creating a new group, the user can assign a sensor to a group from the dropdown list that appears by clicking the dropdown on the Group column of a sensor (figure 10).



**Figure 10: Select sensor group**

By closing the menu and navigating back to the map view, the user may now see different colours on the outside border (stroke) of certain hexagons (figure 11).

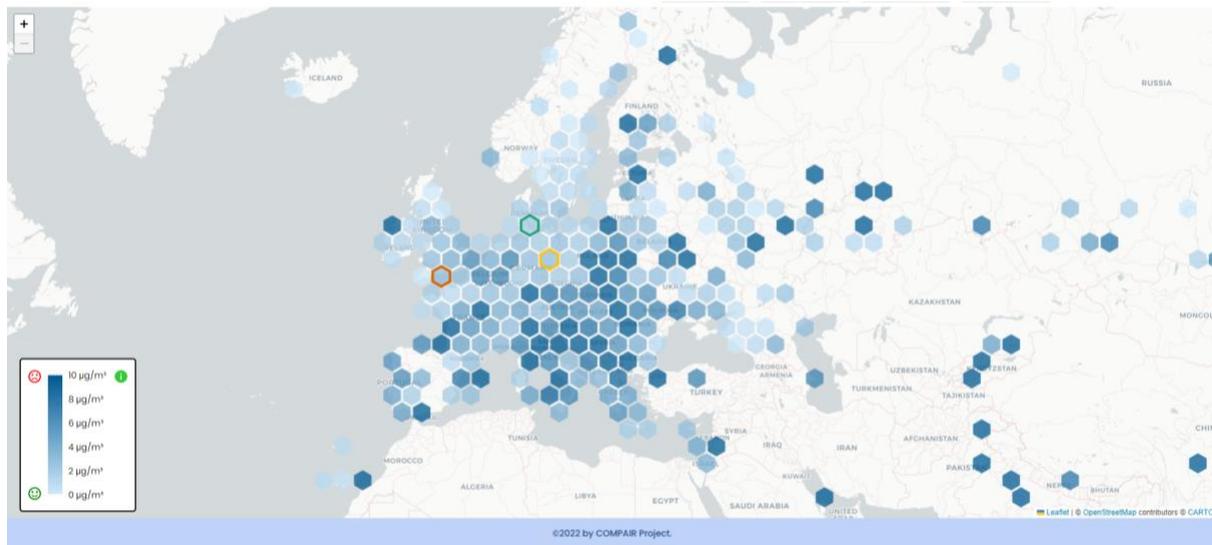


Figure 11: Hexagons with sensor groups

When a hexagon encapsulates sensors that have been assigned to a **single** (same) group, the hexagon stroke colour will be the colour of the group.

When a hexagon encapsulates sensors that have been assigned to **multiple** (different) groups, the hexagon stroke colour will be a specific orange colour.

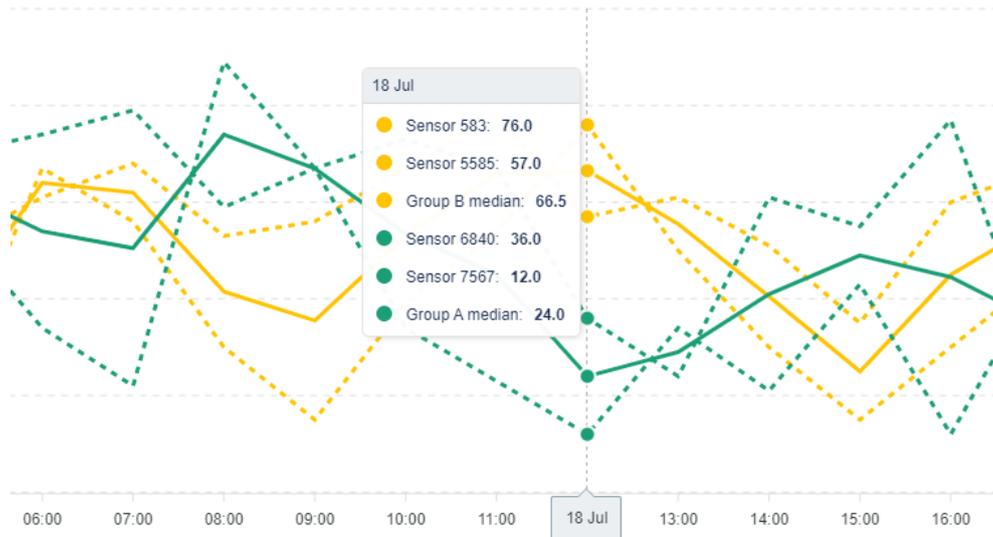
### Sensor group info

For the hexagons that have a stroke colour and therefore have sensors in them that are assigned to at least one group, the user can view additional group graphs. To display these graphs, click on a hexagon that has a stroke colour and select 'Sensor group info' from the context popup menu that has been introduced previously as well (figure 7). A graph as the one in figure 12 will now appear.



Figure 12: Sensor group graph

In this graph, the user can see different lines for all sensors that are assigned in a group and additionally a line for the median of each group. The individual sensors are displayed as dashed lines while the median values for the groups are displayed as a solid line. The colour of each line represents the colour of the group that each sensor is assigned to. While hovering over the graph, a tooltip appears for this specific timestamp showing information about the values of each line (sensor/median) (figure 13).



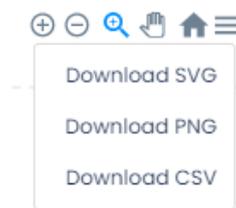
**Figure 13: Sensor group graph tooltip**

At the top of the chart, the user can also find an option to select and deselect specific lines to display them or not on the graph respectively (figure 14).



**Figure 14: Sensor group graph legend**

Additionally, the user can find various options at the top right corner of the graph, such as the option to export and download the data displayed on the graph (figure 15).



**Figure 15: Graph options**

## 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 closed alpha release

The following table presents the list of epics implemented for the closed alpha release.

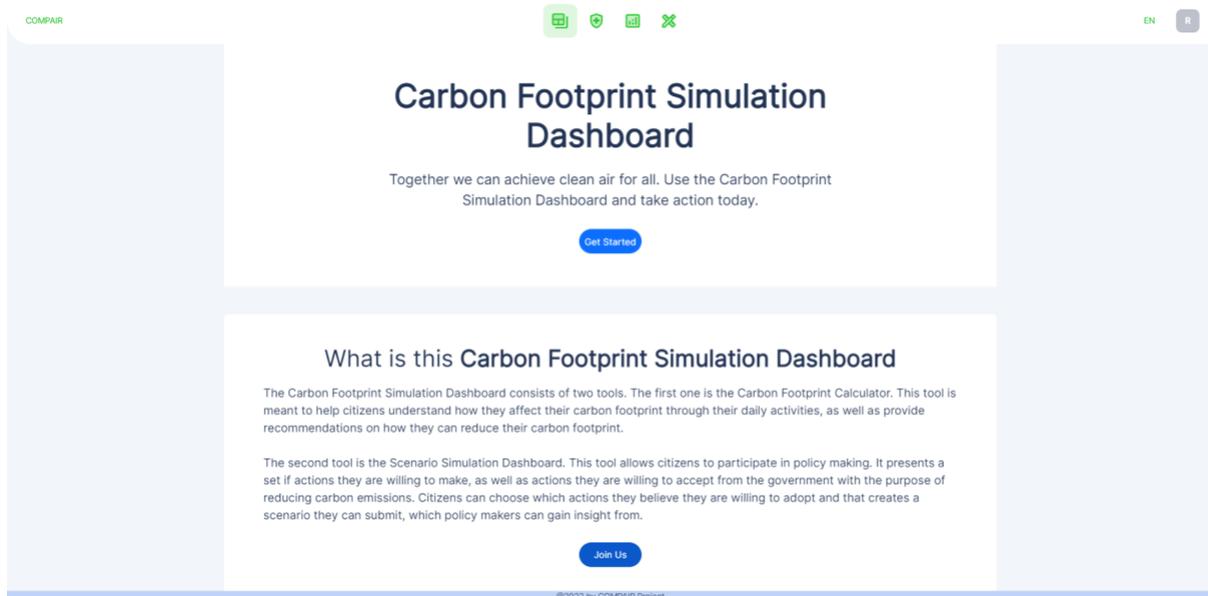
**Table 3: List of epics implemented for the closed alpha release of the Carbon Footprint Simulation Dashboard**

ID	EPICS
<b>CO2Cal</b>	<b>Carbon Footprint Calculator</b>
	Story: As a citizen, I can compare my carbon footprint with averages at European, national and local levels, so I can have an incentive to try adopting greener habits
	Story: As a citizen, I can see the impact of each carbon footprint domain on my total carbon footprint, so I can have a better understanding of how my daily routine affects my carbon footprint
<b>CO2RRe</b>	<b>Carbon Footprint Reduction Recommendations</b>
	Story: As a citizen, I can have a list of recommendations on how I can reduce my carbon footprint, so I can change my habits and see which I can adopt
<b>CO2Man</b>	<b>Dashboard Management</b>
	Story: As an administrator, I can add example scenarios on the Scenario Simulation, so users understand how different scenarios affect emission reduction
	Story: As an administrator, I can add recommendations to the Carbon Footprint Reduction Recommendation system, so users can receive recommendations based on their carbon footprint
<b>CO2Sce</b>	<b>Scenario Simulation</b>
	Story: As a citizen, I want to create scenarios that present how emissions can be reduced, so my suggestions can be taken into consideration by city officials
	Story: As a citizen, I can choose from both actions I can make and actions I am willing to accept from officials so that the scenarios I present are more detailed

## User Guide

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

By entering the URL for the Carbon Footprint Simulation Dashboard, the user is led to the home page of the Dashboard (figure 16). It contains information regarding the **COMPAIR** project, as well as information about the Dashboard itself.



**Figure 16: Carbon Footprint Simulation Dashboard home page**

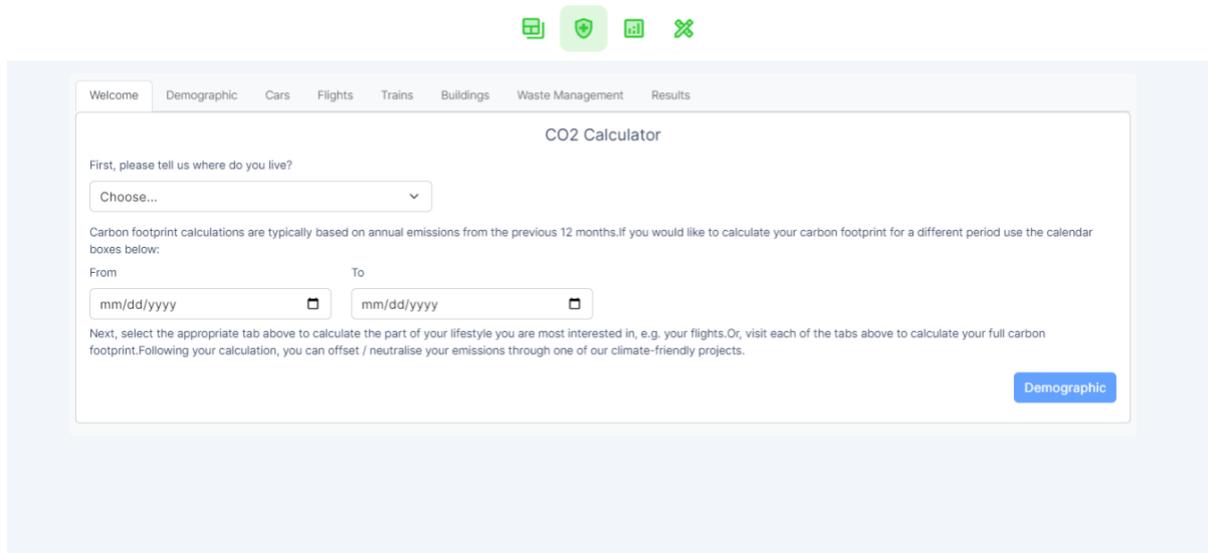
At the top of the page, a menu is available which is how the user can navigate through the various pages of the Dashboard (Figure 17). The first option on the menu leads to the home page. The second option leads to the Carbon Footprint Calculator, which is the first tool available on the Dashboard. The third option leads to the Scenario Simulation, which is the second available tool on the Dashboard. Finally, the fourth option leads to a page with features that will be available to administrators of the Dashboard.



**Figure 17: Navigation menu of the Dashboard**

## Carbon Footprint Calculator

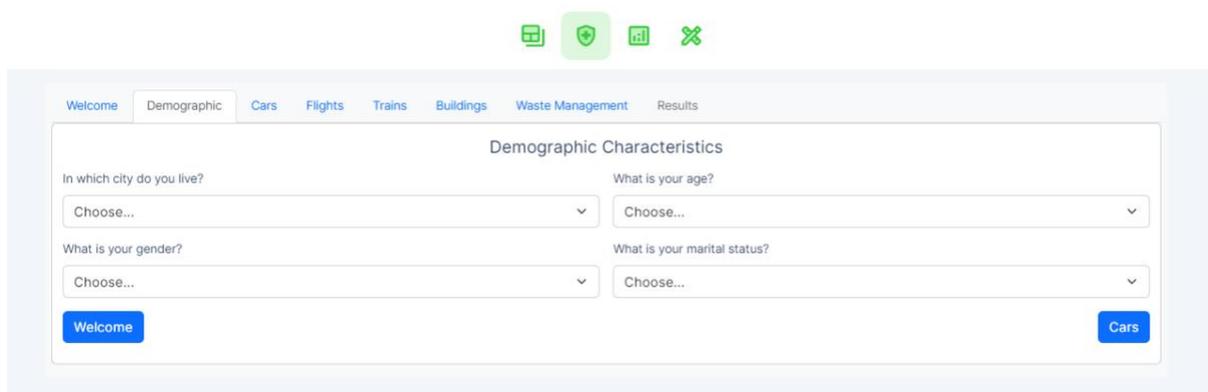
Choosing the second option on the navigation menu, the user is led to the Carbon Footprint Calculator, which allows the user to calculate their carbon footprint (Figure 18). This page consists of various tabs, each with different questions the user has to answer. Currently, there are eight tabs and from left to right they are named: Welcome, Demographic, Cars, Flights, Trains, Buildings, Waste Management, and Results. The names and contents of the tabs can change, since this is still an Alpha Version of the Dashboard and feedback will be received from users.



**Figure 18: 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. This is required so that the user is presented with data relevant to them at the Results tab. The Results tab will become accessible once the questions on the rest of the tabs have been answered. 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.

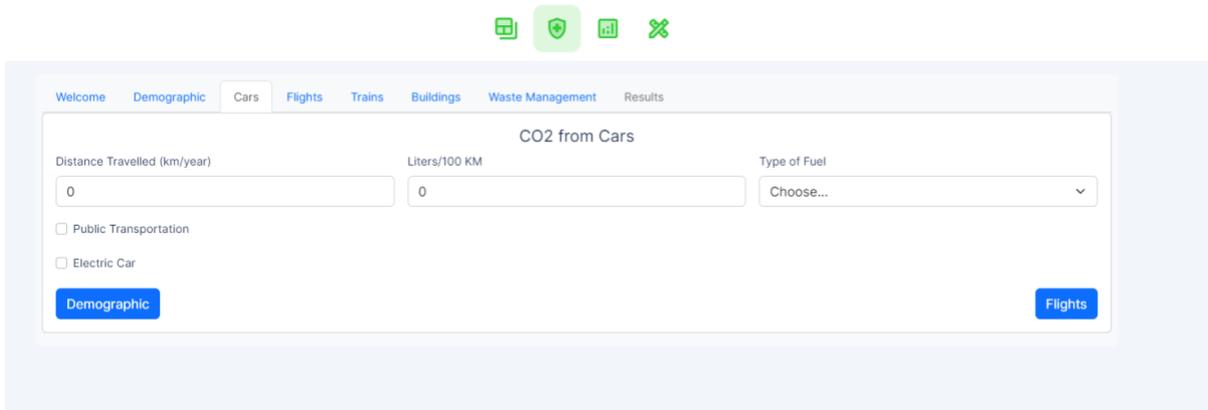
The second tab, Demographic (Figure 19), contains questions about the user that are not related to their carbon footprint. They are not mandatory, but they can help with the calculation of the carbon footprint, as well as the presentation of the results. In a future version of the Dashboard, there will be notes on which questions are mandatory, as well as explanations that will help users answer them.



**Figure 19: Carbon Footprint Calculator - Demographic tab**

On the Cars tab (Figure 20), the user fills in information regarding the usage of their car. 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, as well as the type of fuel the car 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.

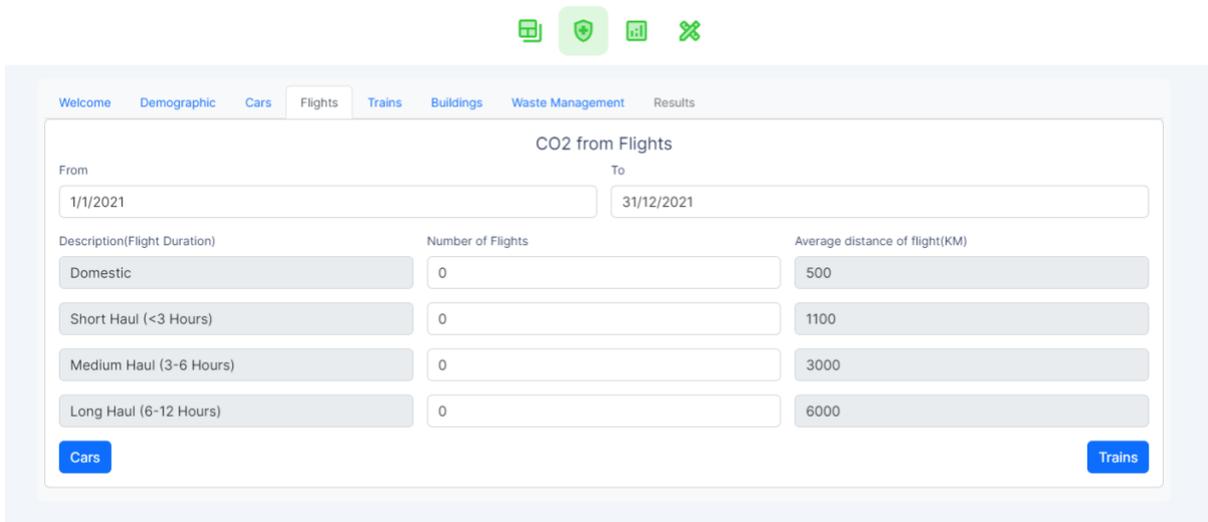


The screenshot shows the 'Cars' tab of the Carbon Footprint Calculator. At the top, there are navigation icons and a menu bar with 'Welcome', 'Demographic', 'Cars', 'Flights', 'Trains', 'Buildings', 'Waste Management', and 'Results'. The main content area is titled 'CO2 from Cars' and contains the following fields:

- 'Distance Travelled (km/year)' with a text input field containing '0'.
- 'Liters/100 KM' with a text input field containing '0'.
- 'Type of Fuel' with a dropdown menu showing 'Choose...'.
- Two checkboxes: 'Public Transportation' and 'Electric Car', both of which are currently unchecked.
- Two blue buttons: 'Demographic' on the left and 'Flights' on the right.

**Figure 20: Carbon Footprint Calculator - Cars tab**

The next tab is the Flights tab (Figure 21), 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.



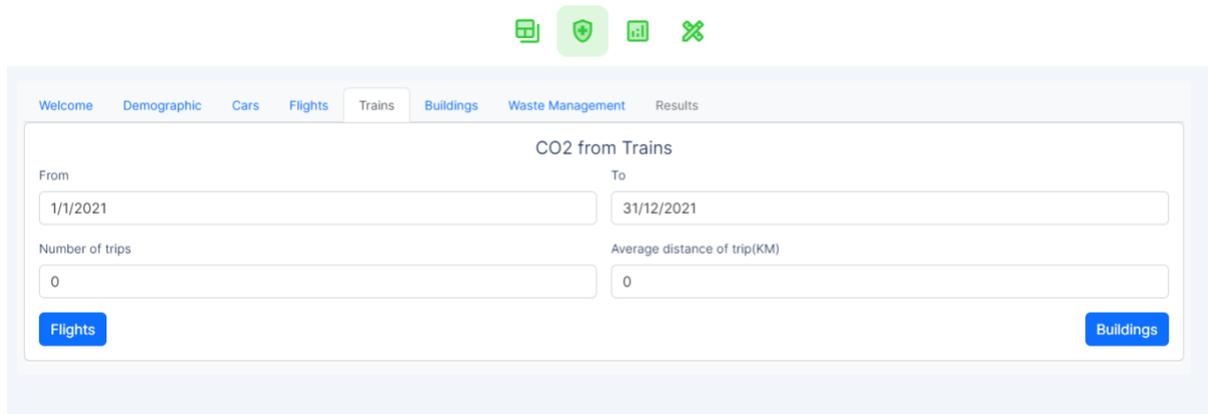
The screenshot shows the 'Flights' tab of the Carbon Footprint Calculator. At the top, there are navigation icons and a menu bar with 'Welcome', 'Demographic', 'Cars', 'Flights', 'Trains', 'Buildings', 'Waste Management', and 'Results'. The main content area is titled 'CO2 from Flights' and contains the following fields:

- 'From' and 'To' date pickers with values '1/1/2021' and '31/12/2021' respectively.
- A table with four rows representing different flight types. Each row has a 'Description (Flight Duration)', a 'Number of Flights' input field, and an 'Average distance of flight (KM)' value.
- Two blue buttons: 'Cars' on the left and 'Trains' on the right.

Description (Flight Duration)	Number of Flights	Average distance of flight (KM)
Domestic	0	500
Short Haul (<3 Hours)	0	1100
Medium Haul (3-6 Hours)	0	3000
Long Haul (6-12 Hours)	0	6000

**Figure 21: Carbon Footprint Calculator - Flights tab**

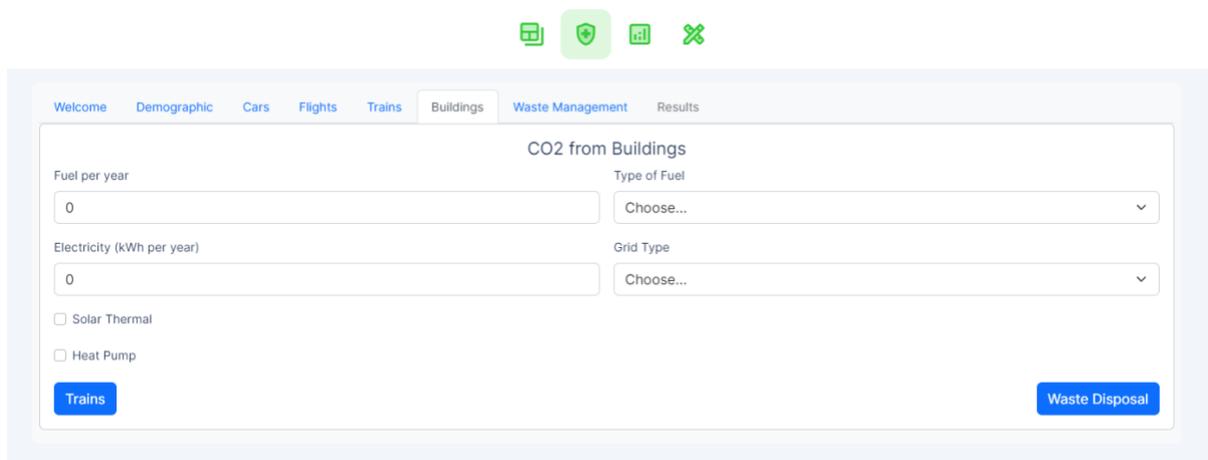
The next tab is the Trains tab (Figure 22). The user can fill in information regarding the use of trains. What the user needs to provide is the number of trips they have had and the average distance of the trips. The time period is pre-filled with the one provided in the Welcome tab.



The screenshot shows the 'Trains' tab of the Carbon Footprint Calculator. At the top, there are navigation icons and a menu bar with tabs: Welcome, Demographic, Cars, Flights, Trains (selected), Buildings, Waste Management, and Results. The main content area is titled 'CO2 from Trains'. It contains four input fields: 'From' (1/1/2021), 'To' (31/12/2021), 'Number of trips' (0), and 'Average distance of trip(KM)' (0). At the bottom, there are two buttons: 'Flights' on the left and 'Buildings' on the right.

**Figure 22: Carbon Footprint Calculator - Trains tab**

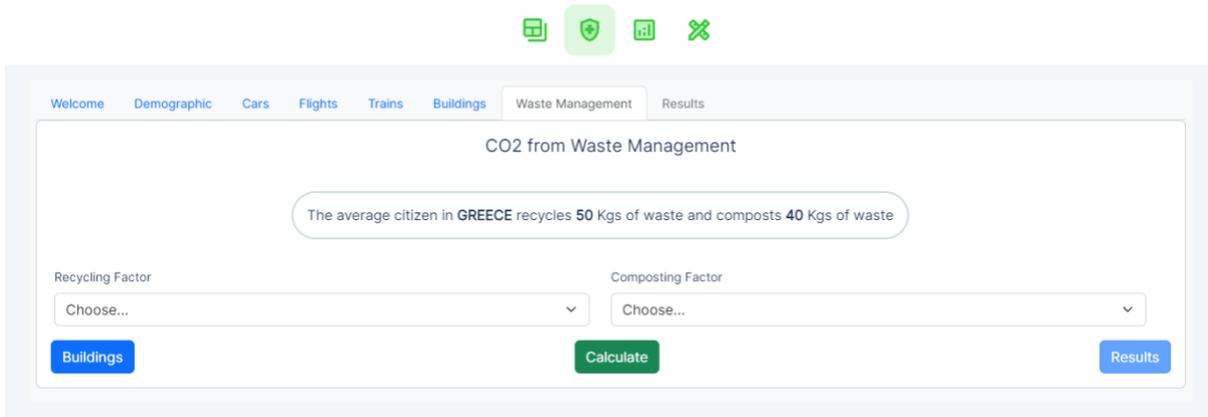
The Buildings tab (Figure 23) is next, and the user has to fill in information regarding the use of energy in their home. The user has to provide the amount and type of fuel they have used, the amount of electricity they have used, and which grid type their house belongs to. Moreover, there are two checkboxes 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.



The screenshot shows the 'Buildings' tab of the Carbon Footprint Calculator. At the top, there are navigation icons and a menu bar with tabs: Welcome, Demographic, Cars, Flights, Trains, Buildings (selected), Waste Management, and Results. The main content area is titled 'CO2 from Buildings'. It contains four input fields: 'Fuel per year' (0), 'Type of Fuel' (Choose...), 'Electricity (kWh per year)' (0), and 'Grid Type' (Choose...). Below these are two checkboxes: 'Solar Thermal' and 'Heat Pump', both of which are unchecked. At the bottom, there are two buttons: 'Trains' on the left and 'Waste Disposal' on the right.

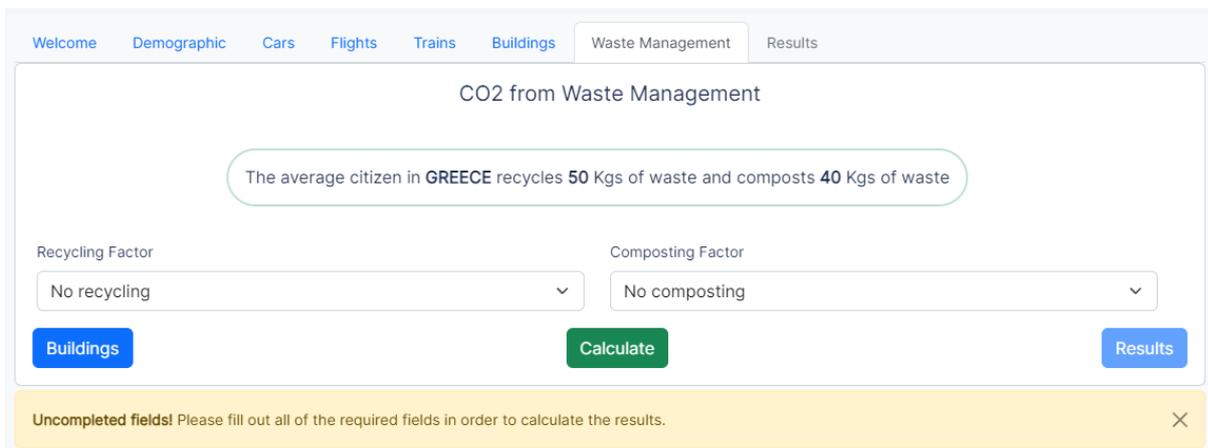
**Figure 23: Carbon Footprint Calculator - Buildings tab**

The final tab, in which the user has to provide input, is the Waste Management tab (Figure 24). 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.

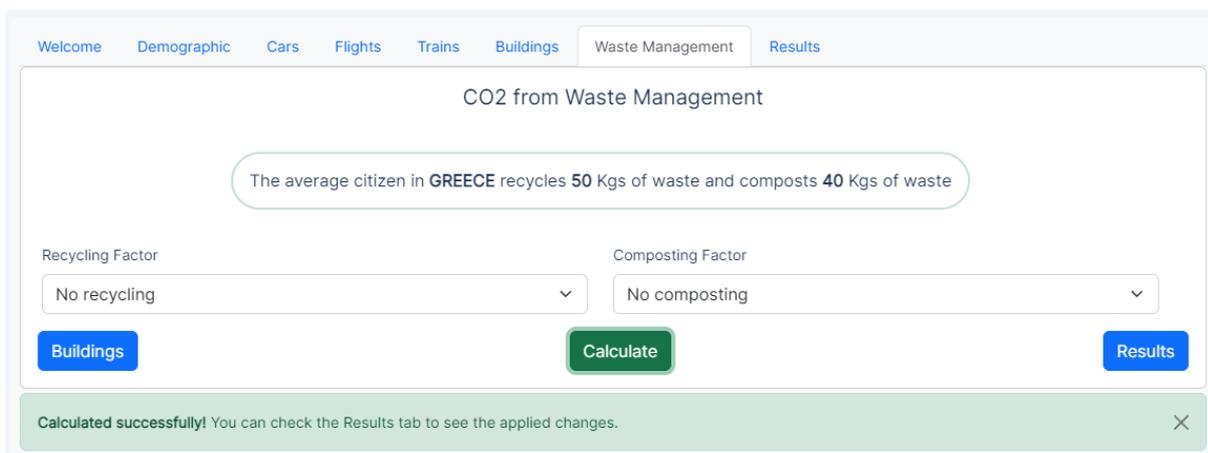


**Figure 24: Carbon Footprint Calculator - Waste Management tab**

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 25). If they have filled in all the fields, then they are informed that they can proceed to the Results tab (Figure 26).

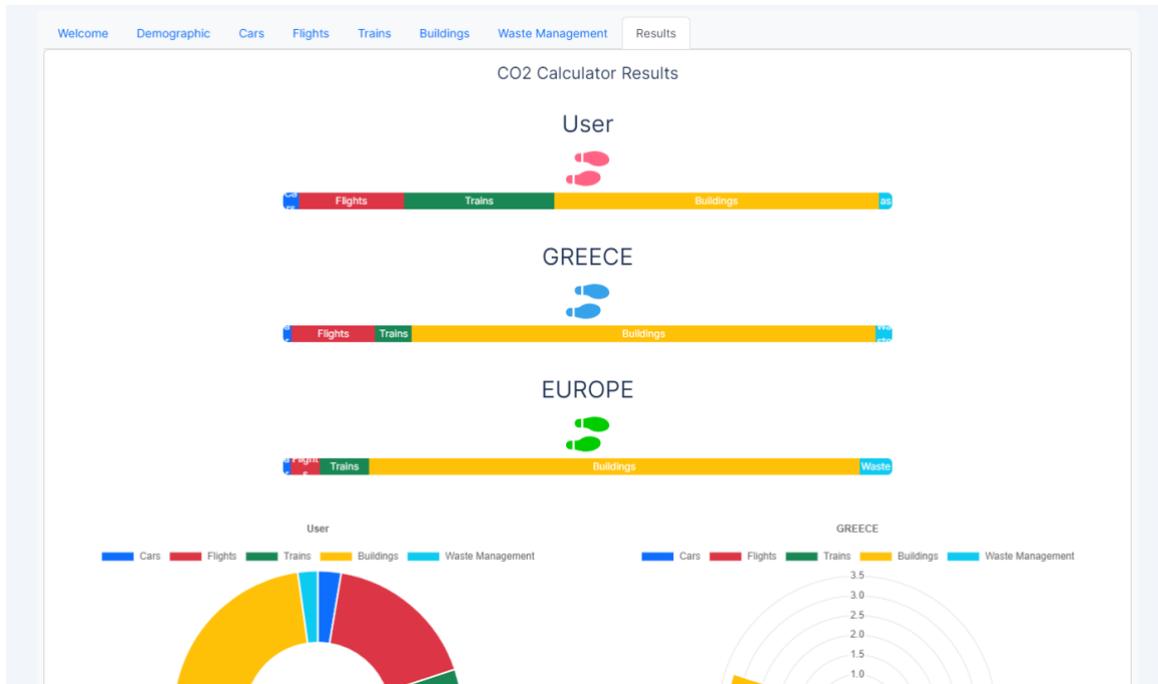


**Figure 25: Error informing some fields haven't been filled in**



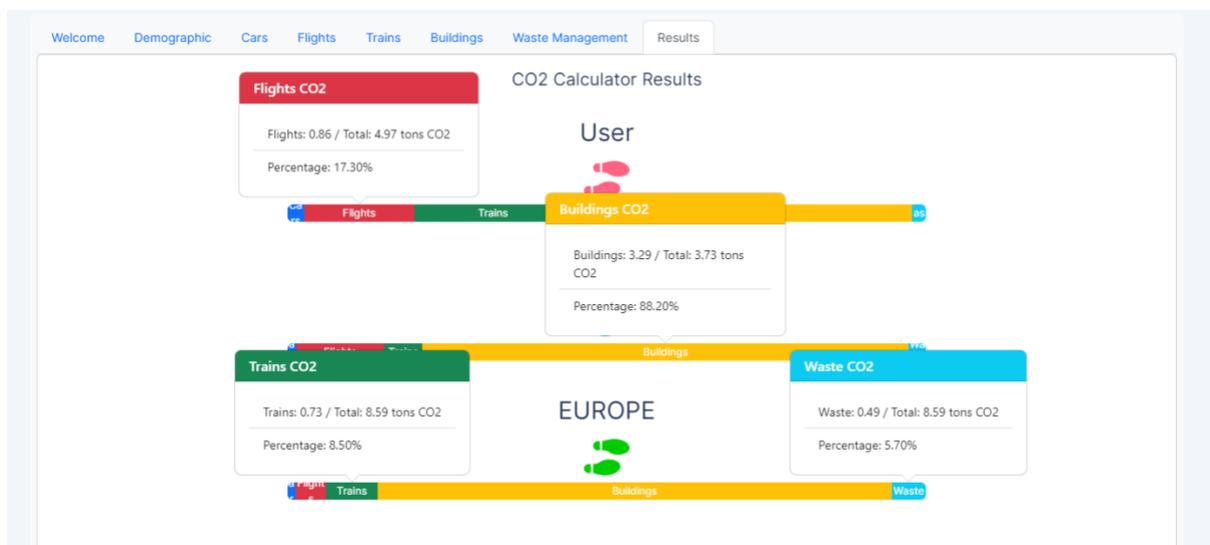
**Figure 26: Calculation Successful**

On the Results tab, the user receives information regarding their carbon footprint. At the top of the tab are three bars (Figure 27). The topmost bar provides the user's footprint. The middle one provides the average of the user's country. The bottom one provides the EU average. This allows the user to compare their results with various averages.



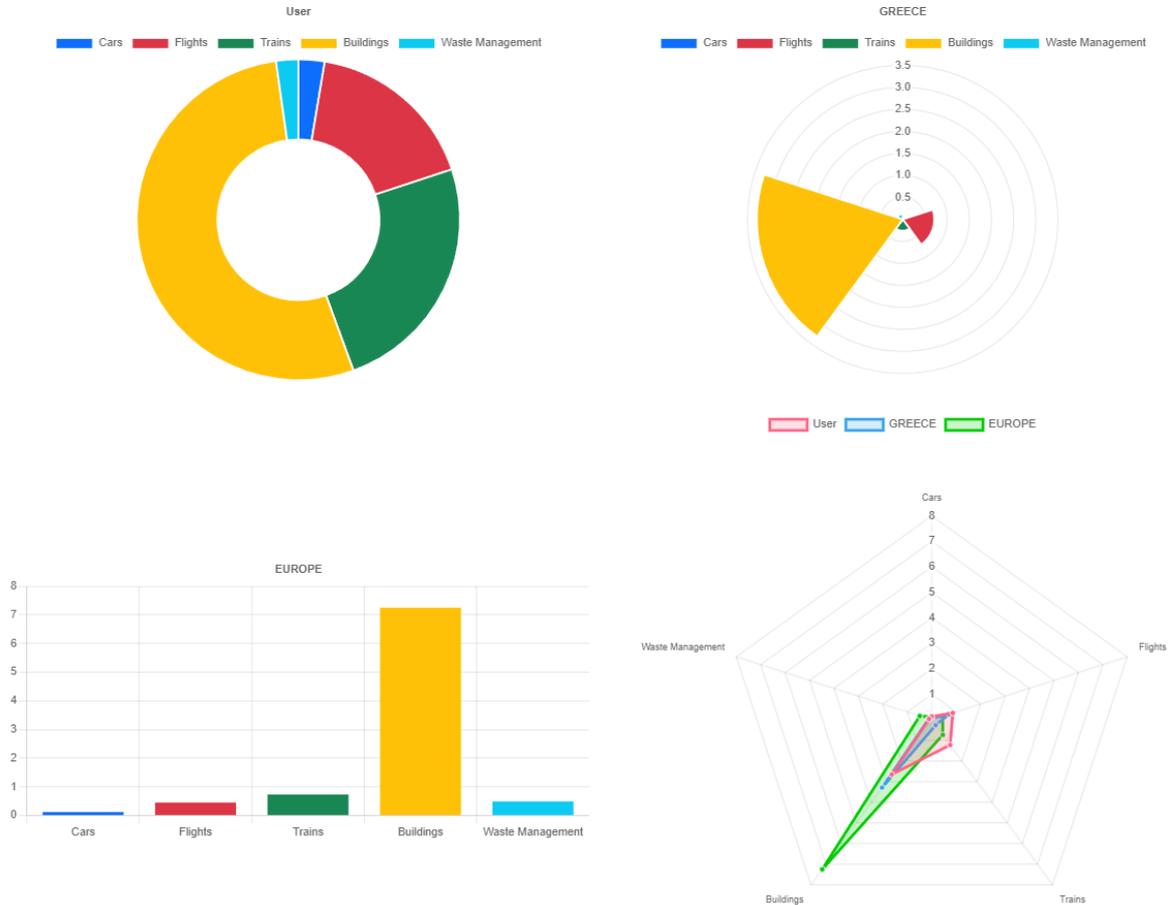
**Figure 27: User's results comparison**

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 28), a message appears that shows to the user how much that domain takes up from their total carbon footprint. If they click on the domain again, the message disappears.



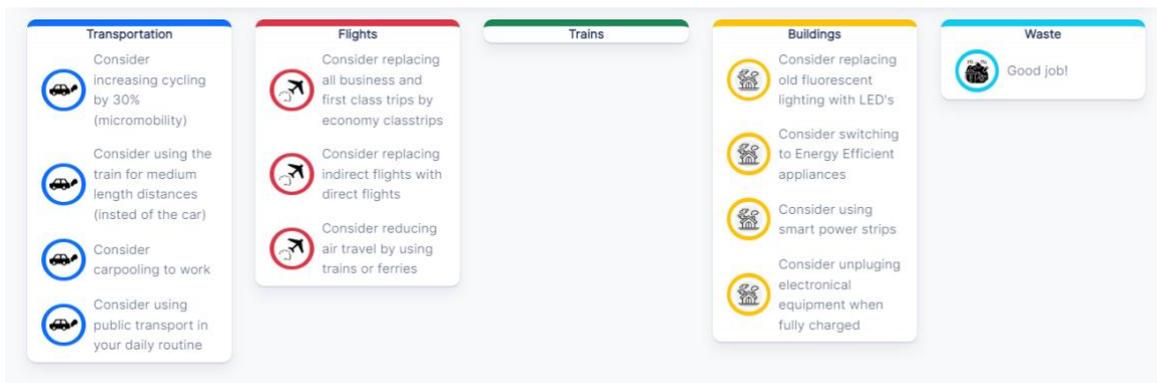
**Figure 28: Information about each carbon footprint domain**

Right below the bars, there are various graphs (Figure 29) 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 29: Visualisation options**

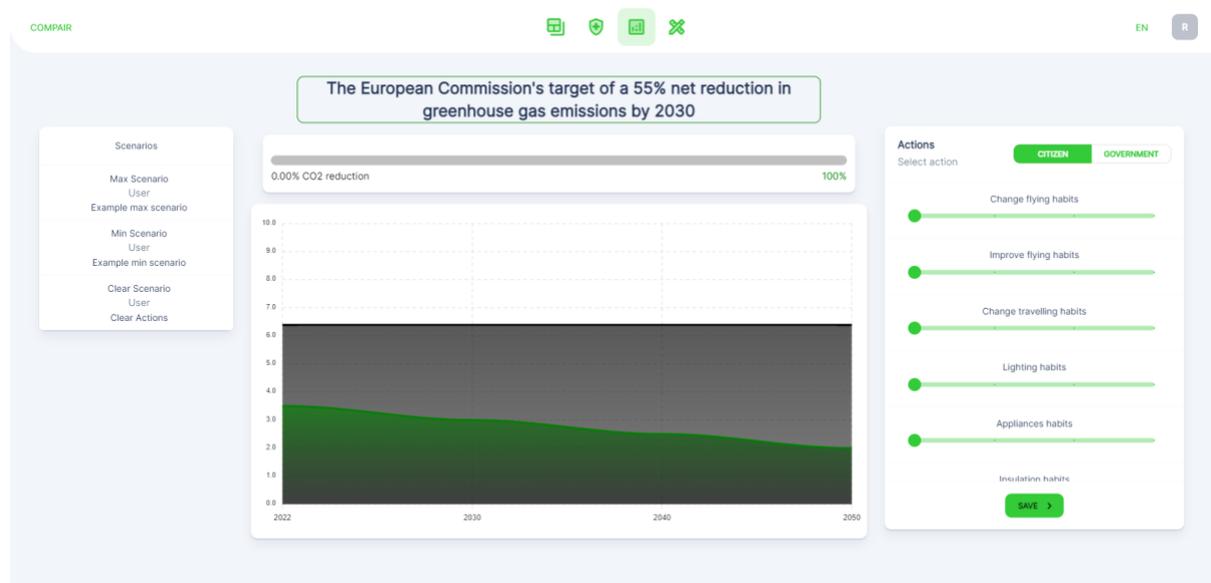
Finally, the user has also access to recommendations on how they can reduce their carbon footprint (Figure 30). There is one recommendation category for each domain. The recommendations that appear here depend on what answers the user has provided in the previous tabs.



**Figure 30: Recommendations by domain based on user's results**

## Scenario Simulation

Choosing the third option on the navigation menu, the user is led to the Scenario Simulation (Figure 31). 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 31: Scenario Simulation**

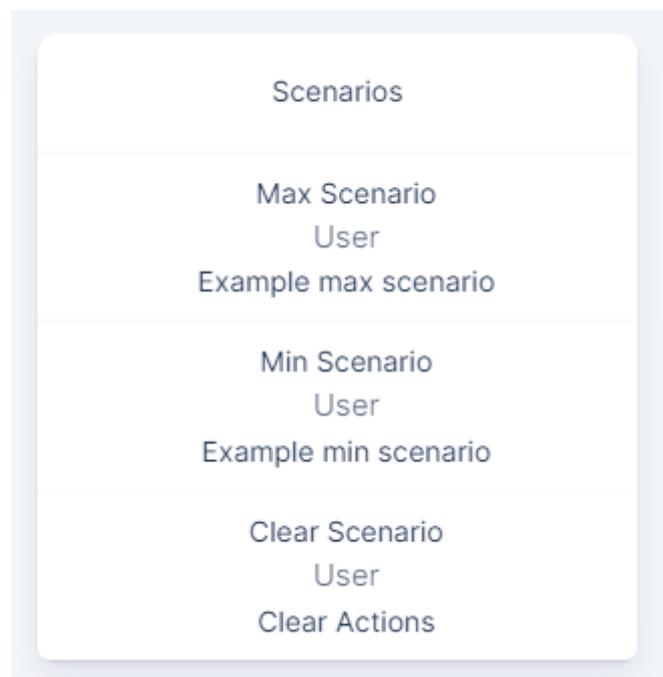
Below the goal there is a progress bar and a graph. The progress bar shows the emissions reduction caused by the actions chosen by the user. The graph shows the current and the target emissions.

To create scenarios, the user can choose between two types of actions (Figure 32). 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 32: Action sliders**

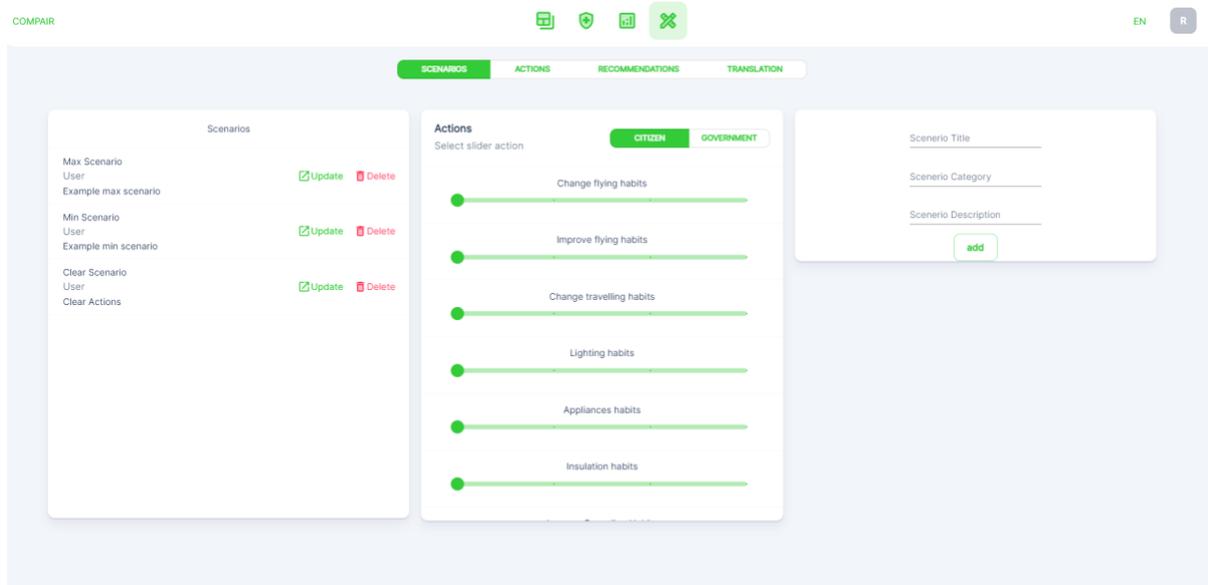
Moreover, on the left side of the page, there are example scenarios (Figure 33). These can be viewed by the users so that they can get a better idea on how various actions affect carbon footprint and what strategies governing bodies are considering in order to reach the set goal.



**Figure 33: Example Scenarios**

## Administrator Page

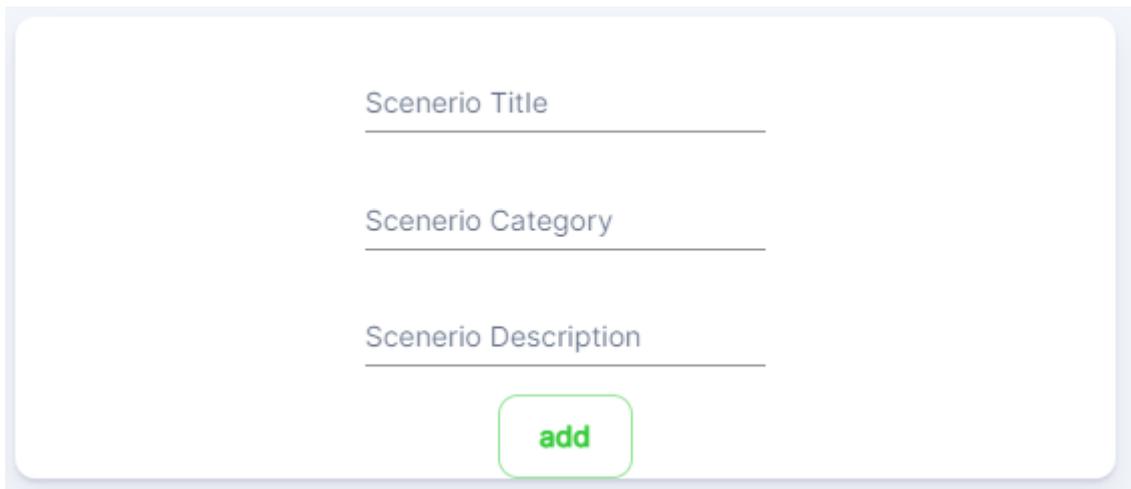
Choosing the fourth option on the navigation menu, the user is led to the administrator page (Figure 34) which provides various tools to the administrators of the Dashboard. Administrators are meant to be policy makers that are going to gain insight on citizen's opinions on what actions they are willing to perform towards the achievement of a policy target and the probability of achievement. It is still under development but some of its features will be available in the Alpha Version of the Dashboard. The features that will be available in the Alpha Version are presented below.



**Figure 34: Admin Page**

The admin page has its own navigation menu right below the main navigation menu. There are currently four options in the menu, and the first three are available. 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, category, and description on the right part of the page (Figure 35). The Scenario categories are under development so the field can currently be left blank in order to proceed. Finally, they can press the "add" button and their scenario is created. Currently the administrator has to refresh the page for the scenario to appear in the list of scenarios in the left part of the screen.



Scenario Title

---

Scenario Category

---

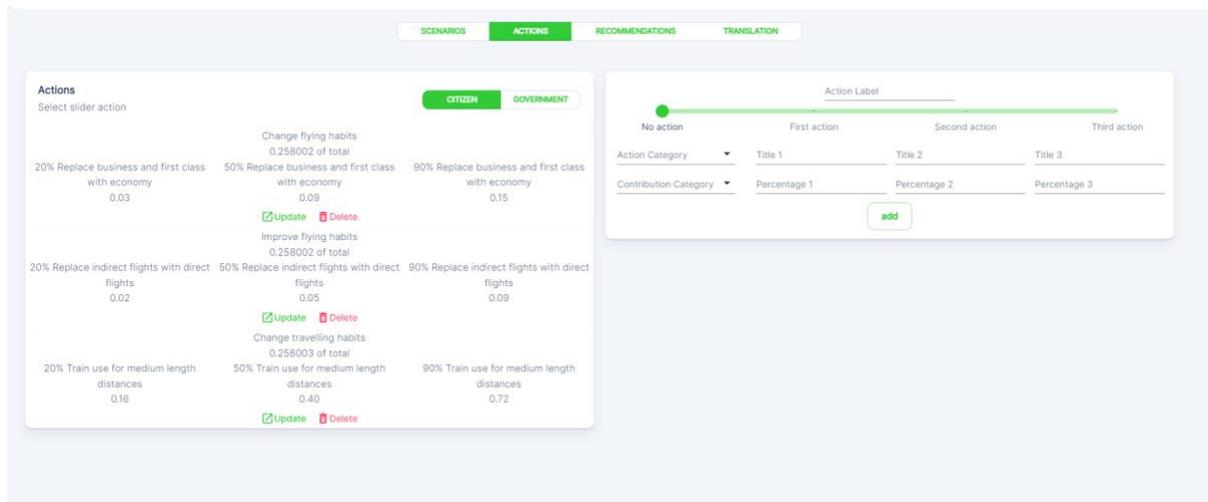
Scenario Description

---

add

**Figure 35: Add the title, category, and description for a new scenario**

The second option in the admin page navigation menu leads to the actions page (Figure 36). 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.



SCENARIOS ACTIONS RECOMMENDATIONS TRANSLATION

**Actions**

Select slider action

CITIZEN GOVERNMENT

Change flying habits  
0.258002 of total

20% Replace business and first class with economy  
0.03

50% Replace business and first class with economy  
0.09

90% Replace business and first class with economy  
0.15

Update Delete

Improve flying habits  
0.258002 of total

20% Replace indirect flights with direct flights  
0.02

50% Replace indirect flights with direct flights  
0.05

90% Replace indirect flights with direct flights  
0.09

Update Delete

Change travelling habits  
0.258003 of total

20% Train use for medium length distances  
0.16

50% Train use for medium length distances  
0.40

90% Train use for medium length distances  
0.72

Update Delete

Action Label

No action First action Second action Third action

Action Category Title 1 Title 2 Title 3

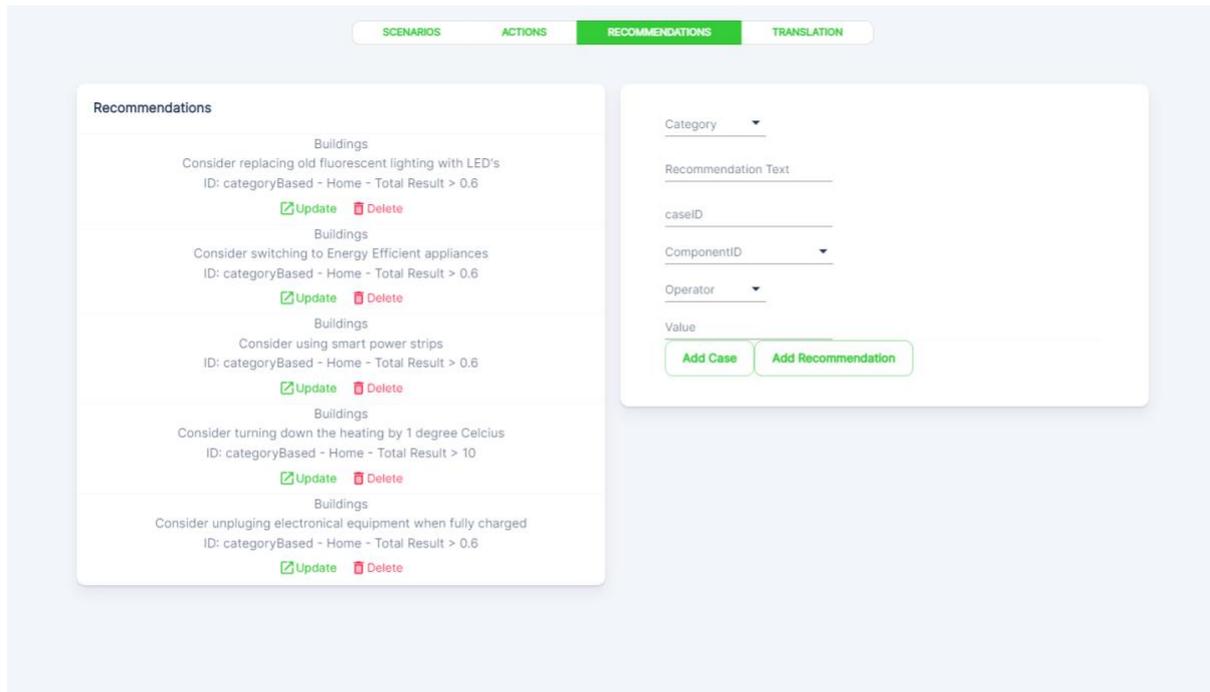
Contribution Category Percentage 1 Percentage 2 Percentage 3

add

**Figure 36: 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 “Action Category” dropdown. The “Contribution Category” dropdown menu allows the administrator to choose which emissions category the action belongs to. Finally, they have to add a title and the percentage of contribution for each level of the action.

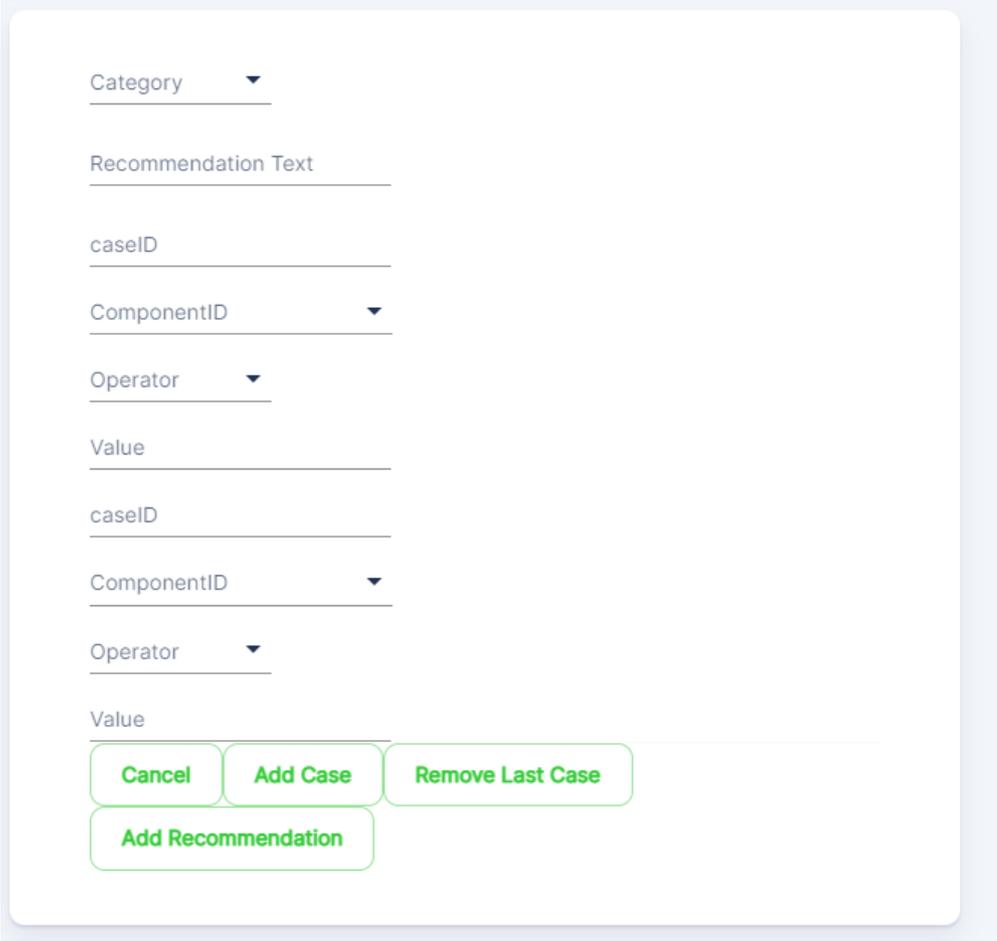
The third option in the admin page navigation menu leads to the recommendations page (Figure 37). This allows the administrator to create, update, and delete recommendations that are available in the Carbon Footprint Calculator. On the left part of the screen there is a list of the recommendations that are currently available. From there, the administrator can update or delete a recommendation.



**Figure 37: 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 38).



Category

Recommendation Text

caseID

ComponentID

Operator

Value

caseID

ComponentID

Operator

Value

Figure 38: Adding more cases to a recommendation

## 5. Dynamic Exposure Visualisation App (DEVA)

The Dynamic Exposure Visualisation Application (DEVA) is to enable people 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 closed alpha release

The following table presents the list of epics implemented for the closed alpha release.

**Table 4: List of epics implemented for the closed alpha release of DEVA**

ID	EPICS
<b>DEVAUI</b>	<b>User interface</b>
	Story: As a citizen, I want to be able to switch between portrait and landscape mode and to have a day/night mode
	Story: As a citizen, I can login on the app (also via quick login)
<b>DEVAUsI</b>	<b>Update user information</b>
	Story: As a citizen, my settings are saved
	Story: As a citizen, I can indicate my gender, height, age
	Story: As a citizen, I want to be able to select my user role (scientific, child, developer, etc.
<b>DEVARea</b>	<b>Real-time communication and information visualisation</b>
	Story: As a citizen, I can get an alert (visual and sound) on my smartphone when the backend doesn't receive measurements
	Story: As a citizen, I can get a signal on my smartphone when I've exceeded an exposure limit value (which I've set myself) as well as receive other notifications
	Story: As a citizen, I want to be connected to COMPAIR's database
	Story: As a citizen, I can see the real time measurement data of the sensors around me on my smartphone, as a layer on top of reality
<b>DEVAViz</b>	<b>Visualise 3D data in space</b>
	Story: As a citizen, I want abstract graphical AR visualisation with choice of visual type (pins, clouds, etc.)
	Story: As a citizen, I want different colours to represent different data types and values
	Story: As a citizen, I want to visualise data as near or far, using 2-3 levels of detail (dynamic visualisation)
<b>DEVAMan</b>	<b>Manage projects of experiments</b>
	Story: As a researcher, I can see when data from a sensor is calibrated

## User Guide

The following section presents a User Guide for the first release (Alpha version) of the Dynamic Exposure Visualisation App (DEVA).

Screenshots of the main views of the DEVA are presented in the following sub-sections, which describe the DEVA's main functionalities.

### Installation

The DEVA alpha version is not published in a store at this time. Furthermore, it currently supports only Android devices, which have augmented reality capabilities. A publishing on Google Play and Apple Store is planned in the future. A manual app installation is necessary via an APK file (Android Package). To install an apk, the user needs to activate the developer mode of the device.

*Note:* Information to switch a smartphone or tablet to developer mode would be found by the device's provider or manufacturer. This only concerns Android devices.

#### Installation steps:

- 1) First, the user has to download the current APK file which is available here <https://drive.google.com/drive/folders/11-9LsfqkVLMqW0k9Nwv17I8zZiZRQPJw> from the **COMPAIR** server.
- 2) Then, the file has to be copied to the smartphone or tablet via USB (or what the user prefers to use to transfer data to the memory of the device). The user can put the APK anywhere the user wants.
- 3) Once the file is on the device, the user opens the APK file and the system will install the app. The user can remove the app as usual if it's not needed anymore. Be careful with this because all app data is also removed from the device (i.a. the system and user settings, etc.).
- 4) After successful installation, the app can be started. A splash screen and afterwards the start screen will appear (see Figure 39). If the app is starting the first time after a first installation, then the device will ask the user for some permissions (i.a. Camera and GPS location).
- 5) After having clicked the big button "Start Your Journey Now", the user will access the login screen. In the case where an auto-login was set up then the user will be directly logged in. (The next subchapter "Login Process" - see below - is then irrelevant).

*Note:* In the screenshots in this chapter, background pictures are still photos (background pictures) and replace the regular live camera images for the purpose of documentation.



Figure 39: Splash screen, start screen and login screens (existing vs. new user)

## Login Process

There are different ways to login depending on the rights and if the user is already a registered user in the app. First, you can directly login either as a guest or administrator with the two quick login buttons (grey buttons) or you can create a new user with the **+** symbol that will appear in the button on the right side of the text field. The button shows this sign automatically when a name is unknown. Be careful when creating a new user: check your name exactly before creating the user.

If the name already exists, then the user can login via the **>** sign or by pressing the “return” key (the sign changes automatically to this symbol). In order to avoid complex login, the last username appears in the quick login list the next time when the user login.

The login name is used to store information in a specific user’s folder, directly in the memory of the device. So, it is possible for the same user to experiment with the app as a different user or user group by only doing a logout and then a relogin.

*Note:* The DEVA prototype doesn’t use a login system with password currently. This will be taken into account in a future version.

## User Interface

After the user has logged in, the main user interface is shown. It consists of a status bar and user bar at the top (see Figure 40) and a toolbar with shortcuts and toolbox with additional functionalities on the bottom (see Figure 41). The toolbox can be opened by clicking the tool button  in the centre of the tool bar. To close the box, you must click on the button again.

*Note:* not all functions of the toolbox are implemented yet.



**Figure 40: Status bar (top) and user bar (bottom)**



**Figure 41: Toolbar with shortcuts and opened toolbox with additional functionalities**

If the user is logged in as an administrator (user group), then a special window with extra functionalities appears at the bottom of the screen (see Figure 42) in order to allow proper development and testing, e.g. synthetic data can be generated without internet connectivity or GPS positioning. Note that not all functions are implemented yet. With a click on “x” the developer bar will disappear. To recall the window, the button  on the top bar should be clicked again.



**Figure 42: Special administrator functionalities (developer bar in yellow)**

By clicking the hamburger menu  (icon on the left side of the user bar), the menu will flow into the screen for setting up the app (see Figure 43). By clicking this button once again or selecting a function, the menu will disappear.

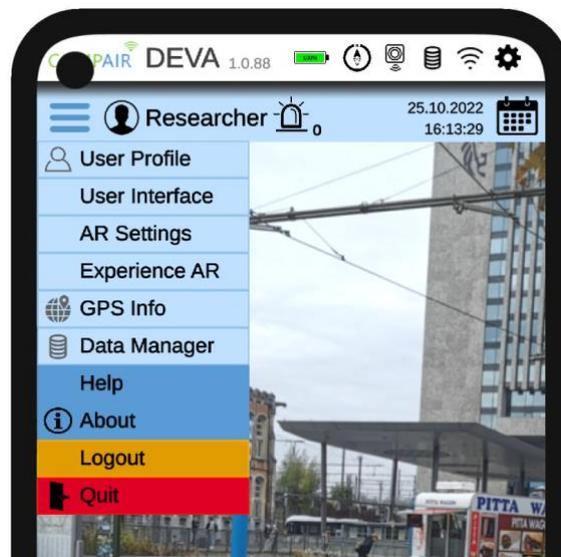


Figure 43: System menu

DEVA can be used in portrait or landscape format. Depending on how the user is holding the device, the arrangement of the graphical elements is adapted automatically (responsive design, see Figure 44). If the user switches from portrait to landscape format, it may be possible that some settings or parameters windows are not completely visible any more. To see the whole window the user has to rotate their device back to portrait.

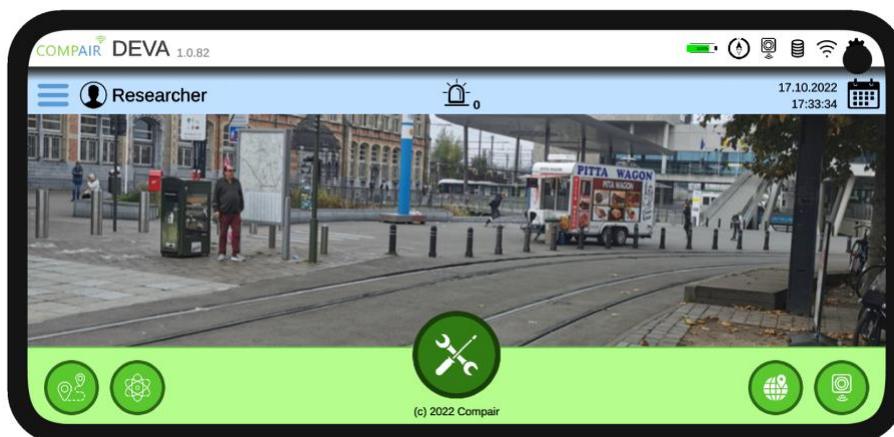


Figure 44: Landscape arrangement of the user interface

## Main Settings

DEVA uses a modal window system to set up the system, to edit parameters and to select themes or other UI and AR relevant functions and values. When a modal window is open, no other UI or AR action can be done. Changes have to be confirmed by clicking the “Save” button. To discard a change, the user has to click the “Cancel” button. Some windows have a “Try!” button so that parameters can be tested beforehand. Note that a click on this button closes the modal window also.

The user profile settings as well as server settings can be defined and stored (see Figure 45). Both windows can be accessed either via the system menu or by a click directly on the related symbol in the top bars (  and  )

For the user profile, some information can be entered (i) that is either voluntary (e.g. age, gender), (ii) that is relevant for the user because it has an impact on the amount of functionalities and the look-a-like (e.g. user level and user role), or (iii) that is mandatory for visualisation (e.g. height of the user). The height determines where objects are displayed in the augmented 3D space.

Deleting a user account: In this prototype, to remove a user “x”, the user has to login in the account of “x”, open the users settings and then click on the “Delete Current User” button. the current user “x” is removed from the local storage of the device, and DEVA will directly switch to the login screen.

*Warning:* Be careful with this function because all the user’s data (settings, etc.) are deleted. It is then possible to recreate the same account with base settings.

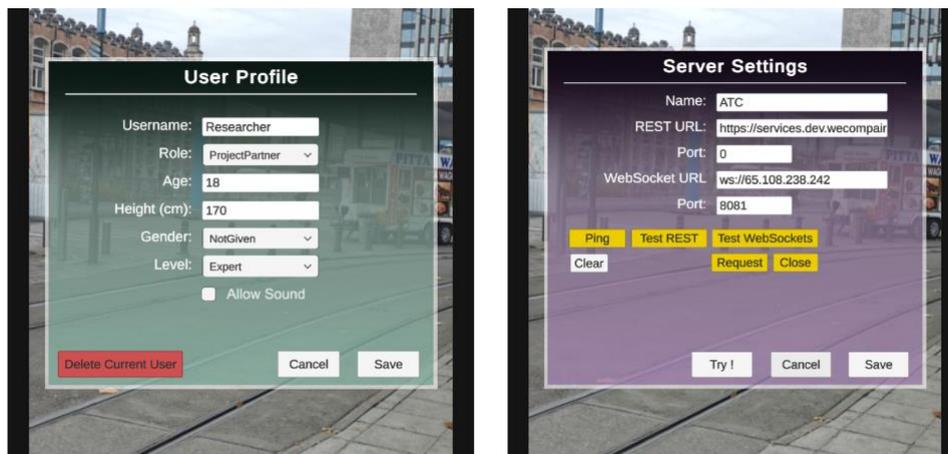


Figure 45: User and server setting interface

In the server settings, the IP number of the Data Manager and their port numbers for REST and WebSockets can be defined. This is set to default for a common user, but for development purposes, the administrator can change these parameters. Some buttons allow testing the connectivity.

*Note:* On the status bar, the database symbol will blink if the connection with the Data Manager was lost for a specific time. The connection will automatically be re-instantiated.

The light intensity of the user interface of DEVA can be changed to allow a better experience at night or in dark situations. For this, the user opens the “User Interface” setting window (see Figure 46) and activates the checkbox “Night Mode”. Then, the user can change the brightness intensity with the slider.

*Notice:* Not all UI elements are currently adapted to the value. The brightness value influences the AR graphical visual as well (in the figure below, the pins appear darker).



**Figure 46: Night mode in the UI settings window (centre: disabled, right: enabled, 75% darker)**

## COMPAIR Data

DEVA receives data packets from the Data Manager (a centralised **COMPAIR** server) and generates a visual for each observation related to the type of the observation.

### Synthetic Data:

Alternatively, the user can generate test data (synthetic data) to be able to test the app in different locations and without connectivity to the server. This function is currently accessible by all user groups.

Therefore, two shortcuts are placed in the toolbar, see Figure 47, left). More functionalities can be found in the simulation windows (see Figure 47, right) via the button “Simulate Observations” in the developer bar (yellow bar). In this window, the user can generate random data around the current location.

The first three buttons generate data from the exemplary types: temperature, humidity and NO2. The three “Mixed” buttons create data from all three types. All values will be added to the current scene. The gauge indicates how much data is active in the AR scene (0 - 1000 values). The button “New Values” starts a timer updating all data with new random observed values. A second click on it stops the timer.

By clicking the “Clear” button, all produced values are deleted from the AR scene.



Figure 47: Shortcut to activate the Near-n-Far view (left) and to create synthetic data (right)

## AR Visualisation

The different types of environmental information are visualised in various manners using predefined settings for colours, symbols and positioning (see Figure 48). The user can access the special AR settings window from the system menu. Three main parameters are available (an explanation of the values can be found later in the text):

- Visual Themes: Selection of the colour of data.
- Symbols: Selection of the graphical representation of data.
- Near-n-Far Render Modes: Selection of the placement method of data in the AR world.

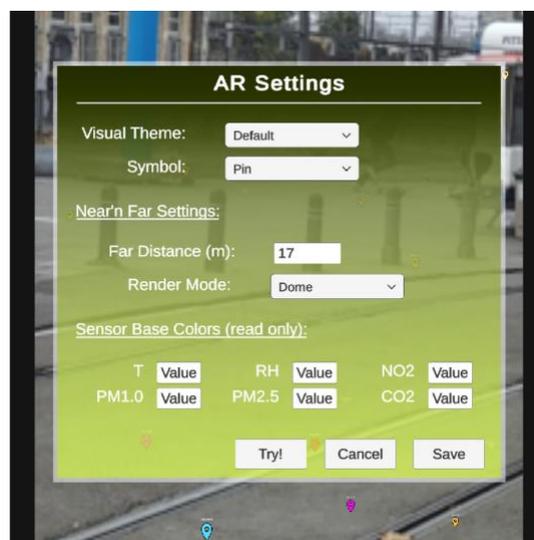


Figure 48: Visualisation of different observations

## Visual Themes:

DEVA uses different colours for the observation types with colour gradients to draw the data or symbols, e.g., temperature goes from orange to red, humidity from light blue to dark blue etc. The information is placed in “themes”. Currently, the themes serve as examples only: The number of themes will grow in future versions, and the colours and functions of AR objects will be adapted to new user requirements.

The intensity of the colour represents the amount of the value according to the selected AR themes: e.g. a light colour represents a small value and dark colour represents a large value. Data exceeding some value limits are represented in red (see also part below “real-time information visualisation”).

After having selected a visual theme and clicking the “Save” button, all data is updated according to the selection. The selection is saved locally into the device. The user can also “Try!” the parameter first. Figure 49 shows a switch from a colorized theme to the black and white one.



**Figure 49: Visualisation of different observations using the Default and B&W colours (themes)**

*Note:* If the user is logged in with administrator rights, the un-calibrated sensor data (observations) can be visualised. The un-calibrated data are visualised in magenta (see Figure 49 above).

## Symbols:

The AR rendering system uses graphical symbols or 3D models to represent the data and values, the way the data are represented in the AR environment. In the AR settings, different visualisations (symbols) can be selected for the available observations. Currently spheres, cubes and pins are implemented. For the pins, the value of the observation appears above the symbol (see Figure 50).



Figure 50: Different visualisation for observations using the symbols “Cube”, “Sphere” and “Pins”

Render Modes (Near-n-Far view):

The DEVA rendering system offers different geometrical solutions for placing the data in the environment. In the AR settings, the user can define the type of the spatial positioning of the observations according to the Near-n-Far principle (see also deliverable “D3.3 AR design”). These methods allow to visualise far away data without unwanted perspective collisions between rendered data and real objects in the farness like buildings or trees.

To experience the Near-n-Far representations, DEVA implements many methods and allows a quick switch between the original data and the Near-n-Far ones.

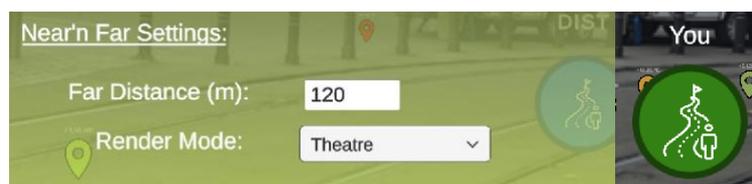


Figure 51: Original (left, flat), Amphi theatre and Dome presentation (right)

Five different Near-n-Far concepts are proposed to the user:

- Flat: Reference presentation, presented on a horizontal plane, of the original data (see Figure 51, left). The collisions between the real world and rendered objects is visible, especially in the far area.
- Cut: Equal to the flat mode but only the near data are visible. Thus, no or less collisions should happen.
- Theatre: The data (far area) are shifted in the height depending on their distance to the user, like in an amphi-theatre (see Figure 51, right centre). Faraway objects are now floating above the street and do not produce any collisions anymore. Objects in the far appear respectively smaller.
- Dome: The data are repositioned on a sphere as in a dome theatre depending on their distance (see Figure 51, right). Thus, far objects are all in the same distance to the user. This perspective allows a better recognition of the data colour code.
- Ring: The data are placed over a ring near the user. The ring is extended with a compass to show the user in which direction the observations are located (this feature is planned for coming versions).

In addition, in the AR settings, a threshold can be set where the far distant data begins in order to allow a user-preferred visualisation (see Figure 52, left). Whenever the Near-n-Far mode is active, an overlay window is shown over the AR view, on the right side of the screen. With the green button the user can quickly deactivate the Near-n-Far view as mentioned before (see Figure 52, right). The distance can also be quickly set by using the slider.



**Figure 52: Setting for the Near-n-Far data representation (left), activation button (right)**

After the split of the original data to their near and far clones, a virtual border emerges where the Dome and the Theatre visuals would start their special representations. Data in the near area are represented using the symbol from the selected AR themes (see Figure 51, list with the current existing modes). For the far area, all data are represented by a sphere. Those objects cannot contain textual information because they are too far away and text should be unreadable.

The transition between near and far data goes from the original positions (at border line) to the geometrical transformed one using special formulas:

- Dome: Sphere with dynamic radius and dynamic position to the top pole where the user is in the middle of the sphere.
- Theatre: Exponential curve for the amphitheatre where the user is located on the stage and looks forward to the audience.

*Note:* The screenshots above can not depict the real AR look-n-feel of DEVA. To experience the AR scene, the user has to use the app. Then, the user can freely move around, stand or walk, creating a parallax movement necessary to better perceive 3D depth on a 2D display.

## Real-time information visualisation

It is necessary that the user is informed about some important states of the app. In the case of the Data Manager not sending data for some time, an alert (icon visual) is shown in the status bar and a message bar appears (UI overlay window). If no warning exists anymore both elements would be reset.

When data arrives from the Data Manager or from the simulator (synthetic data), the data are checked against the exposure limit (minimum and maximum values). E.g. the user can use an individually predefined exposure limit for PM2.5 and it automatically shows an alert if this limit is exceeded in the area. In the user bar, a siren is blinking and the number of exceeded values are displayed (see Figure 53).



Figure 53: Visualisation of exposure limit

A warning message or other notifications will also appear under the user bar (Figure 53: the dark-blue bar with the two icons). In the AR environment, the individual exposed data are red coloured. Additionally to the visual output, a notification or alarm sound can be played to inform the user about state changes of the observation values.

By clicking the siren symbol, a window will appear showing more information about the exposed values (see Figure 54). Each entry of sensor types shows the number of values they are under the minimum threshold, and the number of values above.

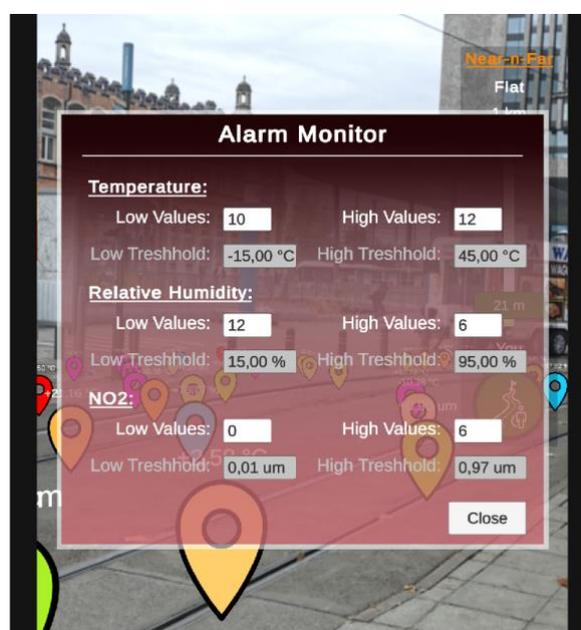


Figure 54: Visualisation of exposure limit

When DEVA renders the observatory data with the pin symbol, the user can select it by clicking on it. Then, a window will appear showing more information about the observation and the sensor having produced this value (see Figure 55). A click on the button “Google Maps” opens an external browser window showing the position in Google Maps where the value was measured.

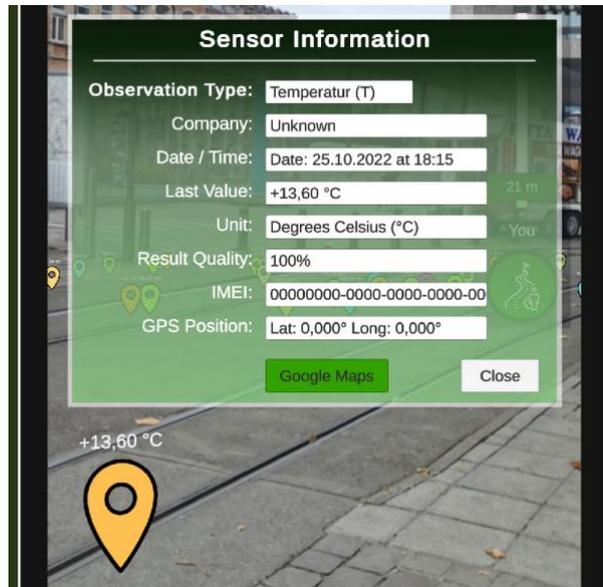


Figure 55: Specific information for an observation

## 6. Conclusion

This document is the report following the alpha release of the **COMPAIR** prototype. This is a first working version of the prototype that offers an initial set of the expected functionalities, mainly supporting the epics defined by the Pilots and will act as the test bed for the **COMPAIR** stakeholders to experience with this initial set of **COMPAIR** provisions 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. This will be the aim of the following period: to continue the enhancement of platform capabilities, make it more stable, more sophisticated and more efficient for the target end users, by plugging additional functionalities and calibrating existing ones.

This version of the prototype will be enriched with more functionalities to support the Pilots by M20 (May 2023) so that the planned evaluation iteration will be performed in the next period (M13 – M20). 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 prototype by M30 (March 2024).

## 7. References

- [1] COMPAIR Consortium, “D2.1: Value Network Canvas”, February 2022
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- [3] COMPAIR Consortium, “D3.3: AR design”, September 2022
- [4] COMPAIR Consortium, “D3.4: Dashboards Design”, September 2022
- [5] COMPAIR Consortium, “D4.1: Solution architecture report”, October 2022