VISIONARY NATURE BASED ACTIONS FOR HEALTH, WELL-BEING & RESILIENCE IN CITIES

D5.8 VARCITIES H&WB platform final- live data

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Abbreviation list

Term	Description
H&WB	Health and Well-being platform
NbS	Nature Based Solutions
KPI	Key Performance Indicators

1 Executive Summary

This document gives a high-level overview of the Health & Well-Being (H&WB) platform developed as part of the Varcities project. This platform was created by IESR&D and illustrates the time series data from sensors, digital illustrations and info on each pilot site as well as user feedback page where project participants can feedback their experience.

The H&WB platform forms the core of all detail operations on the Varcities project serving as a conduit between the real world and the its digital representation (digital twin) on a user-friendly platform. Moreover, the H&WB platform has enabled project partners and external users to extract meaningful data from the pilot sites towards the development of internal and external research in Europe.

All pilot sites have now had a fully functional H&WB Platform ready to illustrate sensor data, educate participants, and receive participant feedback. The following document outlines the final iteration of the H&WB platform and illustrates how it will be used in the pilot sites.

2 Introduction

The vision of VARCITIES is to implement nature-based actions in cities to establish sustainable models for increasing the health and well-being of citizens exposed to different climatic conditions and challenges (Varcities Consortium, 2020). At the core of this research project, there are a suite of digital solutions developed for the processing, analysing and disseminating of all digital information related to nature-based solutions (NbS) within the VARCITIES pilot sites (WP5). This deliverable produced a prototype H&WB platform (also known as dashboards) that can relay information, such as time-series environmental data from the sensors, informing users on the current conditions of the site. Furthermore, these H&WB platforms can receive information from the user who input their experience via survey questions which provides insights into user experience in each location a H&WB platform has been dispatched. Moreover, the H&WB platform provides users with insights into each visionary solution (VS) applied to each pilot site which is bespoke to each pilot site (VS implemented within WP6). These insights include text and VS digital renders (3D models of the VS) geolocated on each site digital twin which illustrates future NbS related development for each site. Finally, the H&WB platform provide users information on local biodiversity bespoke to each site which provides a means of educating the public on the important role natural infrastructure plays in urban environments. Furthermore, within this local biodiversity page, the most representative Key Performance Indicators (KPIs, developed within WP7) provide an overview of the site's main figures.

Understanding where the H&WB platform is situated in the overall digital architecture provides the reader with a sense in which the role of the H&WB platform plays within the VARCITIES project. In Figure 1, the digital architecture of the project is illustrated, with the VARCITIES Rest API severing as the main conduit for all time-series data generated by sensors installed by the project team. These data are pulled into the H&WB platform (Figure 1) and feed each of the pilot sites bespoke KPIs that record the environmental seasonal flux of each site while communicating this environmental flux in a user-friendly medium (3D renders and dashboards) for the public and internal users described in greater detail in section 4 of this deliverable. Given this description, it is reasonable to describe the H&WB platform as a digital window into the past, current, and future pilot site activity via an interactive dashboards and insightful 3D renders across the VARCITIES pilot sites.

The following sections of this deliverable describe the H&WB platform overall structure and provides greater detail for each element of the H&WB platforms template. Section 3 describes the H&WB platform template and overview tab, section 4 demonstrates the visionary solutions and digital twins approach used in the VARCITIES project; section 5 illustrates how the biodiverse info is illustrated; section 6 demonstrates the user feedback aspect of the project; and, section 7 the time-series dashboards developed for sensors data dissemination. For the purpose of this report, the Castlefranco Veneto pilot site will be used as the archetypal H&WB platform as it is the most developed site in the project to date. Other pilot sites will be demonstrated to illustrate various work carried out to develop this work package.

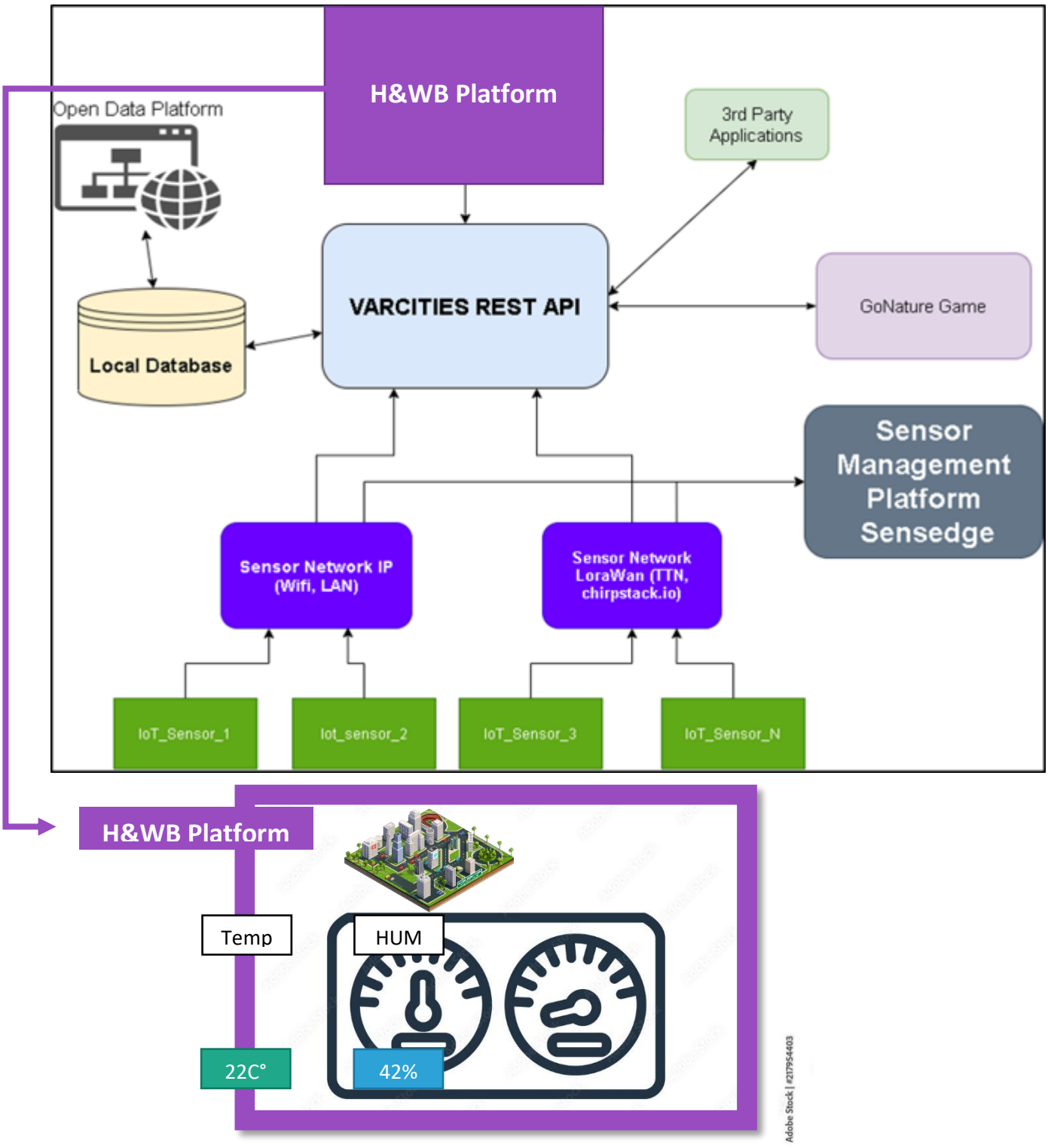


Figure 1 : VARCITIES Digital Architecture and H&WB platform

3 H&WB Platform Template and Overview

3.1 H&WB Platform Template

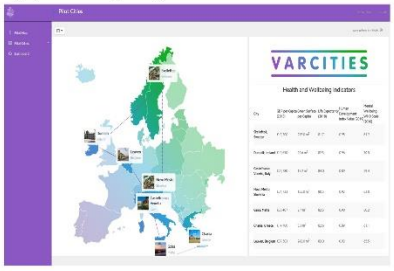
The overall template of H&WB platform is the same for each pilot site; Skelleftea and Dundalk have advocated for an additional "Survey Page" to disseminate their bespoke surveys related to WP7 (Figure 2) which is also available for other pilot sites who request this service. Each page serves a purpose for either disseminating data (local information on pilot sites and sensor data) or receiving data (surveys, feedback, and sensors).

The template of the health well-being platform are as follows:

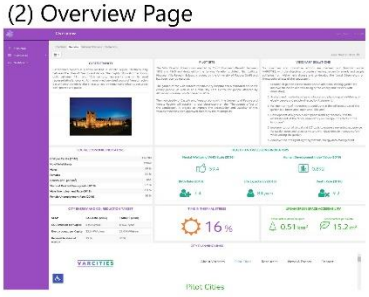
1. Landing page map of all pilot sites with and macro information describing each site.
2. Pilot overview page describing the context of the site as well as its local environment.
3. Visionary Solutions page describing all the VS in text, images, and 3D renders (where applicable).
4. Biodiversity page which devices various local species of flora and fauna.
5. Feedback page for user feedback on their preceded health and well-being.
6. Survey page for users to fulfil KPIs for applicable pilot sites.

The template follows a hierarchy based on geographic scale (Figure 2), which best describes the context of the pilot sites within the wider scope of the VARCITIES project. However, the feedback and survey page can work independent of the hierarchy as pilot sites may choose to survey participants first to prioritize user feedback over dissemination. Overall, the template for the H&WB Platform adequately displays pilot information and feedback questions to support the desired results of the H&WB platform for the VARCITIES project.

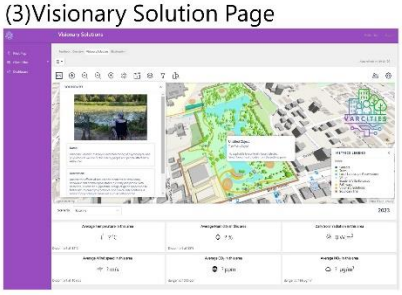
(1)Landing Page



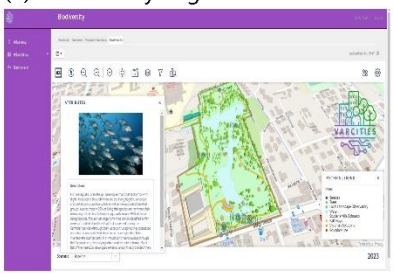
(2) Overview Page



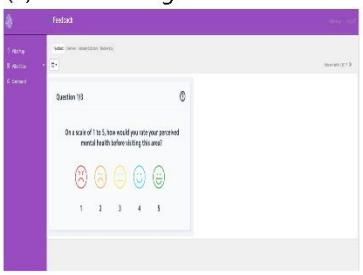
(3)Visionary Solution Page



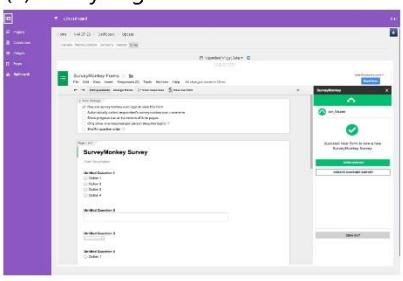
(4) Biodiversity Page



(5)Feedback Page



(6)Survey Page



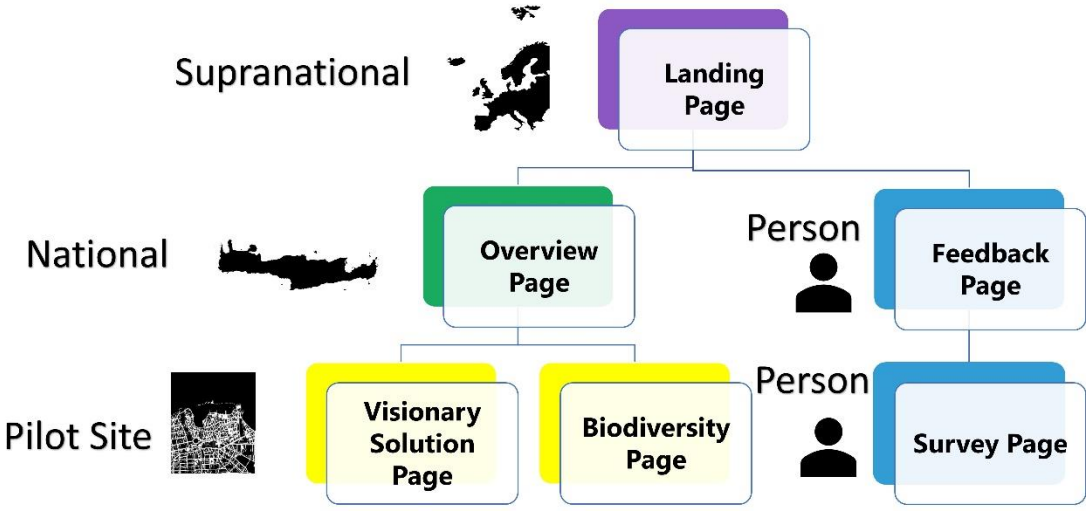


Figure 2 : H&WB Platform Template and Hierarchy Page Progression (small images provided by VectorStock, 2023)

3.2 Landing page – Pilot map

The landing page of the dashboard showcases the Pilot Map, displaying the different sites included in the research project. Users can interact with the map and explore Health and Well-being Indicators for each city.

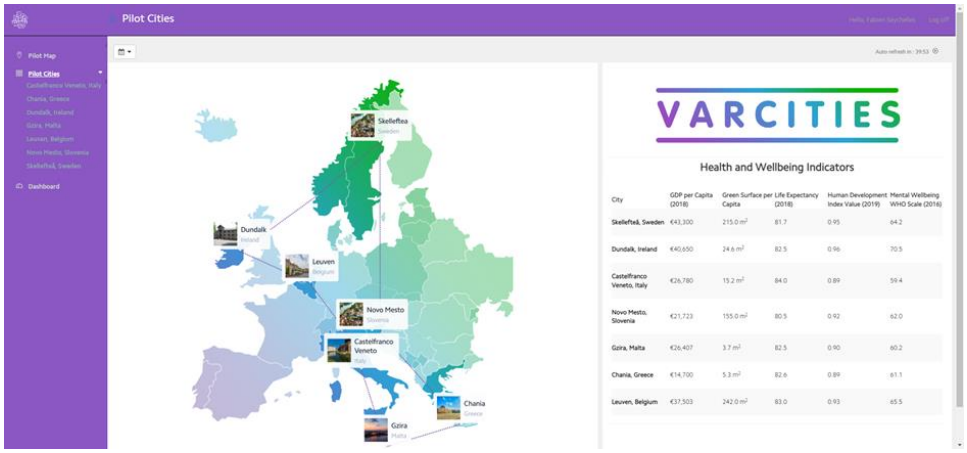


Figure 3 : Landing Page Illustration

The side bar menu provides convenient navigation options for users, granting them access to three main sections within the dashboard: Pilot Map, Pilot Cities Dashboard, and Sites KPIs Dashboard. The Pilot Cities page lists all the cities included in the project, each with its own individual dashboard. These dashboards consist of four key pages: Feedback, Overview, Visionary Solutions, and Biodiversity. Castlefranco is used as an example to highlight this aspect of the dashboard.

3.3 Overview Page

The overview page disseminates information supplied by each pilot site that best describes the pilot site and its current Health and well-being indicators. The overview page serves to give participants a bird's eye view of the pilot site, visionary solutions, KPI benchmarks (average values associated with local sociological and environmental data) and geographic context of other VARCITIES pilot sites (Figure 4).

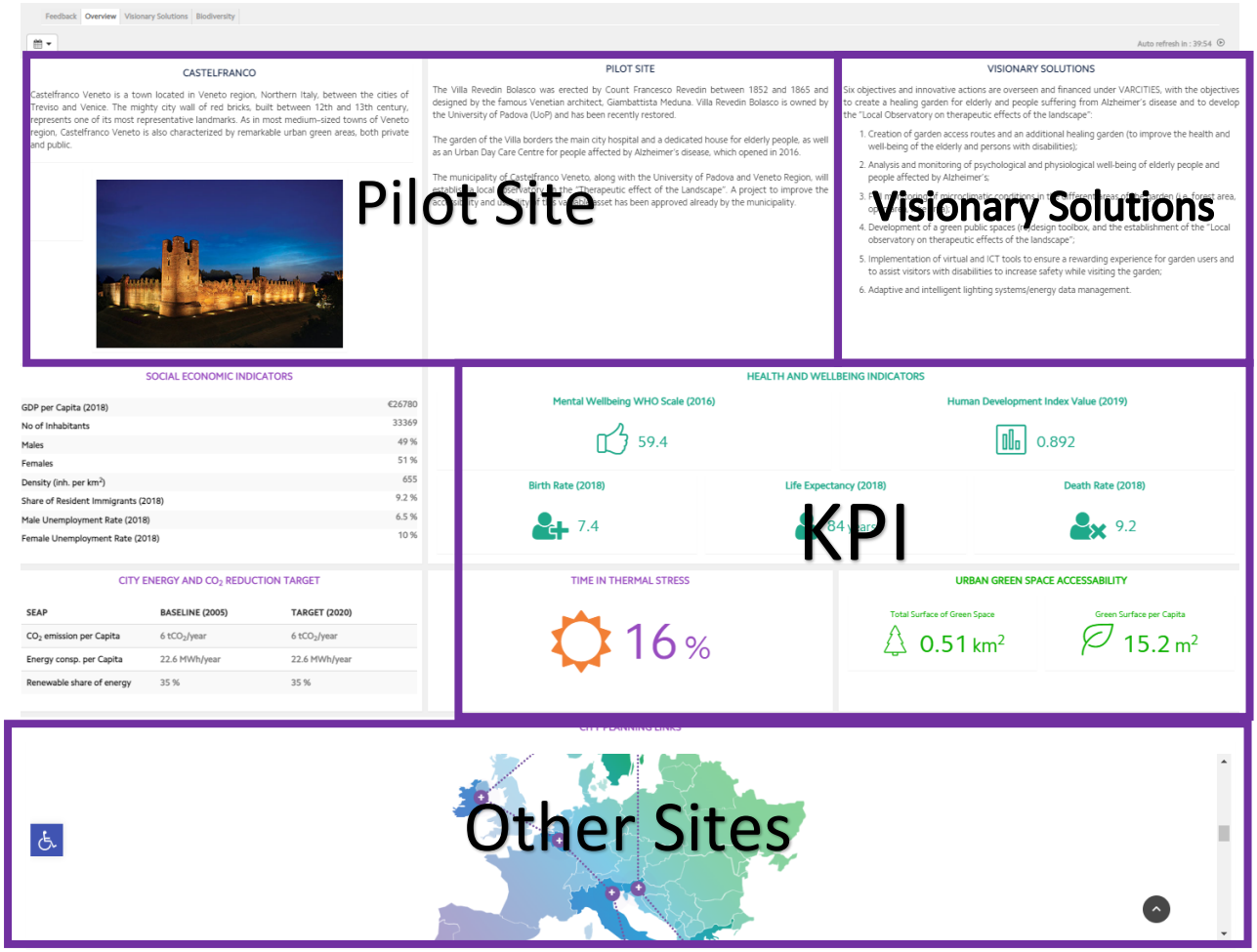


Figure 4 : Overview Page Illustration

With the H&WB platform user adequately informed about the pilot site, the user can now manoeuvre to the following pages to learn more about the VS, current KPI metrics from sensor data, and be able to feedback their own experience into the platform for qualitive analysis.

4 Digital Twins & Visionary Solutions

4.1 Digital Twins

Digital twin refers to a digital representation of real-world physical systems which aims to mirror those systems processes in real-time. However, real-world processes often have vastly complex and detailed variables which cannot all be accounted for. Therefore, in practice, digital twin refers to a real-world model which abstracts the key parameters of the physical system under observation. Although the term does not entirely live up to the idea of a mirror image, the overall goal is to capture the physical systems as accurately and detailed as possible in an endeavour that may never be fully attainable (Batty, 2018). To this end, digital twins can be best exemplified by their ability to capture as much detail as possible of a given system that current state-of-the-art will allow.

Currently, NbS systems in the VARCITIES project are too complex to capture at city scale and thus they are abstracted to a minimum visual object to illustrate various NbS assets within the digital twin models created for the VARCITIES project. As a result, the 3D renders developed by the IESR&D consultants only serve to illustrate their juxtaposition in the wider context of the pilot sites (Figure 5). Digital twins created for the VARCITIES models will be data driven and derive most of their insights from the sensor data deployed at each site.

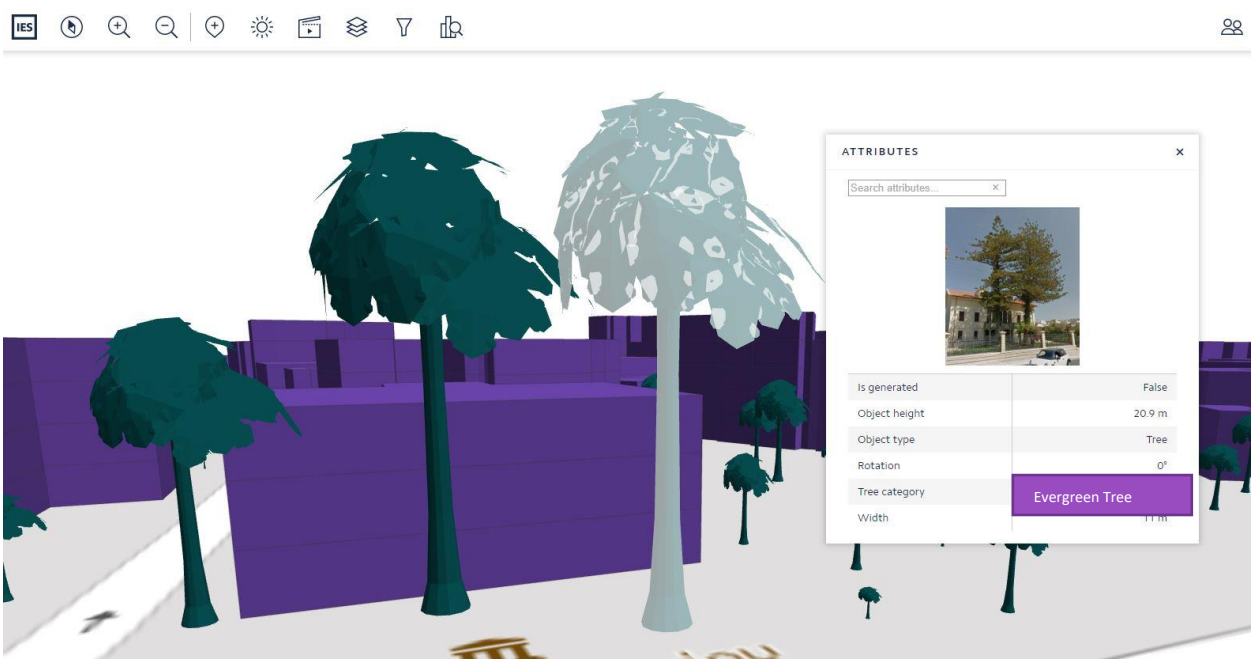


Figure 5 : Digital Twin Illustration Chania – Tree Example

4.2 Visionary Solutions (VS)

Each site has multiple VS that will be installed over the duration of the project towards achieving the NbS goals outlined by the project partners. Each of these VS a digital twin render and text on the H&WB platform has been created. These VS renders were incorporated into each of the pilot sites digital twins. Each site varied in size and each VS had varying degrees of complexity which. Some examples and expiations on the creating each VS render are described in greater detail below.

Based on publicly available data (such as google earth, and Open Street Maps) or data from future site renders and plans, detailed interactive Digital Twins were created for all the pilot sites as shown in the examples below (Figures 6, 7, 8). Most of the pilot sites limited data and various degrees of complexity.

Figure 6 : Dundalk Digital Twin Example Google Earth Above, IES Digital Twin Below

For example, in Figure 6, Dundalk pilot site is illustrated in Google Earth and IES Digital Twin 3D renders. Although the site had limited 3D data (GeoJSON, CAD, LiDAR) the site itself was sufficiently small to create a detailed model of both the buildings, trees, parks, pavement, and VS. On the contrary, if we compare the Figure 6 with Figure 7, an illustration of Leuven's pilot site, the size and complexity of site takes considerable amount of time to digitise, resulting in more resources to keep to the same standard of digitisation than the smaller pilot site of Dundalk.

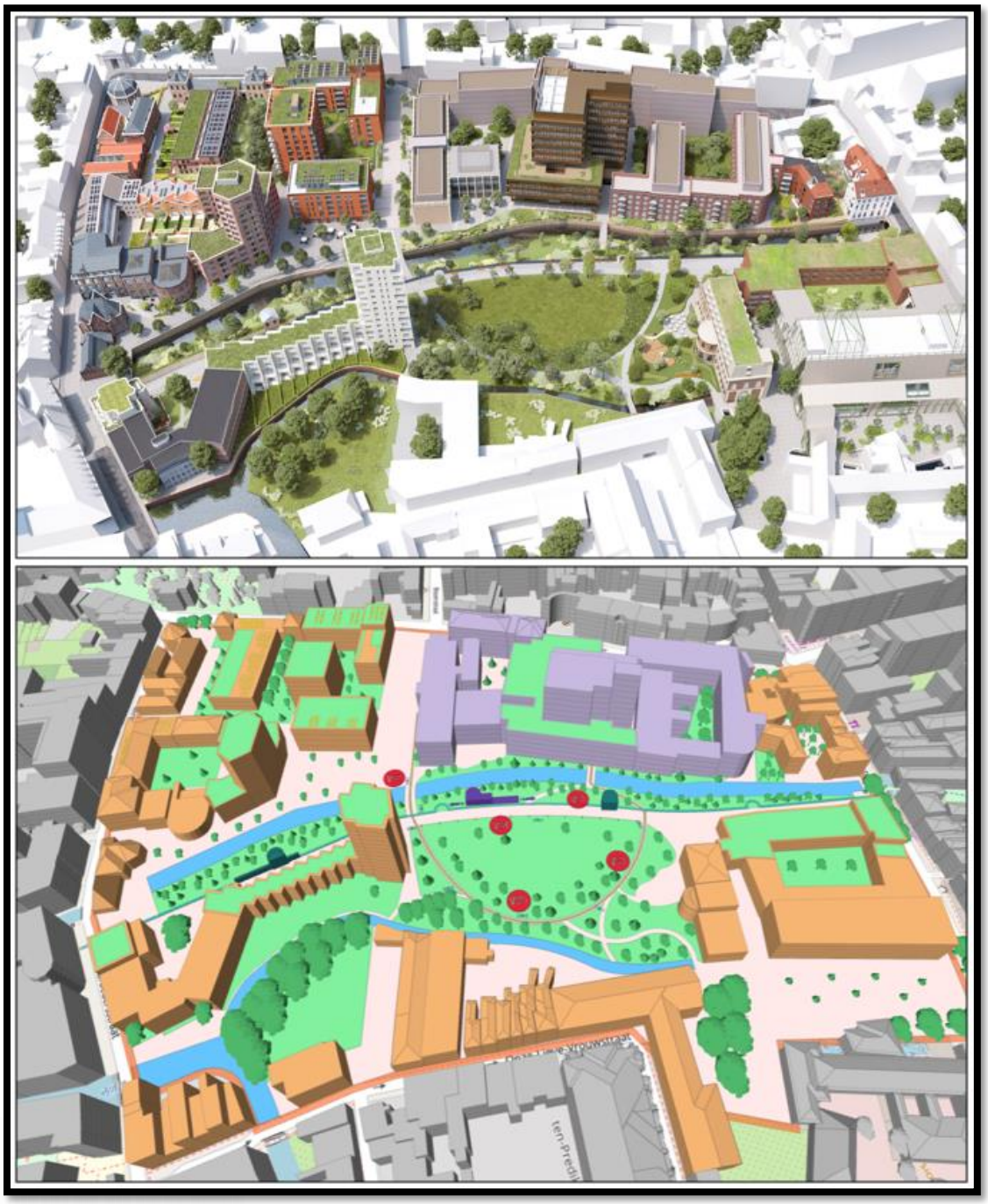


Figure 7 : Leuven Digital Twin Example – Local 3D Redner Digitized into an IES Digital Twin

Where provided, data from GeoJSON files was incorporated in the models, as shown in the below example of digitised trees in the Castlefranco model (Figure 8). This provided some automation of the digital process and resulted in less resources being used up in the manual digitization process. However, some pilot's sites size and scale limited the quality of VS digitization due to buffering issues with loading large amounts of 3D objects onto one platform. This issue is exemplified in Figure 9, Chania pilot site has scope is too large for one single model and had to be split into four pilot sites in order to reduce buffer times and improve user experience.

Figure 8 : Castlefranco Digital Twin Example using GeoJSON

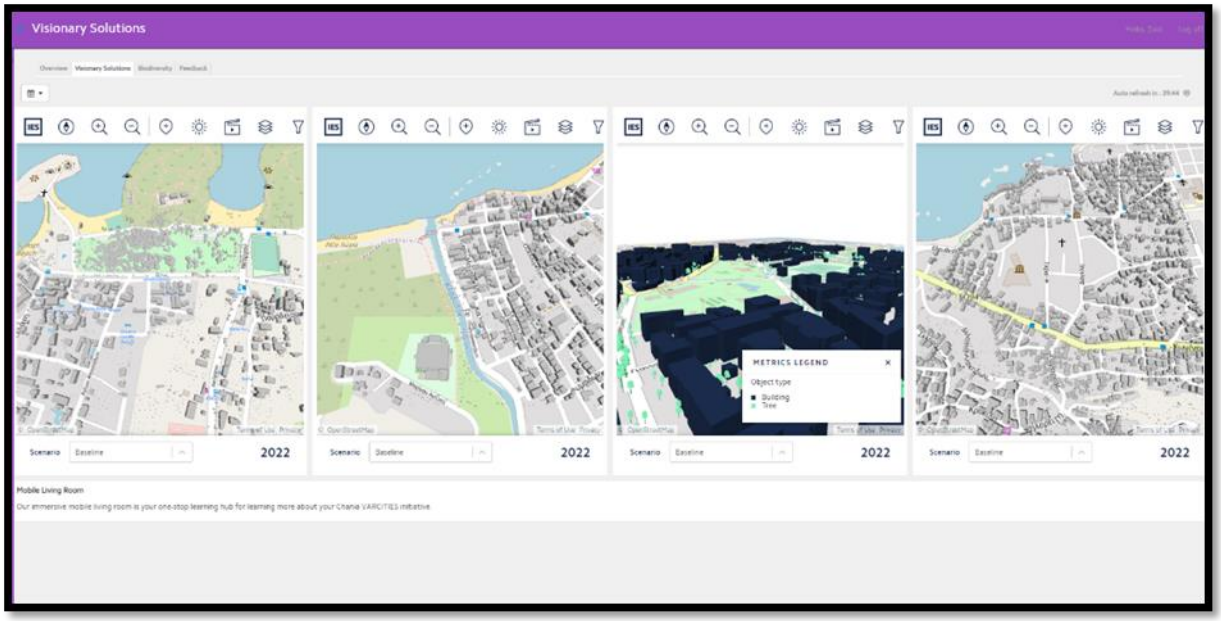


Figure 9 : Multiple Large Pilot Sites Chania

Once the digital twins are complete with accompanying VS, the models are uploaded onto the H&WB platform onto the visionary solutions page which is described in greater detail below.

Visionary Solutions page:

The Visionary Solutions page is for users to interact with an immersive digital twin of the area. These digital twins provide a visual representation of sensor locations and showcases the aforementioned VS. Complementing the map, a series of KPI cards is displayed, linked to live IoT sensors deployed in the area (Figure 10). The KPI cards include key measurements such as average temperature, humidity, wind speed, CO2 levels, NO2 levels, and daily solar radiation (these metrics vary from site to site). These metrics play a role in evaluating the area's environmental quality.

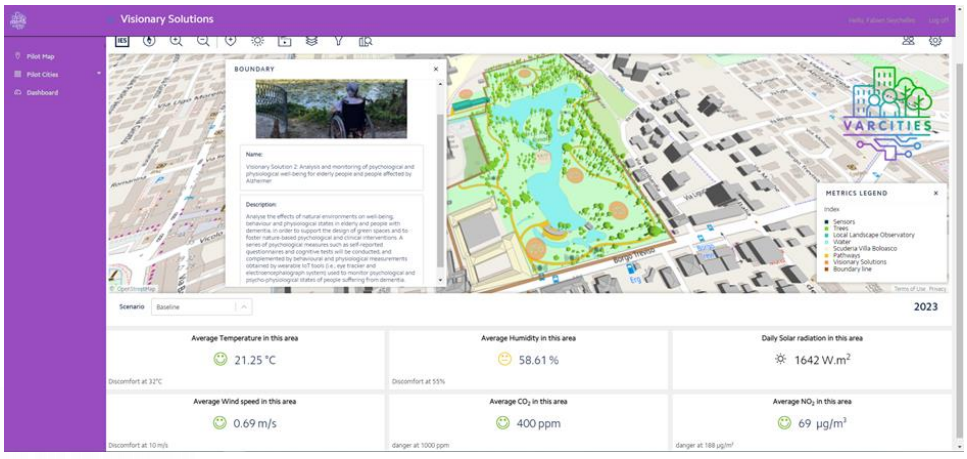


Figure 10 : VS of the Digital Twins

To enhance usability and comprehension, the KPI cards also feature visual indicators in the form of coloured icons. These icons assist users in quickly assessing the comfort or danger levels associated with each metric. By incorporating discomfort or danger limits on the cards, users can understand how uncomfortable or unhealthy the area can be.

VS Digital Objects:

By clicking the circular VS indicators (Figure 11), an info informative tab with an image and description of the VS will open, this is also true for any notable objects or structures in the model; however, these objects have limited data. Currently, the text and images are describing the VS provided by each pilot site which can be updated with more current information in the future.

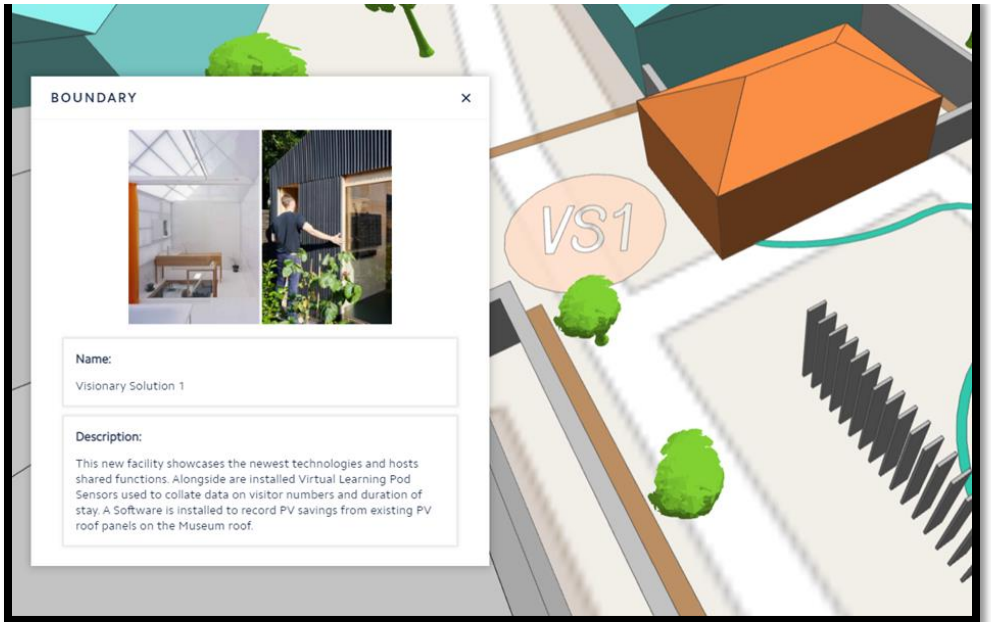


Figure 11 : VS Objects in Pilot Digital Twins

Outside of the VS, other model objects contain information on the pilot site. In Figure 12, the local museum that neighbours the pilot site has additional information supplied by the pilot site which describes other activities occurring at the site that is related to projects outside of the VARCITIES project.

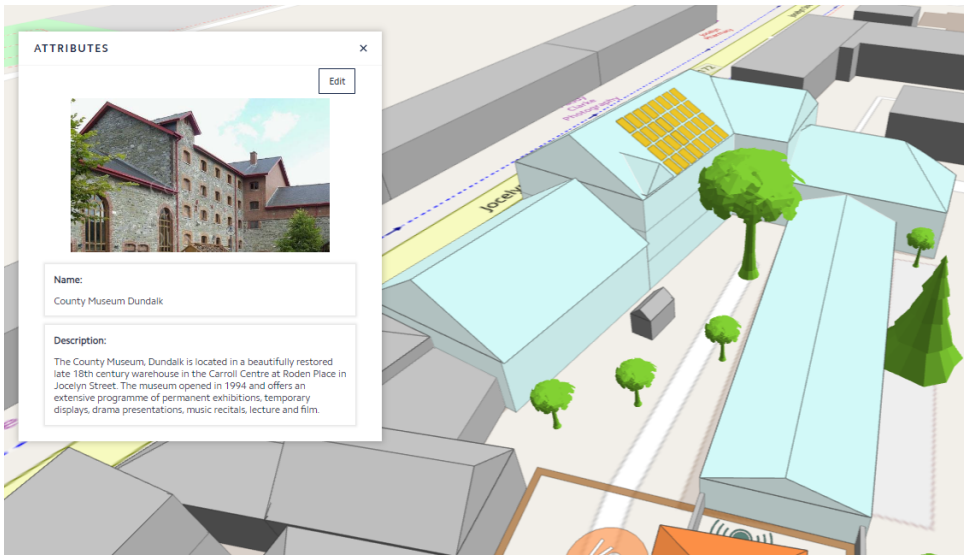


Figure 12 : VS Digital Renders on the H&WB Platform

Finally, Figure 13 illustrates a brief overview of each pilot site digital twin (excluding Chania which is 4 separate sites). Each pilot can now use the data generated from these 3D renders to support their own activities related to the VARCITIES project for public engagement and dissemination.

Figure 13 : Overview of Pilot Sites Digital Twins

5 H&WB Platform Biodiversity

Biodiversity page:

The biodiversity imitates the VS page except on a separate model designed to disseminate local biodiversity rather than VS (Figure 14).

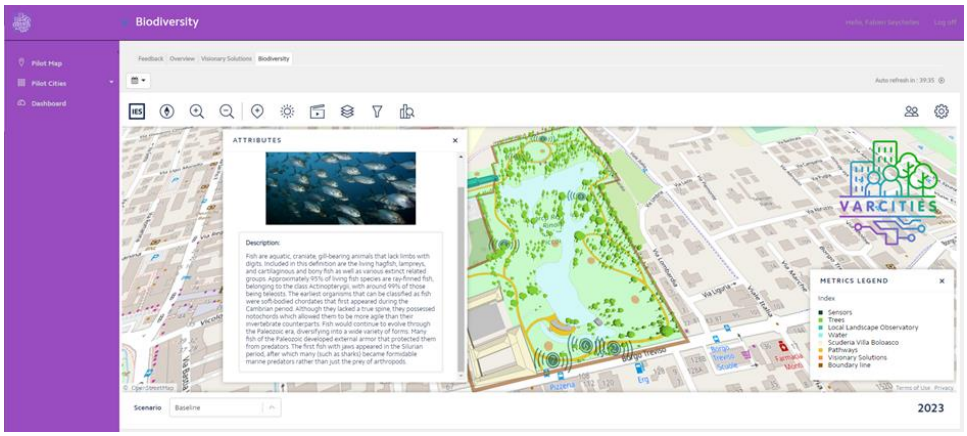


Figure 14 : H&WB Biodiversity Page Illustration

By navigating on the map, users can explore specific regions, zoom and click points of interest to understand the ecosystems, habitats, and species that contribute to the area biodiversity Much like the VS objects. Moreover, the biodiversity digital twins will focus on highlighting sensor locations and biodiversity data are to be displayed as shown below.

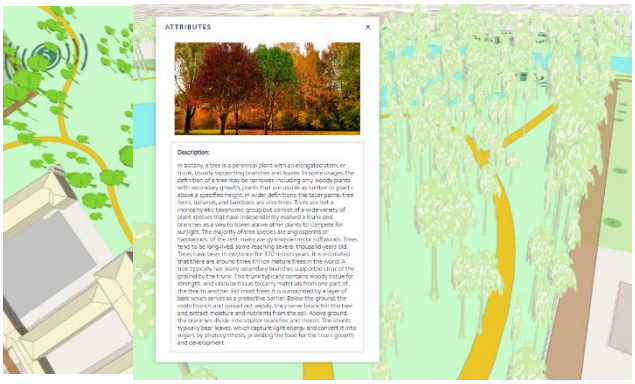


Figure 15 : Biodiversity Digital Twin Illustration – left sensor location and right object biodiversity info

As of now, only the Castlefranco pilot site has provided locations for the sensors, it should be noted that the text and images which pop up on clicking certain objects in the models are just placeholders for now, pending more data to be provided.

6 H&WB Platform Feedback & Survey Pages

The Feedback Tab & Survey page feature offers users a platform to provide valuable input and share their experiences when visiting the area. Both pages are available to all pilot sites with each tab having strengths and weakness towards the pilot's sites KPIs. The feedback page is illustrated in Figure 16; this page can consist of single or multiple questions with interval data inputs (Careerfoundry, 2023) . The user can select an icon accompanied by text to feedback their current mood, physical state, perception of the space they occupied, or any other subjective feedback the pilot site wishes to obtain from the pilot site participants (users).

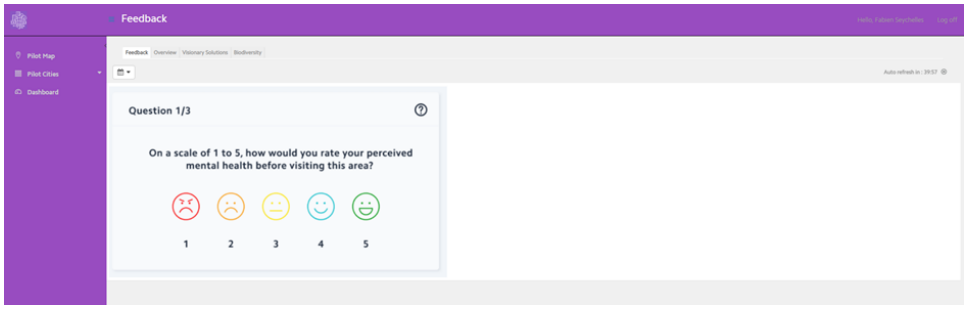


Figure 16 : Feedback Page

By considering user feedback, the lived experiences and perceptions of those interacting with the area can be analyzed. This information can help for decision-making, highlight areas of improvement, and refine strategies and interventions.

The survey page illustrates how survey feedback can be inputted by the user. In this example (Figure 17), we can see the popular survey webtool Survey Monkey, illustrated in an iFrame for user input. This survey will be designed by the local pilot site to archive their KPI goals outline in WP7. Although this survey template demonstrates text inputs, the surveys that will be implemented will only contain multiple choice questions to facilitate touchscreen user interface. Moreover, the pilot sites will need to use a survey platform or tool that atomically resets the survey after user input as this service will need to run automatically in situ without any inputs from the project team. Any survey tools that do not provide this service will run the risk of the survey window

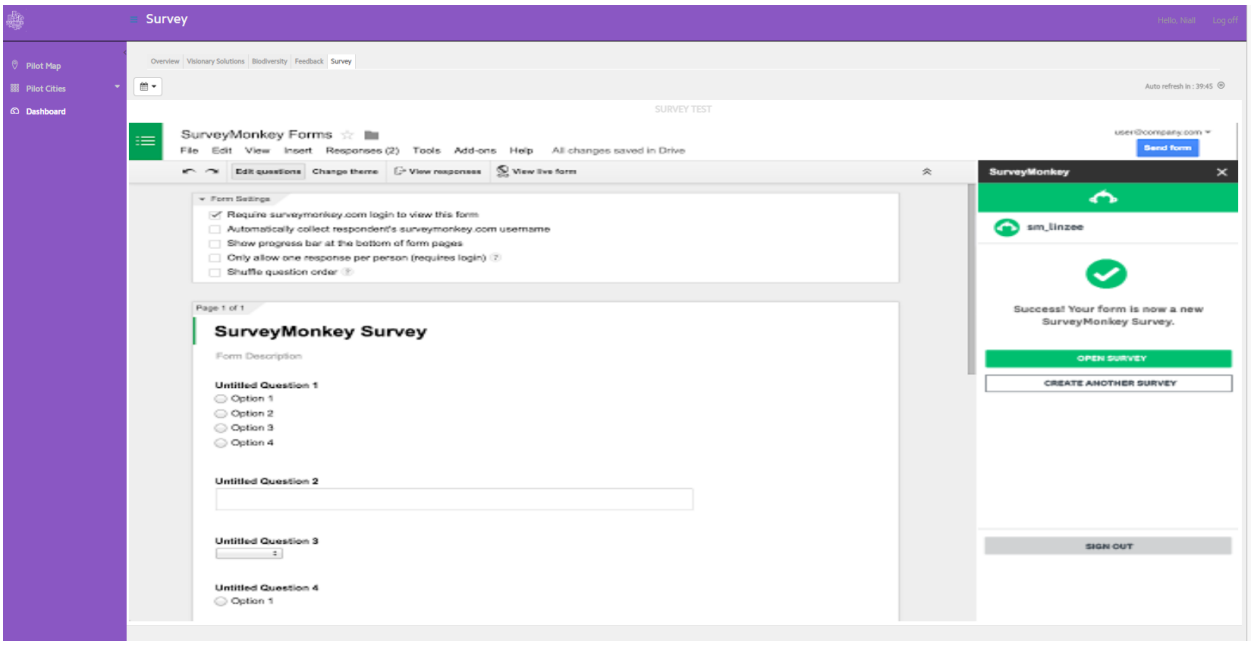


Figure 17 : Survey Page

7 H&WB Platform Dashboards

In this section, the focus will be on live data collection, dashboard creation, and dashboard content within the H&WB Platform. The process of collecting real-time data from IoT sources and integrating it into the dashboards will be explored, providing up-to-date information for analysis and decision-making. The creation of the dashboards, including the design and layout, will be discussed to ensure a user-friendly and intuitive experience. Additionally, the content available on the dashboards, such as key performance indicators, visualizations, and indicators related to health and well-being, will be reviewed. H&WB platform dashboards pull data from the VARCITIES API which gathers data directly from the sensors via the LoraWan and Sensor Network for use across all VARCITIES work package functions (Figure 18). The following sections describe how these data is used within the H&WB platform.

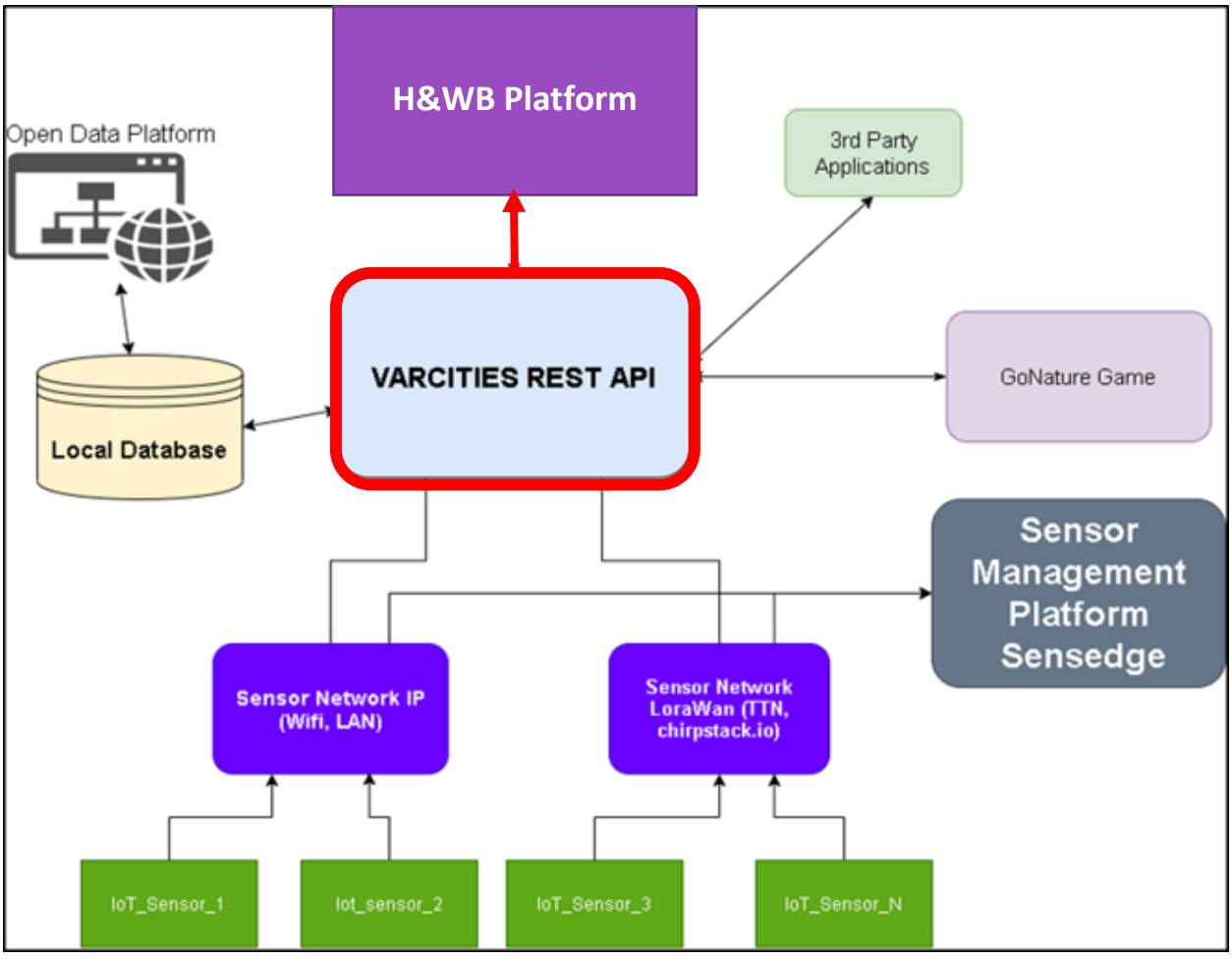


Figure 18 : VARCITIES Digital Architecture and H&WB platform Data flow

7.1 Live data collection

7.1.1 iSCAN project set-up

iSCAN (Intelligent Control and Analysis) allows to consolidate a range of time-series data from different BMS systems, utility meters, sensors and portable data loggers in one platform. Users can organise and analyse this data to gain hidden insights to improve portfolio operation. Any data source, format and time series can be organised and tagged. iSCAN has its own API that uses REST (representational state transfer) API as the design principles (Figure 19). REST APIs can be developed using any virtual programming language and support variety of data formats. IES iSCAN uses Python scripting as the platform's programming language. Users can use any platform that supports Python scripting.

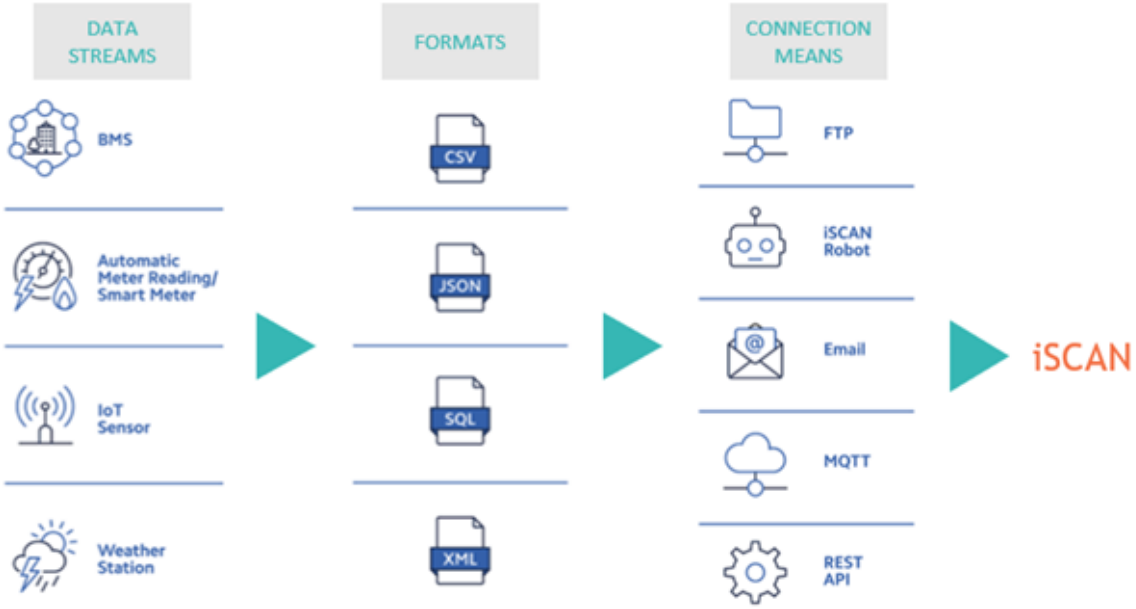


Figure 19 : Data Processing

Every pilot city will be added to iSCAN with the relevant information such as name and location (Figure 20).

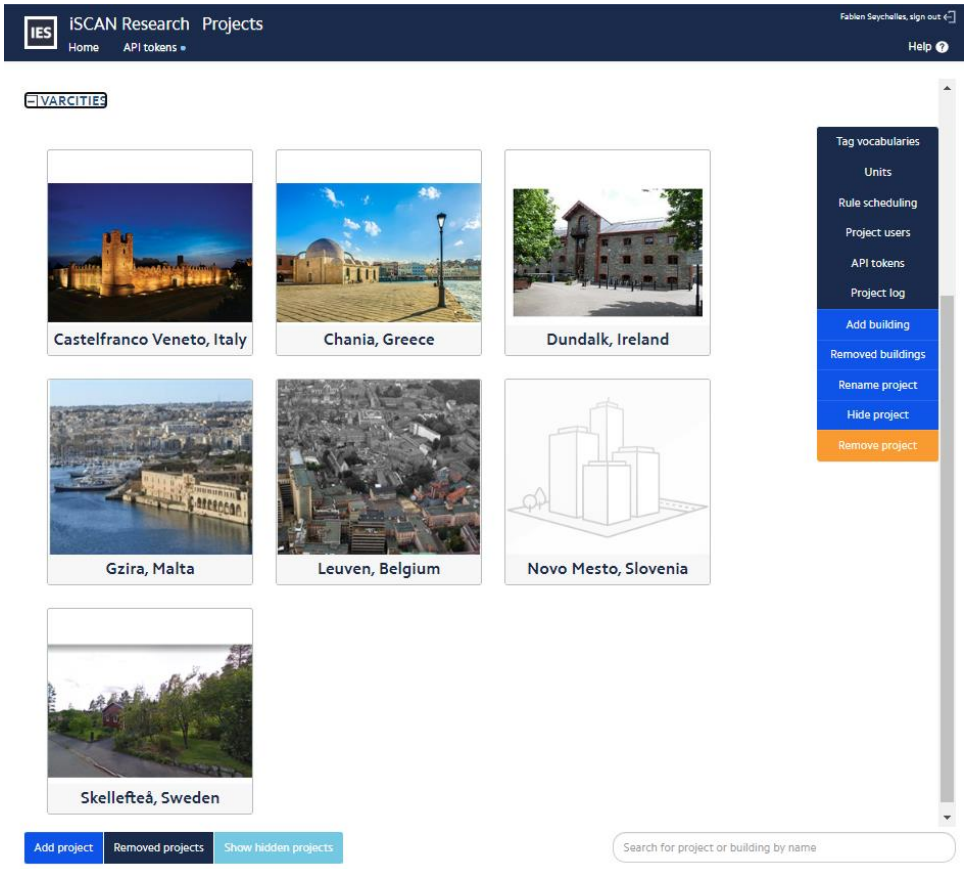


Figure 20 : Pilot Site Data Nodes

To initiate the collection of live data from sensors, a data import will be set. This process involves uploading a JSON template file that contains the name datapoint from IoT sensors (Figure 21). By utilizing this template, the associated channels required for data collection will be generated.

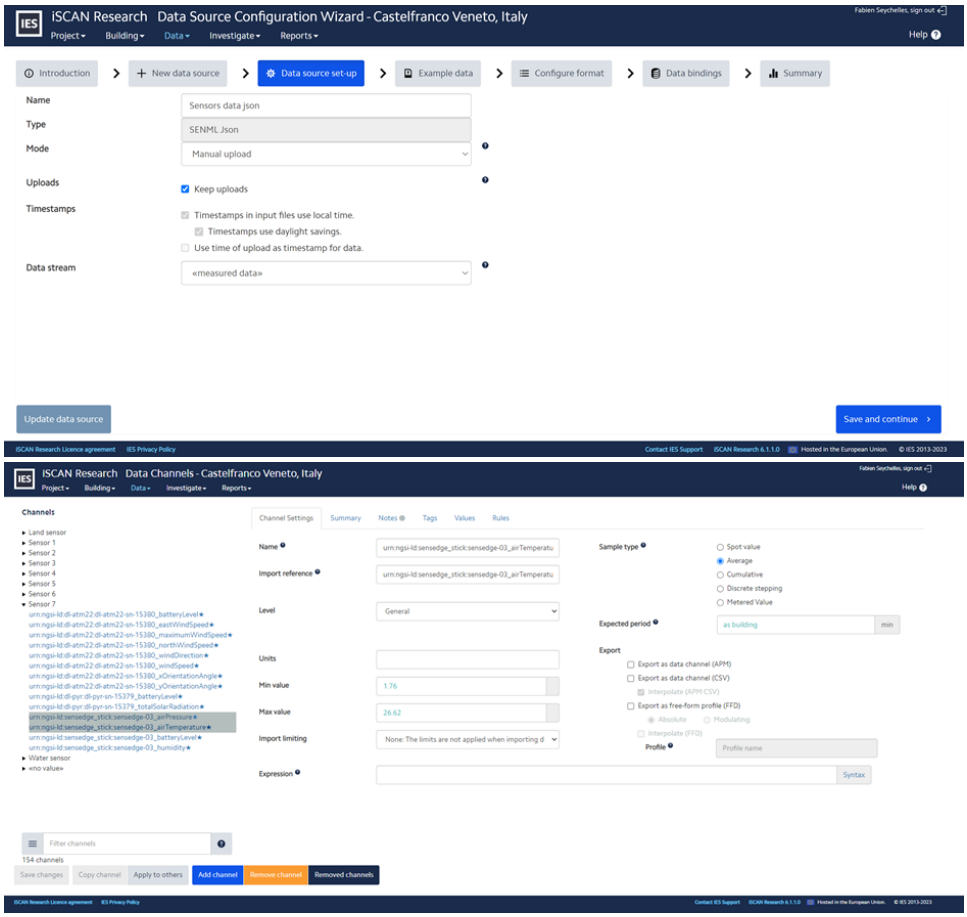


Figure 21 : iSCAN Workflow

7.1.2 Python script set-up

The live data collection process is implemented using API calls in Python. To make these API calls, certain information is required, including access to the list of sensors and the IoT data platform (Figure 22).

Figure 22 : Python Script for Pulling data from Varcities API and Converting it into Json

The Python script is structured as follows to facilitate the data collection process:

Importing Libraries:
The script begins by importing the necessary libraries and modules required for interacting with the IoT data platform and performing data manipulation tasks.

Logging in to the IoT Data Platform:
Next, the script authenticates the user by logging in to the IoT data platform. This step ensures that the script has the necessary permissions to access the required data.

Retrieving the List of Devices:
The script retrieves the list of devices or sensors available on the IoT data platform. This information is crucial for identifying the devices from which data needs to be collected.

Downloading IoT Data Points from Devices:
Using the device information obtained in the previous step, the script makes API calls to download the IoT data points from each device. This step involves retrieving data records or time series data associated with the specified devices.

Cleaning and Formatting Data:
Once the data is downloaded, the script performs data cleaning and formatting operations to ensure the data is in a consistent and usable format. This may involve removing any irrelevant or erroneous data points, handling missing values, or transforming the data into a standardized format.

Saving Data as a JSON File:
The cleaned and formatted data is then saved as a JSON file (Figure 23). This file serves as a structured representation of the collected data.

Figure 23 : Json Format from python script

Uploading Files on iSCAN using iSCAN API:

Finally, the script utilizes the iSCAN API to upload the saved JSON files onto the iSCAN platform. This allows for seamless integration of the collected data into the platform, enabling comprehensive analysis, visualization, and reporting (Figure 24).

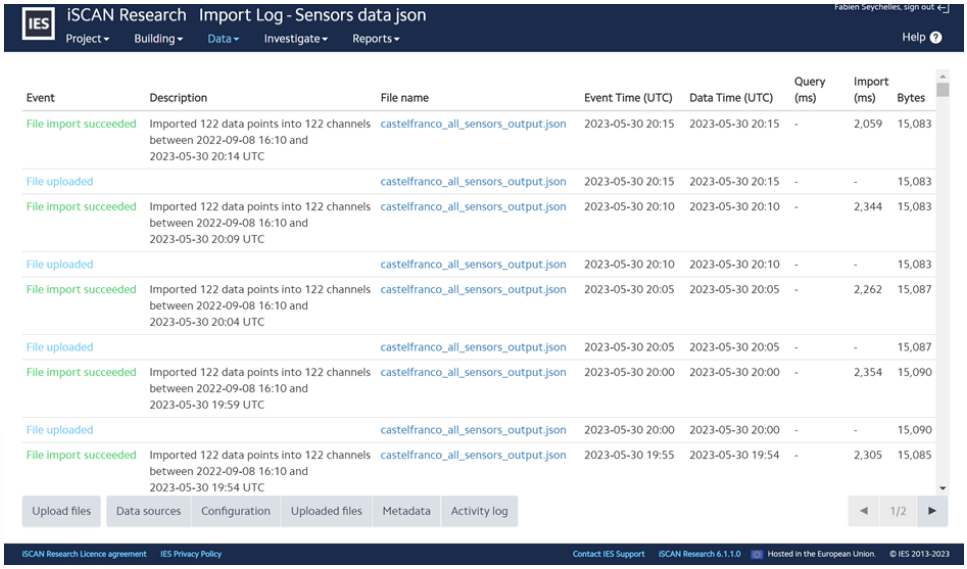


Figure 24 : Data Management and Visuals iSCAN

7.1.3 Automation

To automate the data collection process, the Python script is scheduled to run and upload data at regular intervals. Specifically, the script is configured to execute every 30 minutes . This automation is achieved by setting up a task in the Windows Task Scheduler on the IES Virtual Machine (Figure 25).

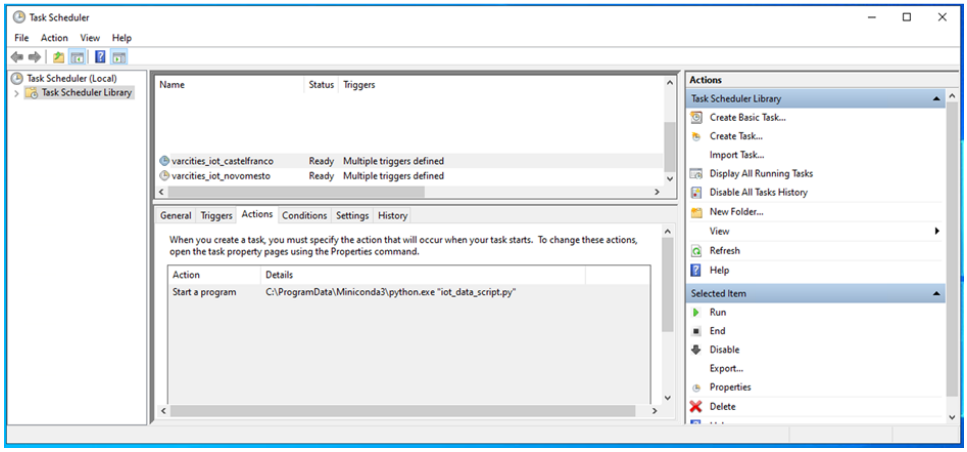


Figure 25 : Virtual Machine User Interface

The scheduled task is responsible for running the previously described script, which involves the following steps: data collection, data formatting, and data upload to iSCAN. By setting up the task in the Windows Task Scheduler, the script is executed automatically without the need for manual intervention, save time and ensures a continuous and efficient data collection process.

7.2 Dashboard

7.2.1 Dashboard creation

Dashboard creation involves several key steps to ensure a comprehensive and user-friendly data visualization experience.

Set Data Connection with iSCAN:

The first step in dashboard creation is establishing a data connection with the iSCAN platform. This connection enables the retrieval and integration of relevant data into the dashboard (Figure 26).

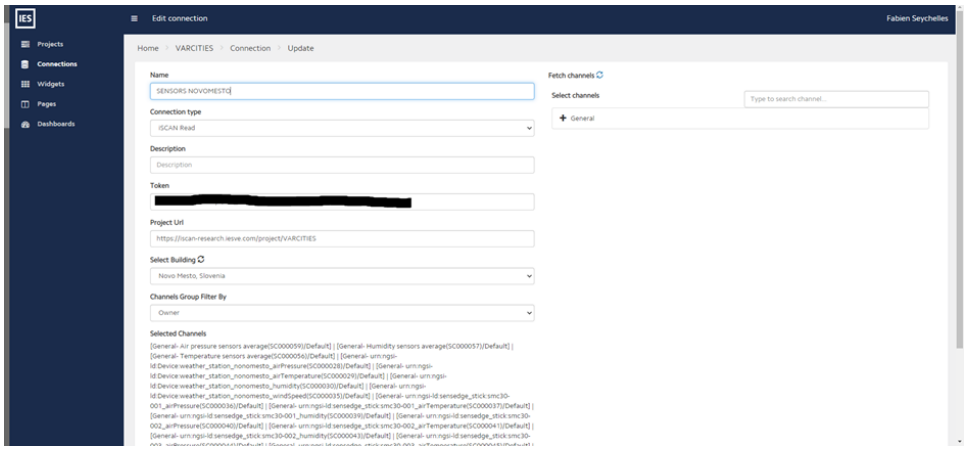


Figure 26 : Dashboard Creation Tab

Creating Widgets:

Once the data connection is established, various widgets are created to display the data in an informative and visually appealing manner. These widgets can include KPI cards, charts, tables, graphs, and other data visualization elements (Figure 27).

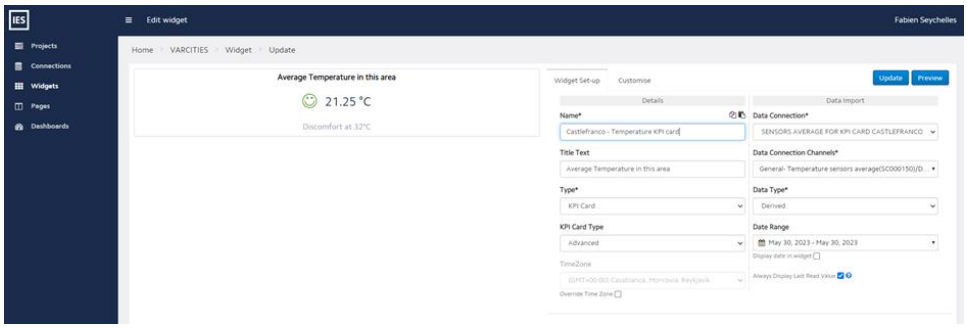


Figure 27 : Widget Creation Tab

Creating Pages and Assembling Widgets:

Next, pages are created within the dashboard to organize the content logically. Widgets created in the previous step are then assembled and placed strategically on the pages to present the data effectively (Figure 28).

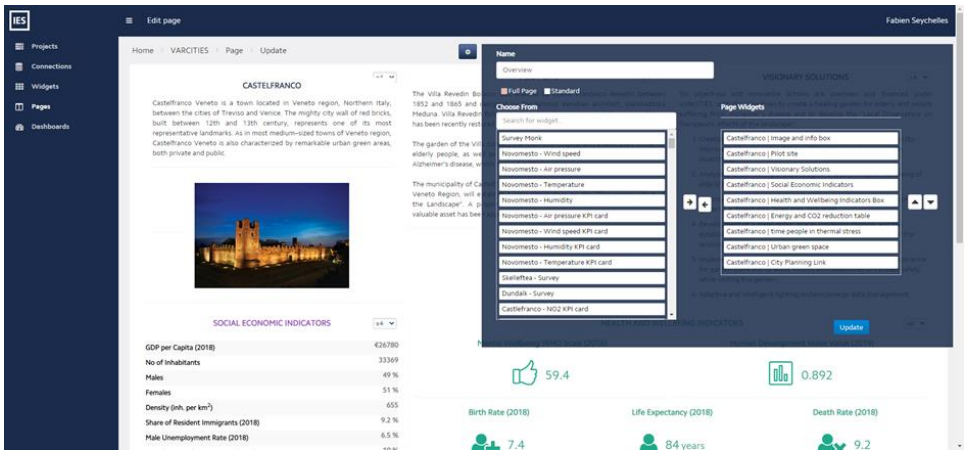


Figure 28 : Page Creation Tab

Creating and Publishing Dashboards:

After assembling the widgets and organizing the pages, the final step is to create and publish the dashboards (Figure 29).

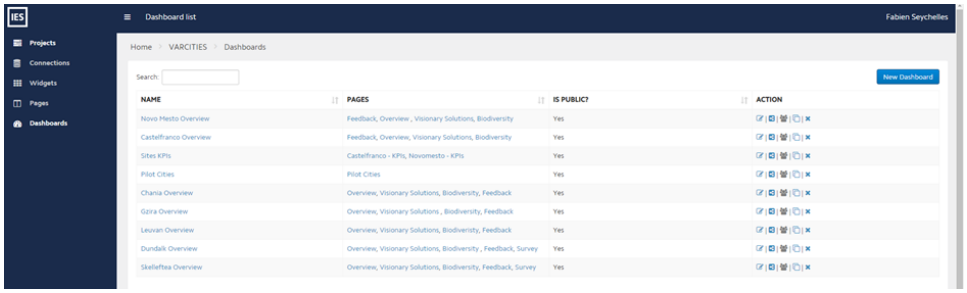


Figure 29 : Dashboard Tab for Pilot Sites

7.2.2 H&WB Dashboard content overview

Sites KPIs dashboard:

The dashboard link in the side bar menu grants users' access to advanced graphics and line charts for each pilot city. This feature provides a comprehensive overview of KPIs associated with the study sites.

Users can also access KPI cards of relevant parameters that display real-time data sourced from IoT sensors deployed across the study sites (Figure 30). In figure 31 intermitted data is illustrate 15/05/2023 -17/05/2023 from the Castlefranco pilot site demonstrating the flow of data from sensors, via the Varcities software architecture, into the H&WB platform. These charts offer a dynamic perspective on the evolution

of different KPIs over time, enabling users to identify patterns (figures 30, 31). At the time of writing this proposal, the automation of data was not deployed fully resulting in figures Illustrating sparse data. This will be fully operational on H&WB deployment.

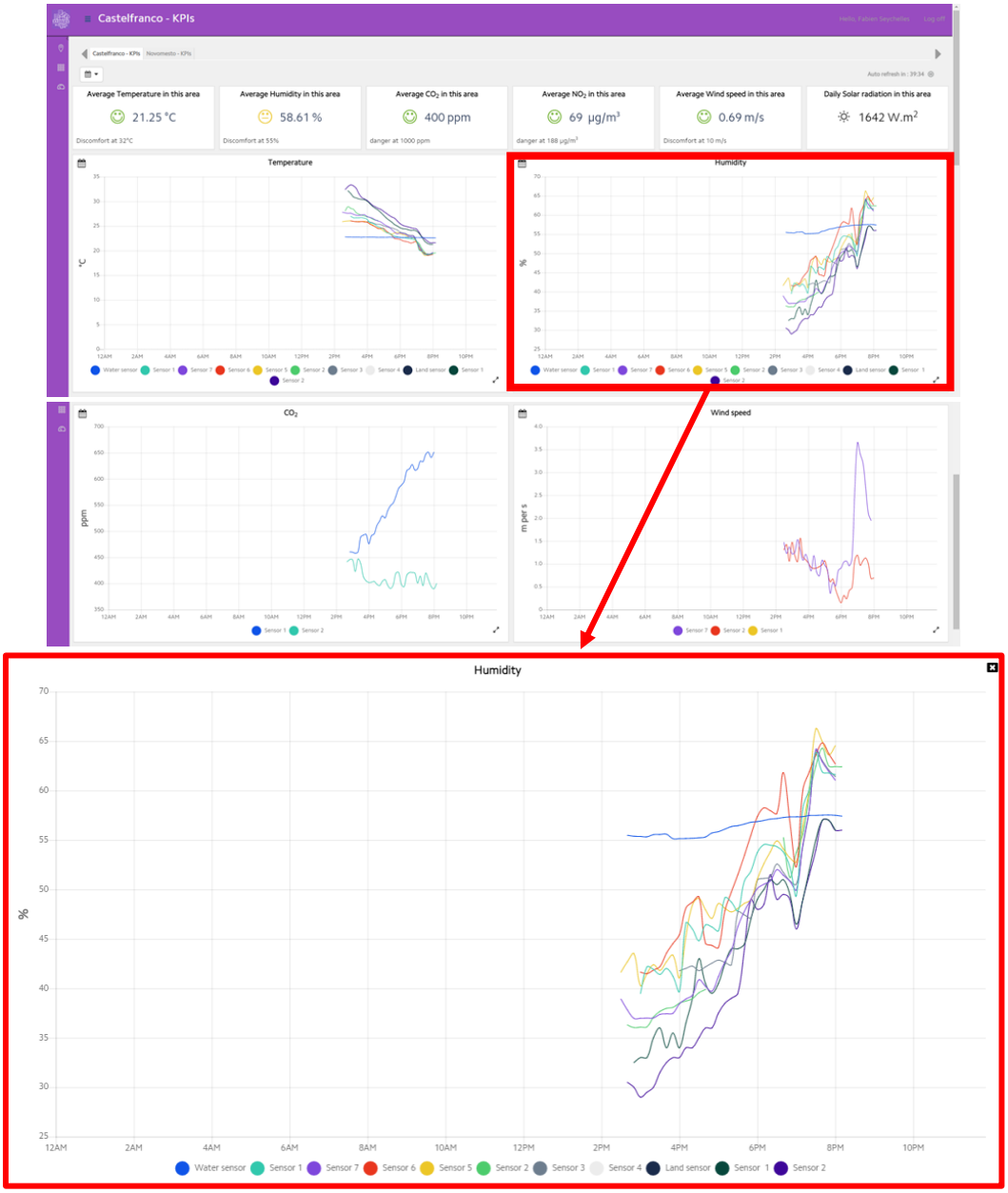


Figure 30 : Live API Sensor Data in Castlefranco Dashboards

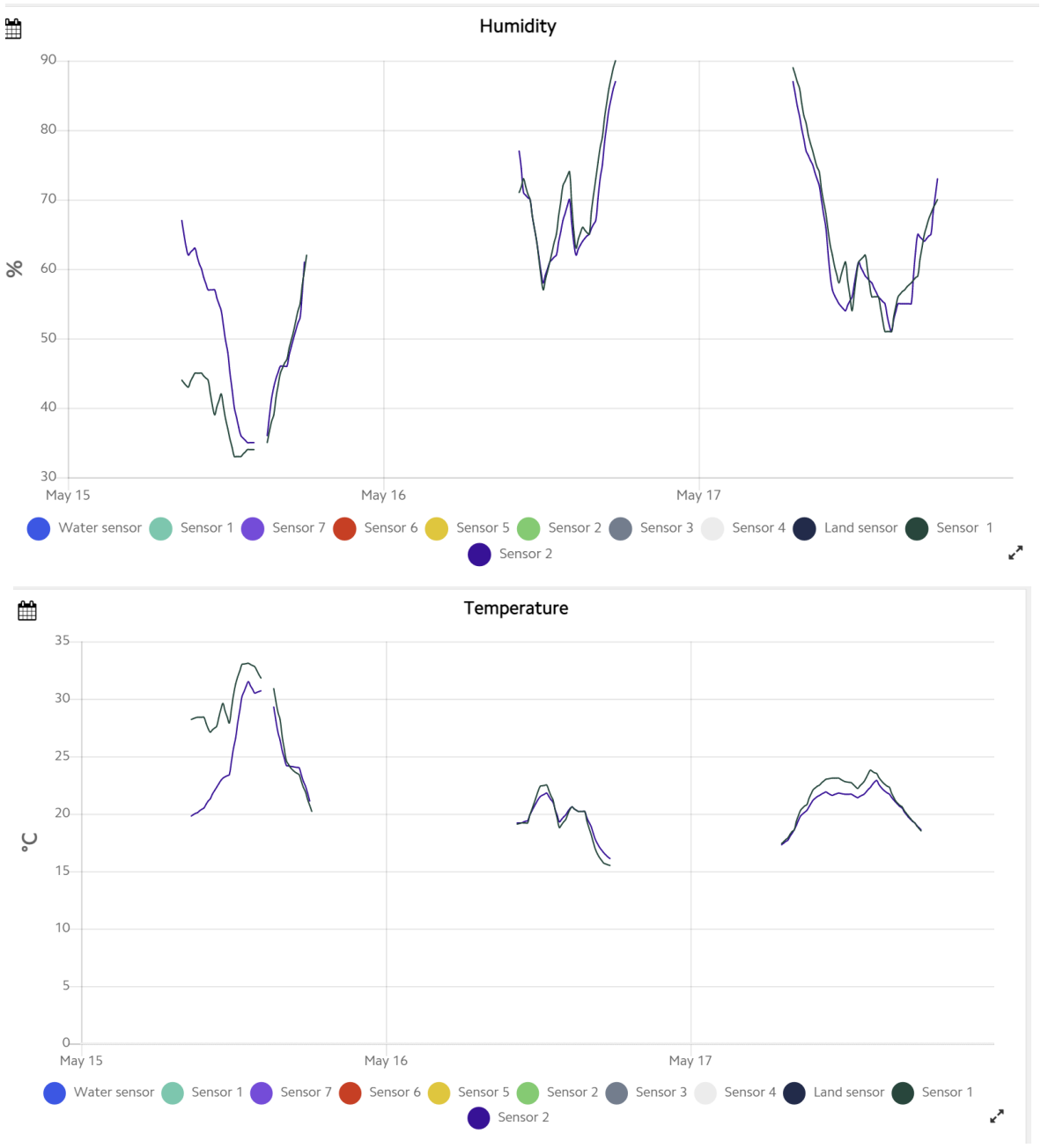


Figure 31 : Data flow from Sensors to H&WB platform

8 Conclusions

The Health & Well-Being (H&WB) platform developed as part of the Varcities project represents a pivotal tool in realizing the project's vision of implementing nature-based actions in urban environments. Serving as a digital twin, the H&WB platform acts as a bridge between real-world conditions and their digital representations, providing a user-friendly interface for stakeholders and the public.

The platform has successfully reached its final iteration, featuring a comprehensive template for each pilot site. Digital twins and visionary solutions form integral components of the H&WB platform, offering immersive 3D renders that visualize NbS assets and their real-world counterparts. Despite the complexity of NbS systems, the platform effectively abstracts key parameters to provide meaningful insights based on sensor data.

More in detail, this platform template includes a landing page map, an overview page describing the site's context, a visionary solutions page detailing nature-based solutions, a biodiversity page showcasing local flora and fauna, and user feedback and survey pages for participant engagement. Regarding these different pages, the digital twins accompanied by Visionary Solutions are uploaded onto the platform, creating an interactive space for users to explore and understand each pilot site's unique features (Visionary Solutions page). The Biodiversity page, similar in structure to the Visionary Solutions page, focuses on disseminating information about local biodiversity, contributing to public education about the vital role of natural infrastructure in urban settings. Finally, the Feedback and Survey pages add an interactive dimension to the platform, allowing users to provide valuable input and share their experiences. These features serve as crucial tools for analysis, decision-making, and refining strategies based on the lived experiences and perceptions of participants.

In parallel, the H&WB Platform Dashboards section details the live data collection process, emphasizing the integration of IoT sensor data into the platform. The creation of dashboards ensures a user-friendly and intuitive experience, providing real-time information for analysis and decision-making. The automation of data collection using iSCAN and Python scripting further enhances efficiency.

In conclusion, the H&WB platform stands as a robust and dynamic tool that not only illustrates the past, present, and future activities of Varcities pilot sites, but also facilitates user engagement, research development, and decision-making processes. Its successful implementation marks a significant milestone in achieving the project's goals for enhancing the health and well-being of citizens in urban environments exposed to diverse climatic conditions and challenges.

9 References

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