



H2020-LC-SC3-2018-RES
EUROPEAN COMMISSION
Innovation and Networks Executive Agency
Grant agreement no. 818329



Sun coupled innovative Heat pumps

D4.6 – SunHorizon Integrated Tool Manual

Due date of deliverable: **30/09/2022**

Actual submission date: **30/11/2022**

Organisation name of lead contractor for this deliverable: SE

Dissemination Level (Specify with “X” the appropriate level)		
PU	Public	X
CO	Confidential	

Project Contractual Details

Project Title	Sun coupled innovative Heat pumps
Project Acronym	SunHorizon
Grant Agreement No.	818329
Project Start Date	01-10-2018
Project End Date	30-09-2023
Duration	60 months
Supplementary notes:	This document will be publicly available (on CORDIS and project official websites as soon as approved by EC)

Table of Figures	3
Table of Tables	5
Introduction	6
Abbreviations and notations	6
1 Proactive maintenance	8
1.1 How it works	8
1.2 Functional test description	8
1.3 Functional test validation	12
1.4 Proactive maintenance workflow and how to use it	13
2 Design Under Uncertainty	18
2.1 How it works	18
2.2 How to use it	18
2.3 Troubleshooting	22
2.4 Examples	22
3 Feedback App	24
3.1 How it works	24
3.2 Feedback app validation and configuration	26
3.3 How to use it	28
3.4 Troubleshooting	29
4 Decision making tool	30
4.1 How it works	30
4.2 How to use it	30
4.3 Troubleshooting	34
5 Dashboards	35
5.1 Dashboards in EcoStruxure	35
5.1.1 How it works	35
5.1.2 How to use it	35
5.1.3 Troubleshooting of devices/system	39
5.2 Dashboard in iDashboards tool	41
5.2.1 How it works	42
5.2.2 How to use it	43
5.2.2.1 Auto-refresh	44
5.2.2.2 Calendar date selection	44
5.2.2.3 KPI card	45
5.2.2.4 Line chart	45
5.2.2.5 Alarms/Alerts	46
5.2.2.6 Administrator functionalities	47
5.2.3 Troubleshooting	48
6 Conclusion	49

Table of Figures

Figure 1: Proactive maintenance tool process	8
Figure 2: SunHorizon codification system for KPIs for proactive maintenance	9
Figure 3: Functional test building repository.....	12
Figure 4: I.EFESH-9 daily data.....	13
Figure 5: K.RERSy-9-15m danger alarm.....	13
Figure 6: Error log file.....	13
Figure 7: Appearance of the e-mail received by the user.....	14
Figure 8: Maintenance KPIs flow.....	17
Figure 9: Input page section.....	19
Figure 10: Widget selection.....	19
Figure 11: Location dropdown menu.....	19
Figure 12: Technology package result table	20
Figure 13: Output page example.....	20
Figure 14: Cooling Demand	21
Figure 15: Cooling Demand	21
Figure 16: Peak cooling power distribution	22
Figure 17: Peak heating power distribution	22
Figure 18: Example input specification.....	23
Figure 19: Extended result page	23
Figure 20: SunHorizon app login view.....	24
Figure 21: SunHorizon app Overview view	25
Figure 22: SunHorizon app Energy view.....	25
Figure 23: SunHorizon app Feedback view	25
Figure 24: SunHorizon app More view	26
Figure 25: ISCAN portal showing feedback sent by the app.....	26
Figure 26: Feedback stored in App database.	27
Figure 27: Feedback app database logs.....	27
Figure 28: Feedback app database feedback data	28
Figure 29: SunHorizon app Riga building configuration	28
Figure 30: Feedback app download links in QR-code.....	29
Figure 31: DMT landing page.....	30
Figure 32: DMT Map page	31
Figure 33: DMT new Building page.....	31
Figure 34: DMT Solar Tech page.....	32
Figure 35: DMT System Type page	32
Figure 36: DMT new Results page.....	33
Figure 37: DMT Monitoring page	33
Figure 38: Questionnaire.....	34
Figure 39: Login page	35
Figure 40: Landing page	36
Figure 41: Site Homepage	36
Figure 42: Room Dashboard.....	37

Figure 43: Energy meter Dashboard	37
Figure 44: Water Meter Dashboard	38
Figure 45: Weather Station Dashboard	38
Figure 46: Data List View	39
Figure 47: Demo sites Landing page – how to see alarms	39
Figure 48: How to select only device offline alarms	40
Figure 49: How to acknowledge an alarm	40
Figure 50: KPI card widgets examples in iDashboards	41
Figure 51: Example KPI card, floor plan and line chart widgets	41
Figure 52: SunHorizon monitoring tool workflow	42
Figure 53: SunHorizon iDashboards tool – Riga Sunisi house Example	43
Figure 54: iDashboards login page	43
Figure 55: Riga Sunisi dashboard KPIs page	44
Figure 56: iDashboards – Auto refresh	44
Figure 57: iDashboards - date selection button	45
Figure 58: iDashboards – KPI card	45
Figure 59: iDashboards - Line Chart	46
Figure 60: Dashboards – Alarms/Alerts	46
Figure 61: iDashboards – Display & Acknowledge Alert	47
Figure 62: iDashboards – administrator view 1	47
Figure 63: iDashboards – administrator view 2	48

Table of Tables

Table 1: Terms and description used within SunHorizon project	6
Table 2: KPIs included in the Proactive Maintenance Tool functional test	9
Table 3: Pls included in the Proactive Maintenance Tool functional test	10
Table 4: Indicators included in the Proactive Maintenance Tool functional test	10
Table 5: Alarms levels.....	12
Table 6: FMECA, Riga Sunisi demo site (RGS, TP2)	15
Table 7: Type of current maintenance action and maintenance action to be followed; indicators are calculated and recommended maintenance actions can be implemented if the failure happens a lot (which will mean the current maintenance action can be improved to the recommended one).....	16

Introduction

This user manual is a technical communication document intended to give assistance to end-users on how to use SunHorizon tools, with the aim of providing a general description and a guide to their use, and also to provide information and instruction on how to use the App and the Dashboards developed and used for the project.

The SunHorizon tools that will be detailed in this manual are:

- Proactive Maintenance tool, used to obtain the best operating strategy in a process or equipment, analysing different maintenance scenarios, taking into account consequences and cost of failures on a preventive, corrective and predictive basis
- Design Under Uncertainty tool, used to identify the optimal configuration for each technology package, providing an estimation of size, capital cost and operative costs
- Decision making tool, a web platform that allows assessing, for specific condition, which is the most suitable SunHorizon technology package, recommending the combination of technologies that should suit best the selected application and country.
Decision making tool, a web platform that allows assessing, for specific condition, which is the most suitable SunHorizon technology package, recommending the combination of technologies that should suit best the selected application and country.

This user manual consists of textual visual information (illustrations, screenshots, tables etc.) to assist the user in completing specific tasks. It also contains both procedural information (step-by-step instructions) and conceptual information needed to understand how to approach, to use, and to manage the tools and their related issues.

The document also provides a series of instructions on the use of the application and of the dashboards related to the SunHorizon project, suggesting certain user behaviours thus to obtain optimal user experience, and best performance.

The SunHorizon Feedback App has been developed to permit to the user to see real-time data about indoor climate and energy consumption, but also to provide to the SunHorizon system the user's feedback, essential for the self-learning algorithms. The manual will then focus on the description of the two dashboards:

- Dashboards in EcoStruxure Platform, created by Schneider Electric, with which is possible to visualize and consult in real time or over time, every data monitored thanks to graphic pages
- iDashboards created by IES, a web-based platform to provide a customisable end-user interface to visualize real-time data and KPIs of project from iSCAN.

Moreover, regarding the structure of the instructional manual we can distinguish blocks and sections, each of them with its characteristics, communicative purposes, and consequent complexity. Each section is dedicated to the description of the procedures for the correct use of the integrated tools and of the information about their composition and operation.

Therefore, the communicative intention of the manual is to facilitate the relationship between the user and the Integrated Tool, in order to guarantee maximum user satisfaction, by taking advantage of its functionality.

Abbreviations and notations

In the following table some of the terms and abbreviations frequently used in the document are shown.

Table 1: Terms and description used within SunHorizon project

Term	Description
DMT	Decision Making Tool
DUU	Design Under Uncertainties
FMECA	Failure Modes, Effects and Critically Analysis

I	Indicator
KPI	Key Performance Indicator
PI	Performance Indicator
PV	Photovoltaic
RCM	Reliability-Centred Maintenance
RUL	Remaining Useful Life
TP	Technology Package
$\Gamma_{comfort}$	Thermal Comfort score
Γ_{cost}	Cost score

1 Proactive maintenance

1.1 How it works

The SunHorizon project's proactive maintenance is based on the Reliability-Centred Maintenance (RCM) strategy, which is used to obtain the best operating strategy in a process or equipment through failure detection and maintenance monitoring capabilities.

RCM, which focuses on understanding the failure modes of equipment, analyses different maintenance scenarios to evaluate and implement the best possible strategy, taking into account consequences and cost of failures on a preventive, corrective and predictive basis, seeking to improve reliability and maintenance throughout the life-cycle.

To achieve this objective, and detect failures, several Key Performance Indicators (KPIs) have been defined. The KPIs are calculated in real time operation and compared with the baseline simulation data. Upon alarms, each KPI has been implemented that in case the alarm is reached, the detection of the failure triggers the maintenance actions defined in the Failure Modes, Effects and Critically Analysis (FMECA). In addition, the remaining useful life (RUL) is calculated to predict possible future failures.

The methodology tool flow developed in the Python programming environment is shown in Figure 1, where it includes several steps that will be executed once a day every day. First, the monitoring data located in IES platform is collected through the use of an API. Then, both KPIs, PIs and other specified indicators (Is) are calculated, whose KPIs refer to the SunHorizon system as a whole and PIs focus on the performance of each of the installed technologies, using their formulas with a given resolution time for each of them, which can be 15 minutes, hourly, daily or yearly.

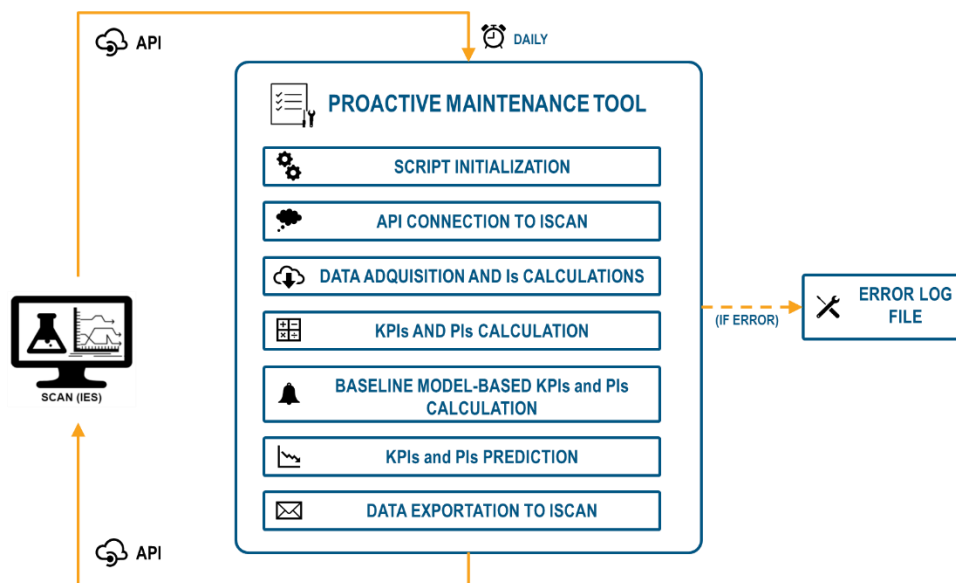


Figure 1: Proactive maintenance tool process

In the next step, both KPIs and PIs are estimated by using the baseline modelled in a dynamic simulation program, which is called TRNSYS, and the actual measured data as inputs to make a comparison between the actual and expected indicators in order to detect possible failures in the installed devices. The RUL calculation of the different systems is launched to obtain the value for the scheduling of maintenance tasks. Finally, KPIs, PIs and Is, which are previously calculated, are sent to IES platform, and the stakeholder could check the evolution of each indicator. However, if any alarm is triggered, a notification is sent via web and email to the worker.

1.2 Functional test description

To validate the tool, a preliminary functional unit has been developed for Riga Sunisi demo site. For the sake of clarity, only daily and 15-minute KPIs and PIs have been considered and coded for ease of storage in iSCAN. Figure 2 explains the methodology for constructing the code alarm which will be used to create the channels in iSCAN and use the channel

names to get the data in the KPI maintenance tool. The codification follows the same structure presented in deliverable D4.2.

H.AAANN-D-XXXN

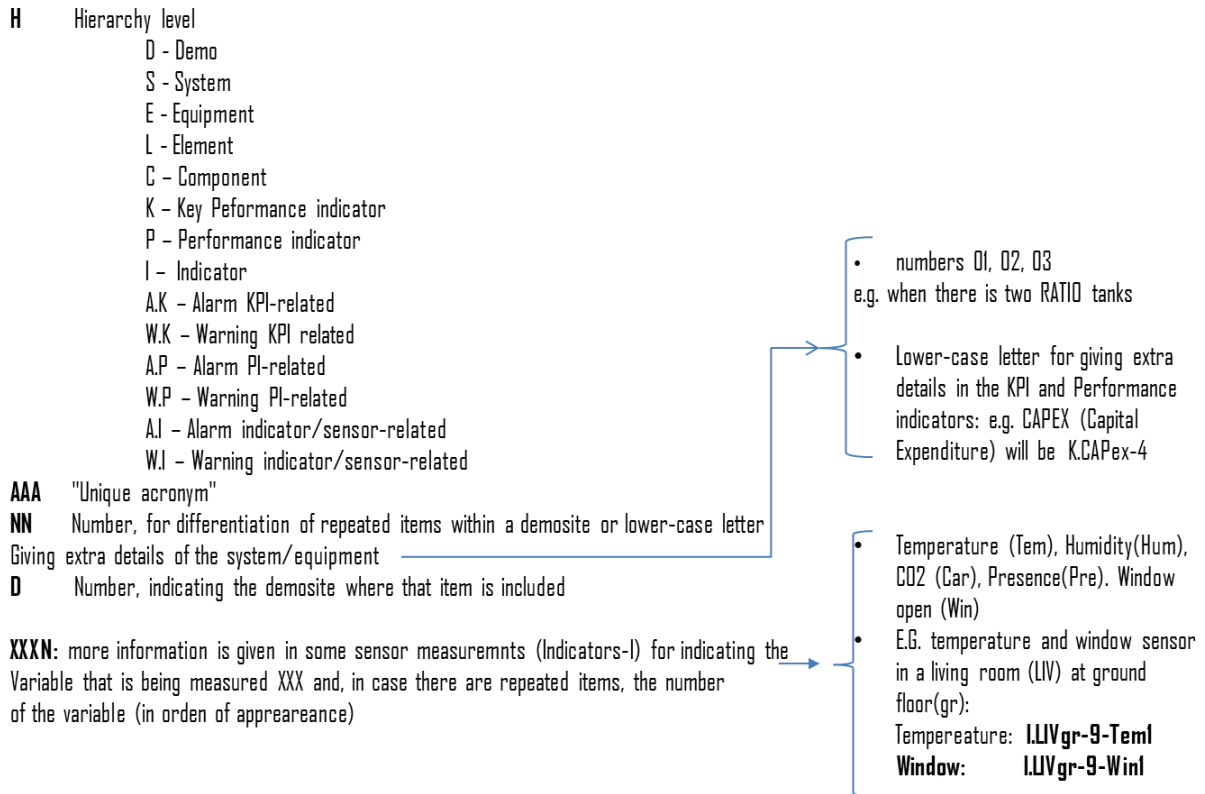


Figure 2: SunHorizon codification system for KPIs for proactive maintenance

The KPIs and PIs are presented in Table 2: KPIs included in the Proactive Maintenance Tool functional test and Table 3, where both indicate the status of the system and perform fault detection. The list of KPIs is associated with environmental, comfort or saving aspects, while the list of PIs is associated with the current state technologies.

Table 2: KPIs included in the Proactive Maintenance Tool functional test

Code	Description	Unit	Sampling time
K.CBRsy-9-day	Customer's bills reduction	€	Day
K.GHGsa-9-day	GHG emissions reduction	gCO ₂	Day
K.HCIff-9-15m	First floor heating comfort index	°C·h	15 minutes
K.HCIff-9-15m_est	First floor heating comfort index, estimated	°C·h	15 minutes
K.HCIff-9-day	First floor heating comfort index	°C·h	Day
K.HCIgr-9-15m	Ground floor heating comfort index	°C·h	15 minutes
K.HCIgr-9-15m_est	Ground floor heating comfort index, estimated	°C·h	15 minutes
K.HCIgr-9-day	Ground floor heating comfort index	°C·h	Day
K.HCIsy-9-15m	System heating comfort index	°C·h	15 minutes
K.HCIsy-9-15m_est	Ground floor heating comfort index, estimated	°C·h	15 minutes
K.HCIsy-9-day	System floor heating comfort index	°C·h	Day
K.PESnr-9-day	Non-renewable primary energy savings	kWh	Day
K.RERSy-9-15m	Renewable energy ratio	%	15 minutes
K.RERSy-9-15m_est	Renewable energy ratio, estimated	%	15 minutes
K.RERSy-9-day	Renewable energy ratio	%	Day

Code	Description	Unit	Sampling time
K.SCRsy-9-15m	Electricity self-consumption ratio	%	Day
K.SCRsy-9-day	Electricity self-consumption ratio	%	Day

Table 3: Pls included in the Proactive Maintenance Tool functional test

Code	Description	Unit	Sampling time
P.EFEds-9	DaulSun solar electric efficiency	%	15 minutes
P.EFEds-9_est	DaulSun solar electric efficiency, estimated	%	15 minutes
P.EFTds-9	DaulSun solar thermal efficiency	%	15 minutes
P.EFTds-9_est	DaulSun solar thermal efficiency, estimated	%	15 minutes
P.FSOds-9	DaulSun solar thermal fraction	ratio	15 minutes
P.FSOds-9_est	DaulSun solar thermal fraction, estimated	ratio	15 minutes
P.RATdt-9	Ratiotherm tank stratification efficiency	°C	15 minutes
P.RATdt-9_est	Ratiotherm tank stratification efficiency, estimated	°C	15 minutes
P.SGUbh-9-15m	BOOSTHEAT seasonal gas utilization efficiency	ratio	15 minutes
P.SGUbh-9-15m_est	BOOSTHEAT seasonal gas utilization efficiency, estimated	ratio	15 minutes
P.STGdt-9	Glycol tank stratification efficiency	°C	15 minutes
P.STGdt-9_est	Glycol tank stratification efficiency, estimated	°C	15 minutes
P.TERds-9	DualSun thermal-electricity ratio	%	15 minutes
P.TERds-9_est	DualSun thermal-electricity ratio, estimated	%	15 minutes

The indicators (variables) required for the calculation of the KPIs and Pls listed above are exposed in Table 4.

Table 4: Indicators included in the Proactive Maintenance Tool functional test

Code	Description	Unit
I.CELbs-9	Electricity costs (baseline)	€
I.CELpr-9	Electricity costs (post-retrofit)	€
I.CFUbs-9	Fuel costs (baseline)	€
I.CFUpr-9	Fuel costs (post-retrofit)	€
I.EFAux-9	Electricity consume by auxiliaries	kW
I.EFBoh-9	Electricity consumption boostheat	kW
I.EFEbs-9	Total electricity demand (baseline)	kW
I.EFEIp-9	Electricity consumption of non-SunHorizon loads	W
I.EFEsh-9	Electricity consumption of SunHorizon system	kW
I.EFEsy-9	Total electricity demand (post-retrofit)	kW
I.EFEsy-9_est	Total electricity demand (post-retrofit), estimated	kW
I.ELPri-9	Electricity price	€/kW
I.EPVsf-9	Electric energy self-consumed	kW
I.EPVto-9	DualSun electric power output	kW
I.EPVto-9_est	DualSun electric power output, estimated	kW
I.FFMdt-9	First floor mean temperature	°C
I.FFMdt-9_est	First floor mean temperature, estimated	°C
I.GAPri-9	Gas price	€
I.GFMdt-9	Ground floor mean temperature	°C
I.GFMdt-9_est	Ground floor mean temperature, estimated	°C
I.GHGbs-9	GHG emissions (baseline)	gCO ₂
I.GHGto-9	GHG emissions (post-retrofit)	gCO ₂
I.PENnb-9	Non-renewable primary energy (baseline)	kWh
I.PENnp-9	Non-renewable primary energy (post-retrofit)	kWh
I.PENnp-9_est	Non-renewable primary energy (post-retrofit), estimated	kWh
I.PENre-9	Renewable primary energy	kWh
I.PENre-9_est	Renewable primary energy, estimated	kWh

Code	Description	Unit
I.PENto-9	Total primary energy	kWh
I.PENto-9_est	Total primary energy, estimated	kWh
I.QFBoh	BOOSTHEAT thermal power output	kW
I.QFBoh-9_est	BOOSTHEAT thermal power output, estimated	kW
I.QFDus-9	DualSun thermal power output	kJ/h
I.QFDus-9_est	DualSun thermal power output, estimated	kJ/h
I.QFEbs-9	Total gas demand (baseline)	kW
I.QFEfu-9	Total gas demand (post-retrofit)	kW
I.QFEfu-9_est	Total gas demand (post-retrofit), estimated	kW
I.QFElh-9	Electric heater thermal power output	kW
I.QSHwh-9	Space heating thermal energy	kW
I.QUSdh-9	DHW time outside heating comfort	kW
I.RGSwe-9-Hum1	Ambient relative humidity	%
I.RGSwe-9-ldh1	Ambient diffuse horizontal irradiance	W·h/m ²
I.RGSwe-9-lgh1	Solar irradiation horizontal	W·h/m ²
I.RGSwe-9-lts1	Solar irradiation on the tilted surface	W·h/m ²
I.RGSwe-9-Tou1	Ambient temperature	°C
I.RGSwe-9-WindD	Wind direction	°
I.STA01-9-tem1	Top ratiotherm tank temperature	°C
I.STA01-9-tem1_est	Top ratiotherm tank temperature, estimated	°C
I.STA01-9-tem4	Bottom ratiotherm tank temperature	°C
I.STA01-9-tem4_est	Bottom ratiotherm tank temperature, estimated	°C
I.STG01-9-tem1	Top glycol tank temperature	°C
I.STG01-9-tem1_est	Top glycol tank temperature, estimated	°C
I.STG01-9-tem2	Bottom glycol tank temperature	°C
I.STG01-9-tem2_est	Bottom glycol tank temperature, estimated	°C
I.TKE01-9-tdw1	Temperature at DHW distribution	°C
I.TOHdh-9	Time outside of heating comfort, DHW	%
I.TOHwh-9	Time outside of heating comfort, whole house	%

To calculate the actual values of KPIs, PIs and indicators, monitoring data stored in iSCAN is retrieved with the codified channels. The estimated values of KPIs, PIs and indicators are obtained through the Riga Sunisi demo site building model developed in TRNSYS. In order to simulate the model, some inputs associated with the weather and demand channels provided by iSCAN are needed (I.RGSwe-9-Tou1, I.RGSwe-9-lgh1, I.RGSwe-9-ldh1, I.RGSwe-9-WindD, I.RGSwe-9-Hum1, I.EFElp-9) and are fed into the model to have the same conditions as the actual behaviour of the system. The TRNSYS model is used as the “ideal system” and how the system is expected to work.

When the estimated KPIs and PIs are obtained, the alarms are ready to be evaluated. If the alarm is raised it means the system is not behaving as expected and it is out of range (within a predefined threshold). This evaluation takes place on iSCAN. All the PIs (See Table 3) are compared with their model-based version, but in the case of the KPIs only K.HClff-9-15m, K.HClgr-9-15m, K.HClsy-9-15m and K.RERSy-9-15m are assessed from the whole list (Table 2), as they are the main necessary ones to perform the Failure Modes, Effects and Criticality Analysis (FMECA). More information about FMECA can be found in deliverable D4.2. All the alarms are evaluated following the expressions from Table 5, the *Indicator actual* in the monitoring value and the *Indicator estimated* is the value obtained from TRNSYS model and both are compared to obtain a percentage ratio, then depending on its value, the alarm level can be defined as danger or warning.

Table 5: Alarms levels

Alarm level	Formula
Warning	$50\% \leq \frac{Indicator_{actual} - Indicator_{estimated}}{Indicator_{estimated}} \leq 80\%$
Danger	$\frac{Indicator_{actual} - Indicator_{estimated}}{Indicator_{estimated}} \geq 80\%$

1.3 Functional test validation

Before the execution of the Proactive Maintenance Tool simulation, a building repository has been defined in iSCAN, where all the data would be stored and managed in order to evaluate the SunHorizon technologies performance through alarms. This building repository is called: “*Riga Sunisi Maintenance Validation Tool*” and each repository in iSCAN could have an image on the building demo site. It is not necessary, and in case it does not have an image, the repository shows “No Image Available”, as is possible to see in Figure 3). The building repository includes all the indicators channels, as well as all the alarms rules definitions and scheduling. The sample period of the building repository is 15 minutes.



Figure 3: Functional test building repository

In order to run the simulation, synthetic data have been uploaded to the iSCAN indicators channels, taking the place of the currently missing monitoring data. This synthetic data has been obtained by running the Riga –Sunisi demo site TRNSYS model with the weather and building load consumption forecast provided by IES channels. To upload and download data from Python to IES, the connection is made via a Python API used in the Proactive Maintenance Tool script. When the Proactive Maintenance Tool program is executed, it checks the communication with iSCAN and, if there is no connection problem, reads the information required from the corresponding channels. After that, KPIs, PIs and the rest of indicators are calculated accordingly.

When all data are obtained and the KPIs, PIs and Is are calculated, the tool loads and stores the values directly in iSCAN in their corresponding channels associated to the current date. In Figure 4, the daily data for the I.EFESh-9 indicator is showed.

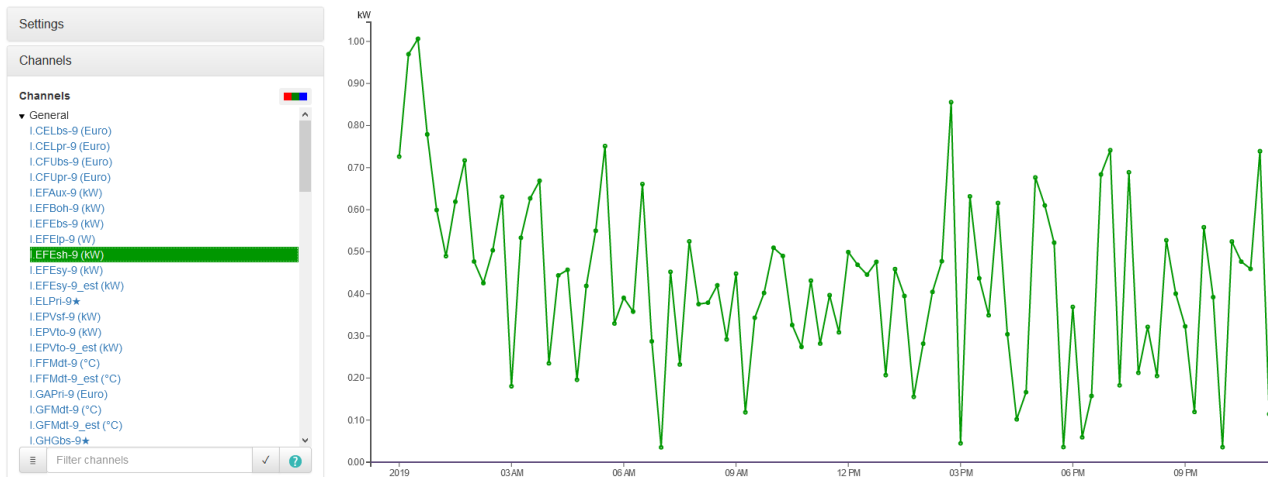


Figure 4: I.EFesh-9 daily data

- The alarms are evaluated every 24 hours by IES platform. When a warning or a danger alarm level is reached, a notification is raised in the iSCAN application, and another notification is sent via email to the demonstration site managers. Figure 5: K.RERSy-9-15m danger alarm

Condition	Context	Definition	Level	Raised At
K.RERSy915m	K.RERSy-9-15m	SUNHORIZON/RigaSunisIMaintenanceValidationTo	Danger	2021-04-26 08:55

Figure 5: K.RERSy-9-15m danger alarm

In addition, several execution errors have been forced, verifying the correct generation of the error log file. The appearance of the log file is showed in Figure 6, where the structure is associated with the date, the reported error counted and the associated error type (e.g Year/Month/Day;Hour:Minute:Second;Reported error counter; Error type).

```
Date;Time;ErrorId;ErrorDescription
2021/04/21;08:30:28;10;An error occurred at iSCAN Connection Configuration
2021/04/21;08:32:14;11;An error occurred at Data Adquisition and Calculation
2021/04/21;08:32:26;11;An error occurred at Data Adquisition and Calculation
2021/04/21;08:34:14;12;An error occurred at KPIs and PIs Calculation
2021/04/21;08:35:01;13;An error occurred at Model-based KPIs calculation
2021/04/21;08:35:59;14;An error occurred at KPIs and PIs Exportation to iSCAN
```

Figure 6: Error log file

1.4 Proactive maintenance workflow and how to use it

In order to identify the alarm level in each channel of the building, iSCAN has incorporated an alarm library where the stakeholder can define the alarm expression to show. In relation to the Proactive Maintenance Tool, the alarm levels have been defined according to Table 5, based on the percentage ratio value obtained from the *indicator actual* and the *indicator estimated*.

When an alarm associated with the main one necessary to perform the Failure Modes, Effects and Criticality Analysis (FMECA), which are KPIS "K.HCIff-9-15m, K.HCIgr-9-15m, K.HCIsy-9-15m and K.RERSy-9-15m", is triggered the actions indicated in the demo tables of D4.2 need to be followed:

1. Check table of alarms and troubleshooting.
2. Follow the instructions indicated in the table
3. Calculate the FMECA

An example is given below in relation to the dual outlet temperature, which is an indicator, to validate the flow work:

1. The DualSun outlet temperature has reached a value above the threshold (i.e. 80°C). Alarm "A.I.S.DST01-9-Tmax" is activated and the operator receives an email :

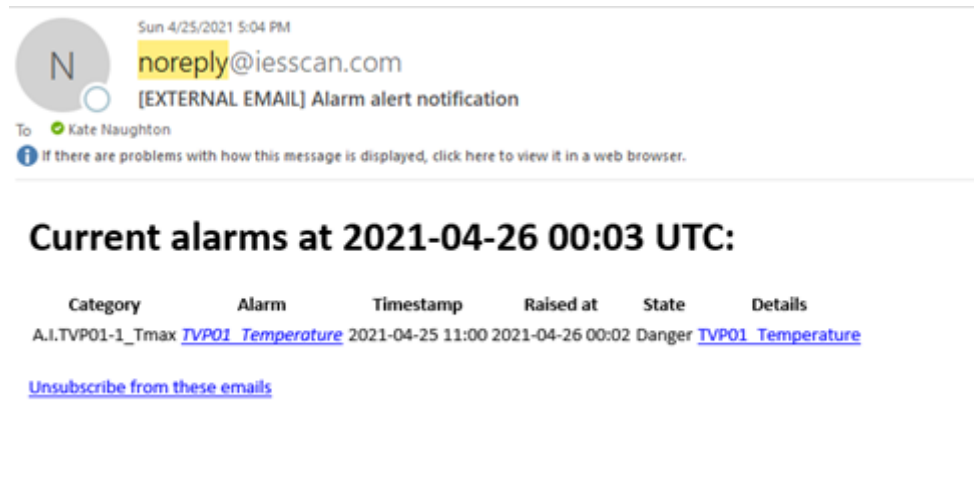


Figure 7: Appearance of the e-mail received by the user

2. The FMECA Table of Riga Sunisi demo site is checked, looking for the alarm code "A.I.S.DST01-9-Tmax"

Table 6: FMECA, Riga Sunisi demo site (RGS, TP2)

DS9 [TP2] Riga Sunisi [Single-family, detached. No. 02: Sunisi]										
Sys.	Function	Potential Failure Mode	Potential Effect(s) of Failure	Potential Cause(s) of Failure	Faulty Equipment	Fault code	Current Process Controls (Detection)	MAS	DOO	MOB
S.DSE01-9	Electricity production from sunlight	Insufficient production	Reduction of renewable energy production (equipment cannot be supplied by PV)	Dirt on PV modules	E.PVW01-9	FE.PVW01-9-01	M.DSE01-8	2	4	8
				Disconnection/malfunction of one or more element(s)	S.DSE01-9	FS.DSE01-9-01	M.DSE01-8	4	2	32
				Inverter malfunction	E.INW01-9	FE.INW01-9-01	M.DSE01-8	5	2	30
S.DST01-9	Energy absorption from sunlight, conversion into heat and transmission to a heat carrying fluid (water + glycol), from 10°C up to 65°C	Heat-carrying Fluid (glycol) Leakage	Environmental pollution	Break of Glycol pipes	S.DST01-9	FS.DST01-9-01	A.K.REP01-9	6	2	72
		Insufficient thermal production	Reduction of RE production (Increase of HP consumption)	Break of collector's cover Dirt on collector's cover	E.FRW01-9	FE.FRW01-9-01	M.DST01-9	3	3	45
		Stagnation	Degradation of solar loop (e.g. pipes, glycol, collectors) Reduction of RE production (Increase of HP consumption)	Pump failure	E.PUM01-9	FE.PUM01-9-01	M.DST01-9 A.I.S.DST01-9-Tmax	6	1	18
				Sensor failure	E.PUM01-9	FE.PUM01-9-02	M.DST01-9 A.I.S.DST01-9-Tmax	2	4	8
				Insufficient capacity of HX	E.HEX01-9	FE.HEX01-9-01	M.DST01-9 A.I.S.DST01-9-Tmax			
				Insufficient capacity of storage tank (glycol)	E.STG01-9	FE.STG01-9-01	M.DST01-9 A.I.S.DST01-9-Tmax	6	1	6
				Insufficient capacity of storage tank (Ratio)	E.STA01-9	FE.STA01-9-01	M.DST01-9 A.I.S.DST01-9-Tmax	6	1	6
	(3-Way Valve) distribution to demand (Stratified tank or glycol tank)	Stagnation	Degradation of solar loop (e.g. pipes, glycol, collectors) Reduction of RE production (Increase of HP consumption)	Malfunction of the valve (Break)	E.3WV01-9	FE.3WV01-9-01	M.DST01-9 (Possible stagnation A.I.S.DST01-9-Tmax)	6	2	72
		No distribution to S.RAT01-9	Reduction of RE production (Increase of use of existing system)	Malfunction of the valve (obstruction to distribution to S.RAT01-9)	E.3WV01-9	FE.3WV01-9-02	M.DST01-9 (Possible stagnation A.I.S.DST01-9-Tmax)	6	2	72
		No distribution to E.STG01-9	Reduction of RE production (Increase of HP consumption. Efficiency HP drops)	Malfunction of the valve (obstruction to distribution to E.STG01-9)	E.3WV01-9	FE.3WV01-9-03	M.DST01-9 (Possible stagnation A.I.S.DST01-9-Tmax) Efficiency of BOH drops A.P.SGUbh-9	6	2	72

- It may happen that a Fault code has two or more fault detections, such as the last case shown in the Table 6. Tasks are followed up by the maintenance manager to check which is the Failure (e.g. do visual inspection of the DualSun Panels, if there is dirty, clean the panels).

Table 7: Type of current maintenance action and maintenance action to be followed; indicators are calculated and recommended maintenance actions can be implemented if the failure happens a lot (which will mean the current maintenance action can be improved to the recommended one).

DS9 [TP2] RiGa Sunisi Single-family, detached. No. 02: Sunisi												
Fault code	RPNi	FC	Current Maintenance Action(s)			Recommended Maintenance Action(s)						
			Type	Task	MC	Type	Task(s)	SEVc	OCG	DETc	RPNr	MC
FE.PVH01-9-01	8		PREVENTIVE	Visual inspection. Clean PV surfaces every week		PREVENTIVE	Increase regularity of the cleaning process					
			CONDITION-BASED	Visual inspection. Clean PV surfaces		CONDITION-BASED	Model based M.PVH01-9 Detect Fill Factor changes (defined new KPI)					
FS.DSE01-9-01	32		RUN-TO-FAILURE	Wiring inspection. Repair wires and connectors		CONDITION-BASED	IR Thermography					
FE.INV01-9-01	30		RUN-TO-FAILURE	Inverter inspection. Repair/replace the equipment		CONDITION-BASED	Model based M.INV01-9 Installation of new power sensor at the input					
FS.DST01-9-01	72		RUN-TO-FAILURE	Check leak tightness. Replace the pipe		PREVENTIVE	Visual pipe inspection					
FE.FRW01-9-01	45		RUN-TO-FAILURE	Check glass. Replace the collector/glass		PREVENTIVE	Increase regularity of the cleaning process					
FE.PUM01-9-01	18		RUN-TO-FAILURE	Cover collectors until completed repair Replace the pump		CONDITION-BASED	Model based M.PUM01-9 Check temperature, vibration, pressure etc.					
FE.PUM01-9-02	8		RUN-TO-FAILURE	Cover collectors until completed repair Replace the sensors								
FE.HEX01-9-01			PREVENTIVE	Cover collectors		RE-DESIGN	Increase tank capacity					
FE.STG01-9-01	6		RUN-TO-FAILURE	Check and unblock Replace valve		CONDITION-BASED	Model based M.STG01-9 Check temperature at different levels, estimated power injection/energy balance in the tank					
FE.STA01-9-01			RUN-TO-FAILURE	Check and unblock Replace valve		CONDITION-BASED	Model based M.STA01-9 Check temperature at different levels, estimated power injection/energy balance in the tank					
FE.3WV01-9-01	72		RUN-TO-FAILURE	Check and unblock Replace valve		CONDITION-BASED	Model based M.3WV01-9 Check temperature, pressure, etc.					
FE.3WV01-9-02	72		RUN-TO-FAILURE	Check and unblock Replace valve		CONDITION-BASED	Model based M.3WV01-9 Check temperature, pressure, etc.					
FE.3WV01-9-03	72		RUN-TO-FAILURE	Check and unblock Replace valve		CONDITION-BASED	Model based M.3WV01-9 Check temperature, pressure, etc.					
FE.STG01-9-02	24		RUN-TO-FAILURE	Visual detection. Repair element		CONDITION-BASED	Model based M.STG01-9 Check temperature at different levels, estimated power injection/energy balance in the tank					

- Report in WP6 deliverables the problem that has occurred and what has been done to solve it
- Automatically the maintenance KPIs will be calculated to evaluate the performance of the maintenance strategy especially when new maintenance tasks are defined (this is done automatically inside the maintenance tool)

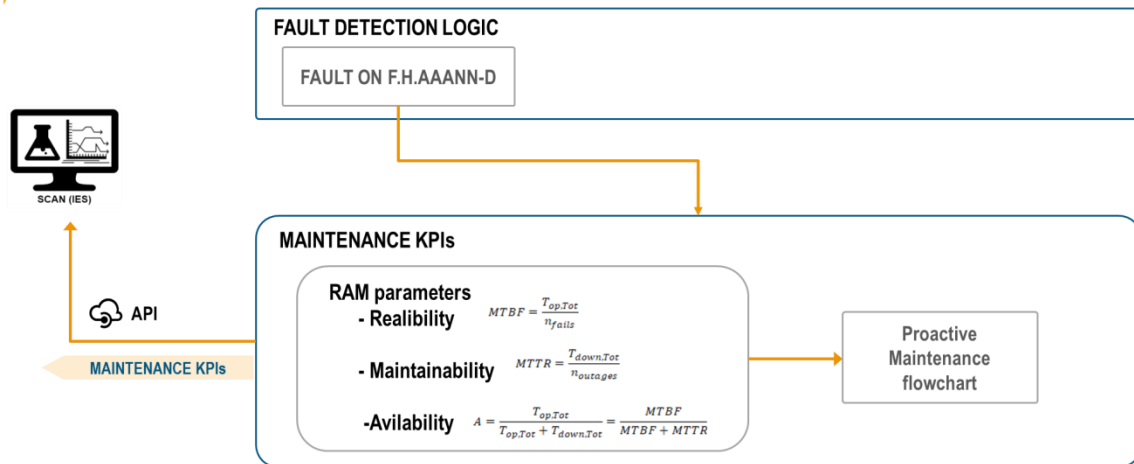


Figure 8: Maintenance KPIs flow

2 Design Under Uncertainty

2.1 How it works

The user will use the tool in the pre-design phase in order to investigate the optimal design of the SunHorizon Technology Packages. The design is evaluated “under uncertainties” because the tool applies to the input parameters provided by the user, statistical variation to take into account the uncertainties, and calculates a peak load distribution using Monte Carlo method. Subsequently, the tool performs a multi-criteria system design which takes into account the thermal comfort and the costs. Thus, the final output is the identification of the optimal configuration for each technology package, providing an estimation of size, capital cost and operative (energy related) costs.

As first step, the user provides a list of inputs in order to characterize the building; these data together with the weather data already stored within the tool and selectable among the location provided by the tool itself, are used to calculate the building heating and cooling demand profile of one year. The peak load distribution is used to select a series of design capacities (seven) associated to a risk to be overcome varying from 50% to less than 1%, causing thermal discomfort to a certain extent. Seven associated energy demand are then calculated proportionally to the peak loads selected.

After having defined peak loads and energy demands the tool perform the multicriteria analysis that takes into account the Thermal Comfort score ($\Gamma_{comfort}$) and the cost score (Γ_{cost}).

The $\Gamma_{comfort}$ considers how many hours the hourly demand is higher than the peak load considered.

The Γ_{cost} is associated to the technology packages to be evaluated and depends on the capital and energy costs, that depend on the sizes and energy performance calculated by the tool.

For each technology package, five different configurations are assessed, varying the size of the Solar Thermal or PV panel with respect to the available space indicated by the user. Configuration 1 consider 100% of the possible Solar Thermal or PV panel, configuration 5 consider the 0%. The aim is to calculate for each of the selected design capacities and for each configuration the capital costs depending on the size and the operative costs depending on the energy performance. For each combination the tool calculates the final performance score J as an equal combination of Γ_{cost} and $\Gamma_{comfort}$.

A detailed description of the tool can be found in Deliverable 4.3.

2.2 How to use it

The web tool can be accessed at the following address: <https://ies-sunhorizon-as-ui-01.azurewebsites.net/>.

In the landing page, the user can manually specify the building input information as well as location of the building.

Figure 9 shows the first page of the Design Under Uncertainty tool, it is divided into three main sections.

Section 1 is used to specify input data for the building; the heat transfer widgets are dynamic therefore the user can add as much elements as needed to best represent the thermal dissipation of the building; the dropdown list allows for the selection of the element to be added among walls, roof, floor and also windows for each orientation; after selecting the element click on the add button Figure 10. This section should also contain the button to switch from residential to tertiary building, but this has not been implemented yet.

Section 2 is used to summarised building metadata such as building name, location, and general description of the facility, an image can be uploaded in a specific window to show the building under analysis. At the moment in which this document is edited, only few locations can be selected among the ones where the demonstrators have been installed, as reported in Figure 11.


Section 3 at the top of the page, is where the name of the current page is reported. After the input data has been submitted and the simulation executed, the user can use the two buttons “Next” and “Previous” which will appear at the bottom of the page, to navigate through the Input, Output and Plot page.

When all the input data and building information have been specify, the use can execute the simulation by clicking the “submit” button at the bottom of the page, Figure 9.

1

Energy cost	Cost,gas - Gas cost	€/kWh	<input type="text" value="0"/>
	Cost,el - Electricity cost	€/kWh	<input type="text" value="0"/>
Ambient Data	Tset,h - Heating set point	°C	<input type="text" value="0"/>
	Tset,c - Cooling set point	°C	<input type="text" value="0"/>
	n - Infiltration rate	1/h	<input type="text" value="0"/>
Building	Ac - Conditioned Building area	m2	<input type="text" value="0"/>
	Vc - conditioned Building Volume	m3	<input type="text" value="0"/>
	Nap - N° of apartment	N°	<input type="text" value="0"/>
	Ac,ap - average Conditioned area per apartment	m2	<input type="text" value="0"/>
	Noc - N° of occupants	N°	<input type="text" value="0"/>
	Amax,sp - Max m2 of PV or ST Panels to be considered	m2	<input type="text" value="0"/>

2



Name

Location

Description

Submit

Figure 9: Input page section

Vc - conditioned Building Volume	m3	<input type="text" value="0"/>
Nap - N° of apartment	N°	<input type="text" value="0"/>
Ac,ap - average Conditioned area per apartment	m2	<input type="text" value="0"/>
Noc - N° of occupants	N°	<input type="text" value="0"/>
Amax,sp - Max m2 of PV or ST Panels to be considered	m2	<input type="text" value="0"/>

Wall1

Name

Location

Description

Figure 10: Widget selection

Figure 11: Location dropdown menu

Once the calculations have been performed the tool automatically drive to the output page to visualise the results. The output page resume in tables the outcome of the DUUT calculations for each technology package. Figure 12 reports the extended set of results of one TP. By selecting other TP the user can access to the other results or close all of them. The output page includes 2 main sections: the one on top reports a summary section with the building metadata, foldable table widgets are used to summarise the results of calculation and organise the visualisation as shown in Figure 13.

Output


TP1 Best Ranking

lambda6 Conf1	BH HP		RATIO TANK		TVP SP	
Size	20.00	kW	881.25	liters	18.75	m2
Energy produced	33082.24	kWh/y	0.00	kWh/y	11711.29	kWh/y
YEOH	1654.11	YEOH	0.00	YEOH	0.00	YEOH
Capital costs	20000.00	€	3546.53	€	12500.00	€
Operative costs	46198.38	€/y	0.00	€/y	0.00	€/y

TP2 Best Ranking

TP3 Best Ranking

Figure 12: Technology package result table



Design Under Uncertainties Tool

Input

Output

Plots

Metadata

Building Name	imanta
Building Description	test
Name loc.	Riga

Output

TP1 Best Ranking

TP2 Best Ranking

TP3 Best Ranking

TP4 Best Ranking

< Previous

Next >

Figure 13: Output page example

Finally in the last page plots of the main KPIs of the tool can be easily analysed and visualised. The following Figure 14 and Figure 15 represents the cooling and heating peak load curve for the whole year respectively.

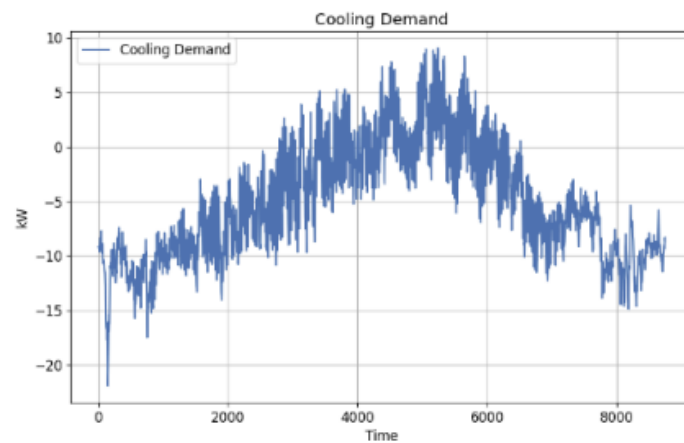


Figure 14: Cooling Demand

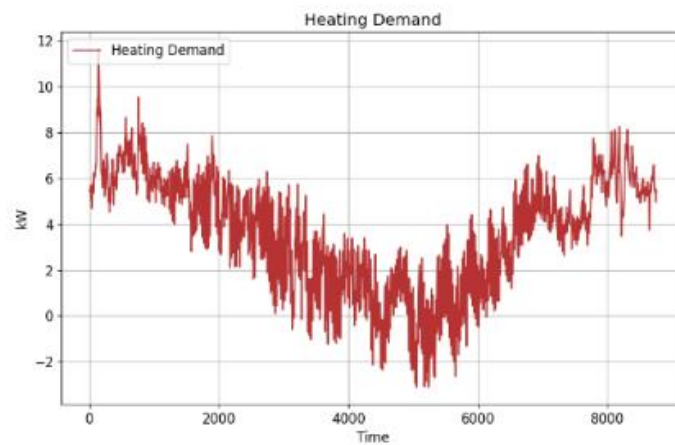


Figure 15: Heating Demand

Moreover, the last two plots report the statistical distribution of the peak power for cooling and for heating respectively. For a more in-depth description of both the heating and cooling peak power probabilistic distribution, refers to the Deliverable 4.3.

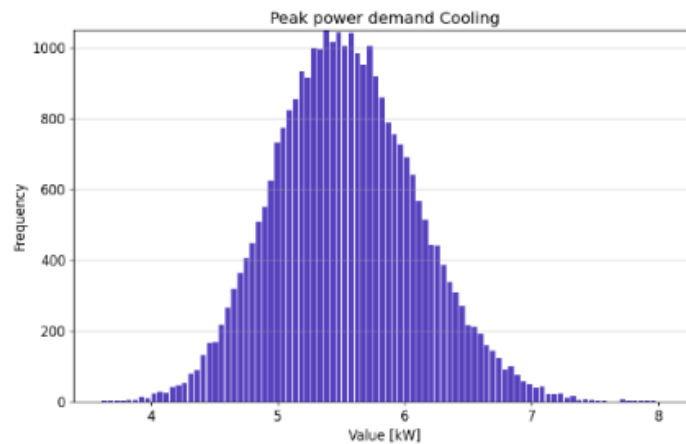


Figure 16: Peak cooling power distribution

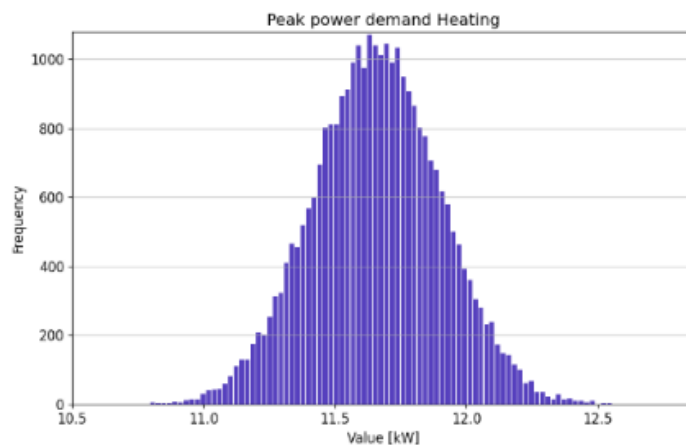


Figure 17: Peak heating power distribution

2.3 Troubleshooting

At the time of the editing of this document, there are no issues we are aware of. However, it has to be noticed that the tool can take up to several minutes to complete the calculations. Moreover, because the application of uncertainties based on the Montecarlo method uses a random function to generate the peak distribution, each simulation cannot be replicated with the exact same values of the peak loads statistically calculated.

Finally, because it is an online tool, if any issues should happen with the connection, just refresh the page and repeat the calculation.

2.4 Examples

The following Figure 18 and Figure 19 show an example of the input data specification and the subsequently results.

Energy cost	Cost,gas - Gas cost	€/kWh	<input type="text" value="0.03"/>
	Cost,el - Electricity cost	€/kWh	<input type="text" value="0.13"/>
Ambient Data	Tset,h - Heating set point	°C	<input type="text" value="20"/>
	Tset,c - Cooling set point	°C	<input type="text" value="24"/>
	n - Infiltration rate	1/h	<input type="text" value="0.53"/>
Building	Ac - Conditioned Building area	m2	<input type="text" value="234"/>
	Vc - conditioned Building Volume	m3	<input type="text" value="946"/>
	Nap - N° of apartment	N°	<input type="text" value="1"/>
	Ac,ap - average Conditioned area per apartment	m2	<input type="text" value="234"/>
	Noc - N° of occupants	N°	<input type="text" value="3"/>
	Amax,sp - Max m2 of PV or ST Panels to be considered	m2	<input type="text" value="65"/>
Wall1	Uwall,1 -wall Transmittance	W/m2K	<input type="text" value="0.244"/>
	Awall,1	m2	<input type="text" value="192"/>

+
Wall

Figure 18: Example input specification

Output

TP1 Best Ranking

lambda6 Conf1	BH HP		RATIO TANK		TVP SP	
Size	20.00	kW	881.25	liters	18.75	m2
Energy produced	33082.24	kWh/y	0.00	kWh/y	11711.29	kWh/y
YEOH	1654.11	YEOH	0.00	YEOH	0.00	YEOH
Capital costs	20000.00	Δ,~	3546.53	Δ,~	12500.00	Δ,~
Operative costs	46198.38	Δ,~ly	0.00	Δ,~ly	0.00	Δ,~ly

TP2 Best Ranking

lambda6 Conf1	BH HP		RATIO TANK		DUAL SUN PVT	
Size	20.00	kW	881.25	liters	18.75	m2
Energy produced	40532.42	kWh/y	0.00	kWh/y		
YEOH	2026.62	YEOH	0.00	YEOH	103.00	YEOH
Capital costs	20000.00	Δ,~	3546.53	Δ,~	14100.00	Δ,~
Operative costs	56602.33	Δ,~ly	0.00	Δ,~ly	0.00	Δ,~ly

TP3 Best Ranking

lambda6 Conf1	FARH SORP CHILLER		COMPR. CHILLER		RATIO TANK		TVP SP	
Size	13.00	kW	9.23	kW	1250.00	liters	18.75	m2
Energy produced	2068.03	kWh/y	15106.24	kWh/y	0.00	kWh/y	4357.41	kWh/y Th
YEOH	0.01	YEOH	0.00	YEOH	0.00	YEOH	0.00	YEOH
Capital costs	24388.00	Δ,~	7385.33	Δ,~	4095.56	Δ,~	12500.00	Δ,~
Operative costs	2372.37	Δ,~ly	11.95	Δ,~ly	0.00	Δ,~ly	0.00	Δ,~ly

TP4 Best Ranking

lambda6 Conf1	BDR ASHP		TANK DHW		TANK H/C		Baxi TH		Baxi EL	
Size	15.05	kW	273.45	kW	234.38	liters	4.69	m2	14.06	m2
Energy produced	5010.26	kWh/y	0.00	kWh/y	0.00	kWh/y	788.07	kWh/y Th	2364.20	kWh/y El
YEOH	332.98	YEOH	0.00	YEOH	0.00	YEOH	0.00	YEOH	0.00	YEOH
Capital costs	9178.43	Δ,~	2055.01	Δ,~	1967.22	Δ,~	1875.00	Δ,~	4218.75	Δ,~
Operative costs	6741.64	Δ,~ly	0.00	Δ,~ly	0.00	Δ,~ly	0.00	Δ,~ly	-10402.47	Δ,~ly

Figure 19: Extended result page

3 Feedback App

The SunHorizon Feedback app that allows the user to see real-time data about indoor climate as well as energy consumption and most importantly provide the SunHorizon system with feedback on their perception of the indoor comfort levels (e.g. temperature, air quality, light). This feedback is essential for the self-learning algorithms. The app is fully integrated with the ISCAN system, where all data shown in the app comes from and where the user provided feedback is sent to. More detail information about the app can be found in D5.2.

The app has been configured for two demo sites, Riga Sunisi and Sant Cugat. The Riga Sunisi building is a private building/house and the app will be used by the family living in set house. The Sant Cugat building is a public building, and the app will be used by the building managers/staff.

3.1 How it works

The app is available for download from both [Google play](#) (for Android users) and [App Store](#) (for IOS users). The app consists of the following functions:

Login/register

Once the app is started the user can either **Register** a new account or **Login**, if they already have an account.

There is also a Getting started function, that gives the user a walkthrough and guidance of the app.

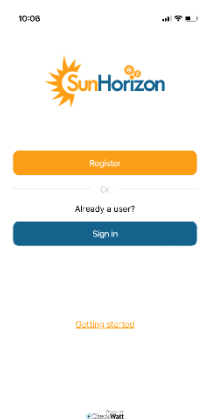


Figure 20: SunHorizon app login view

Overview

The first view in the app gives the user a real-time overview of their building. This view is divided by sections **Air temperature**, **humidity**, **light levels**, and **CO2 levels**.

Each section displays values from each room in the building. Each card where the value is displayed has also a colour coded indicator of what the value translates to in sensation.

For instance, if the temperature in a room is higher than 22 °C the indicator will show the text **Hot** with an orange background, if the temperatures in the room are below 19 °C the indicator will show **Cold** with a blue background. And if the temperatures are between 19 °C and 22 °C the indicator will show **Comfortable** with a green background.

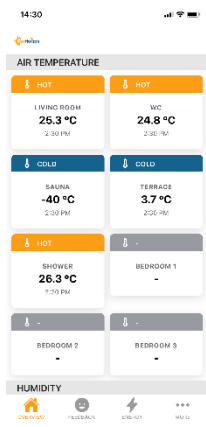


Figure 21: SunHorizon app Overview view

Energy

If the building is configured to show energy consumption in the app this will be shown in the **Energy** view.

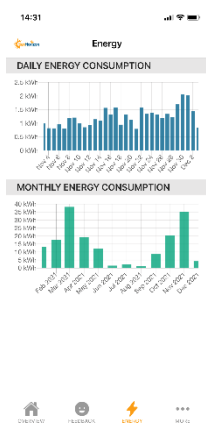


Figure 22: SunHorizon app Energy view

Feedback

To provide the SunHorizon system with valuable user feedback about the indoor comfort levels in the building, the user needs to go to the Feedback view in the app.

From here the user starts by selecting a room and then provide their feedback by selecting and option and then pressing send.

The app will send notifications reminding the user to leave feedback, twice a day (morning and evening). This can be turned off from smart phone settings.

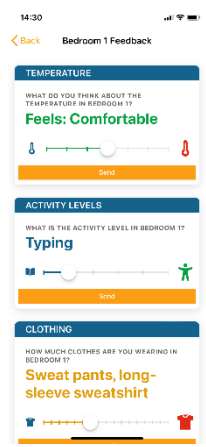


Figure 23: SunHorizon app Feedback view

More

Other functions can be accessed from the More view, such as:

Settings: where the user can connect to a building, select language (English, Spanish, Catalan) or edit account information.

Logout: where the user logs out from the account.

Getting started: the walkthrough guide.

Privacy policy: redirects the user to the SunHorizon projects privacy policy page.

About the project: redirects the user to the SunHorizon page.



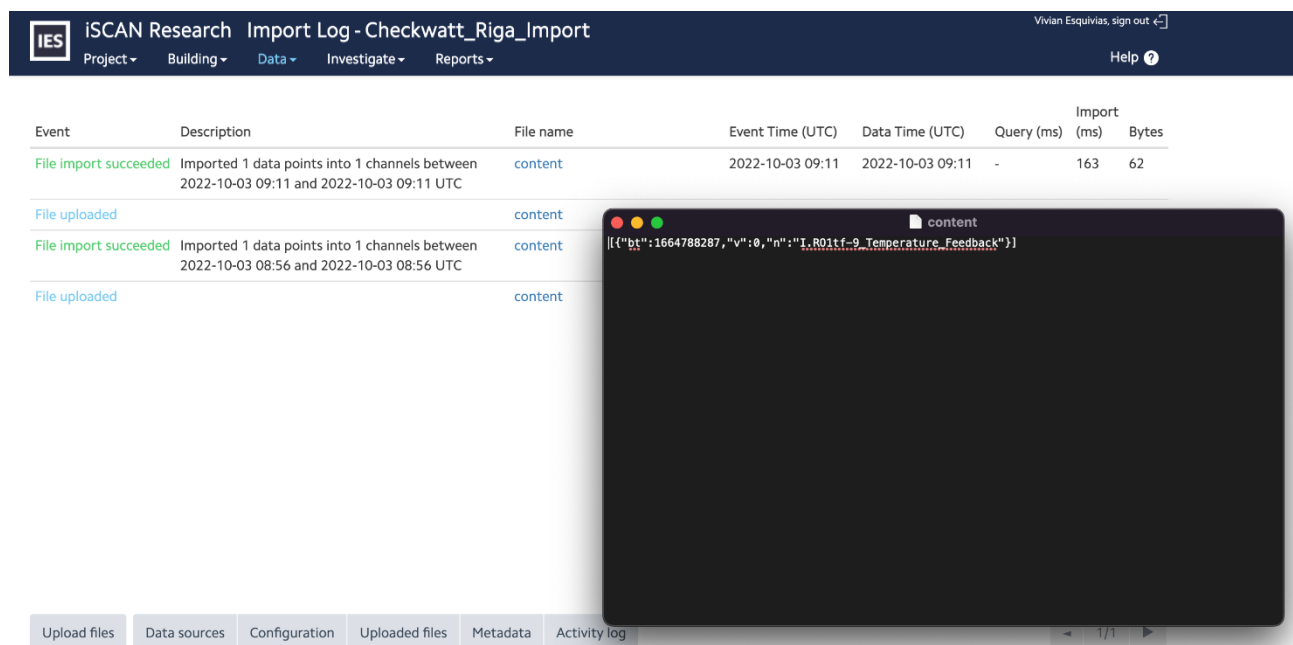
Figure 24: SunHorizon app More view

Notifications

The app is scheduled to send two notifications per day, one in the morning 8 AM the second in the evening 6 PM. This notification is to remind the user to provide feedback. The notifications can be turned off from the smartphone settings.

3.2 Feedback app validation and configuration

The iSCAN portal can be used to verify that the feedback sent from the app is received by the iSCAN system. See Figure 25 below. In case this might fail the feedback data is also stored in a database dedicated for the SunHorizon app, see Figure 26.



Event	Description	File name	Event Time (UTC)	Data Time (UTC)	Query (ms)	Import (ms)	Bytes
File import succeeded	Imported 1 data points into 1 channels between 2022-10-03 09:11 and 2022-10-03 09:11 UTC	content	2022-10-03 09:11	2022-10-03 09:11	-	163	62
File import succeeded	Imported 1 data points into 1 channels between 2022-10-03 08:56 and 2022-10-03 08:56 UTC	content					

```
[{"bt":1664788287,"v":0,"n":"I_R01tf-9_Temperature_Feedback"}]
```

Figure 25: iSCAN portal showing feedback sent by the app

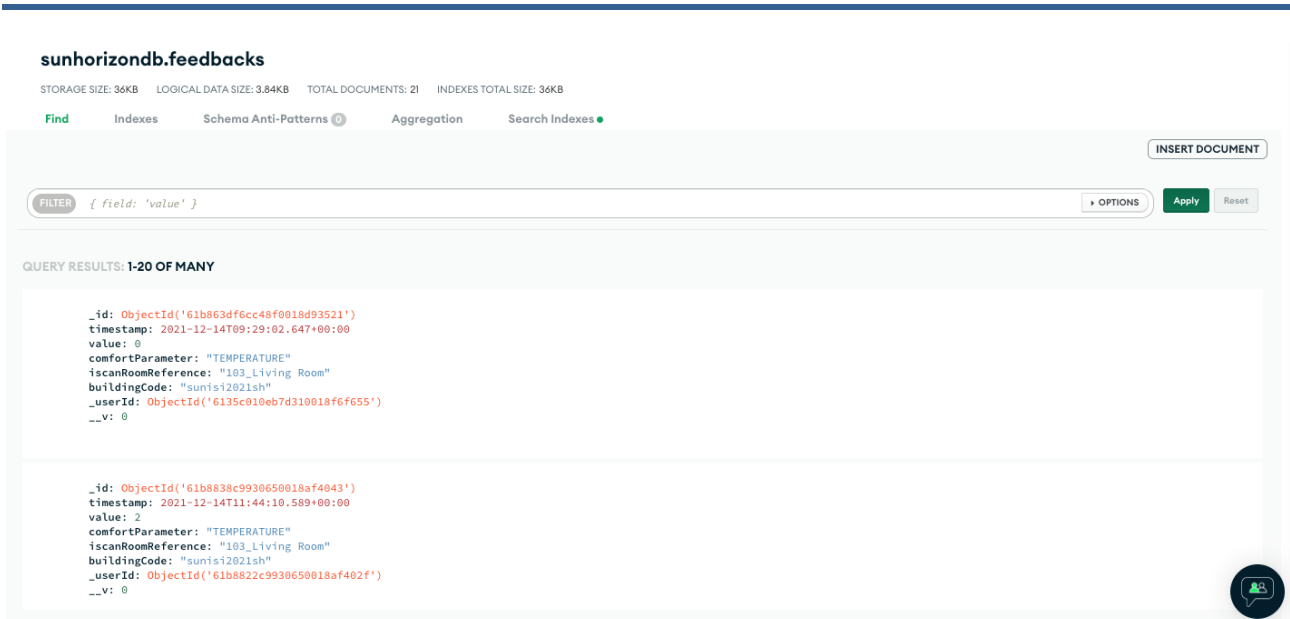


Figure 26: Feedback stored in App database.

Beside feedback data, the app database also keeps track of how the app is used by logging the data requests. The demo sites have also expressed interest in a summarized report based on this stored feedback, off course anonymized. Here are two examples: Figure 27 shows how many times each request has been made, this gives us an indication of which views in the app where the most visited. For instance, the request `/building` that is the by far the most used is made by the Overview view in the app.

Figure 28 show that the most popular feedback topic is *Temperature*.

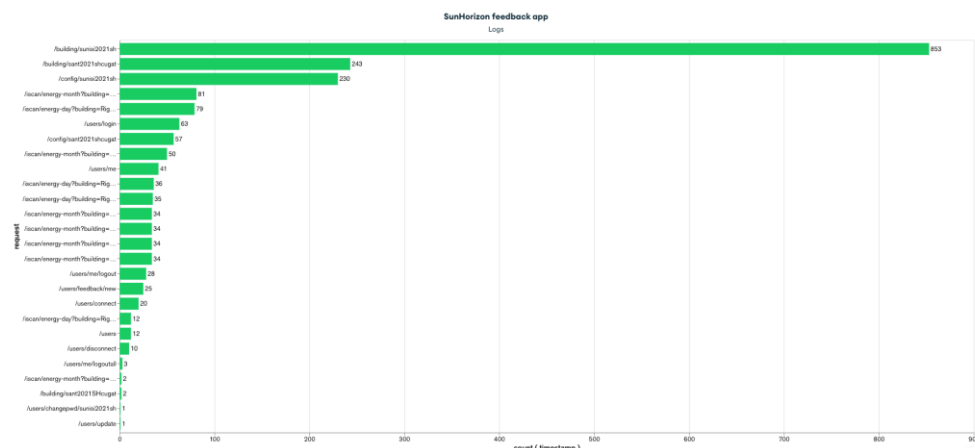


Figure 27: Feedback app database logs

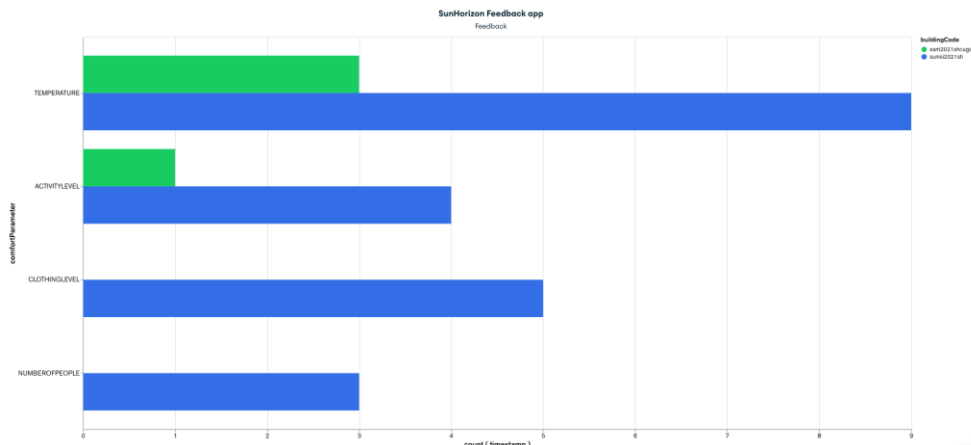


Figure 28: Feedback app database feedback data

Configurations such as rooms, sensors, iSCAN endpoints, feedback options and notification schedules are also stored in the app database for each building, this makes the app flexible and adjustable for different building types. Figure 29 shows the Riga Sunisi building configuration.

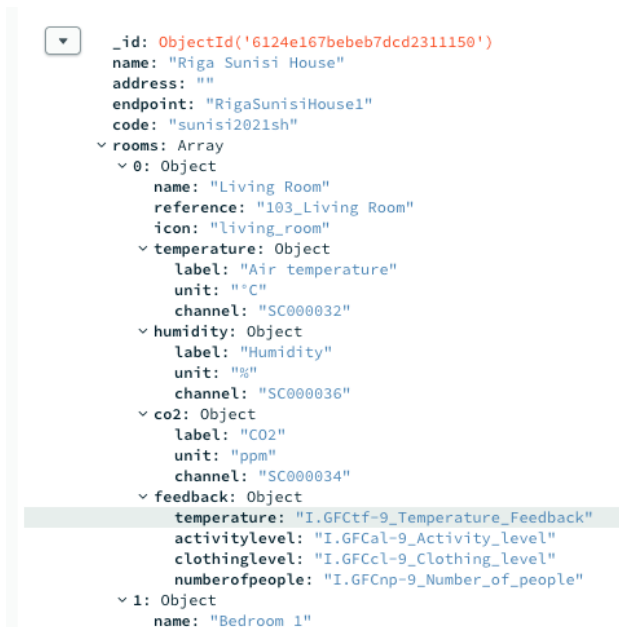


Figure 29: SunHorizon app Riga building configuration

3.3 How to use it

1. Start by downloading the app from [Google Play](#) or [App store](#), the links have been embedded in a QR-code which makes it easy to find the app. The idea is to provide this QR-codes to the end users.



Figure 30: Feedback app download links in QR-code

2. Register (only email and password are mandatory, rest is optional)
3. Get a building access code
 - o Codes were given to demo site representatives with access to end-users
 - o Codes can be changed by app support (CheckWatt) if needed
4. Enter building access code to app,
 - o This is how app is connected to a specific building
 - o Go to More → Settings → Building, enter code and press Connect.
5. App is ready to use!
6. There is a Getting started function in the app to guide the user.
 - o Access from start view (before login)
 - o Or go to More → Settings → Getting started if already logged in

3.4 Troubleshooting

Here is a list of common issues that the user might encounter and how to solve them:

- Nothing is shown in **Overview**
 - o Make sure that you have entered a valid building code in More → Settings → Building
- No rooms are available in **Feedback**
 - o Make sure that you have entered a valid building code in More → Settings → Building
- Nothing is shown in **Energy**
 - o Make sure that you have entered a valid building code in More → Settings → Building
 - o Your building might not have this function, right now only Riga Sunisi has this.
- I forgot my password
 - o From login view, tap Forgot Password below button
 - o Enter email, building access code and enter a new password
- How to change language
 - o Go to More → Settings → Language
 - o Select language and tap the *Save language* button
- How do I turn off the notifications
 - o For Android: Go to settings on your smart phone → Apps & notifications → Apps → SunHorizon → Notifications → Turn off *Allow notifications*
 - o For IOS: Go to settings on your iPhone → Notifications → SunHorizon → Turn off *Allow notifications*

4 Decision making tool

4.1 How it works

The decision making tool (DMT) is a useful and fast digital web platform that allows assessing which is the most suitable SunHorizon technology package for the given conditions. A preliminary estimation of approximate performance is given, based on the location, the system type and outcomes obtained from the energy modelling activity performed. The tool will recommend the combination of technologies that should suit best the selected application and country.

The proposed selection process is user-friendly and accessible, in few steps it is possible to achieve the final result. Each step is represented by a question addressed to the end-user. The selection engine allows the preliminary identification of the technologies suitable for the specified application.

It is mentioned that the DMT can be used anonymously and no data is collected when using it.

4.2 How to use it

The DMT can be accessed from any web browser in: [THIS LINK](#).

The landing page, as seen in Figure 31, provides guidelines how to use the tool. The process starts by pressing “Get Started” and it moves to the next page.

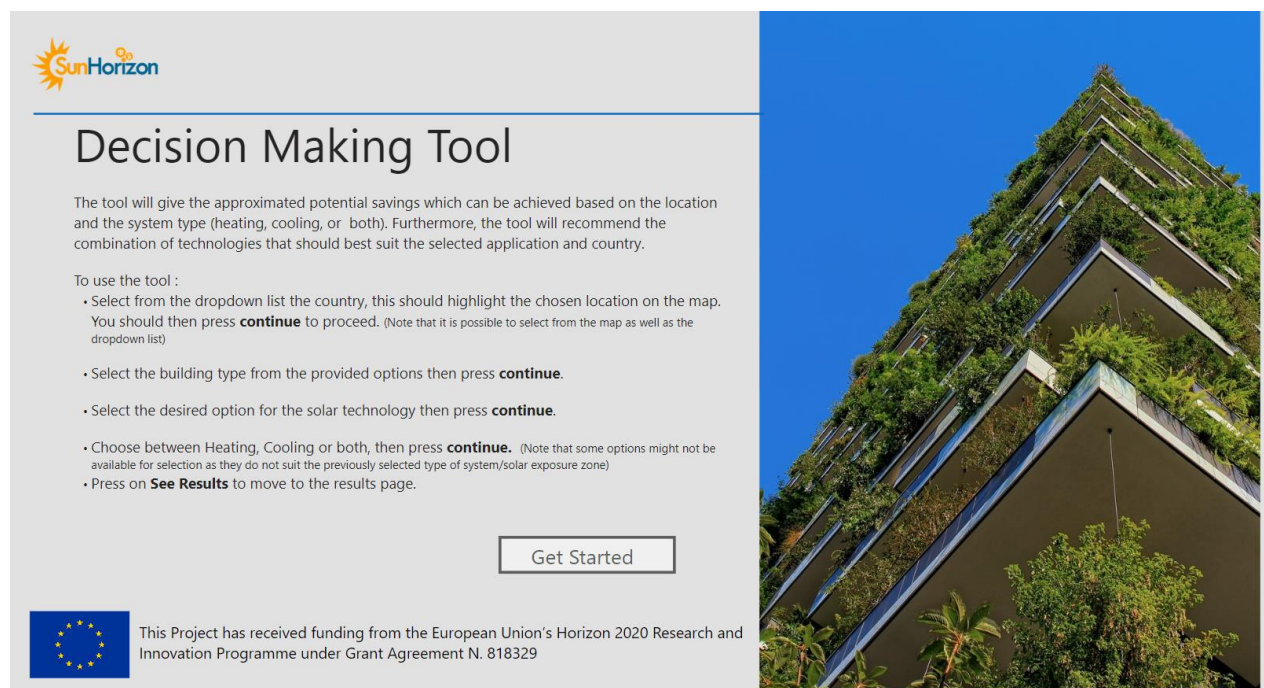


Figure 31: DMT landing page

The first page of the tool is called “Map page” and allows the selection of the country where the property is located. The selection can be made with a single click on the country or by ticking the box in the list on the right-hand side.

In all pages, there are “Continue” and “Back” buttons, as well as a navigation toolbar on top. Once the selection of country is made, the user can either click “continue” or “Building” tab to go to the next page.



Figure 32: DMT Map page

In the Building page the building type can be easily selected, choosing between Tertiary and Residential, the building types suitable to install SunHorizon technologies.

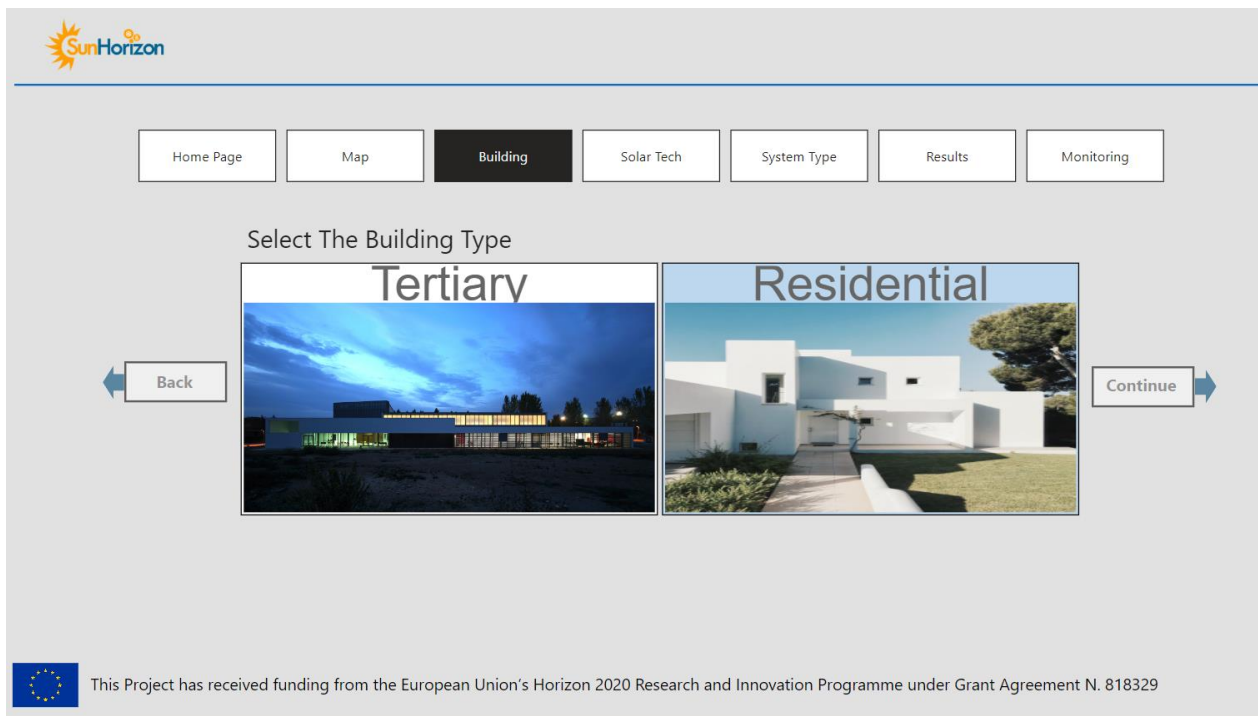


Figure 33: DMT new Building page

By selecting "Continue" the tool moves to the next page and the solar technology can be selected, where screenshot with technical drawing of each one is displayed.

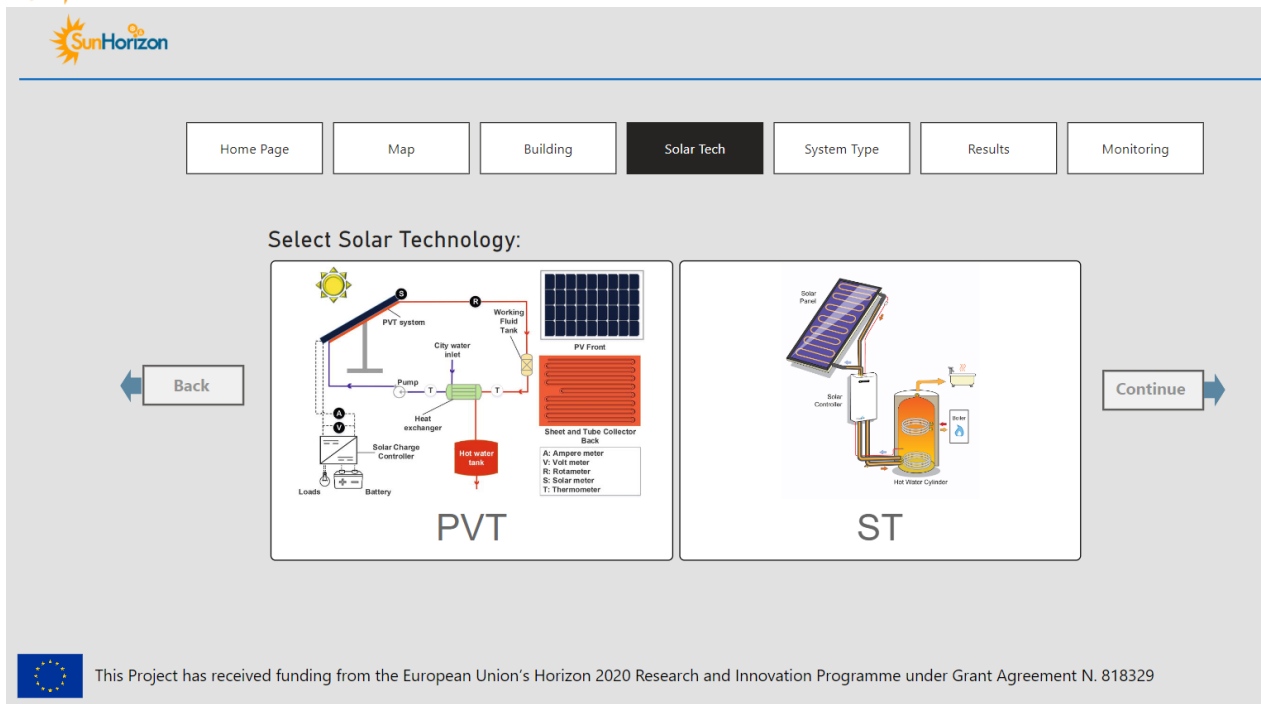


Figure 34: DMT Solar Tech page

Final selection is made in the next page about the system type, with the choice between: “Heating+Cooling” or just “Heating”.

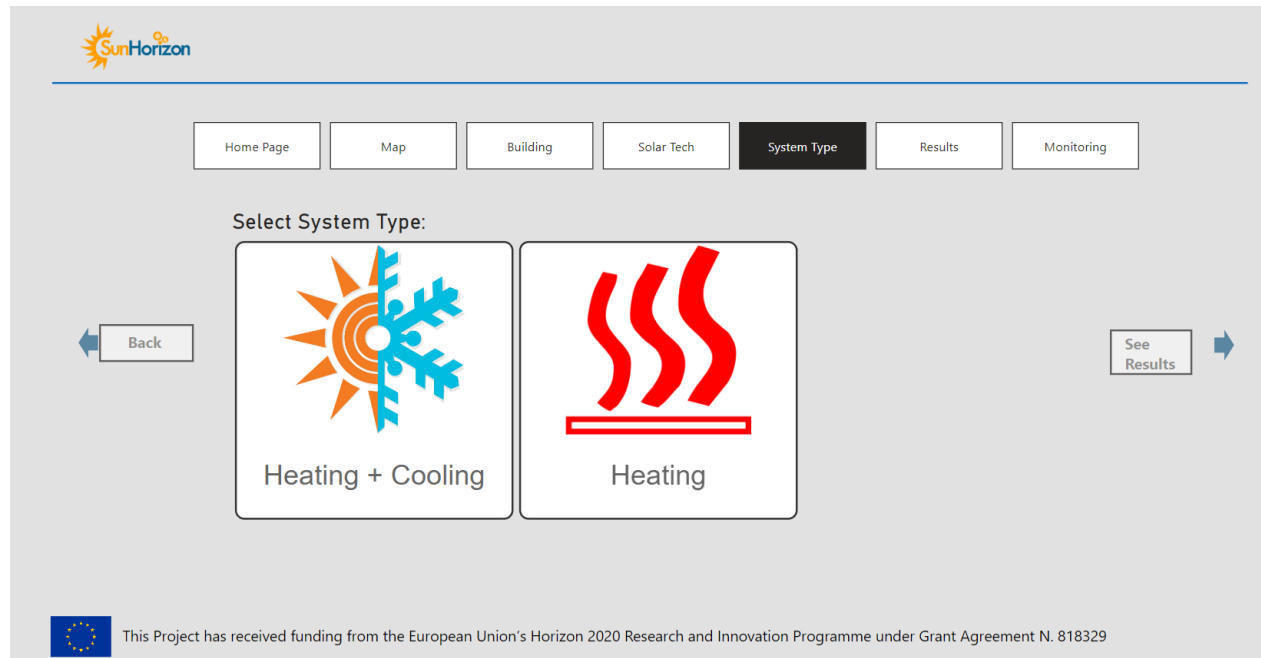
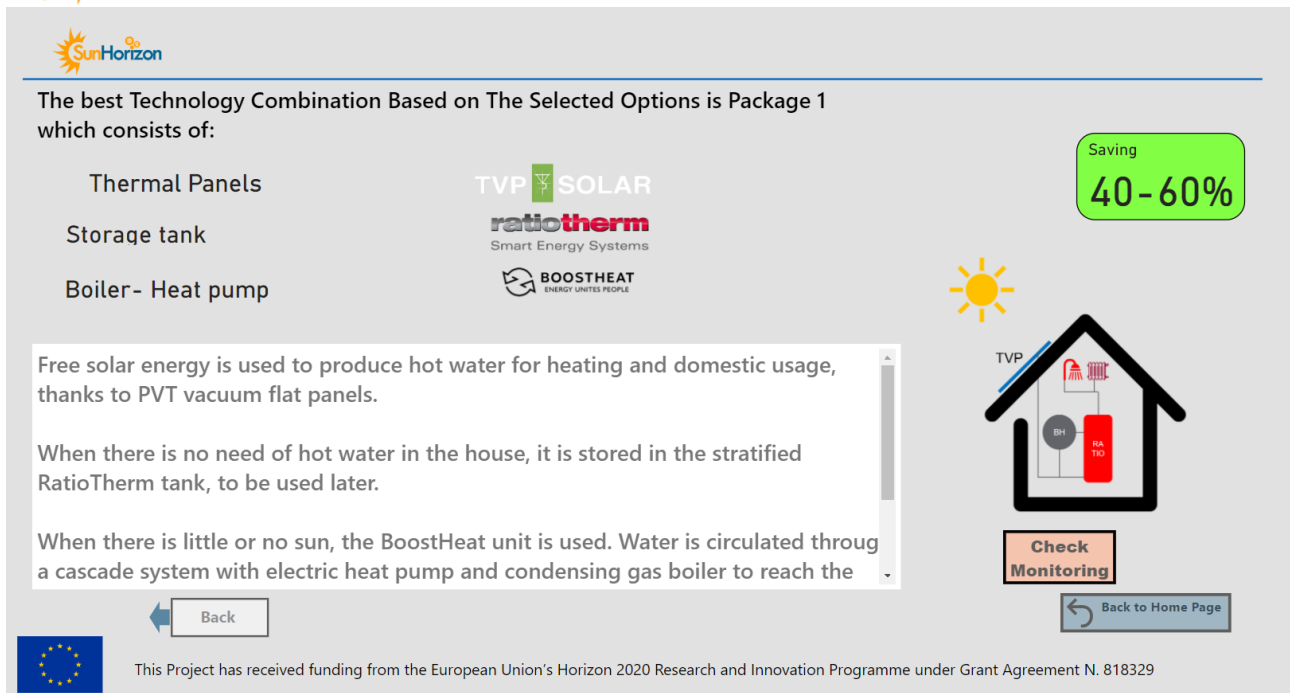


Figure 35: DMT System Type page

The button “See Results” allows displaying the Results page, which includes:

- Which technology package is suitable for the selections made
- Estimated saving based on standard systems simulated (in the green box on the top right corner)
- Button to check monitoring solution
- Button to go back to Homepage and start over



The best Technology Combination Based on The Selected Options is Package 1 which consists of:

- Thermal Panels
- Storage tank
- Boiler- Heat pump

Free solar energy is used to produce hot water for heating and domestic usage, thanks to PVT vacuum flat panels.

When there is no need of hot water in the house, it is stored in the stratified RatioTherm tank, to be used later.

When there is little or no sun, the BoostHeat unit is used. Water is circulated through a cascade system with electric heat pump and condensing gas boiler to reach the

TV P SOLAR
ratiotherm
Smart Energy Systems
BOOSTHEAT
ENERGY UNITES PEOPLE

Saving 40-60%

Check Monitoring

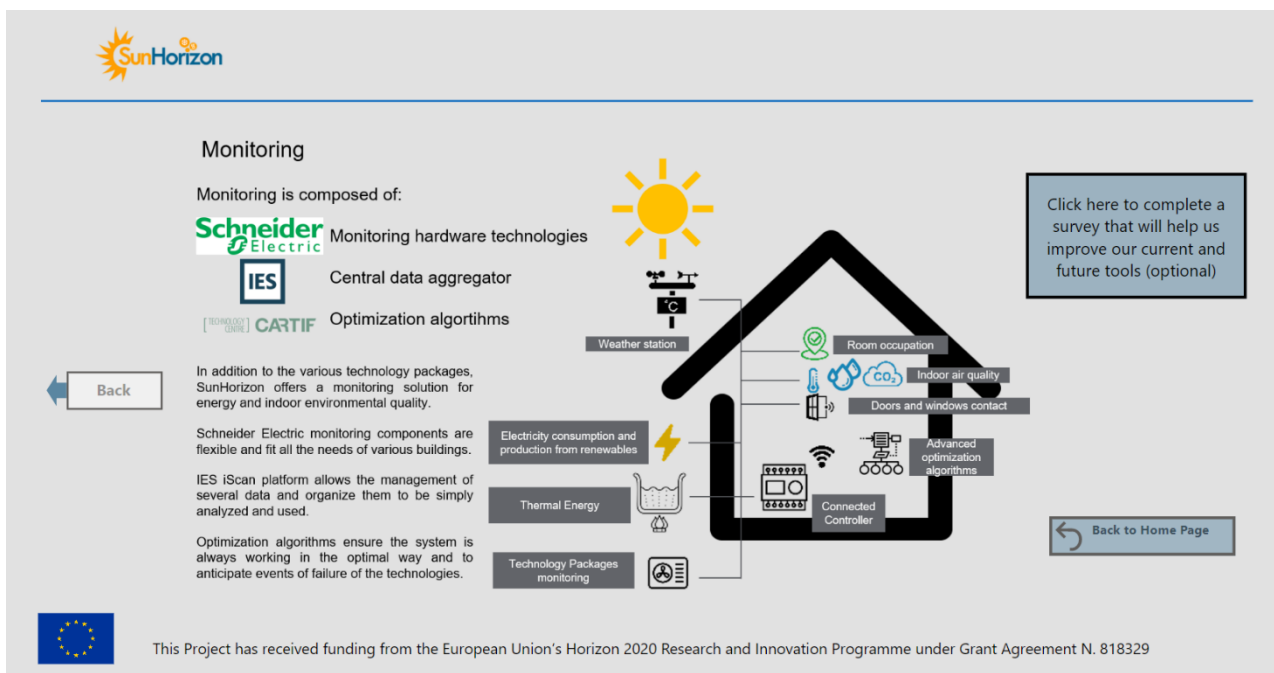
[Back](#)

[Back to Home Page](#)

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Figure 36: DMT new Results page

By selecting “Check Monitoring”, a new page opens where the monitoring solution proposed by SunHorizon is presented, as seen below.



Monitoring

Monitoring is composed of:

- Schneider Electric** Monitoring hardware technologies
- IES** Central data aggregator
- CARTIF** Optimization algorithms

In addition to the various technology packages, SunHorizon offers a monitoring solution for energy and indoor environmental quality.

Schneider Electric monitoring components are flexible and fit all the needs of various buildings.

IES iScan platform allows the management of several data and organize them to be simply analyzed and used.

Optimization algorithms ensure the system is always working in the optimal way and to anticipate events of failure of the technologies.

[Back](#)

Weather station

Room occupation

Indoor air quality

Doors and windows contact

Advanced optimization algorithms

Connected Controller

Electricity consumption and production from renewables

Thermal Energy

Technology Packages monitoring

[Click here to complete a survey that will help us improve our current and future tools \(optional\)](#)

[Back to Home Page](#)

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Figure 37: DMT Monitoring page

Finally, there is a button, besides the one to go back or to home page, to allow the completion of an online survey to help us improve the tool. A sample screenshot is found below.

Please complete the questionnaire

Please consider that your feedback will be treated anonymously, only to make statics studies which will be used exclusively in the framework of the SunHorizon project.

[Συνδεθείτε στο Google](#), για να αποθηκεύσετε την πρόσδό σου. [Μάθετε περισσότερα](#)

* Απαιτείται

Gender *

☐ Male

☐ Female

☐ Prefer not to say

Age *

☐ <30

☐ 30 - 45

☐ 45 - 60

☐ >60

Country *

Figure 38: Questionnaire

4.3 Troubleshooting

The tool sometimes is slow to respond. For any problems, please contact IES.

5 Dashboards

5.1 Dashboards in EcoStruxure

5.1.1 How it works

With the EcoStruxure Building Operation software (by Schneider Electric) is possible, via any web browser, to visualize every project data monitored by Schneider Electric in a way that is easy to understand and consult. Data are displayed in graphic pages called “dashboards” that are composed by different types of widgets:

- Real-time visualization widget: a dashboard component that shows a precise value that is needed for a continuous monitoring, i.e., actual room temperature (Figure 42).
- Chart widget: a dashboard component that shows how a precise value changes over time, i.e., energy consumption (Figure 43).

The user will use the dashboards to monitor:

- Energy consumption data
- Water consumption data
- People presence in the building/room
- Windows status

All data can be downloaded to be stored and consulted at any time.

5.1.2 How to use it

To access to the dashboards the user needs to login into our platform through the address <https://185.168.27.5/> using their own login details, different from site to site. The online platform is free, and it is included for anyone who has the Automation Server (or similar devices that controls the systems).

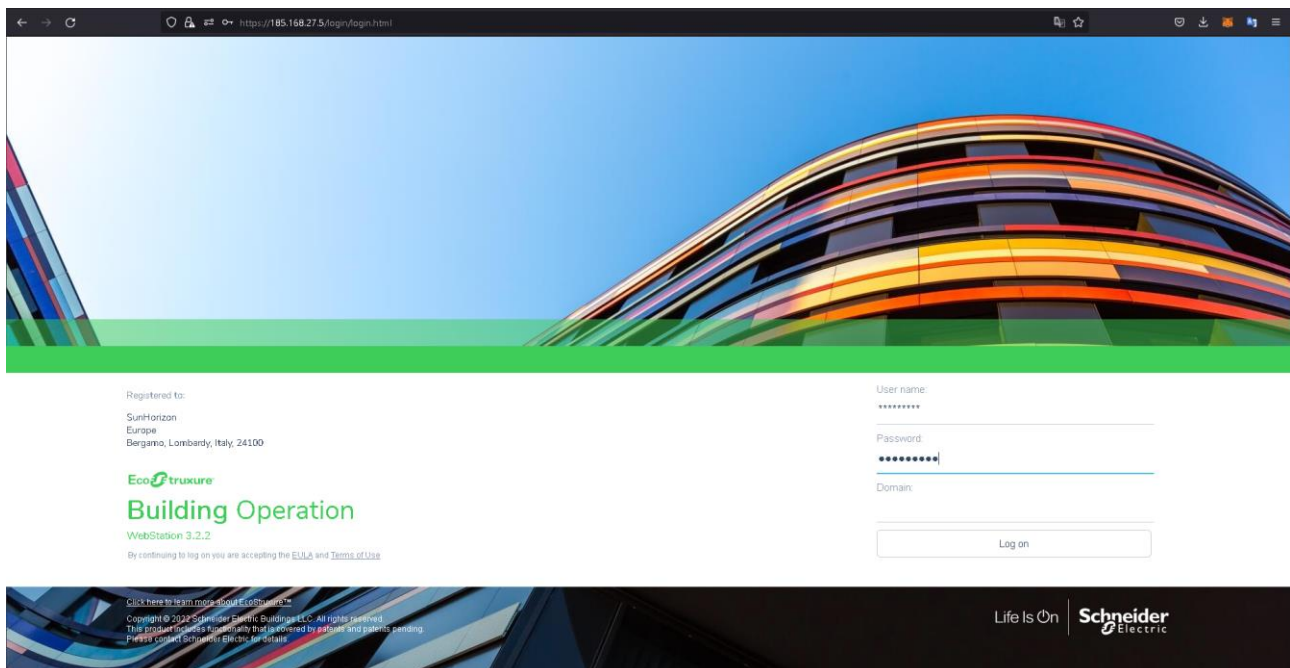


Figure 39: Login page

Once the user logs in with username and password it will visualise the landing page where all the sites are available. The user can enter and visit only the sites for which has a permission. These permissions are setting by the programmers while

commissioning the system. For example, if I'm the site manager of Riga, I'll be able to click only on "Riga Imanta" and "Riga Sunisi" icons and then the system will visualize the relative site homepage (Figure 41).

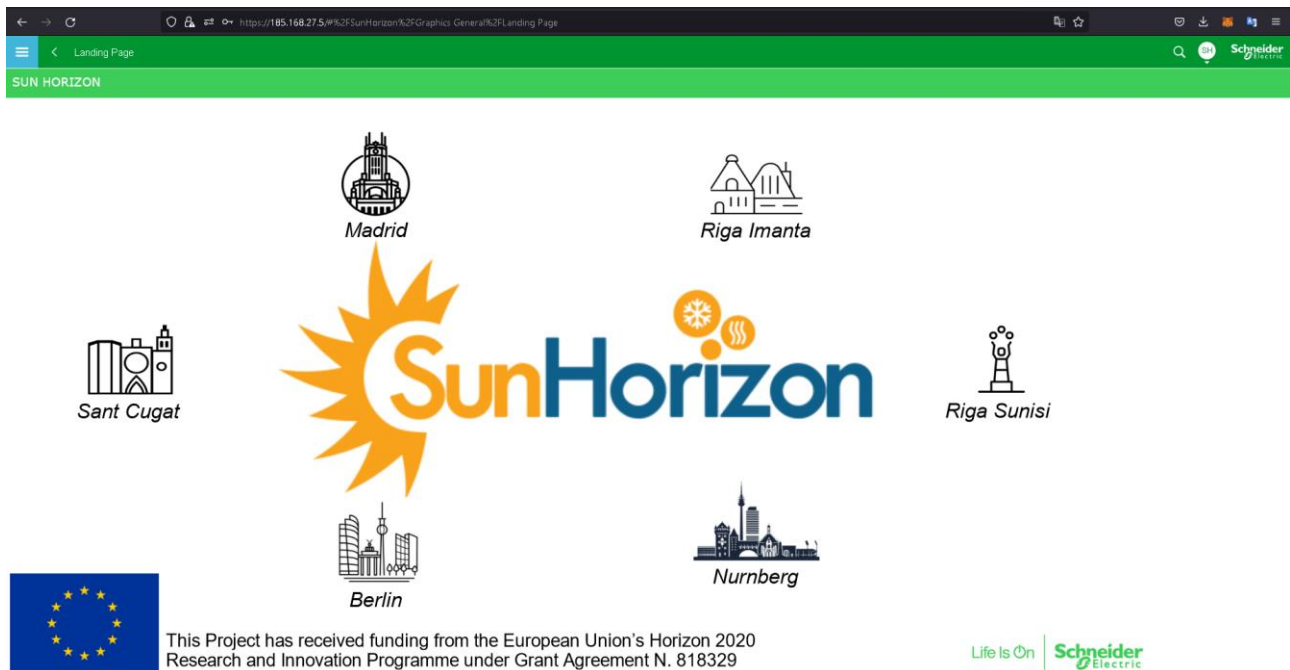


Figure 40: Landing page

After selecting the site from the Landing page (Figure 40) for which you have the credentials, the site's homepage opens, showing the rooms of the building and all the technologies installed.

In the Figure 41 you can see all the rooms on the left side and all the devices and meters on the right side. You can identify them by the names in the blocks/buttons.

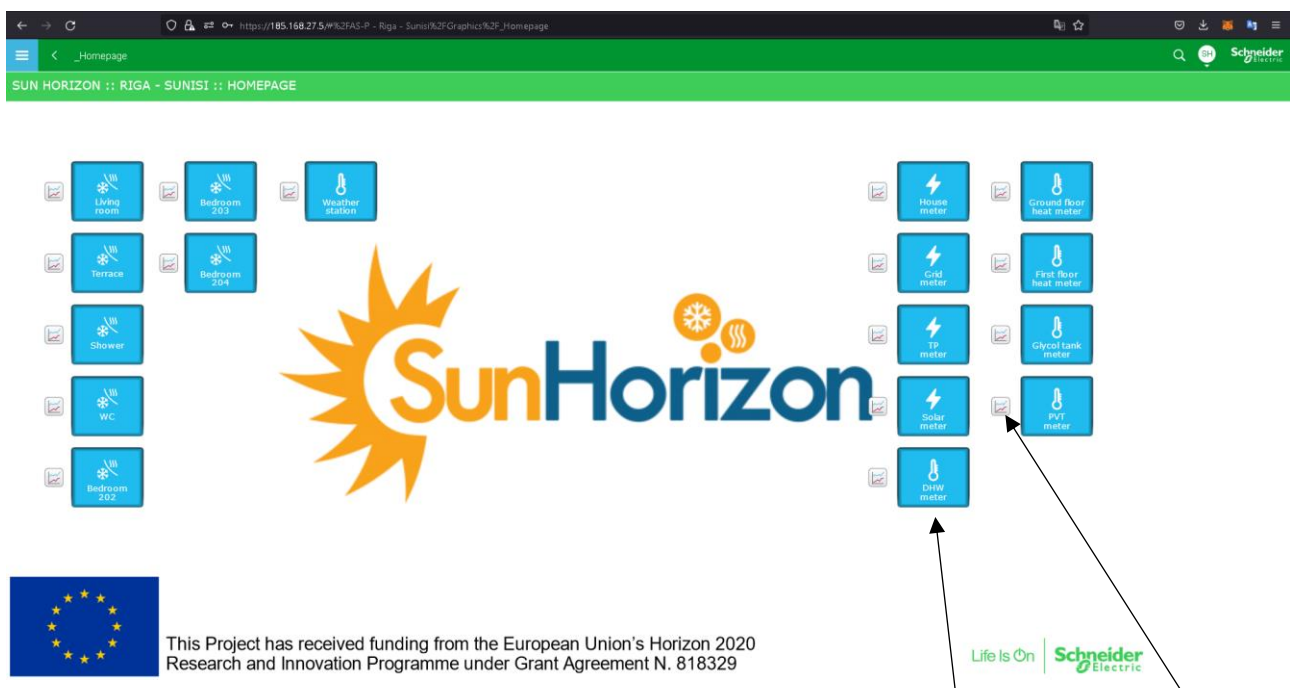
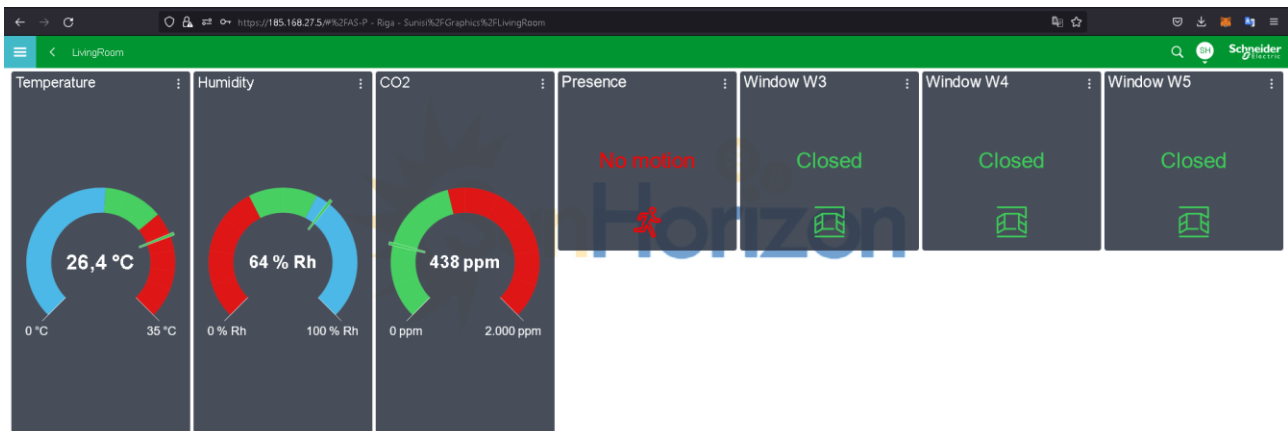


Figure 41: Site Homepage

In the site homepage you can choose which room or device to enter and examine. If you want to consult the dashboard pages with the live value of sensors (in this example we're referring to Figure 42) you have to click on one of the blue

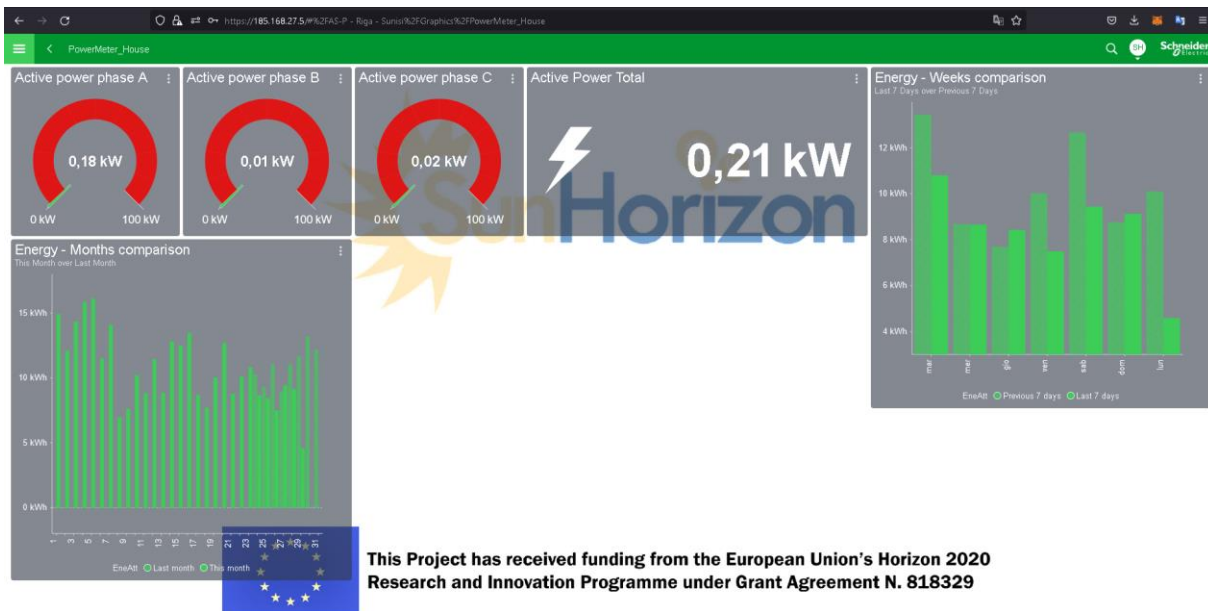
boxes while if you want to download the list of the historical values (as shown in Figure 43) you have to click on one of the little white boxes next to the blue boxes.



This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Figure 42: Room Dashboard

The dashboard linked to the room will display all the sensors that are currently being monitored (temperature, CO2, presence, window contact) while the dashboard relative to a field device (weather station, energy meter, water meter, etc.) will display the most important monitored data (i.e power, flow, T, volume).



This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 818329

Figure 43: Energy meter Dashboard

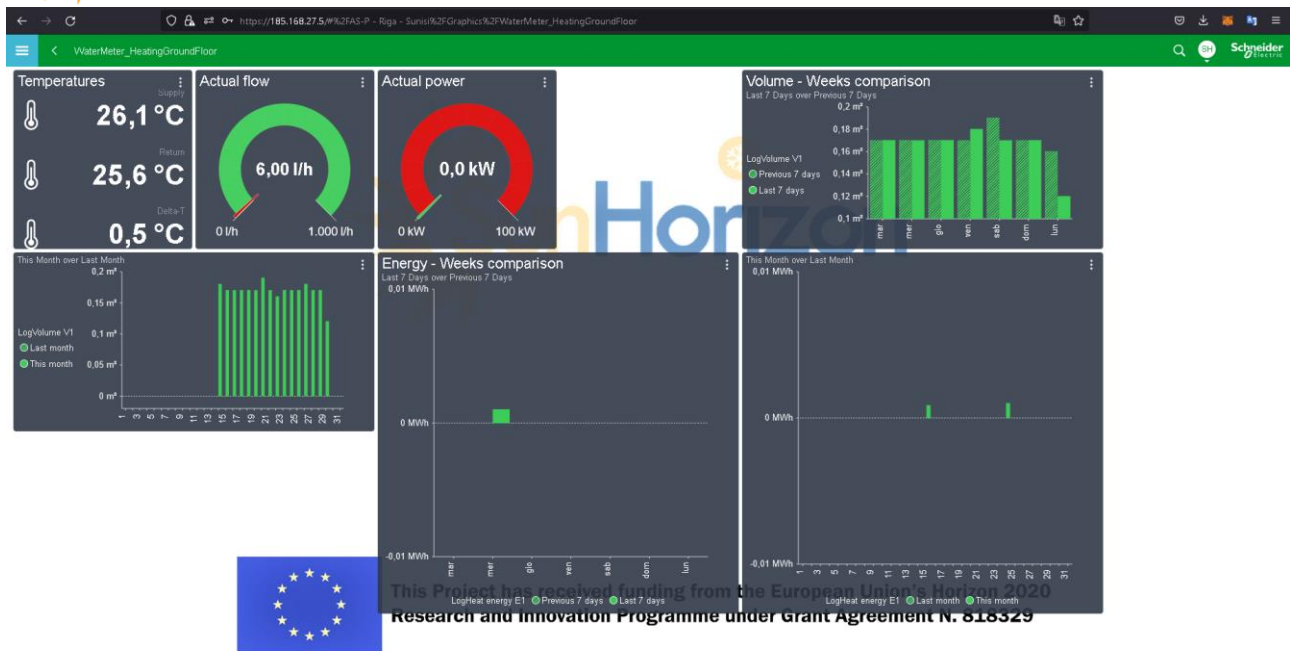


Figure 44: Water Meter Dashboard

Figure 43 and Figure 44 represent the typical dashboards of an energy meter and a water meter where are shown:

- Real-time data such as active power, actual flow, etc.
- Incremental data such as active energy and volume with weeks and months comparisons

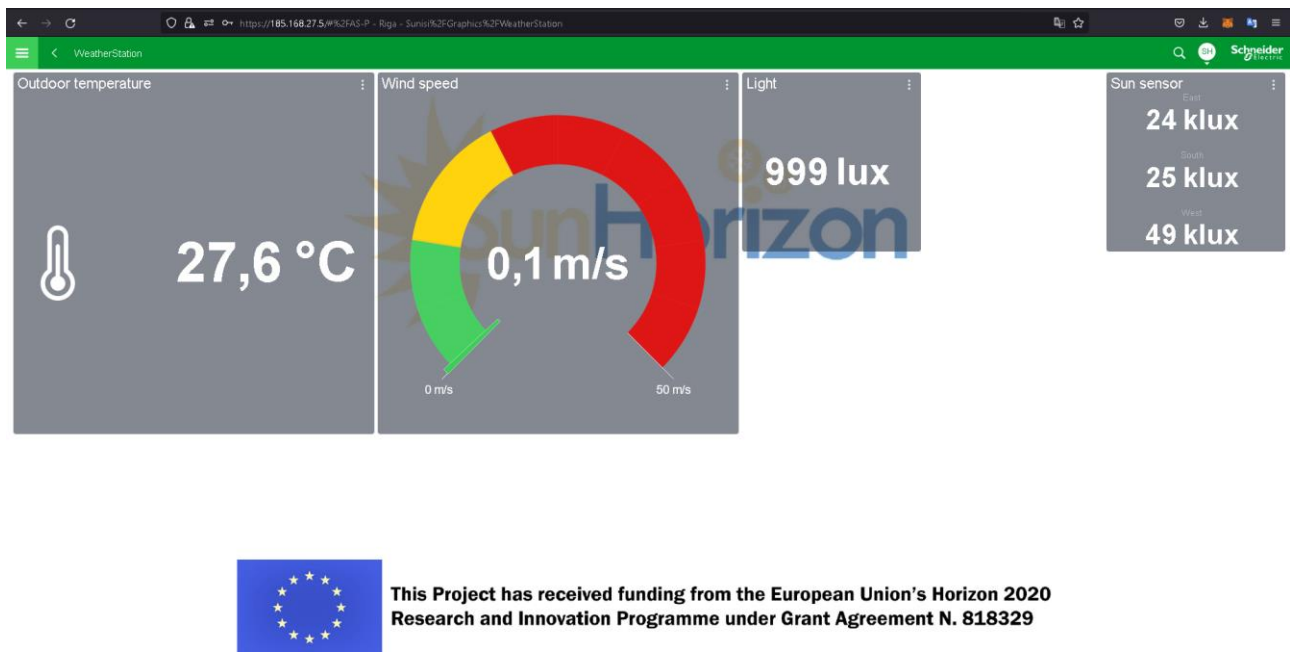
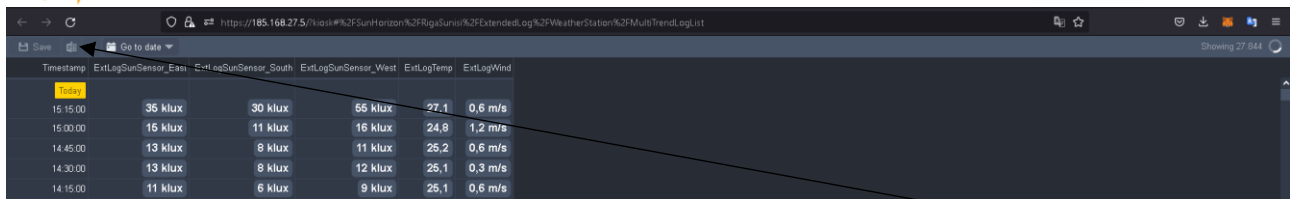


Figure 45: Weather Station Dashboard

The Figure 45 is the typical weather station dashboard where are shown all the data monitored by the device installed outside in real-time.



Timestamp	ExtLogSunSensor_East	ExtLogSunSensor_South	ExtLogSunSensor_West	ExtLogTemp	ExtLogWind
Today					
15:15:00	36 klux	30 klux	55 klux	27.1	0.6 m/s
15:00:00	15 klux	11 klux	16 klux	24.8	1.2 m/s
14:45:00	13 klux	8 klux	11 klux	25.2	0.6 m/s
14:30:00	13 klux	8 klux	12 klux	25.1	0.3 m/s
14:15:00	11 klux	6 klux	9 klux	25.1	0.6 m/s

Figure 46: Data List View

This is the example of historical data shown after clicking on the little white box. You can download all the data shown by simply clicking the excel icon: it will prompt the “Save file” Windows screen where you should choose the file name and where to save it.

5.1.3 Troubleshooting of devices/system

In case the data are not shown or collected and displayed for an extended time period (i.e. more than 1 hour), the system will send an email to the user, with the text “**device_name* is offline*”, or the user shall implement the following actions:

1. Verify that the device is powered (for the room sensors check the battery): if it is not, after having checked that the power reaches the device, unplug/remove the device from the wall-base for a few seconds and reconnect it. For the room sensors try to replace the battery.
2. Verify that the wirings are correct and still intact/undamaged.
3. Verify that the WiFi/Ethernet/Serial connection is up and running, and stable.
4. Verify if the alarm has cleared and acknowledge it.



Figure 47: Demo sites Landing page – how to see alarms

To open the “Alarm Journal” is necessary to click on the bell icon highlighted in the image (right upper corner). It will display all the alarms of the sites you are responsible of.

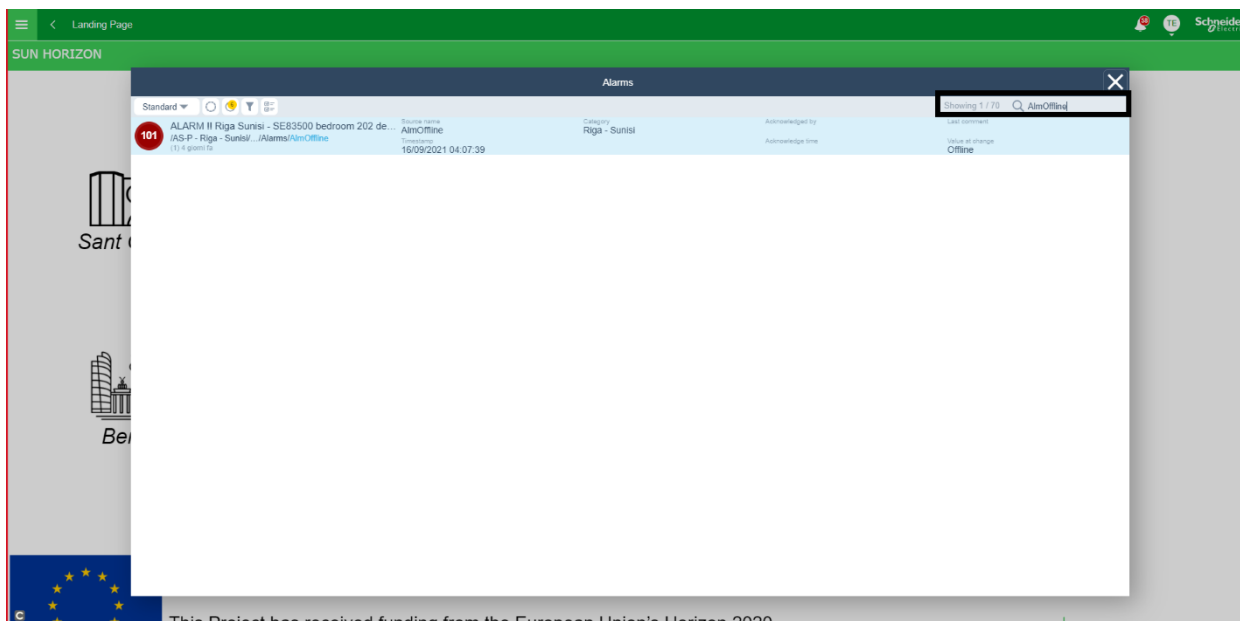


Figure 48: How to select only device offline alarms

To highlight only alarms that report offline devices you should click on the “Search Lens” icon and write in the text field that will appear “AlmOffline”.

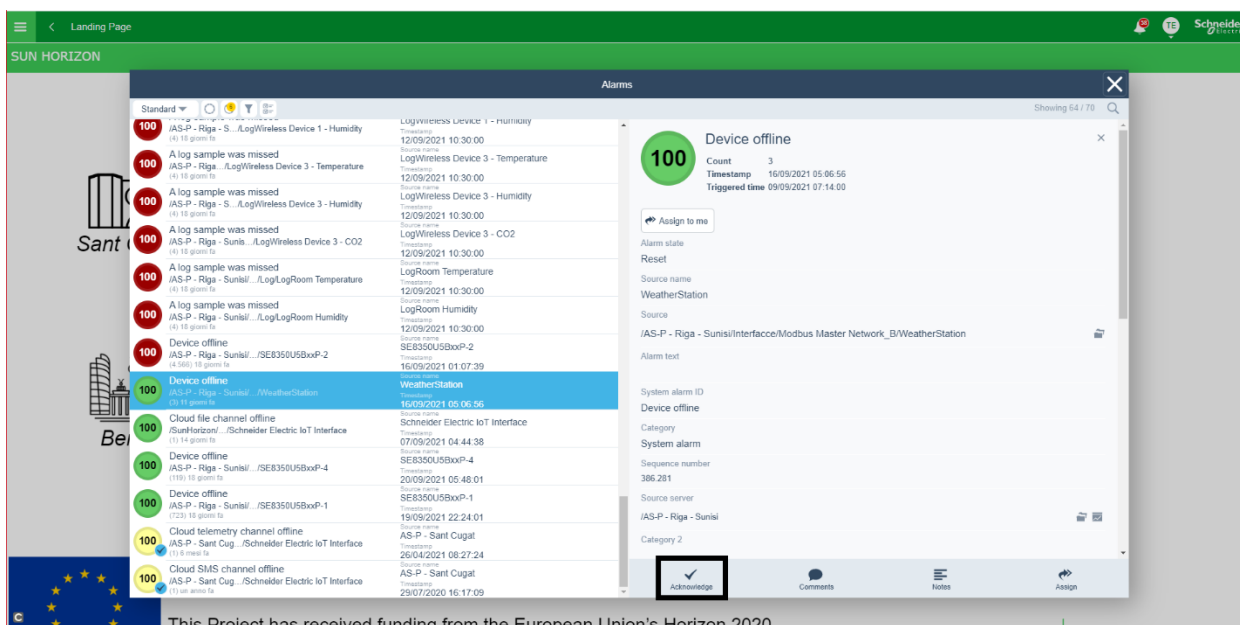


Figure 49: How to acknowledge an alarm

After that an alarm has been correctly handled you should acknowledge it on the WebStation to clear the alarm journal from alarms that are not pending anymore.

If the steps above don't solve your problem, please contact your Schneider Electric referent.

5.2 Dashboard in iDashboards tool

iDashboards is a web-based platform developed by IES Ltd, extension of iSCAN software User Interface, to allow non-energy experts to interact with energy data. It provides a customisable end-user interface build and share insights from any type of time-series operational data in one place. It is used to present end users with near real-time visualizations and KPIs of project data from iSCAN. Dashboards can be customised to arrange data in a concise and easily navigated manner for the specific audience to help get across relevant data and insights to decision-makers in an organisation or to the public. iSCAN is the source of time-series data to be displayed in iDashboards. Through data visualisations including charts, KPI cards and custom image/ floor plans with dynamic values, iDashboards can help to present the project data to a wide audience.

iDashboards is made up of a number of widgets, which can be customised and combined to create user specific dashboards. An example of a widget relevant with SunHorizon is a KPI card, which can provide quick overviews of performance indicators. KPI cards can be easily customised to display different colours or icons depending on the value of the data being displayed (Figure 50). Dynamic formatting makes it easy to identify where attention and effort should be focussed. iDashboards also have the ability of having real-time data displayed over an image of a building floor plan or a piece of equipment, which can provide great contextual insight to what the data means. Seeing all at once, the space temperatures of all the areas in a building, current electrical load of power meters serving different areas provides a way to consume vast amounts of data that's easy to understand.

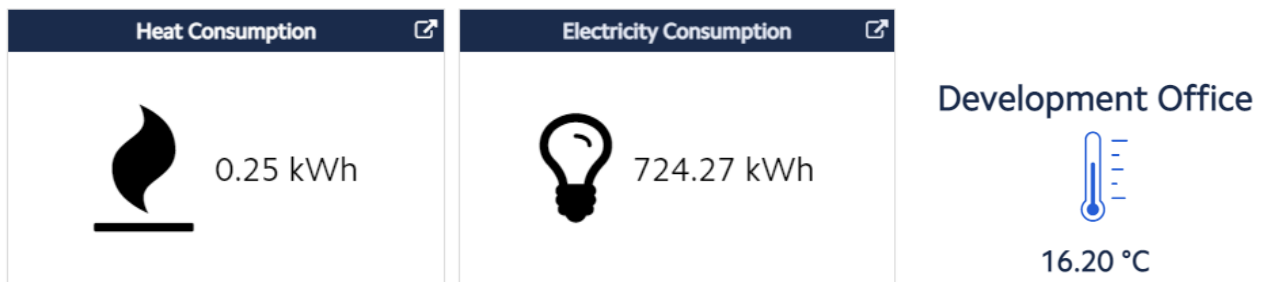


Figure 50: KPI card widgets examples in iDashboards

iDashboards charts also include several highly customisable visualisations for timeseries data. Charts are interactive with the ability to select dates to display at widget level, hover-over a value to see the value and timestamp. An example of these widgets is shown in Figure 51. It is also possible to add a hyperlink to any widget that when clicked, will navigate to another webpage.

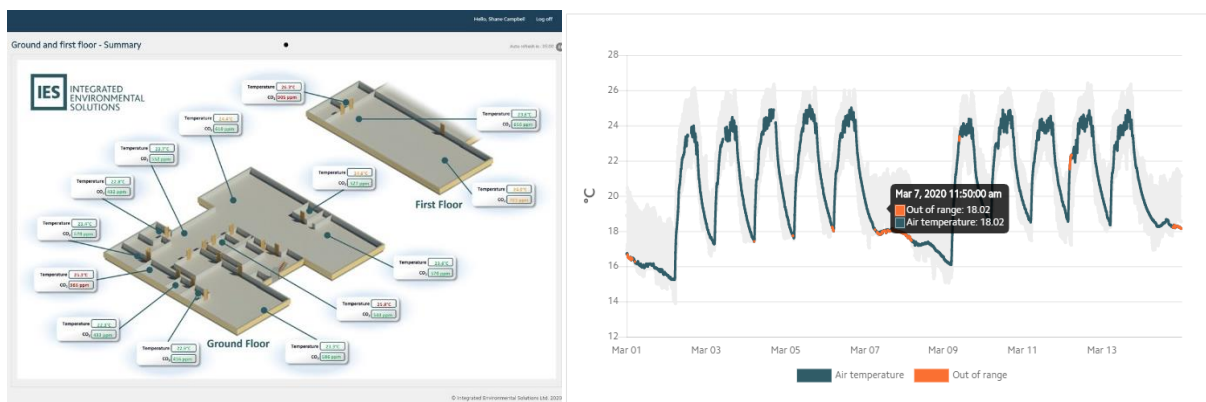


Figure 51: Example KPI card, floor plan and line chart widgets

The images in are just some of the widgets available in iDashboards for creating custom visualisations. Note that all dashboards can be fully customised to include a number of different widget combinations. The dashboards can also have controlled access for users meaning that a project can have executive dashboards focused towards decision-makers or

facilities management while also having more simplified, free-standing dashboards that can be displayed on public displays or accessed by other users at any time for key information.

iDashboards brings the ability to explore and interrogate data to both technical and non-technical people, and will be used in the SunHorizon project to display data to building occupants and facility managers as required. This includes displaying faults and alerts to notify facility managers of maintenance requirements within the building. This is to enable fault and maintenance prioritisation within the building, and to ensure that maintenance issues do not go undetected. The facility manager will also be able to see KPI's in relation to building and system performance in order to understand the current and historic energy requirements of the building.

5.2.1 How it works

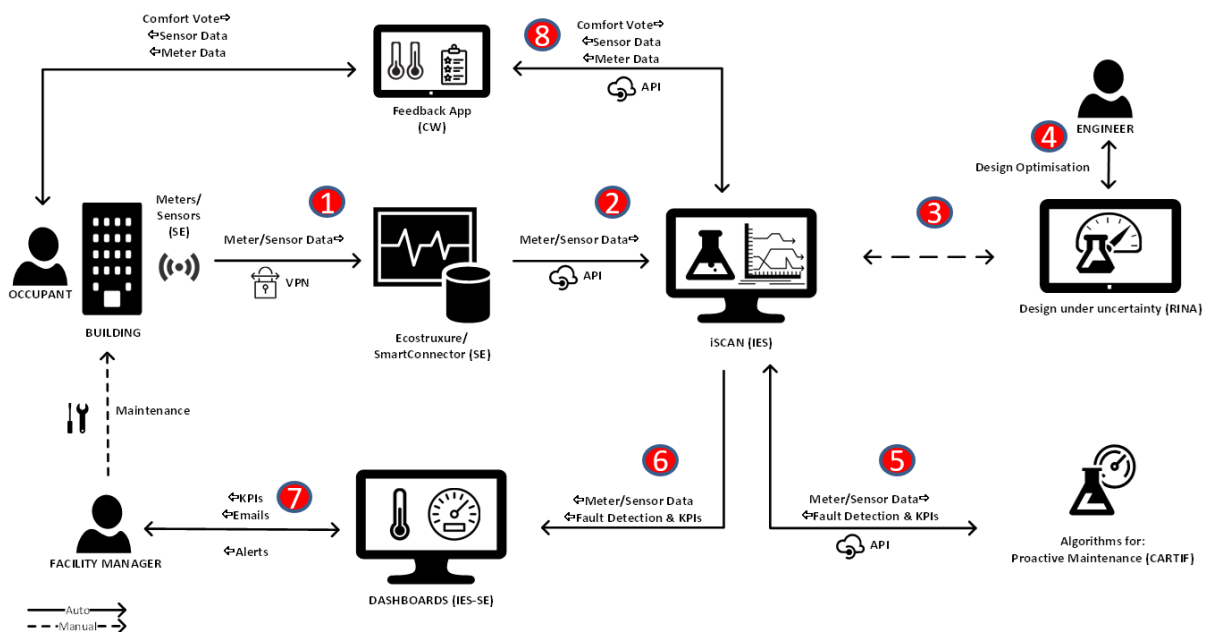


Figure 52: SunHorizon monitoring tool workflow

Figure above illustrates the data flow in the SunHorizon monitoring tool. In step 1, Enterprise Server collects data from sensors and is integrated with iSCAN, and this way all data collected is stored in iSCAN every 15 minutes, including sensors and meters installed in the building (step 2). iSCAN is a tool for data manipulation and analysis, used by trained engineers and integrated with iDashboards tool, which is the tool a SunHorizon user can access (step 7). It is populated with KPIs, PIs and Is, either calculated in iSCAN or directly in iDashboards (step 6). The tool is really flexible and can be customised to display various widgets based on the needs of every facility manager. It can visualise datasets, display current values or alerts/alarms.

An example of the SunHorizon dashboard tool for Riga Sunisi House, set up in iDashboards tool, is found below.

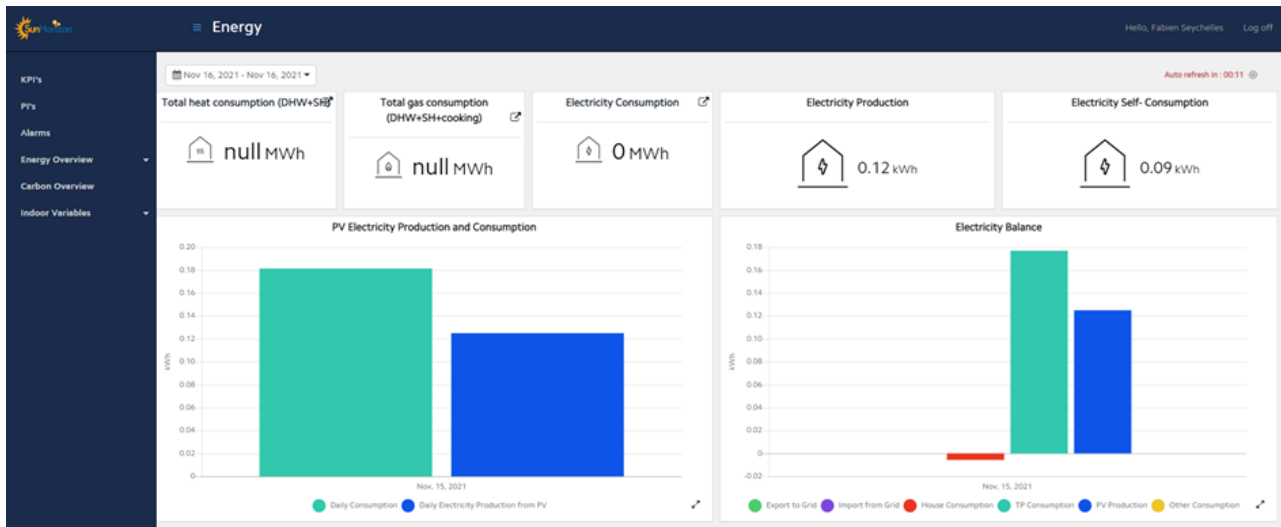


Figure 53: SunHorizon iDashboards tool – Riga Sunisi house Example

5.2.2 How to use it

The Dashboard is accessible via a web browser in dashboards.iesve.com and responsive to the screen. An IES account is required and authorisation by an administrator to access iDashboards that can be created for free in iesve.com.

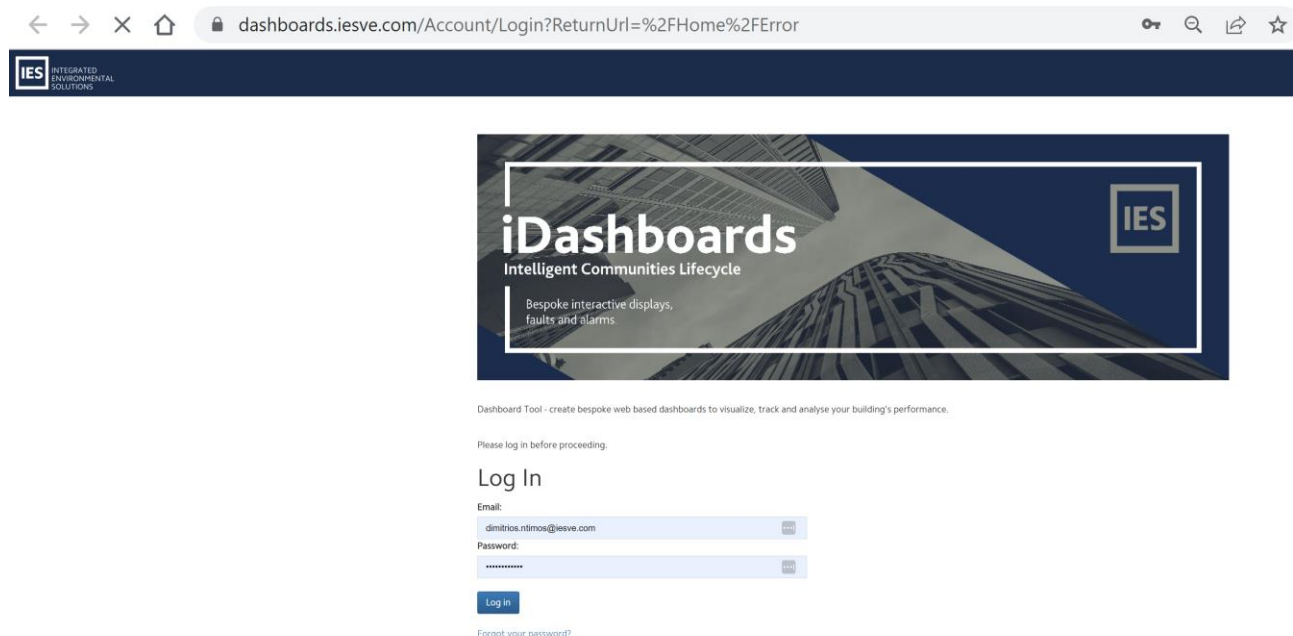


Figure 54: iDashboards login page

Figure 55 shows the KPIs page of the SunHorizon dashboard where the widgets such as KPI cards and diagrams are shown in the main white area of the dashboard. On the left-hand side, a navigation pane is showing the various pages available. A single click on the text of the page in the navigation pane on the left is directing to the page in the dashboard.

Each page might include sub-pages. In this case a downwards arrow is shown, as in “Energy Overview” page in the screenshot below.

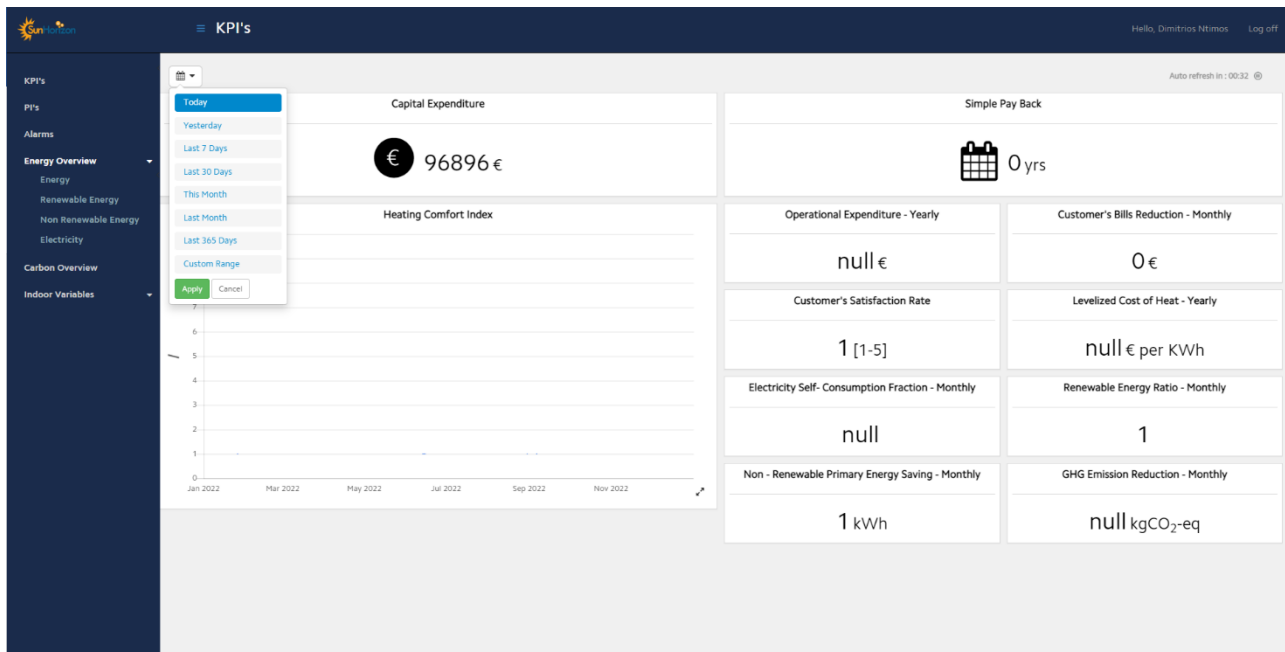


Figure 55: Riga Sunisi dashboard KPIs page

5.2.2.1 Auto-refresh

Auto-refresh functionality allows the automatic update of the dashboard in a pre-selected period. The Play-Pause button can be clicked to enable/disable auto-refresh functionality.

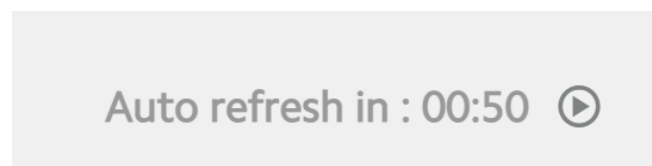



Figure 56: iDashboards – Auto refresh

5.2.2.2 Calendar date selection

A calendar button appears on the top left of each page.  It is used to change the data that appear in the widget(s) to correspond to the selected dates. It allows the selection of a date of:

- Current day,
- Yesterday,
- Last 7 days,
- Last 30 days,
- This month,
- Last month,
- Last 365 or Custom Range.

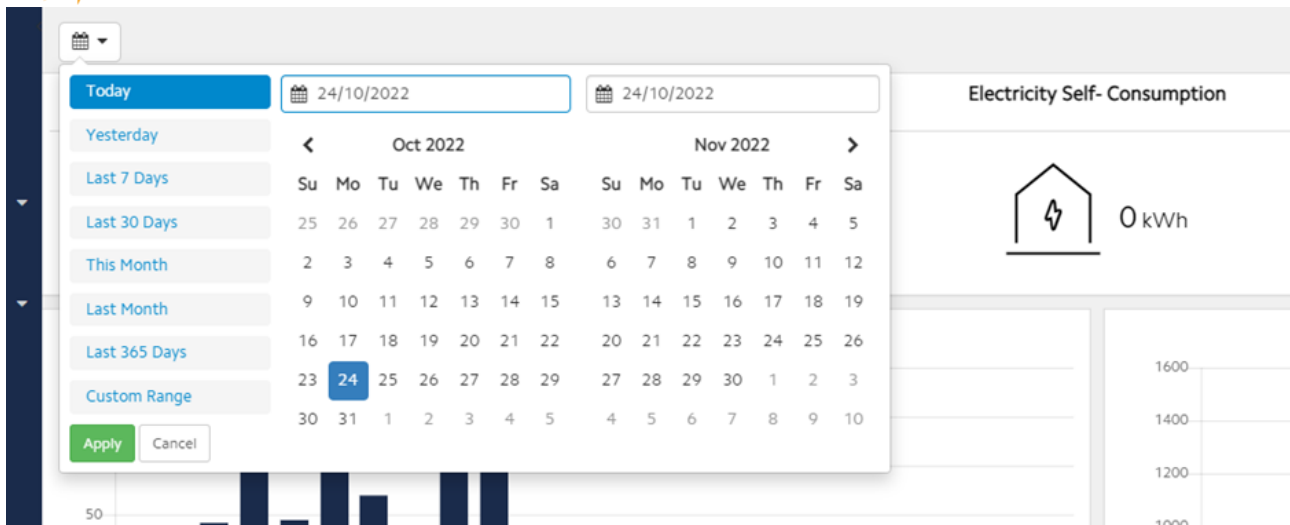


Figure 57: iDashboards - date selection button

Once the desired date is selected, by selecting “Apply” the widget is responding automatically and displays the corresponding data.

5.2.2.3 KPI card

A KPI card widget allows the user to get a direct information of a KPI name, units and value, as seen below.

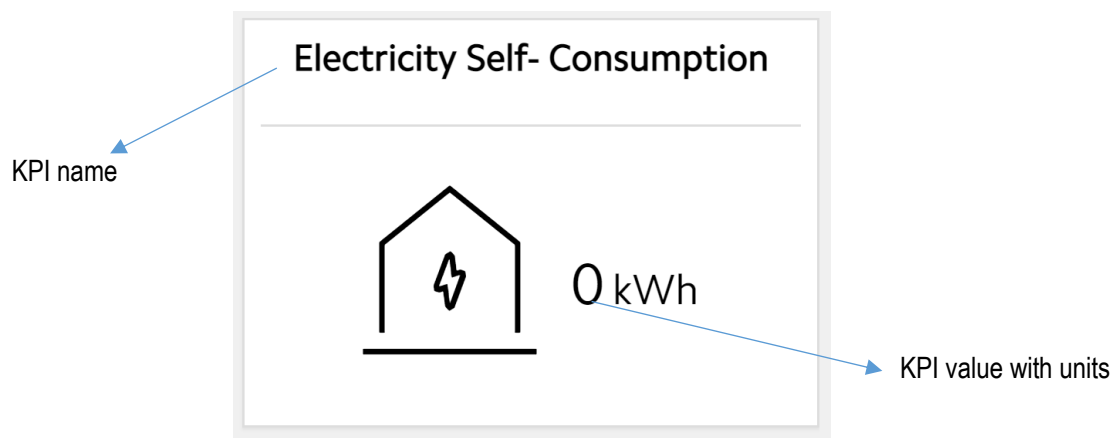


Figure 58: iDashboards – KPI card

On top of the KPI card there is the description, the title of the KPI. In the middle there is an icon, the KPI value and the units, as seen in the screenshot above.

5.2.2.4 Line chart

A line chart widget is using colour coding lines in a X-Y axis diagram to display sensor or meter readings collected by the indoor sensors and meters. In the example below, the title of the chart is on top, the X axis is time of the day, while the Y axis shows the values with units. The legend at the bottom illustrates the colour of the line corresponding to each room A

click on the legend show/hide a room time series from the diagram. Hovering over, a pop up window show the value at that specific time of the day.

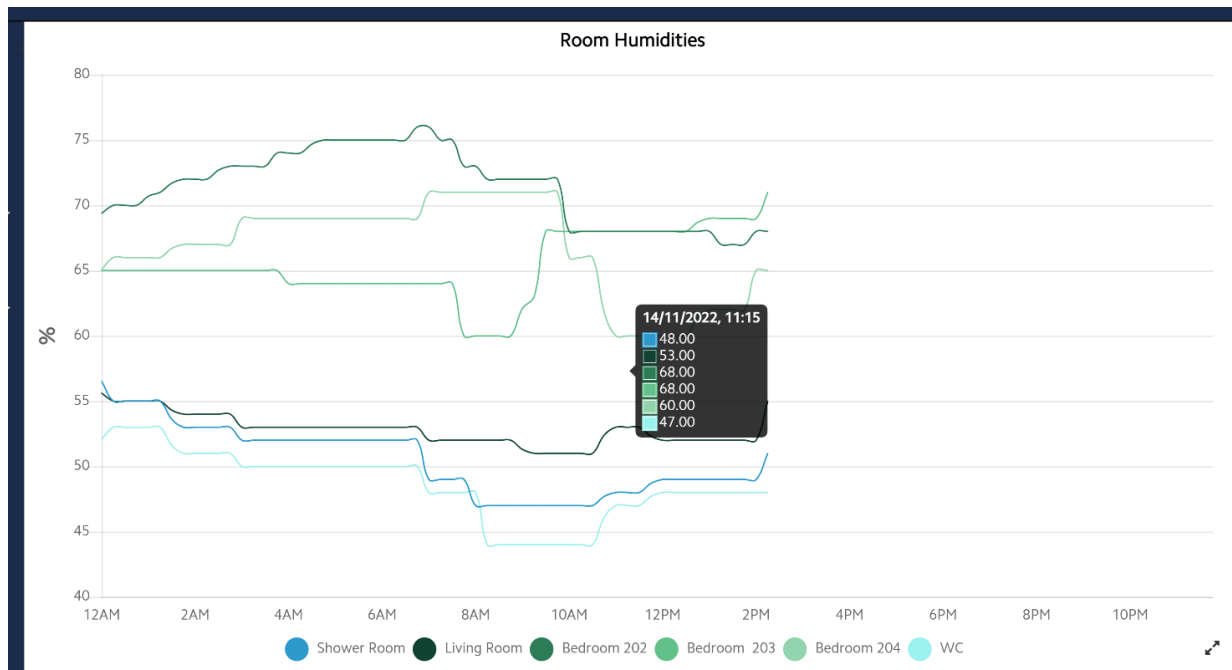


Figure 59: iDashboards - Line Chart

If you are an occupant of a building where SunHorizon has been deployed, you need to contact IES to get access to your dashboards. Riga Sunisi House dashboard is available as an example at the following link:

<https://dashboards.iesve.com/dashboard/1496/KPIs/SunHorizon-RigaSunisi>

5.2.2.5 Alarms/Alerts

The alarms/alerts panel is showing alerts or alarms based on preset rules in iSCAN. For example, if there is a gap in data, an alert pops up, as seen in the screenshot below. The alerts can be customised to show a specific message and colour coded based on severity.

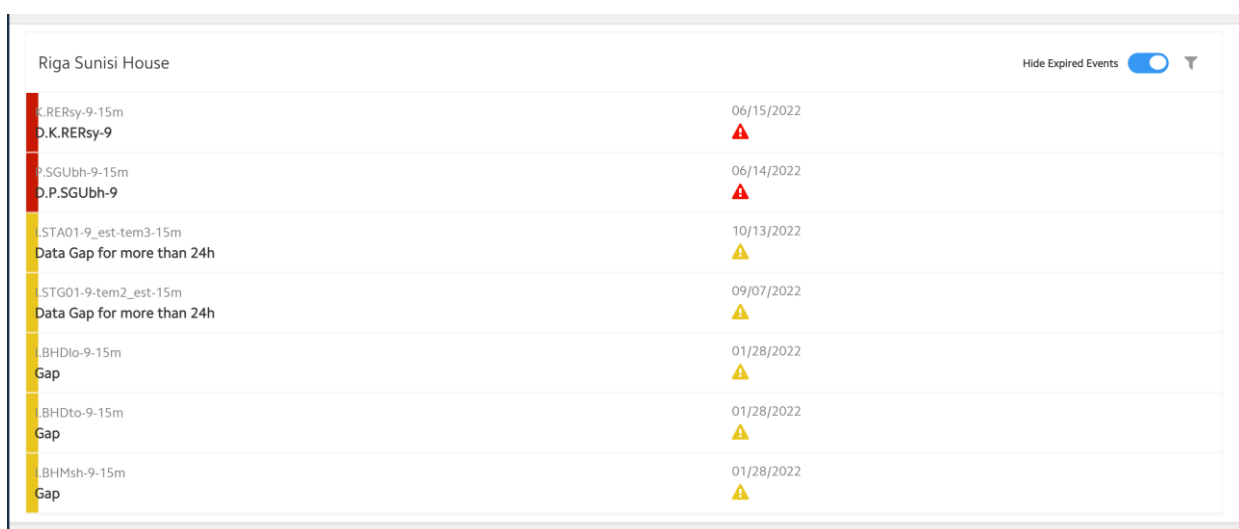


Figure 60: Dashboards – Alarms/Alerts

The alert can be selected, and the following window pops up with more information on the alert and a button to Acknowledge and Delete.

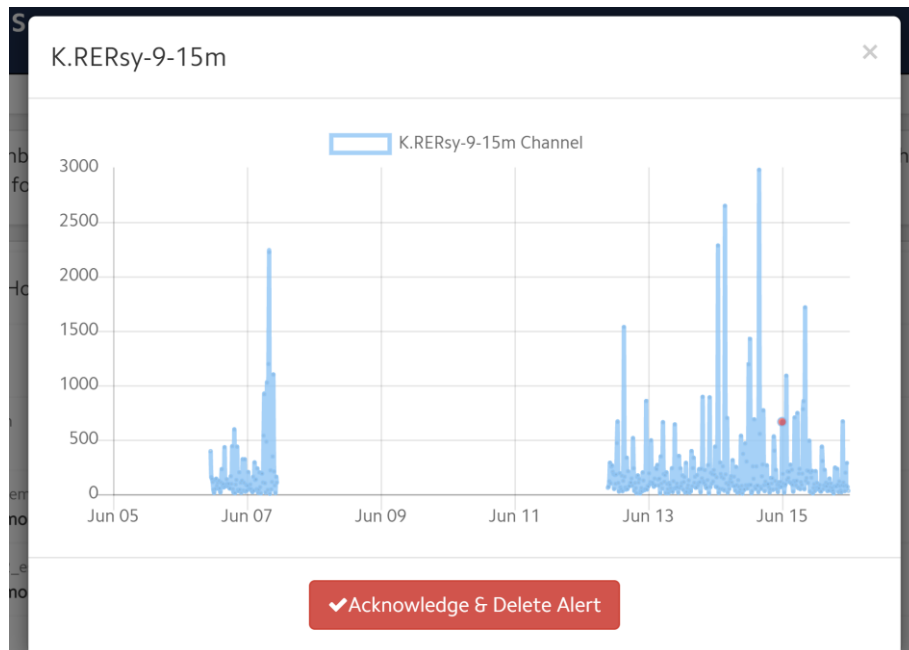
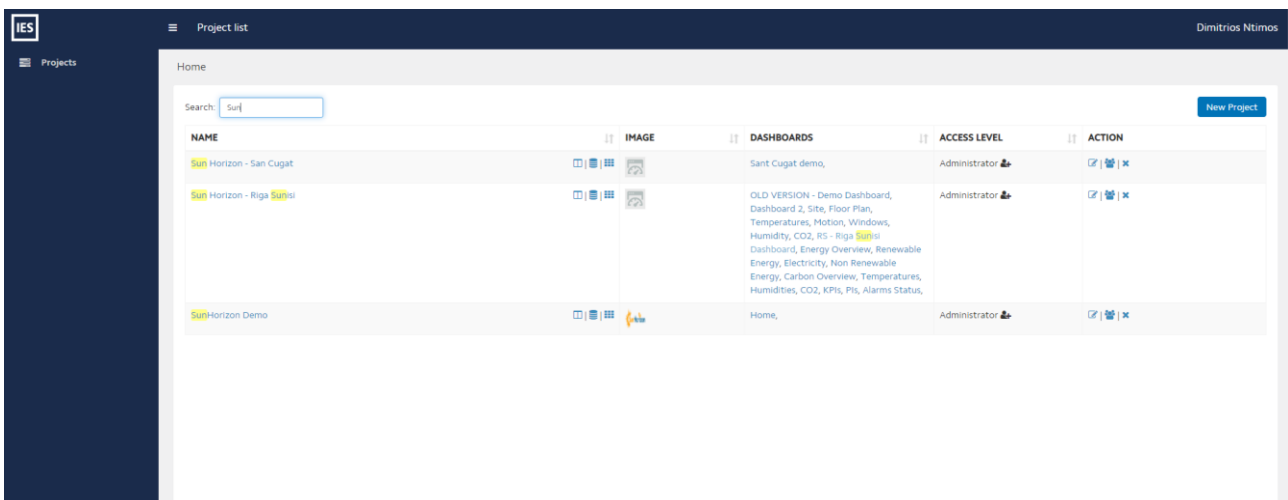


Figure 61: iDashboards – Display & Acknowledge Alert

5.2.2.6 Administrator functionalities

The administrator can access the projects page of iDashboards, and

- view all the dashboards as “projects”
- create new projects
- manage existing projects (view-edit-delete)
- manage the users and their access levels (invite-view-edit-delete)




















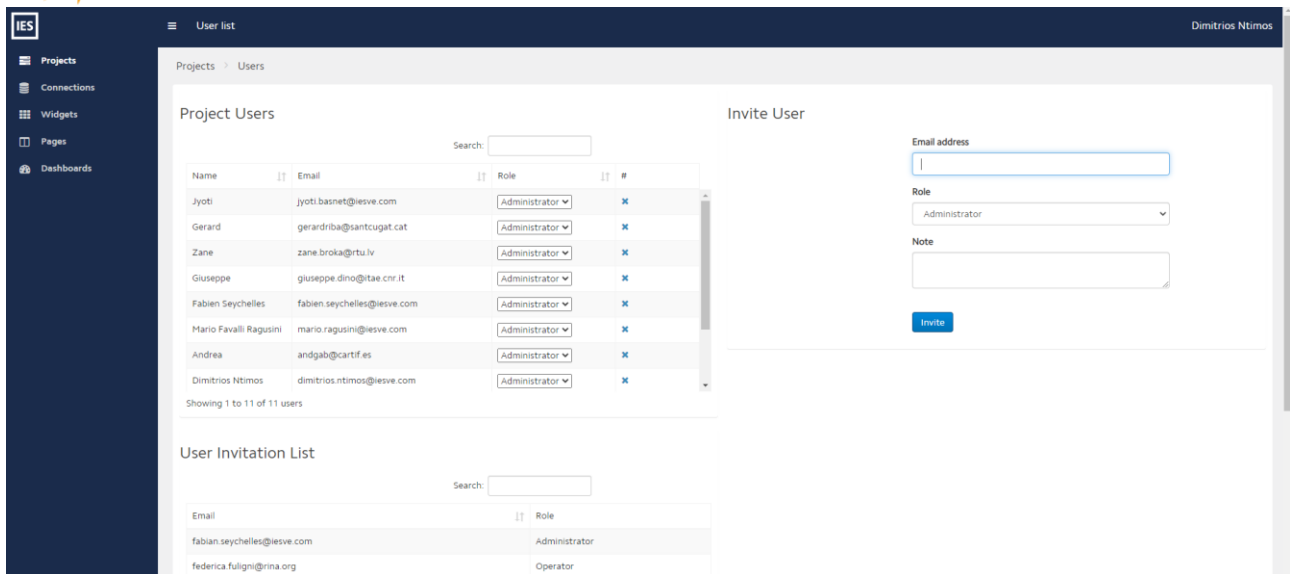
NAME	IMAGE	DASHBOARDS	ACCESS LEVEL	ACTION
SunHorizon - San Cugat		San Cugat demo,	Administrator 	  
SunHorizon - Riga 		OLD VERSION - Demo Dashboard, Dashboard 2, Site, Floor Plan, Temperatures, Motion, Windows, Humidity, CO2, RS - Riga 	Administrator 	  
SunHorizon Demo		Home,	Administrator 	  

Figure 62: iDashboards – administrator view 1



The screenshot shows the iDashboards administrator interface. On the left is a sidebar with navigation links: Projects, Connections, Widgets, Pages, and Dashboards. The main content area is titled 'User list' and 'Dimitrios Ntimos'. It contains two sections: 'Project Users' and 'Invite User'.

Project Users

Name	Email	Role	#
Jyoti	jyoti.basnet@iesve.com	Administrator	X
Gerard	gerardiba@santcugat.cat	Administrator	X
Zane	zane.broka@rtu.lv	Administrator	X
Giuseppe	giuseppe.dino@itae.cnr.it	Administrator	X
Fabien Seychelles	fabien.seychelles@iesve.com	Administrator	X
Mario Favali Ragusini	mario.ragusini@iesve.com	Administrator	X
Andrea	andgab@cartif.es	Administrator	X
Dimitrios Ntimos	dimitrios.ntimos@iesve.com	Administrator	X

Showing 1 to 11 of 11 users

User Invitation List

Email	Role
fabian.seychelles@iesve.com	Administrator
federica.fulgini@rtna.org	Operator

Invite User

Email address:

Role:

Note:

Figure 63: iDashboards – administrator view 2

5.2.3 Troubleshooting

The dashboard works better in Google Chrome browser on a personal computer or laptop. If the dashboard is showing no data or frozen, you can:

- Refresh page
- Clean cache in browser
- Log out and login again

If none of the above work, contact IES for support.

6 Conclusion

This document aims to give technical knowledge to end-users on the operation of all the tools developed during the SunHorizon project, providing information and instruction.

The use of this manual, with visual information (illustrations, tables, screenshots) gives the reader easy-to-understand information.

This user manual will be very useful after the end of the project to give the essential knowledge on the use of the various tools, applications and dashboards, to monitor the progress of the KPI and to know the electrical consumption not only in real time but also in a temporal trend.