This project has received funding from the Interreg Sudoe Programme and the European Regional Development Fund (ERDF) under grant agreement n° SOE3/P3/E0922

P5.1. ARCAS Tool report

Project: New Method of Evaluation of Social Interest, Sustainable and Energy Efficient Housing - Architecture for climate - in the Sudoe Territory (ARCAS)

Technical references

Project Acronym	ARCAS
Reference	SOE3/P3/E0922
Title	New Evaluation Method for Homes of Social, Sustainable and Energy Efficient Interest – Architecture for Climate- in the Sudoe Territory (ARCAS)
Project coordinator	Fundación Estudios Calidad Edificación Asturias. FECEA

Deliverable nº	E 5.3.1 ARCAS Tool Report
Dissemination Level	Public
Group of Tasks	GT5 – ARCAS TOOL
GT Leader(s)	FECEA
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Approved by coordinator	31/03/2023
Due date of deliverable	Septembre 2021

Document Version Control

Version	Date	Comment	Modified by
V1	25/05/2022		ES, MA, PG
V2	01/06/2022	All sections	RO; FN
V3	17/06/2022	All sections	FA, JN, PG, ES, MG
V5	07/02/2023	Review	IFA, MOM
V6	30/03/2023		ES, MA

Content

1. Executive summary

From the task groups GT1 (climate indicators), GT2 (energy performance indicators), GT3 (indicators on best available renewable technologies) and GT4 (energy poverty indicators) together with the research carried out in the GT5 (development of the ARCAS tool), an initial design of the ARCAS tool has been developed with the available information of those indicators that have already been selected and approved by the ARCAS´ research team. The model is already available on the online platform.

For the tool to be fully operational, it is necessary to specify the classes that will definitely be implemented in the three axes of study. In some cases, given the difficulty of finding an objective and balanced weighting, we work on an alternative solution based on a semi-qualitative evaluation that allows obtaining the same results and being equally operational in the ARCAS tool.

2. Context

2.1. The ARCAS project

The ARCAS project aims to develop an evaluation and design methodology aimed at the rehabilitation of buildings and groups of collective buildings of social housing, with the aim of addressing energy poverty and promoting sustainable rehabilitation, energy efficiency and health in the Sudoe territory. The project is based on the integration of three research axes:

- Autonomy/energy efficiency

- Social quality/Energy poverty

- Air quality/health

As a result of this integration, it is intended to determine the optimal relationship between the 3 axes mentioned and obtain the best energy efficiency while maintaining social quality and the well-being of citizens.

ARCAS is based on the use of similar climatology in the South Atlantic Arc for the development of a tool that allows, through key indicators, the design of building architecture based on maximizing energy efficiency, air quality and thus promoting social welfare, making use of the best available techniques, including renewable energy sources.

This project joins forces for the development of strategies and measures that facilitate national, regional and local governments to develop policies for the rehabilitation of collective buildings of housing of great autonomy and energy efficiency (axis 1), with a healthy air quality for the

occupants of the buildings (axis 3) and reducing energy poverty so important in many European countries (axis 2).

The ARCAS Products will be applicable and reproducible in the public and private institutions participating in the project and will be of particular use for professional associations, manufacturers, builders and for national, regional and local public administrations.

The Action Plans that will be developed in an integrated way on the three axes of the research project by the ARCAS beneficiaries, in collaboration with the ARCAS associated partners, constitute a key element that will ensure the transfer of knowledge to the entire Sudoe territory, as well as the future sustainability of the ARCAS methodology.

From a methodological point of view, the project is structured in different task groups (GTs). In a first phase, the indicators that will be used in the ARCAS methodology are defined. These indicators are proposed within the first 4 Task Groups, as well as the specifications and protocols for their quantification. These 4 task groups are specifically:

GT 1 – Selection of climate indicators: CLIMATE MAP

GT 2 – Selection of energy efficiency indicators in residential buildings

GT 3 – Selection of indicators on best available renewable technologies

GT 4 – Selection of social quality indicators

In WP 5, the ARCAS methodology will be developed and implemented in a computer tool. It is therefore essential that the indicators selected in the previous WGs can be measurable and evaluable, as well as compatible with their application to different types of residential buildings and in different countries.

Several demonstration buildings will be selected in GT6. As a selection criterion, buildings that include a representative casuistry of the three axes considered and the three countries of the consortium are sought.

WP 7, WP 8 and WP 9 cover the part of the project that can be considered as the capitalization part. More specifically, GT 7 details the ARCAS certification procedure, generating a series of guides aimed at project owners, referents and certifiers who will audit ARCAS projects. This work will be carried out in coordination with project partners. As for WG 8, this working group has as its main objective the training of professionals, and to achieve this, a training program is defined to train professionals in the application and certification of the ARCAS method, and a pilot training program is given in professional institutions that belong to the value chain of the ARCAS project. Finally, WP 9 develops strategies to establish new policies of sustainability, energy efficiency and social quality in the rehabilitation/renovation of collective housing, this includes proposals for rehabilitation policies, financing models and criteria to prioritize interventions, among others. For this, the indicators defined in WGs1 to 4 are used, and it is

carried out in coordination with public administrations and private organizations associated with the ARCAS project.

3. Objective of this report

The main objective of this report is to explain how the data collection will be incorporated into the tool and which procedures will be used for subsequent analysis for the correct functioning of the ARCAS tool, which will be developed in the GT7 task force.

4. Methodology

With the aim of assessing building rehabilitation, previous work on this work package (GT5 ARCAS Tool) has analyzed other existing standards and tools in the international market (see Deliverables D5.1 and D5.2). The proposed indicators for the different axes (air quality/health-GT1 y GT4, Energy efficiency-GT2, Energy poverty /social quality, GT4) have been incorporated into the tool.

The ARCAS tool consists of a matrix composed of three axes with the selected indicators per axis as shown in Table 1.

	Indicator
1	Primary energy consumption (PEC)
2	Heat loss coefficient - simple (HLCs)
3	Energy needs
4	Renewable energy self-sufficiency ratio (PERc/PEc)
5	Renewable energy self-consumption ratio (PERc/PERPp)
6	Global warming potential (GWP)

Energy axis

	Indicator
T	Temperature (°C) - No mechanical ventilation&heated
	Temperature (°C) - No mechanical ventilation&not heated.
	Temperature (°C) - Mechanical ventilation&heated
	Temperature (°C) - Mechanical ventilation&not heated
A	Acoustic comfort
I	CO_2 (ppm)
	Relative humidity (%)
	Minimum ventilation rate (L s^{-1} p^{-1})
	Moisture (cm^2)
	Particulate matter $PM_{2,5}$ (µg m^{-3})
	Formaldehyde (µg m^{-3})
	Benzene (µg m^{-3})
	Radon (Bq m^{-3})
L	Visual comfort (% of time with iluminance between 300-50

Air quality axis

	Indicator
1	10%
2	High share of energy expenditure in income indicator (2M)
3	Low Income and High Costs (LIHC)
4	Index of Vulnerable Homes (IVH)
5	Renewable energy self-consumption ratio (PERc/PERPp)
6	Global warming potential (GWP)
7	Embodied energy
8	Percentage of hours in adequate comfort conditions (category I or I

Energy poverty axis

The work started with the application R (The R Project for Statistical Computing) has been used for the development of the tool ARCAS (https://www.r-project.org/).

5. ARCAS Tool. Method 1

The ARCAS tool is based on a model that will allow to classify buildings according to their air quality and energy efficiency behaviour, considering also key parameters representative of energy poverty. The classification is based on 4 level system, with the Class I and Class IV representing the best scenario and worst scenarios, respectively. From the matrix obtained, a classification per axis can be obtained.
To achieve this, different weights for the different parameters of each axis need to be assigned.

Work starts from the analysis of influencer databases

5.1. Database for analysis

As mentioned above, it is necessary to have a sufficiently large database so that, through the use of data analysis, conclusions can be drawn, and intervals can be stablished. This must be in a format that is readable for the R application (either .csv, .txt, Excel, etc.).

The structure of the dataset will contain as many variables as objects under study. That is, a significant large amount of data will be needed for all the variables necessary for the calculation of each of the indicators that are intended to be measured and compared. The ranges of measurement and additional details can be found in deliverables GT1, GT2, GT3 y GT4.

There is currently a specific score related to the **quality of the building**. Thus, there will be buildings that have the highest score, since their quality is very good and, on the other hand, there will be others that will have a lower score. All this, in turn, is important when it comes to studying the boundaries between classes.
Information collected from the different buildings must be sufficiently large to account for a wide variation of buildings´ characteristics in terms of quality for the Sudoe area.

Finally, it should be noted that this step is the most important of the design of the tool because the consideration of a non-accurate classification system can lead to wrong conclusions.

As mentioned in the T5.2. deliverable, although there are criteria for the detection of the maximum and minimum limits relative to an axis, there are complications to obtain the limits of the rest of the intermediate classes. Once the data has been collected and registered using the same units, a standardization procedure will be used. The mean and the standard deviation of the sample are used. Then, applying the Central Limit Theorem and knowing that the size of the data sample will be greater than 30 (hypothesis of the Central Limit Theorem), we will obtain a sample that follows a Normal distribution of average 0 and standard deviation 1. The formula would be as follows:

$$\bar{P}_i = \frac{P_i - \bar{P}}{sd(P)}$$

Where P_i is the value of the parameter, ; $\bar{P}$ the sample average value; and $sd(P)$ the sample standard deviation.

Conclusion:

We tried to use the data analysis method, but insufficient data made this approach difficult. For this first phase of the tool, as a second possibility, a committee of experts formed by the project's researchers was used. In the future, beyond the scope of this ARCAS project, it is planned to work with the data obtained from the monitoring of ARCAS buildings together with other similar buildings in order to obtain sufficient data to apply the data analysis method.

6. ARCAS Tool. Method 2

As an alternative to the analysis described above, and as long as there is not enough information to continue along this path, the consortium opts for a complementary method that consists of defining the intervals and weights of the indicators through the committee of experts.

The intervals and relative weights have been assigned considering a committee of ARCAS experts led by UPV-EHU on the energy axis, by URL-TIPEE on the air quality axis, and UMinho on the energy poverty axis.

6.1. Axis 1: Energy efficiency and sustainability

For the energy efficiency and sustainability axis, the following intervals and weights have been defined for the ARCAS classification system (Table 2).

ENERGY EFFICIENCY AND SUSTAINABILITY

Indicator	Relative weight		Intervals proposed for the ARCAS classific			
	%	Please, add the source for these values (results of projects, publications, expertise, etc.)	Class I	Class II	Class III	Class IV
1 Primary energy consumption (PEC)	20	Consensus UPV-EHU experts	<85	[85,125)	[125,165)	[165,205)
2 Heat loss coefficient - simple (HLCs)	30	Consensus UPV-EHU experts	<2,4	[2,4;3,1)	[3,1;4,0)	[4,0;4,7)
3 Energy needs	15	Consensus UPV-EHU experts	<18	[18,50)	[50,85)	[85,115)
4 Renewable energy self-sufficiency ratio (PERc/PEc)	10	Consensus UPV-EHU experts	>=60%	[40,60)	[20,40)	[0,20)
5 Renewable energy self-consumption ratio (PERc/PERPp)	10	Consensus UPV-EHU experts	<40%	[40,60)	[60,80)	[80,100]
6 Global warming potential (GWP)	15	Consensus UPV-EHU experts	>=30	[20,30)	[10,20)	<10
7 Embodied energy						
8 Percentage of hours that the dwelling is in adequate comfort conditions (category I or II) according to standard EN 16798-1 (%HI-II)						
	100					

Table 2. Classes and intervals defined for the classification system (energy efficiency and sustainability).

NOTE: GWP is considered as a percentage reduction of the GWP after the retrofit, taking as a reference situation the GWP of the building in its initial state.

Description:

(1) Total primary energy consumption, per m2 of conditioned floor area. It will be measured disaggregated by use (heating, cooling, DHW, lighting and auxiliaries).
(2) Heat Loss Coefficient. It measures the total thermal losses of the building through the envelope (including thermal bridges and total air change) per unit of the temperature difference between indoor and outdoor temperatures.
(3) For heating or cooling. Heat to be delivered to or extracted from a thermally conditioned space to maintain the intended space temperature conditions during a given period of time.
(4) Ratio between the renewable energy consumption and total primary energy consumption (PERC/PEC).
(5) Ratio between the renewable energy consumption and renewable energy production (PERC/PERP)
(6) Global Warming Potential. CO2 emitted related with materials and equipment lifecycle, as well as the type of energy production during operational use of the building

The definition of the indicators and the methods to be used for their calculation can be found in deliverable D2.2.

Based on the argument that only indicators that add significant information are included in the ARCAS tool, it has been agreed to remove the indicator embodied energy from the ARCAS indicators. This indicator is included also in the GWP. Also, comfort conditions (%HI-II) will be considered in the air quality axis.

6.2. Axis 2: Energy Poverty

For the energy poverty axis, the following intervals and weights have been defined for the ARCAS classification system (Table 3).

Energy expenditure and net income which are considered for the calculation of the 10% indicator are two of the most representative parameters of energy poverty. Therefore, for the experimental validation of the tool, a single indicator (10%) is proposed.

ENERGY POVERTY

Indicator	Relative weigh %	Intervals proposed for the ARCAS classification system				
		Class I	Class II	Class III	Class IV	Correction factor per country required?
1 10%	100	epi≤10%	10%<epi≤15%	15%<epi≤20%	epi>20%	To be evaluated by each partner when applying the indicator and then discussed.
2 High share of energy expenditure in income indicator (2M)						
3 Low Income and High Costs (LIHC)						
4 Index of Vulnerable Homes (IVH)						
5 Renewable energy self-consumption ratio (PERc/PERPp)						
6 Global warming potential (GWP)						
7 Embodied energy						
8 Percentage of hours in adequate comfort conditions (category I or II) (%HI-II)						
	100					

Table 3. Classes and intervals defined for the classification system (energy poverty axis).

The definition of the indicators and the methods to be used for their calculation can be found in deliverable D4.2.

The 10% indicator establishes a direct relationship between a household's net income and energy expenditure.

To evaluate situations of political energy, use the following formula:

Energy expenditure / net income * 100 < 10%

<u>Net income calculation:</u>

To obtain the value of income and given that the ARCAS project focuses on social housing assuming low income, it is proposed to adopt the national minimum wage, multiplied by the number of adult cohabitants. If working with specific witnesses who are essential for evaluation, direct consultation could be used.

For net income, the following equation would be used:

Net income = (non-taxable income + taxable income) – (social security or equivalent + income taxes payable)

The source of this income can be consulted in the different national contexts:

National context	**Data Source for Income**
France	www.insee.fr
Portugal	www.pordata.pt

Spain www.mites.gob.es

Calculation of energy expenditure:

The ideal method for calculating energy expenditure would include directly measuring households' energy consumption using power meters or querying energy from historical data.

If this data is not available, consumption will be calculated from home energy efficiency simulations.

These calculations should include the energy needed to cover the heating and cooling needs of spaces and domestic hot water, using as a reference the standard temperature threshold defined in the different national regulations.

Lighting consumption and appliance use should also be included if available. The numerical model used should consider the physical characteristics of the buildings (*e.g.* thermal transmittance coefficient of the envelope), occupancy and internal gains of the dwelling and the type of heating and cooling system used.

Both dynamic and steady-state calculations can be used to calculate energy needs, preferably in line with what is considered an established method in different national contexts. Current energy prices in each country should be used.

After calculating the energy needs, the energy expenditure should be calculated using the following equation:

Calculated energy expenditure = (NW/ηsystem)*price of energy vector used) + (NS/ηsystem)*price of energy vector used) + (ACS/ηsystem)*price of energy vector used) where NW = Heating needs; NS = cooling needs; DHW= Domestic hot water needs; ηsystem= system efficiency

Due to the high uncertainty involved in this type of simulation, and the significant difference that may exist between the measured values and the simulated values (due, for example, to the behaviour of the occupants), extreme caution should be exercised when comparing indicators using measured values and simulated values of energy efficiency. In general, it is advisable to clearly indicate the approach taken to calculate the indicator and only compare it in situations using the same method. For example, when assessing energy poverty in a specific social housing district, each building and dwelling should follow the same approach to calculating the indicator (measured values or calculated values) to allow direct comparison between all buildings.

6.3. Axis 3: Indoor Air quality

For the air quality axis, the following intervals have been defined for the ARCAS classification system (Table 4).

Table 4. Classes and intervals defined for the classification system (air quality axis).

AIR QUALITY

	Indicator	Relative weight %	Please, add this	Intervals proposed for the ARCAS classification system Class I	Class II	Class III	Class IV
T	Temperature (°C) - No mechanical ventilation&heated	100		21,23	20,24	19,25	Other
T	Temperature (°C) - No mechanical ventilation&not heated.			(0,33Tm+15.8, 0,33Tm+20.8)	(0,33Tm+14.8, 0,33Tm+21.8]	(0,33Tm+13.8, 0,33Tm+22,8]	Other
T	Temperature (°C) - Mechanical ventilation&heated			21,23	20,24	19,25	Other
T	Temperature (°C) - Mechanical ventilation&not heated			23.5, 25.5	23,26	22,27	Other
A	Acoustic comfort			<30	[30,35)	[35,40)	>=40
I	CO_2 (ppm)			<550	[550, 580]	(580,1350]	Other
I	Relative humidity (%)			50-40	30-40	10-30 or 50-60	<10 or >60
I	Minimum ventilation rate (L s^{-1} p^{-1})			>10	(7,10]	(4,7]	<=4
I	Moisture (cm^2)			0	[1-400)	[400, 2500)	>2500
I	Particulate matter $PM_{2,5}$ ($\mu g\ m^{-3}$)			<10	[10, 18)	[18, 25]	>25
I	Formaldehyde ($\mu g\ m^{-3}$)			<30	[30,65)	[65, 100]	>100
I	Benzene ($\mu g\ m^{-3}$)			<2	[2, 3]	[4, 5]	>5
I	Radon (Bq m^{-3})			<100	[100, 200)	[200, 300]	>300
L	Visual comfort (% of time with iluminance between 300-50			(60,100]	(40,60]	(10,40]	<=10

* TBD: pending to be defined

The definition of the indicators and the methods to be used for their calculation can be found in deliverable D4.3.

The ARCAS Tool can be consulted in this following link:

https://arcas-tool.predictia.es/arcas-tool

User: user@predictia.es
Pasword: changeme

7. Performance of the ARCAS tool.

The ARCAS tool is implemented in web format for free use by all agents that make up the process of rehabilitation of social housing buildings.

The process of supporting the design and certification of the renovation of buildings is solved in this tool through a simplified process so that with a minimum and sufficient number of indicators most of the important decisions of the point rehabilitation process can be obtained in addition to the environmental study. The building particularized in the axes of energy efficiency and quality of the interior environment includes a third fundamental aspect in the study of the sustainability of buildings, such as the social quality particularized here in the concept of energy poverty.

The ARCAS tool is accessed through the link above. The first time you use the aforementioned tool it will be necessary to enter username and password that will be saved in the system along with all the projects and simulations that are made under the profile created.

The home screen shows or direct link to the climate and air quality map of the southern Atlantic arc of Europe, another of the products of the ARCAS project that is complementary to the ARCAS tool.

Listed below are the steps to follow until closing a complete cycle of support for the design and/or certification of a building in the rehabilitation phase. To facilitate this process, each comment is accompanied by a screenshot of the tool that includes one of the buildings studied in the ARCAS project.

7.1. Step 1: Entry

Figure 1 shows the home page. To access it will be necessary to enter username and password the first time you access the ARCAS tool website.

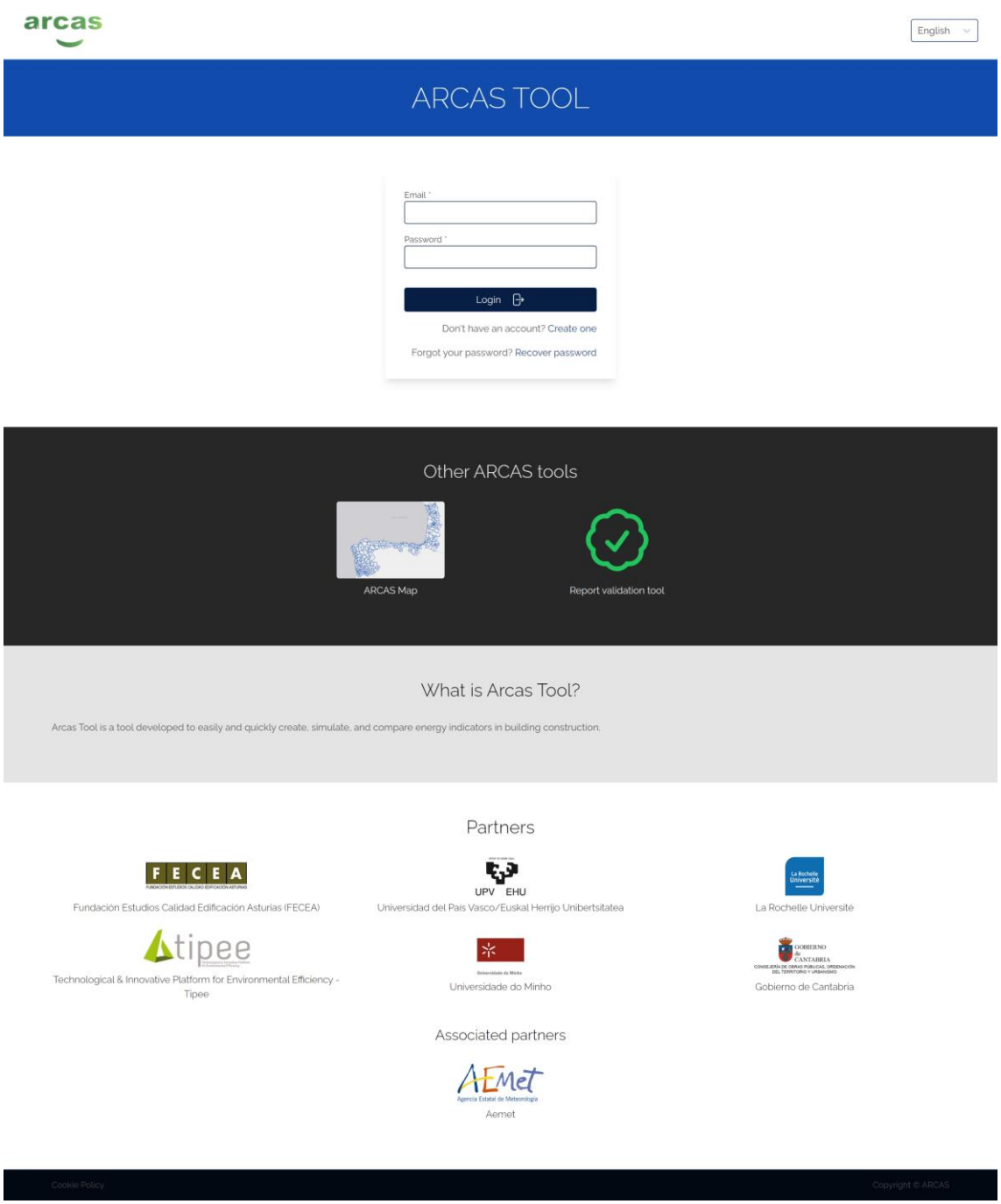
arcas
English
ARCAS TOOL
Email *
Password *
Login
Don't have an account? Create one
Forgot your password? Recover password
Other ARCAS tools
ARCAS Map
Report validation tool
What is Arcas Tool?
Arcas Tool is a tool developed to easily and quickly create, simulate, and compare energy indicators in building construction.
Partners
Fundación Estudios Calidad Edificación Asturias (FECEA)
Universidad del Pais Vasco/Euskal Herrijo Unibertsitatea
La Rochelle Université
Technological & Innovative Platform for Environmental Efficiency - Tipee
Universidade do Minho
Gobierno de Cantabria
Associated partners
Aemet
Cookie Policy
Copyright © ARCAS

Figure 1

7.2. Step 2: Input screen

Here we find the screen that collects a space for internal communication.

The HOME tab shows the internal communication channel between the rehabilitation agents working on the same project and a historical list of the latest projects in which the user had worked. (Figure 2)

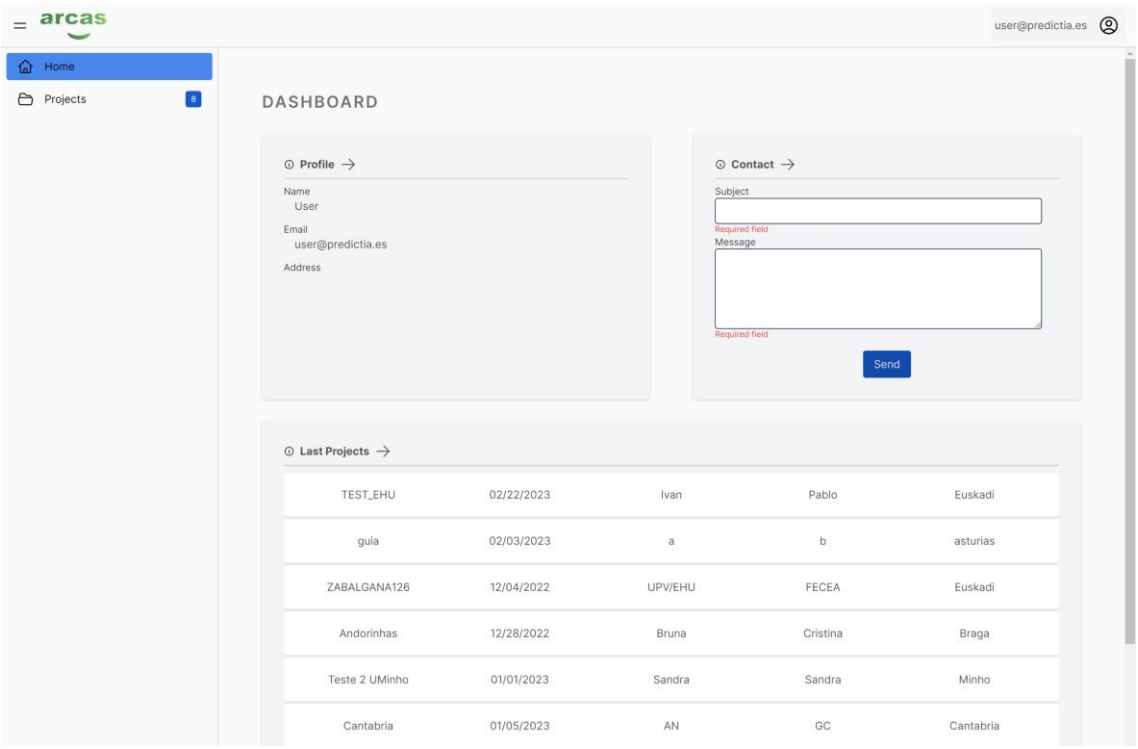

Figure 2

The Projects tab shows in an organized way the list of all the projects that have been developed by the user. It is possible to classify it by name or by category. On the right are 3 icons that allow you to view, edit and delete a project. (Figure 3)

In this same tab above and on the right (Figure 4) 3 buttons are shown that allow you to delete filters, apply filters and in light blue the opening of a new project.

in this same tab at the bottom (Figure 5) two buttons are shown that allow you to download project information in Excel and CSV formats

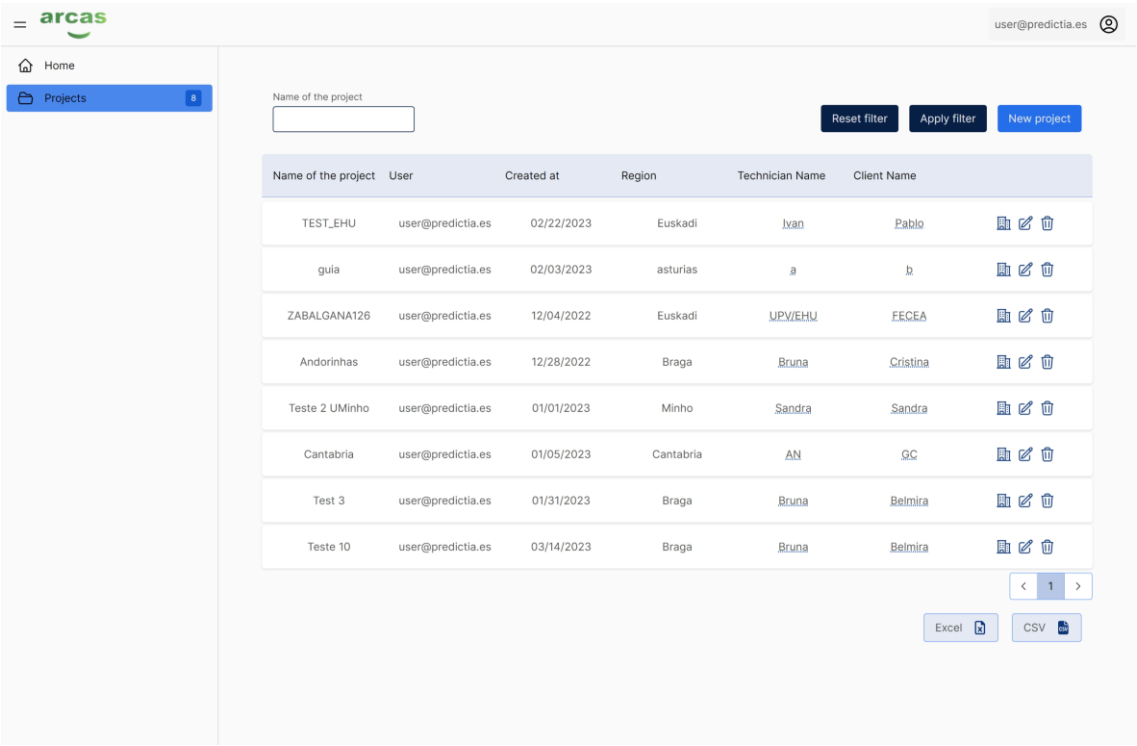

Figure 3

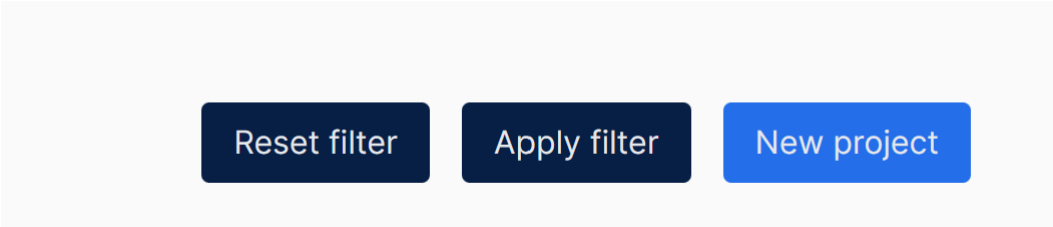

Figure 4

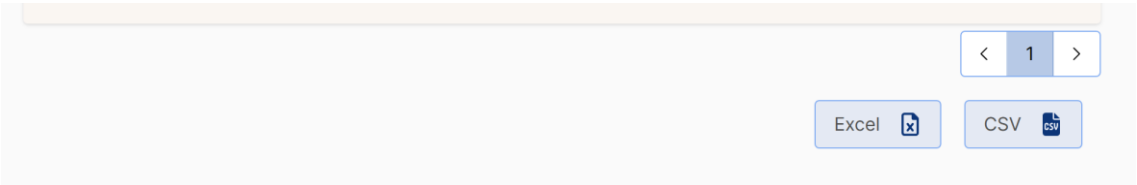

Figure 5

7.3. Step 3: General data

Click on the new project tab to access the project data screen sorted into seven complementary scopes. (Figure 6).

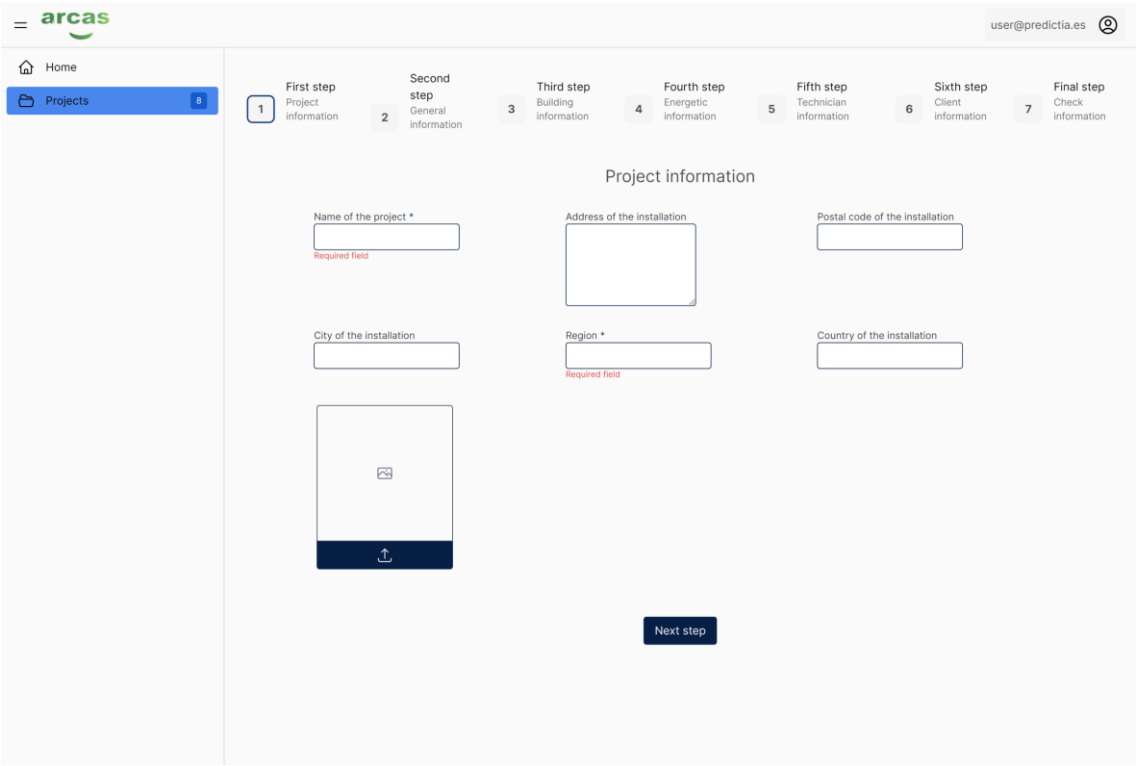

Figure 6

Below are the screens corresponding to the 7 steps that collect basic project information project status project energy information customer comma technician information and a final check. Figures, 7, 8, 9, 10, 11, 12)

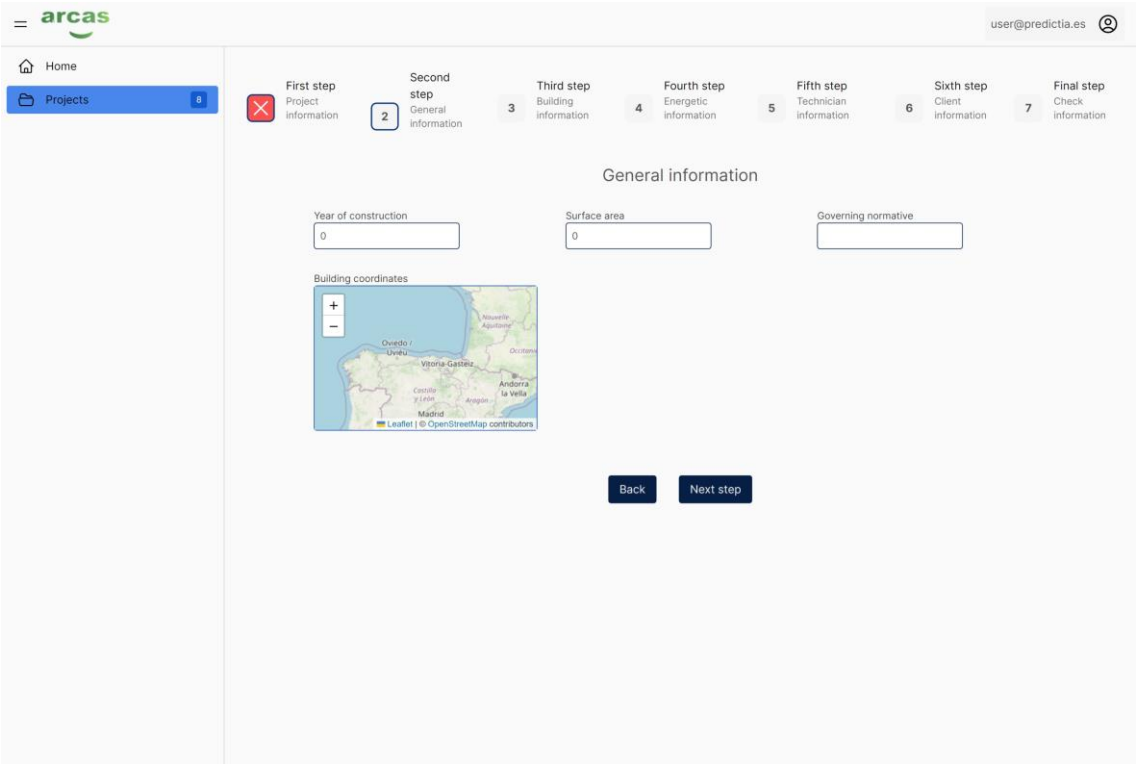

Figure 7

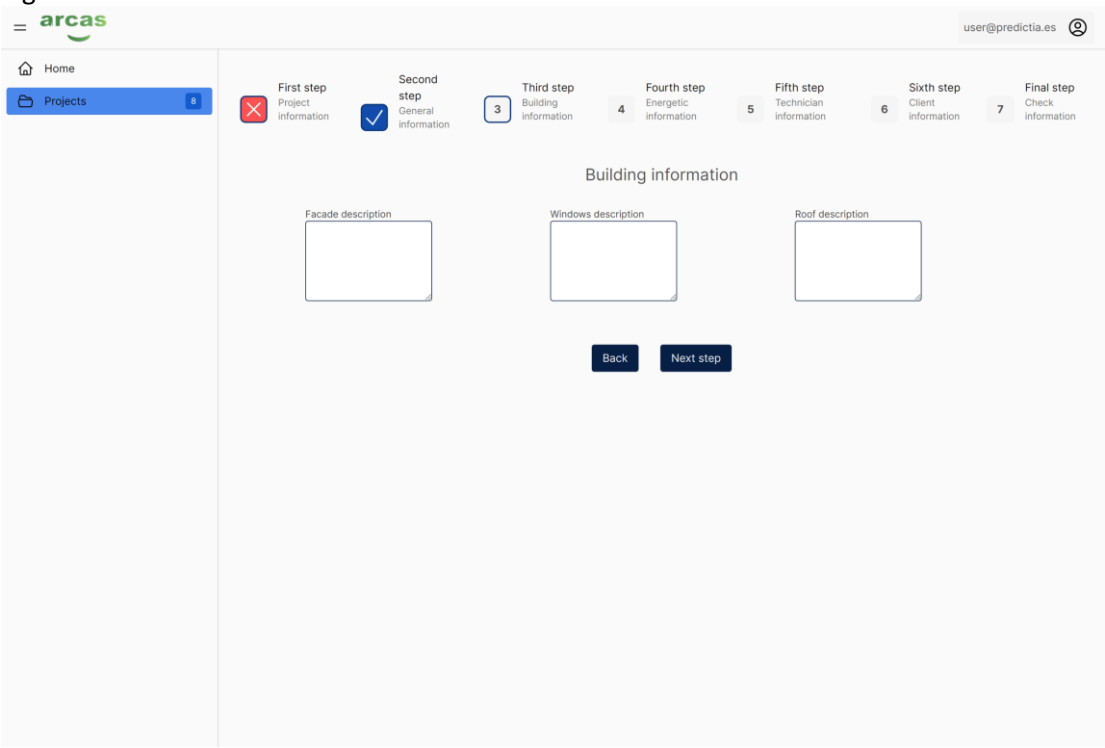

Figure 8

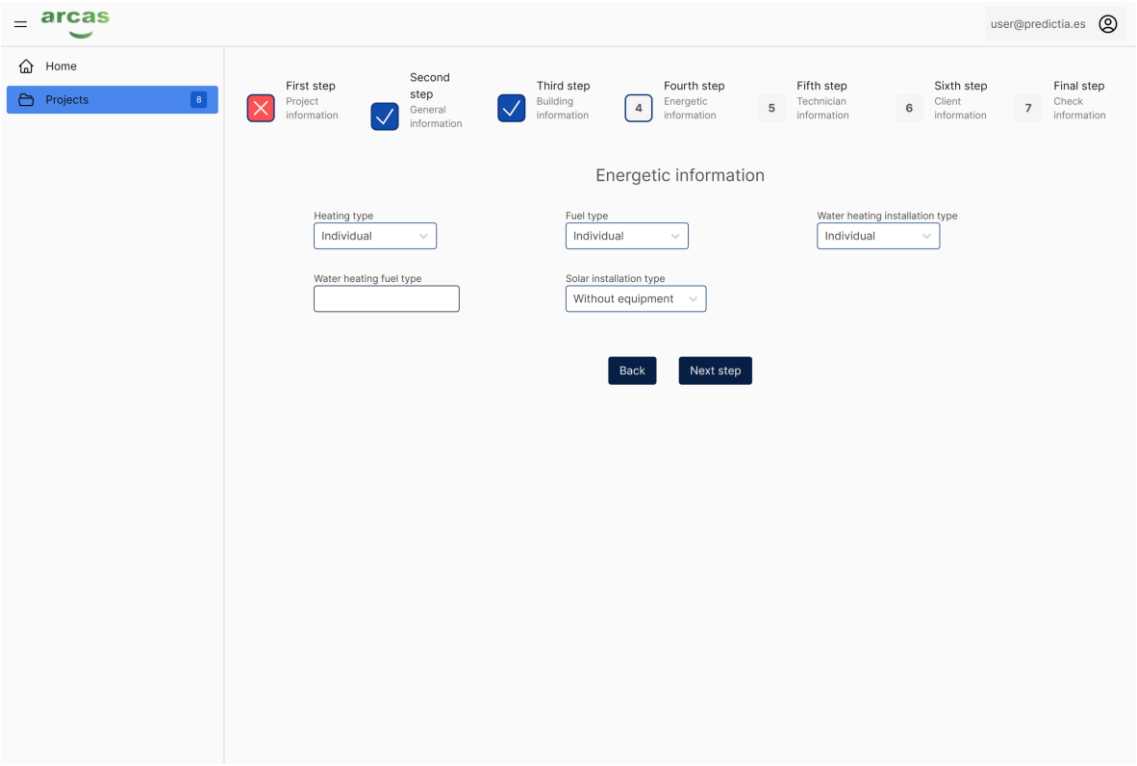

Figure 9

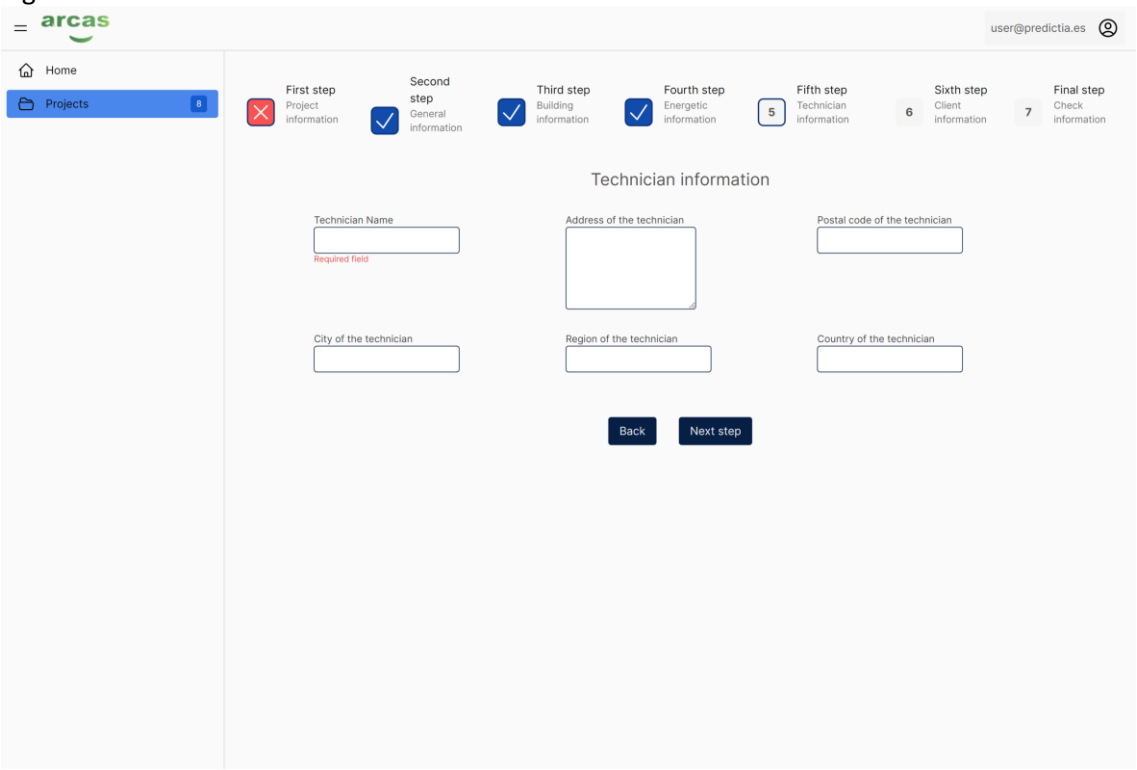

Figure 10

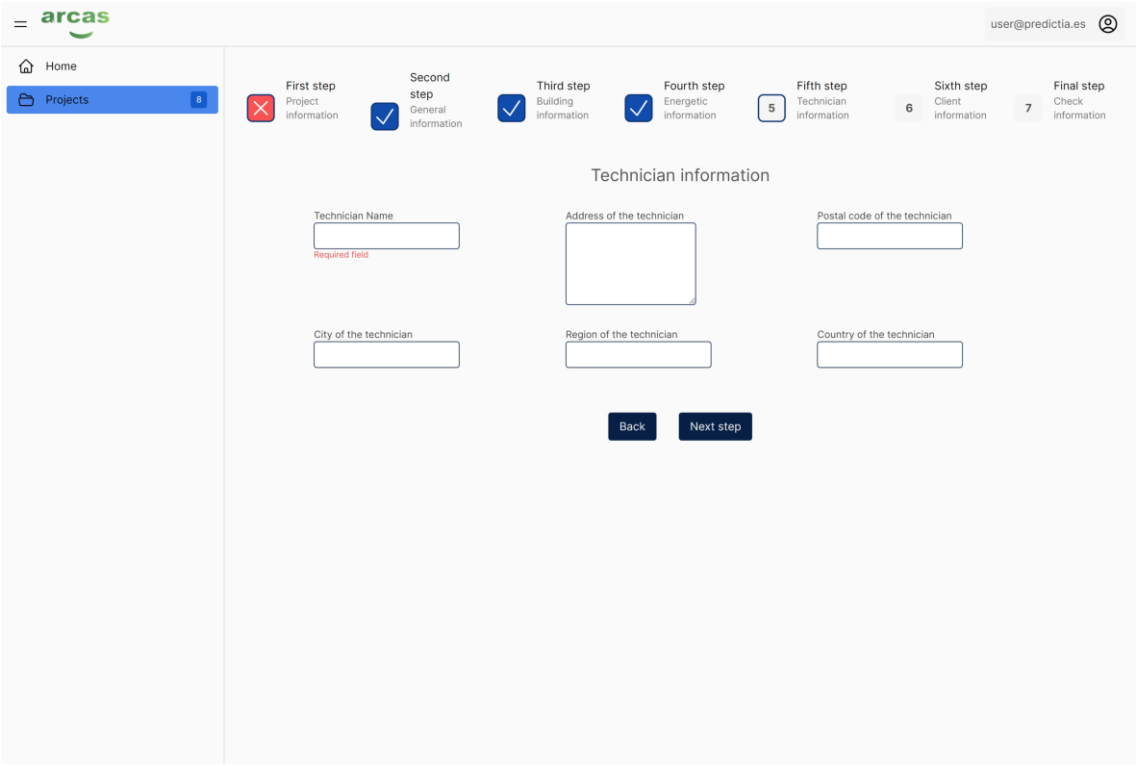

Figure 11

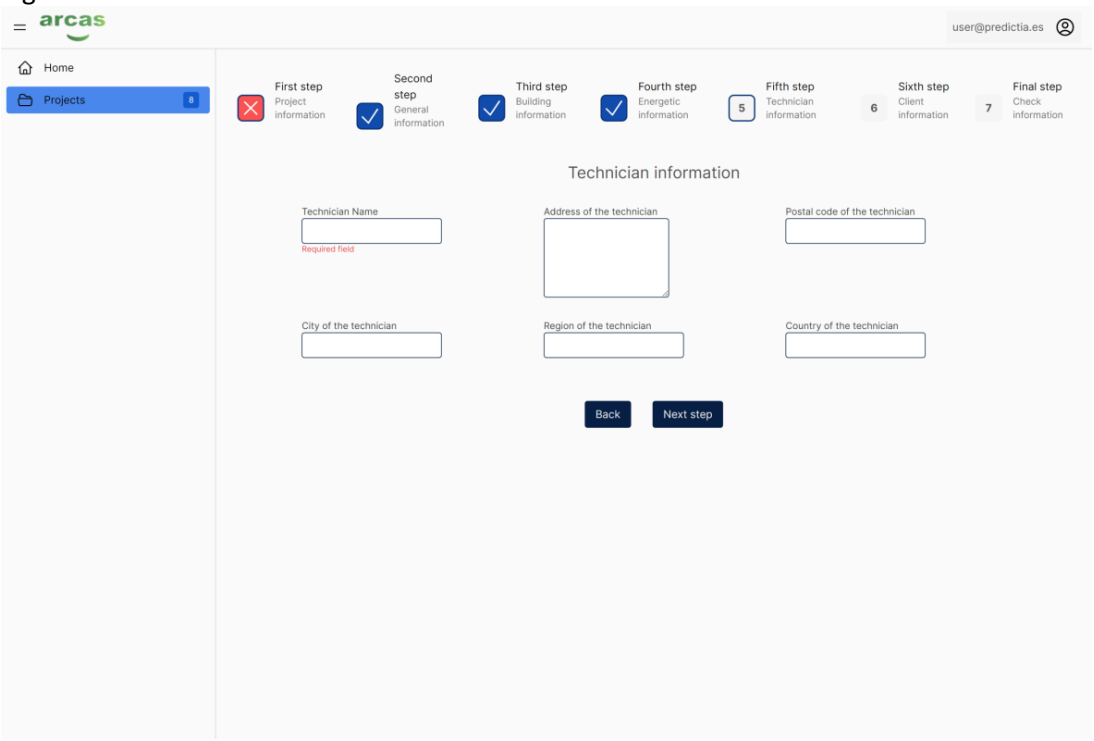

Figure 12

7.4. Step 4: Diagnosis of the current state of the building under study

The next step is to start the building diagnostic process. The tool will display the following page. (Figure 13)

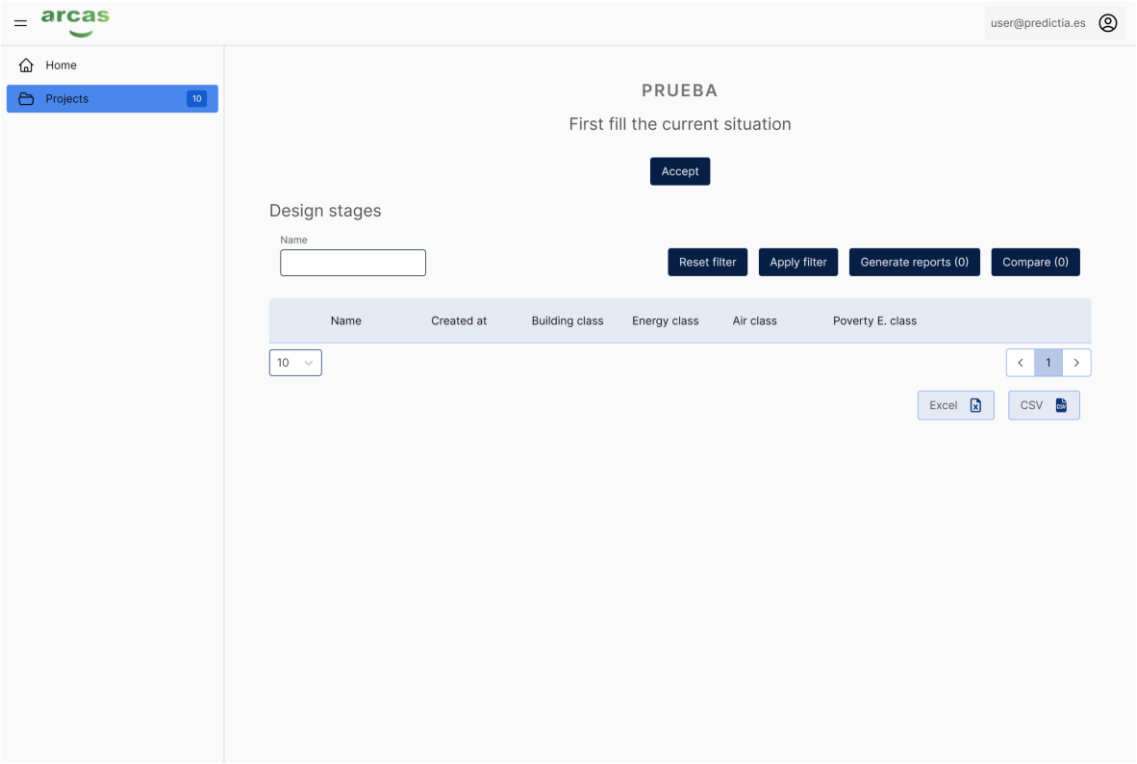

Figure 13

Pressing the accept comma button and you access the 3 tabs that represent the 3 axes of the Arcas tool: the energy efficiency axis, the indoor environment quality axis and the energy poverty axis. (Figure 14)

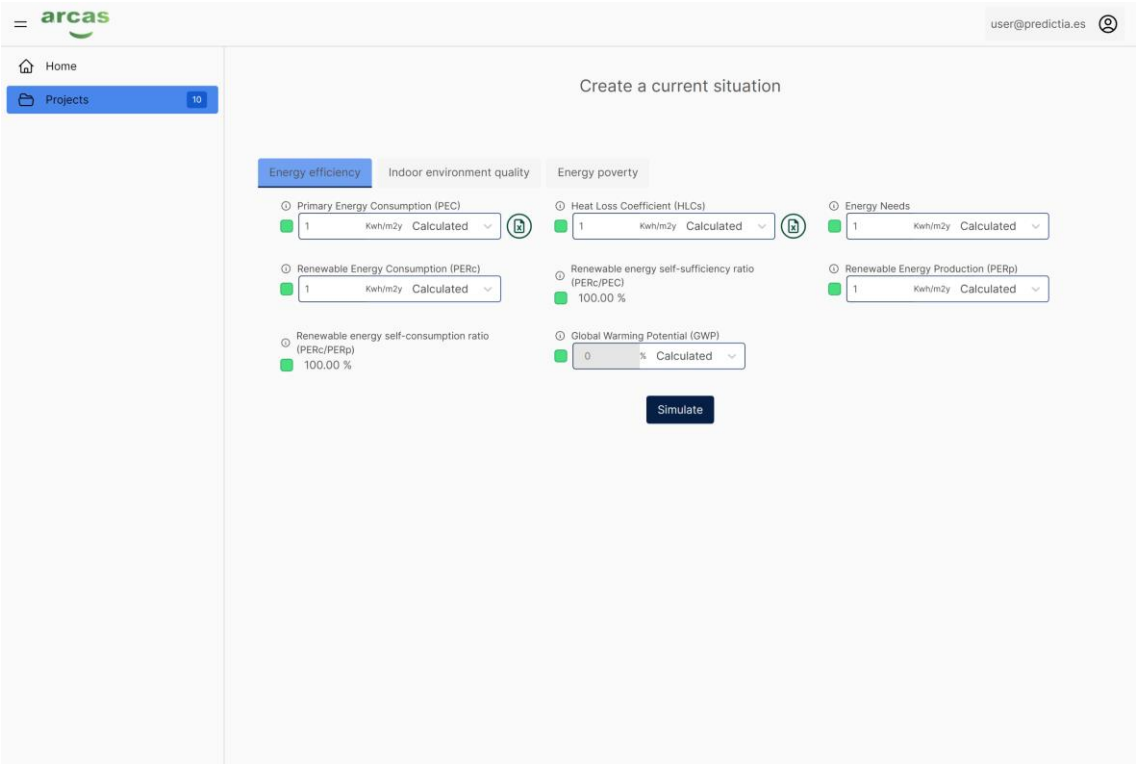

Figure 14

Some of the indicators have support spreadsheets that can be accessed by clicking on the button shown in Figure 15.

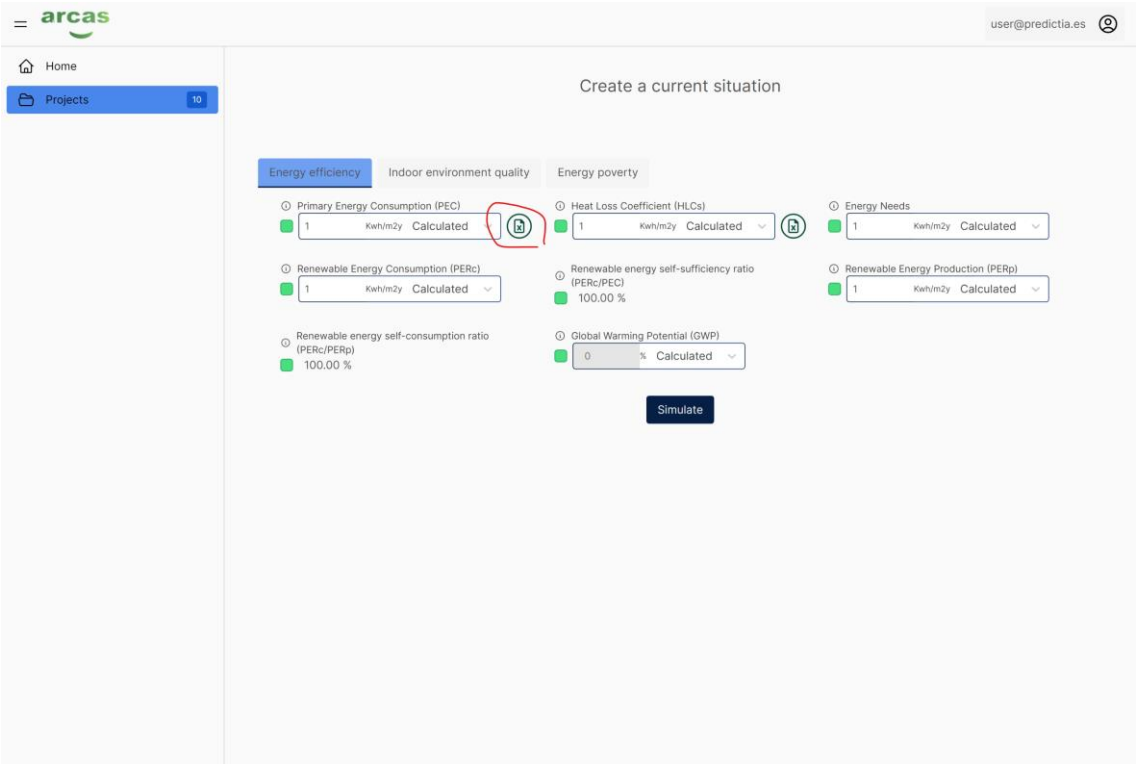

Figure 15

In the following example you can see the data entered from one of the buildings under study of the ARCAS project. The results obtained both quantitatively and graphically are also shown, in both cases ordered in the four classes that are the four colors of the ARCAS traffic light. All this, for each of the three ARCAS axes. (Figures 16, 17, 18)

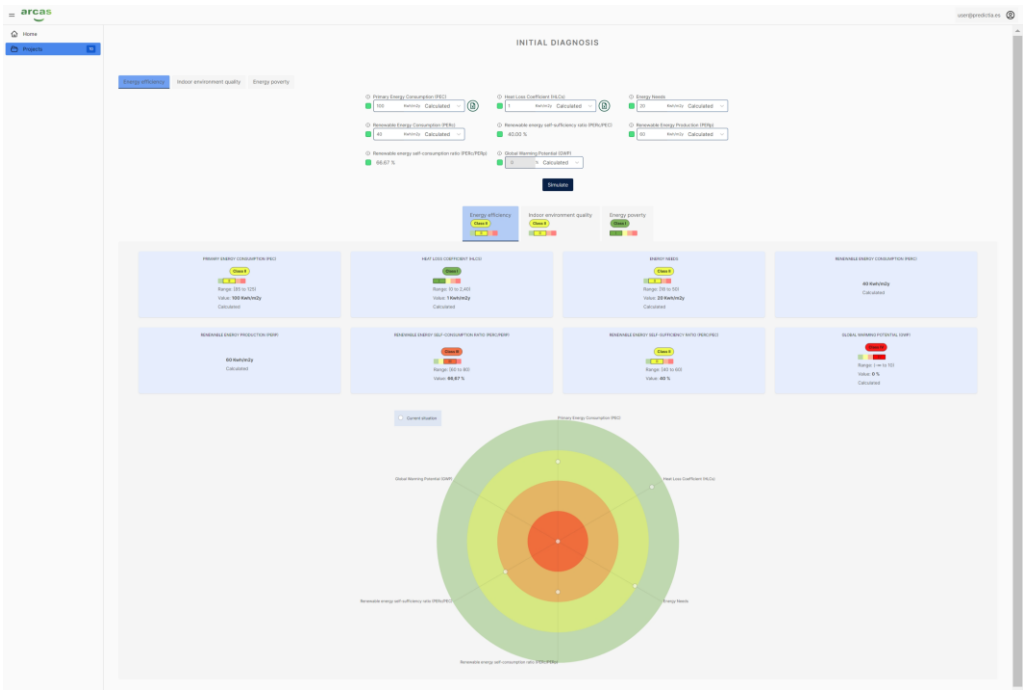

Figure 16

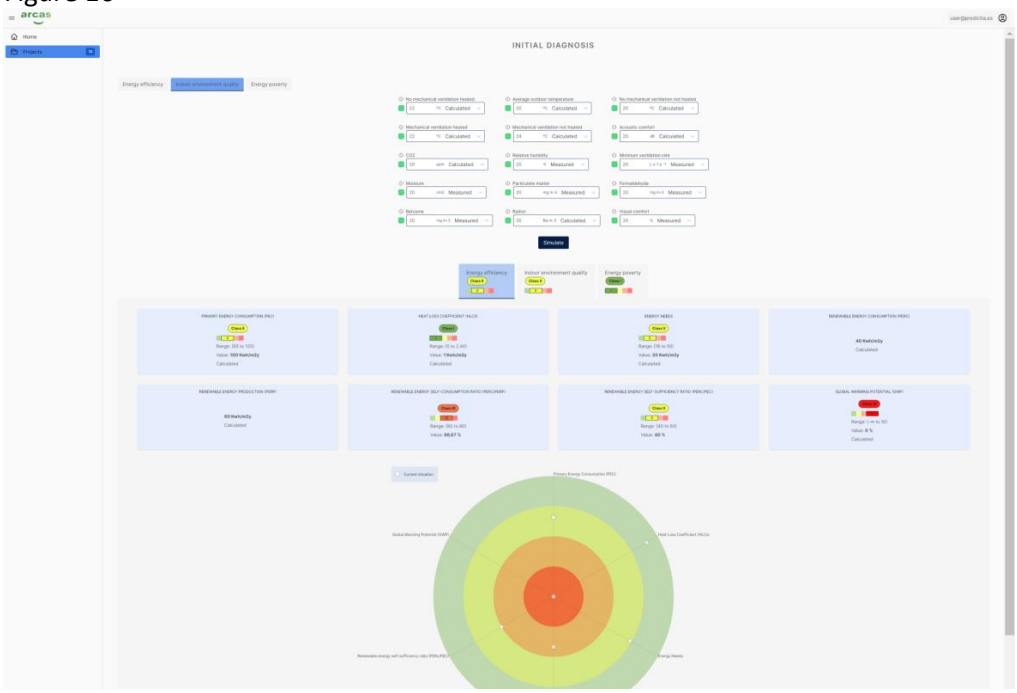

Figure 17

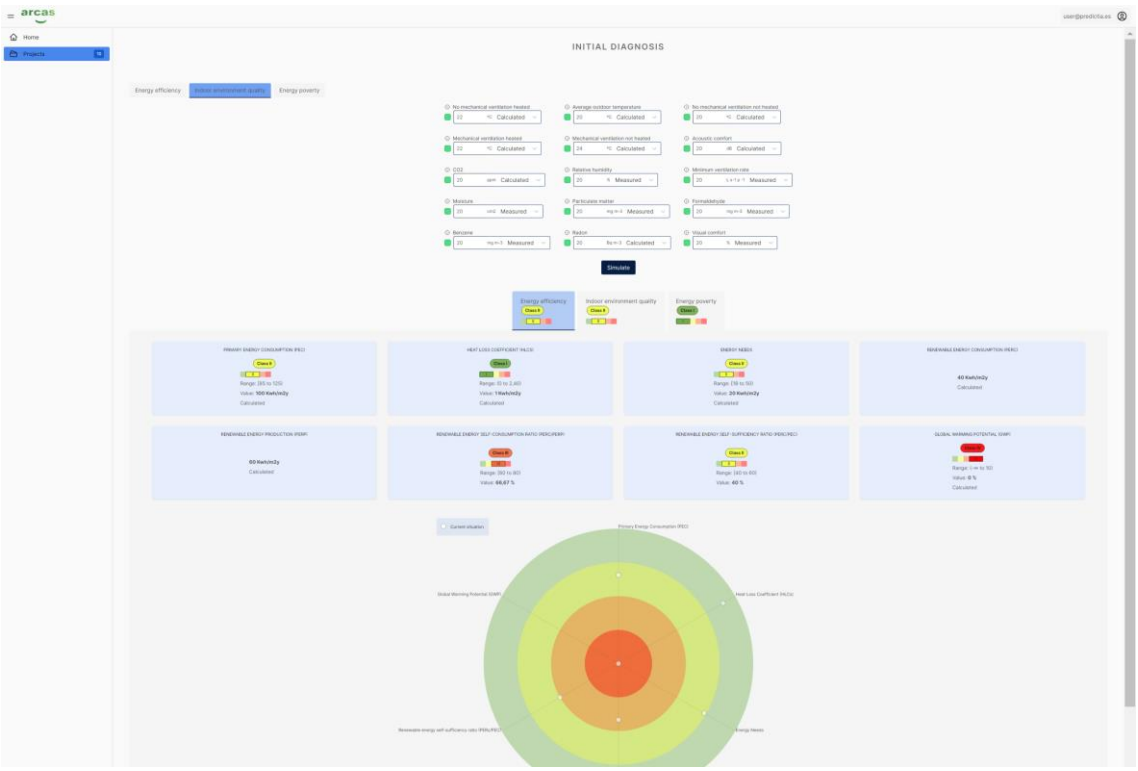

Figure 18

7.5. Step 5: Simulations of the projected state

The next step is to start with the first simulation that includes the conditions that will be implemented in the future rehabilitation process of the building under study. To do this, click on the New Design Phase button. (Figure 19)

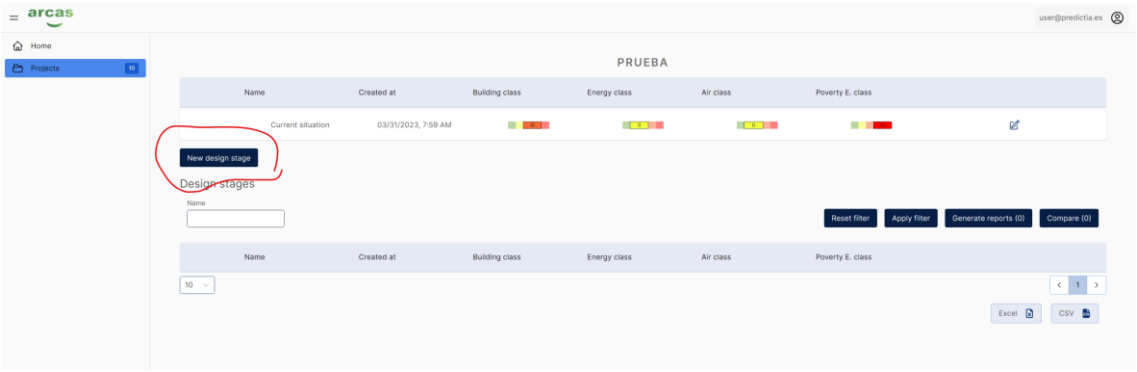

Figure 19

This button takes us to a page where the 3 axes appear with the indicators corresponding to each 1 of them point in this case as we are in the design support phase, the values will be entered in an estimated way. If we are in the certification phase, the values, both in the initial diagnosis phase and in the final diagnosis, must be measured or calculated.

The following three images show the data organized by axes of the indicators of one of the buildings under study. (Figures 20, 21 and 22)

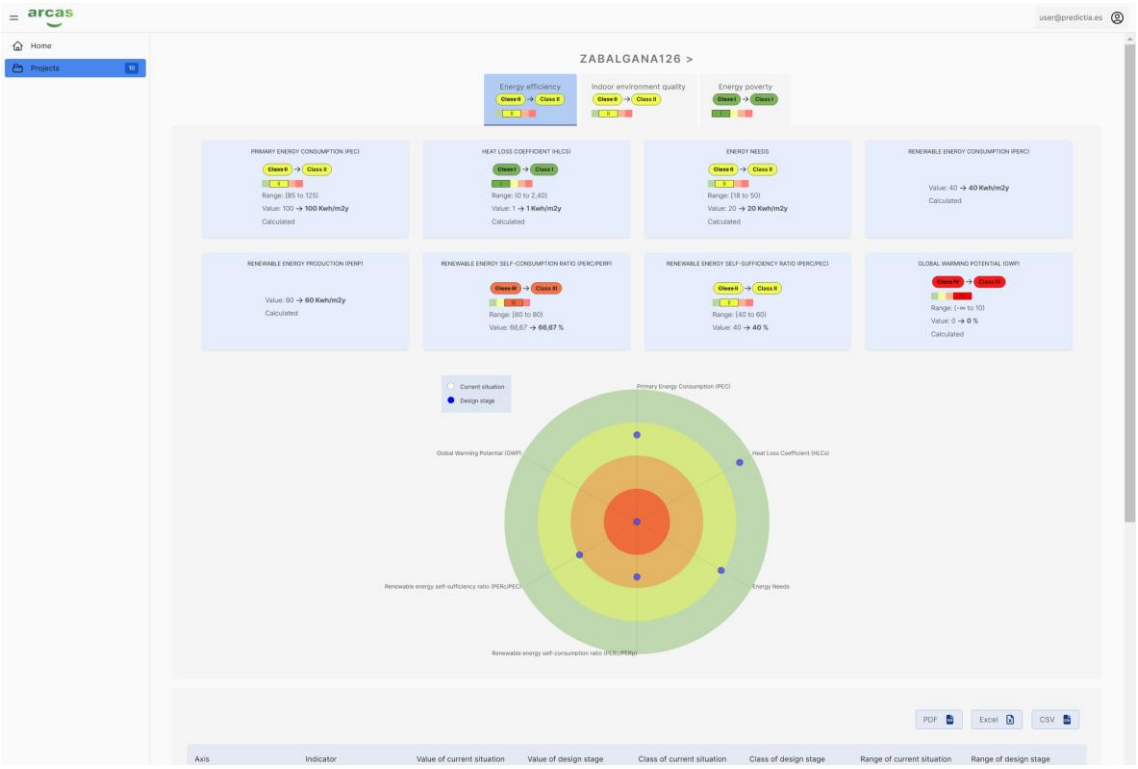

Figure 20

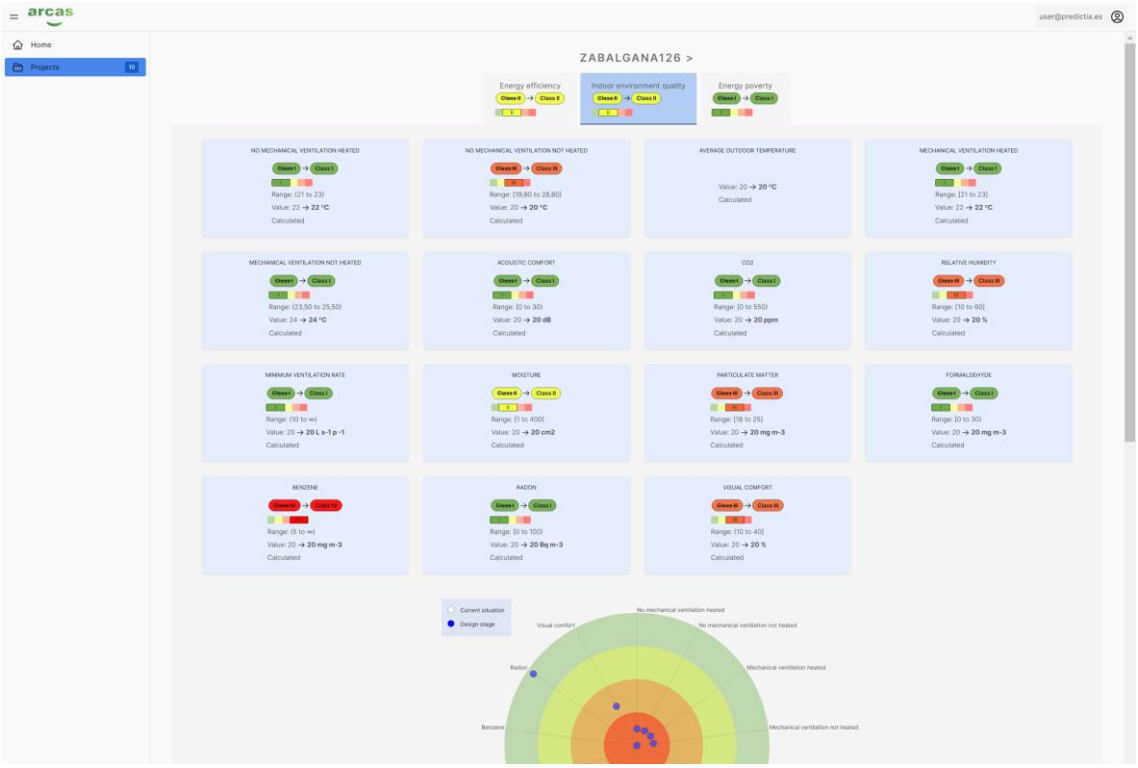

Figure 21

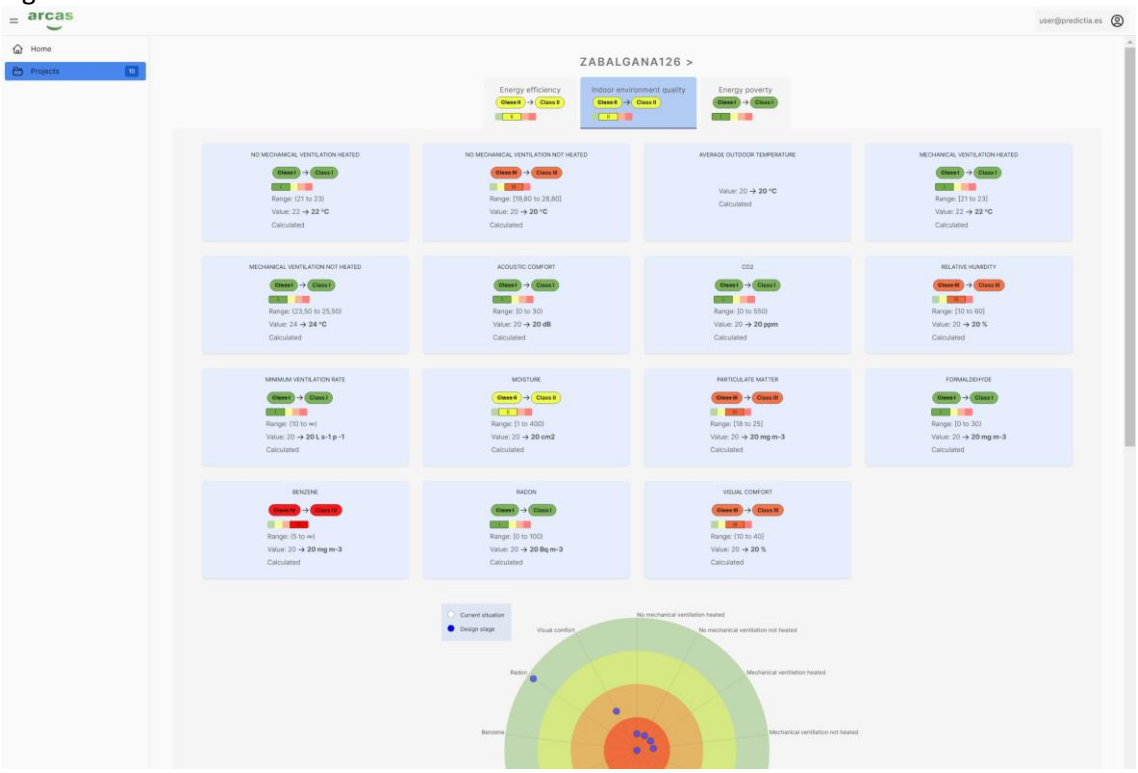

Figure 22

In this study building by the ARCAS project it can be seen that two simulations of the future state of the building have been made. (Figure 23)

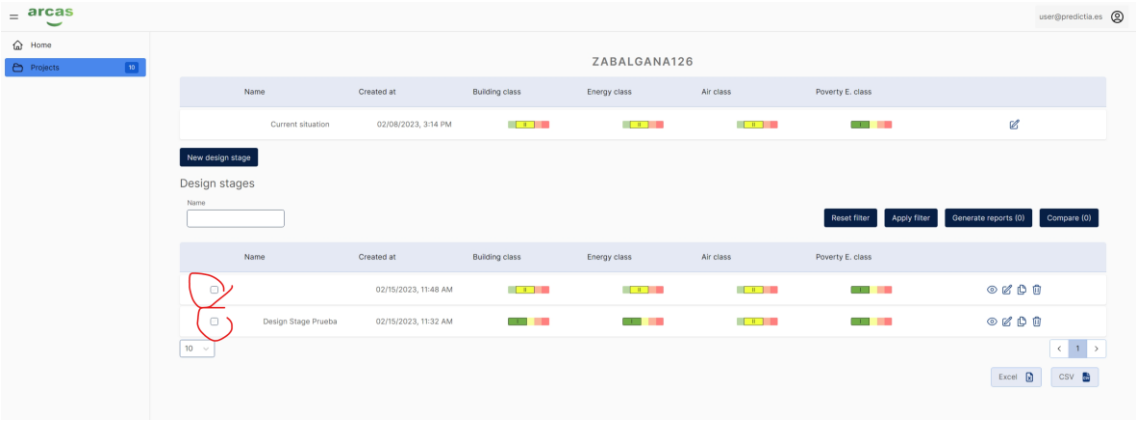

Figure 23

7.6. Step 6: ARCAS Assessment

So far, we have made a diagnosis of the initial state of the building and according to the previous example two simulations of the future behavior of the building according to the indicators and axes ARCAS.

The next step is to make a comparison between the initial situation and one or more designs that have been made. To do this, simply select which simulations we want to compare with the current state points our example case we have selected to compare the first simulation with the current state. (Figure 24)

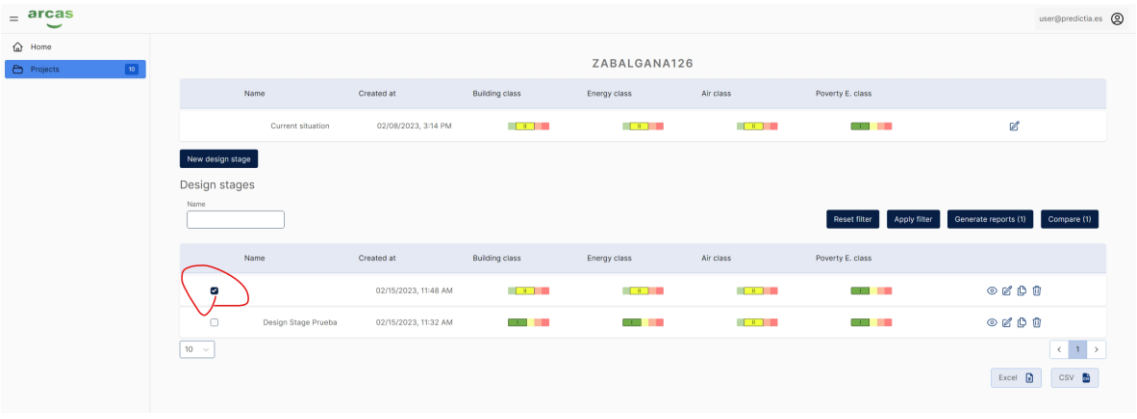

Figure 24

Then, by clicking on the COMPARE button (Figure 25) we obtain the comparative data between before and after, both numerically and graphically, as well as their classification according to the ARCAS traffic light. (Figures 26, 27, 28)

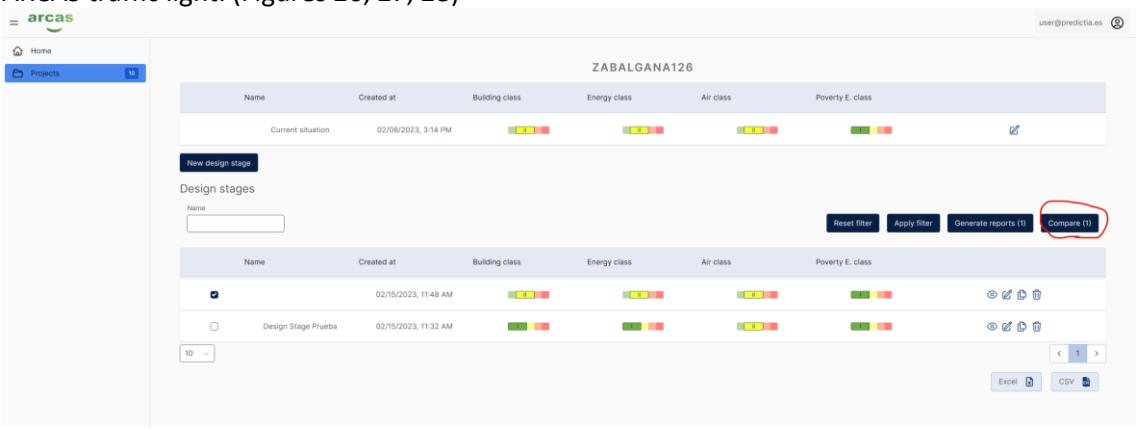

Figure 25

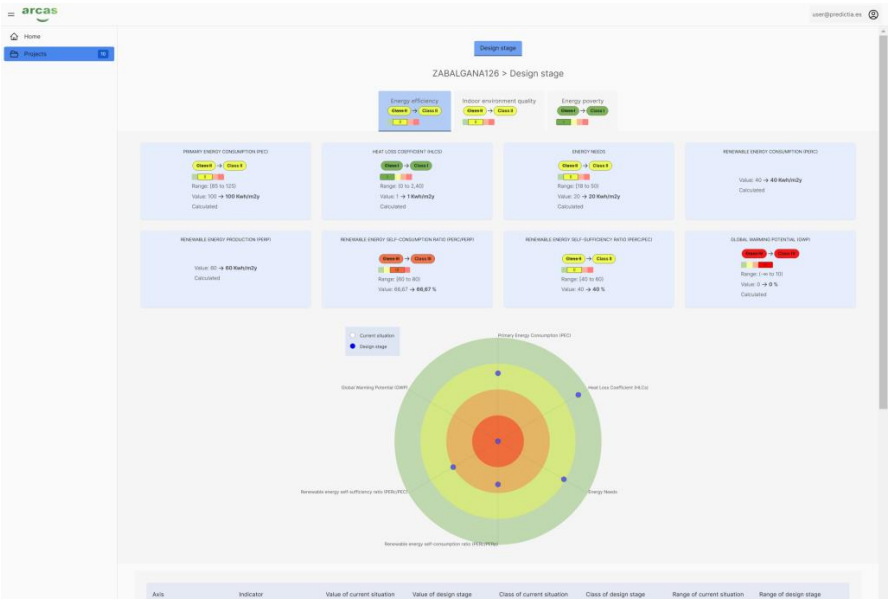

Figure 26

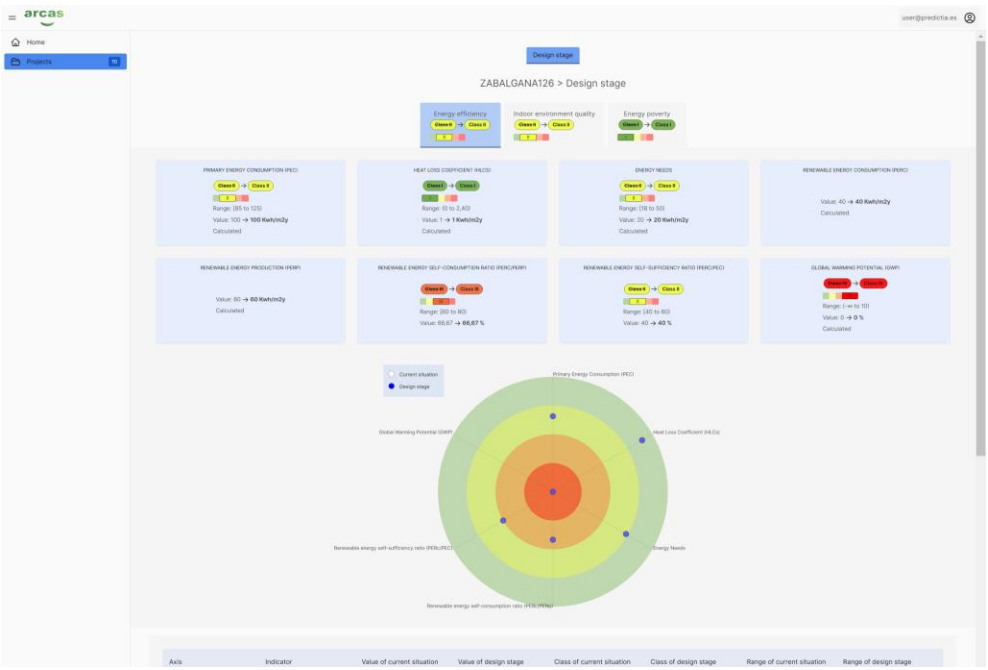

Figure 27

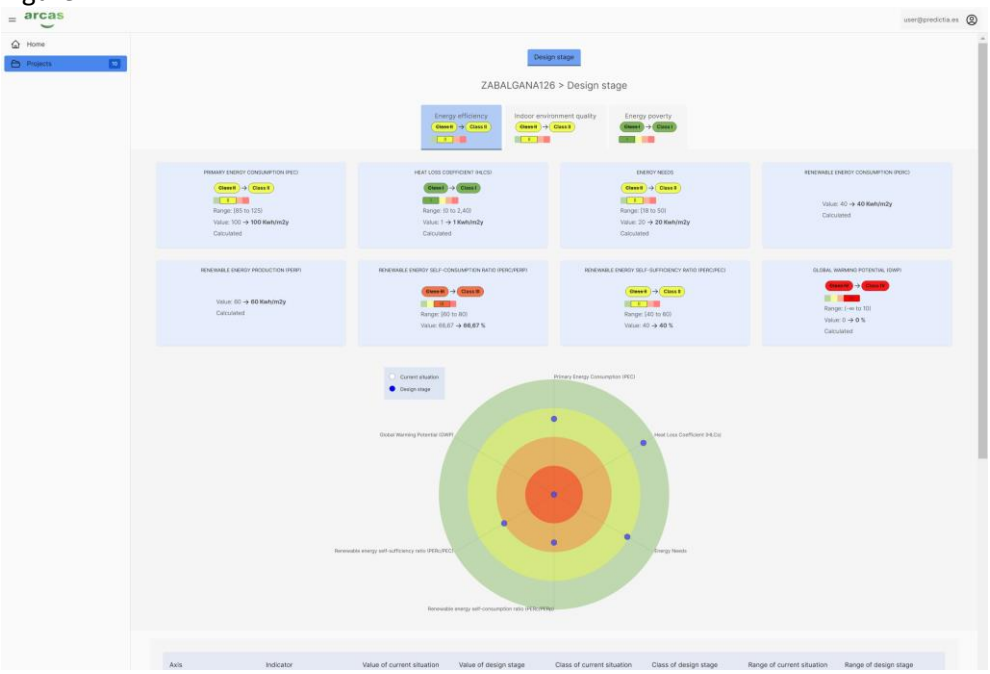

Figure 28

In the lower area of each of the previous screens, the numerical data, the classifications, as well as the environments not between which the reflected data of each of the indicators and axes are moved. (Figure 29)

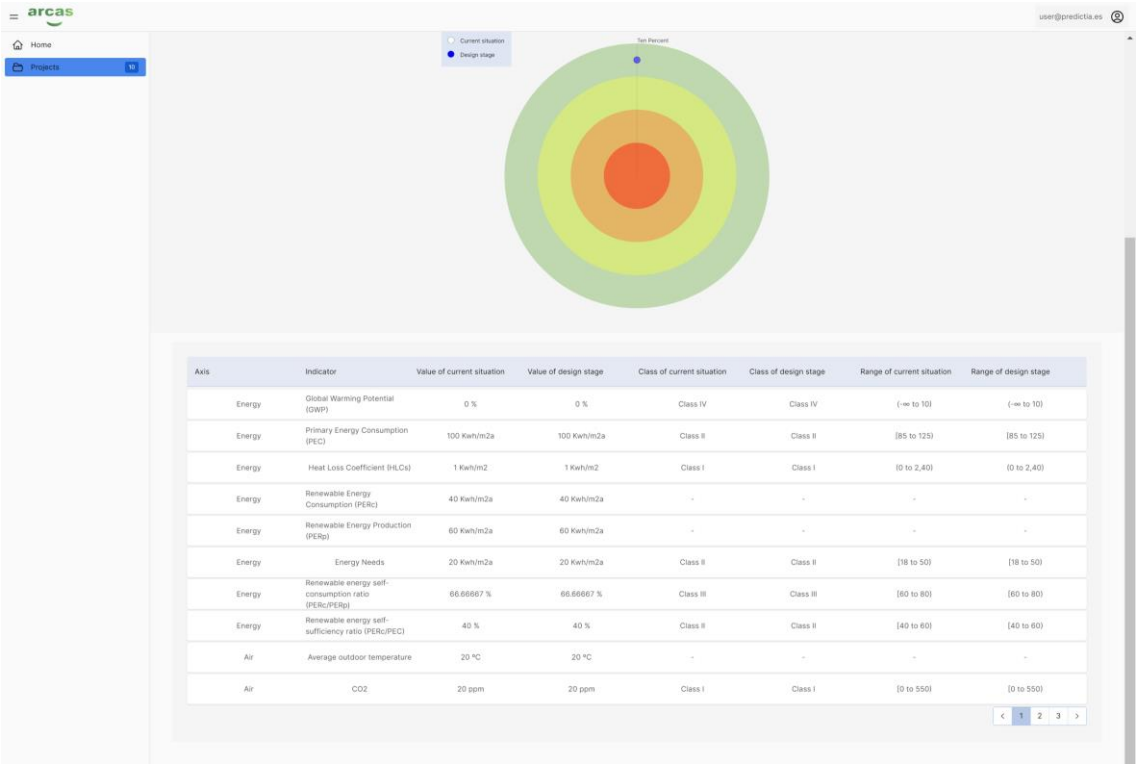

Figure 29

This same process can be performed as many times as desired point It is also possible to compare at the same time several simulations with the initial diagnosis. It should be indicated on the home page as shown in the following. (Figure 30)

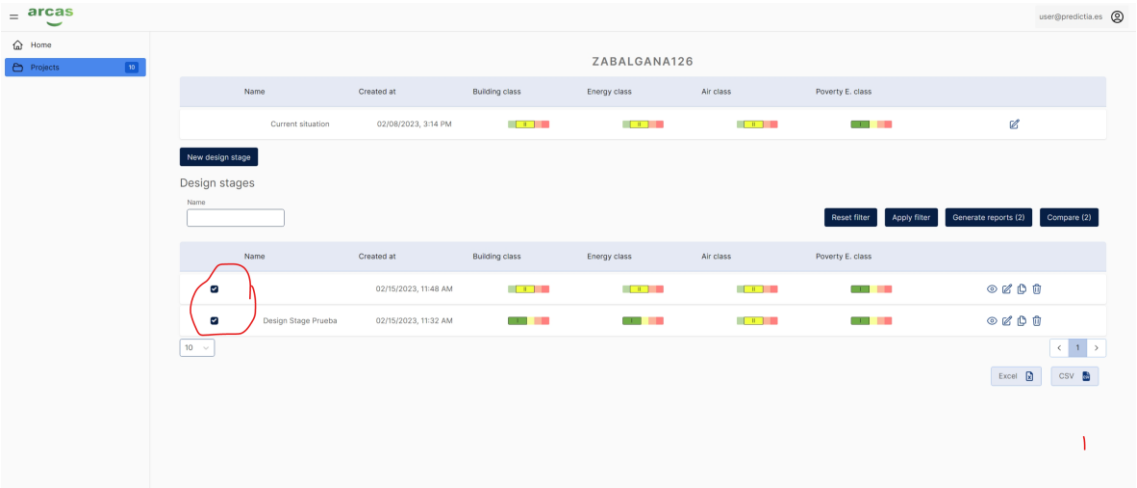

Figure 30

7.7. Step 7: Select the simulation

From the evaluation obtained by comparison between the initial diagnosis and the different design simulations that have been carried out, it remains to choose the design proposal that best suits the initial conditions established to implement the rehabilitation process of the building.

In our example building we select simulation number two as the proposal to be implemented in the rehabilitation project of the building under study. (Figure 31)

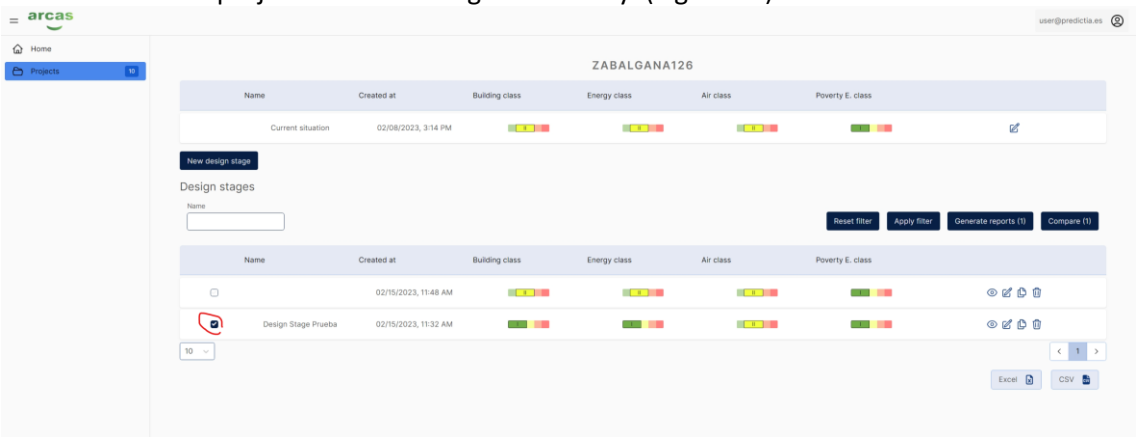

Figure 31

Next, you go on to generate the final report by clicking on the generate report button. (Figure 32)

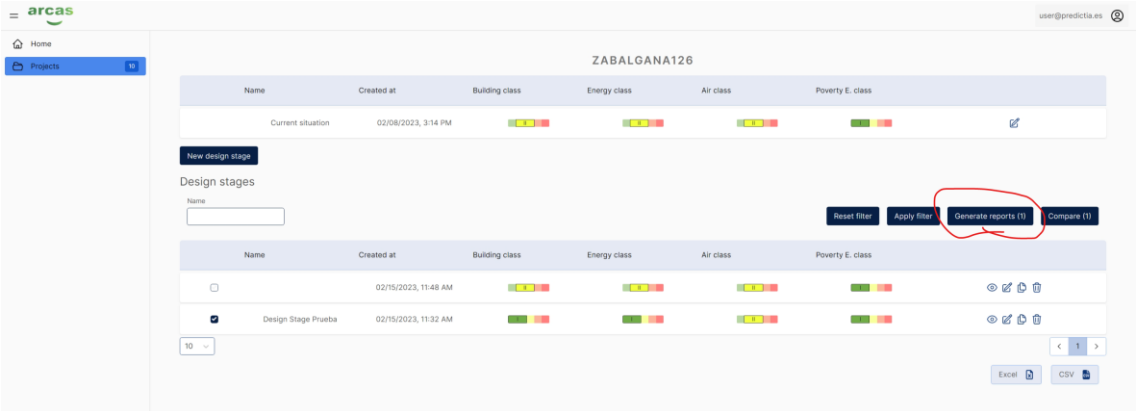

Figure 32

7.8. Step 8: Final Evaluation Report

This last step allows you to generate a report in PDF format with a fingerprint that verifies that the report is complete since it allows you to check the source of the results obtained.

Initially the report is displayed on the screen (Figure 33).

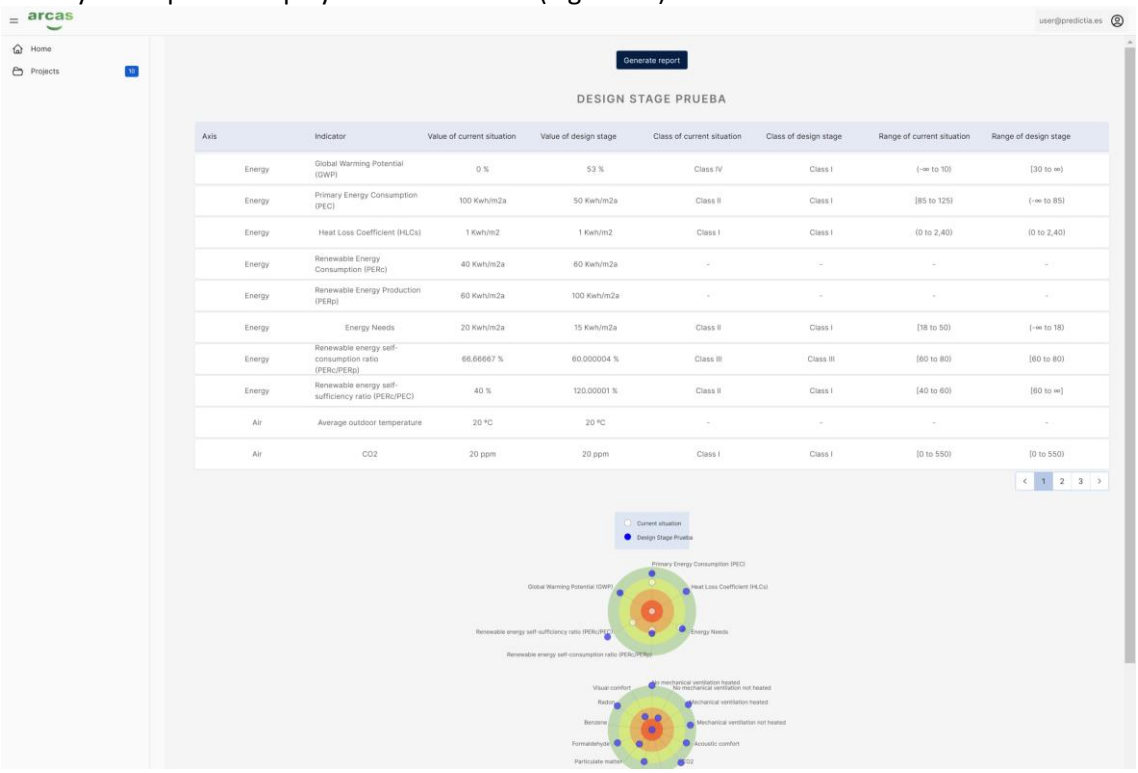

Figure 33

By clicking on the generate report button (Figure 34) you can obtain a full version of the report in PDF format as a base element of the design support report or the future certification of the finished building. (Figure 35)

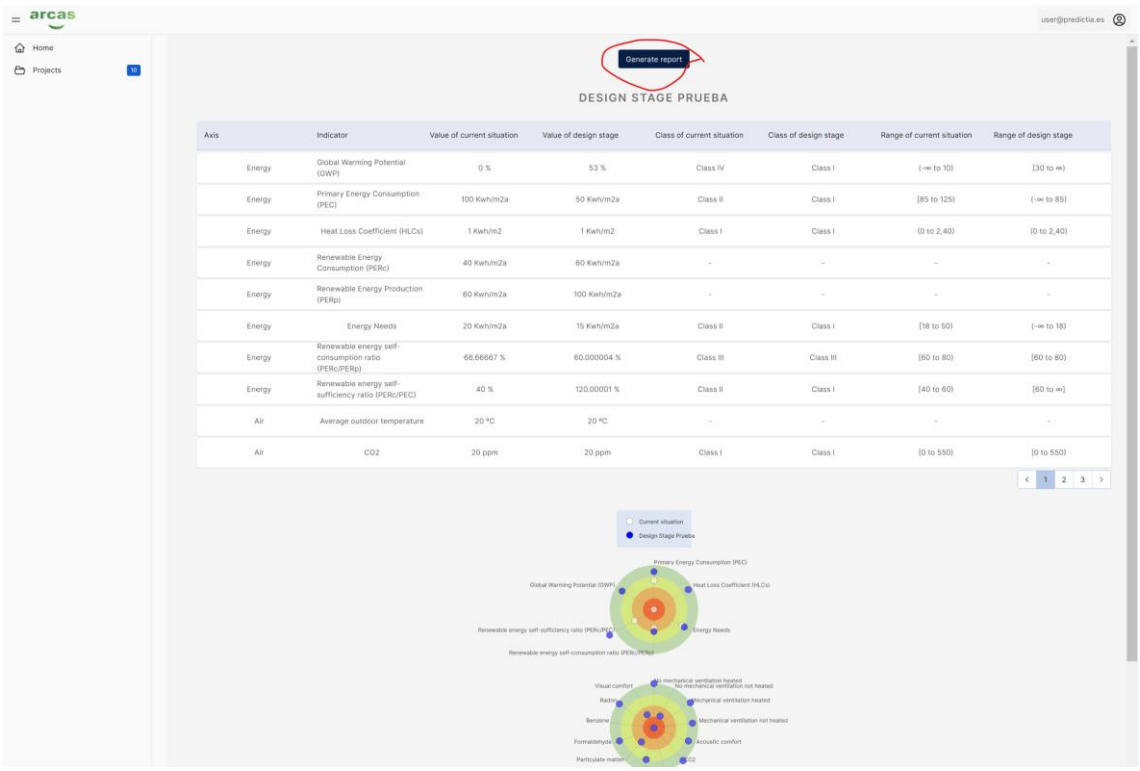
arcas
user@predictia.es
Home
Projects
Generate report
DESIGN STAGE PRUEBA
Axis
Indicator
Value of current situation
Value of design stage
Class of current situation
Class of design stage
Range of current situation
Range of design stage
Energy
Global Warming Potential (GWP)
0 %
53 %
Class IV
Class I
(-∞ to 10)
[30 to ∞)
Energy
Primary Energy Consumption (PEC)
100 Kwh/m2a
50 Kwh/m2a
Class II
Class I
[85 to 125)
(-∞ to 85)
Energy
Heat Loss Coefficient (HLCs)
1 Kwh/m2
1 Kwh/m2
Class I
Class I
(0 to 2,40)
(0 to 2,40)
Energy
Renewable Energy Consumption (PERc)
40 Kwh/m2a
60 Kwh/m2a
Energy
Renewable Energy Production (PERp)
60 Kwh/m2a
100 Kwh/m2a
Energy
Energy Needs
20 Kwh/m2a
15 Kwh/m2a
Class II
Class I
[18 to 50)
(-∞ to 18)
Energy
Renewable energy self-consumption ratio (PERc/PERp)
66.66667 %
60.000004 %
Class III
Class III
[60 to 80)
[60 to 80)
Energy
Renewable energy self-sufficiency ratio (PERc/PEC)
40 %
120.00001 %
Class II
Class I
[40 to 60)
[60 to ∞]
Air
Average outdoor temperature
20 °C
20 °C
Air
CO2
20 ppm
20 ppm
Class I
Class I
[0 to 550)
[0 to 550)
1
2
3
Current situation
Design Stage Prueba
Primary Energy Consumption (PEC)
Heat Loss Coefficient (HLCs)
Energy Needs
Visual comfort
Mechanical ventilation heated
Mechanical ventilation not heated
Acoustic comfort

Figure 34

Building address

Name: ZABALGANA126
Address:
Euskadi,Avenida Derechos Humanos 33-37
Spain,Vitoria-Gasteiz,01015

Technician address

Name: UPV/EHU

Client address

Name: FECEA

Building info

Latitude:	43.261208	**Longitude:**	-2.9333496	**Surface area:**	0.0
Construction year:	2010	**Governing normative:**	CTE DB-HE 2006		
Facade description:					
Window description:					
Roof description:					
Heating type:	Individual		**Fuel type:**	NONE	
Water heating installation type:	Individual	**Water heating fuel type:**		**Solar installation type:**	None

Report generated with the ARCAS tool. Simulation extracted from the ARCAS tool

Figure 35

As an example, a complete report based on one of the buildings under study is attached.

8. Discussion and conclusions

Two work processes with the ARCAS tool are clearly differentiated: a first process of design support, and a second process oriented to the certification of buildings. In the latter case, it establishes minimum ranges of improvement between the evaluation of the building in its initial and final state (after the rehabilitation), so that the worst of the axes are exceeded in at least two classes so that the building can obtain the ARCAS certification. In addition, the building will obtain certification only if it meets the criteria, *i.e.* there will be no intermediate cases.

The ARCAS tool shall be organized into three axes and four classes; the assessment method shall only be valid if the criteria set out in the certification procedure (WG7) set out in the user guide are met.

9. ANNEXES

ARCAS Evaluation Report - ZABALGANA126 pilot building

Building address

Name: ZABALGANA126
Address:
Euskadi,Avenida Derechos Humanos 33-37
Spain,Vitoria-Gasteiz,01015

Technician address

Name: UPV/EHU

Client address

Name: FECEA

Building info

Latitude:	43.261208	**Longitude:**	-2.9333496	**Surface area:**	0.0
Construction year:	2010	**Governing normative:**	CTE DB-HE 2006		
Facade description:					
Window description:					
Roof description:					
Heating type:	Individual		**Fuel type:**	NONE	
Water heating installation type:	Individual	**Water heating fuel type:**		**Solar installation type:**	None

DESIGN STAGE PRUEBA

Axis	Indicator	Value of current situation	Value of design stage	Class of current situation	Class of design stage	Range of current situation	Range of design stage
Energy	Global Warming Potential	0	53	Class IV	Class I	(-inf - 10.0)	[30.0 - inf)
Energy	Primary Energy Consumption	100	50	Class II	Class I	[85.0 - 125.0)	(-inf - 85.0)
Energy	Heat Loss Coefficient	1	1	Class I	Class I	(0.0 - 2.4)	(0.0 - 2.4)
Energy	Renewable Primary Energy Consumption	40	60				
Energy	Renewable Energy Production	60	100				
Energy	Energy Needs	20	15	Class II	Class I	[18.0 - 50.0)	(-inf - 18.0)
Energy	Renewable energy selfconsumption ratio	66.67	60	Class III	Class III	[60.0 - 80.0)	[60.0 - 80.0)
Energy	Renewable energy selfsufficiency ratio	40	120	Class II	Class I	[40.0 - 60.0)	[60.0 - inf]
Air	Average outdoor temperature	20	20				
Air	CO2	20	20	Class I	Class I	[0.0 - 550.0)	[0.0 - 550.0)
Air	Radon	20	20	Class I	Class I	[0.0 - 100.0)	[0.0 - 100.0)
Air	Benzene	20	20	Class IV	Class IV	(5.0 - inf)	(5.0 - inf)

DESIGN STAGE PRUEBA

Axis	Indicator	Value of current situation	Value of design stage	Class of current situation	Class of design stage	Range of current situation	Range of design stage
Air	Moisture	20	20	Class II	Class II	[1.0 - 400.0)	[1.0 - 400.0)
Air	Formaldehyde	20	20	Class I	Class I	[0.0 - 30.0)	[0.0 - 30.0)
Air	Visual comfort	20	20	Class III	Class III	(10.0 - 40.0]	(10.0 - 40.0]
Air	Acoustic comfort	20	20	Class I	Class I	[0.0 - 30.0)	[0.0 - 30.0)
Air	Relative humidity	20	20	Class III	Class III	[10.0 - 60.0]	[10.0 - 60.0]
Air	Particulate matter	20	20	Class III	Class III	[18.0 - 25.0]	[18.0 - 25.0]
Air	Minimum ventilation rate	20	20	Class I	Class I	(10.0 - inf)	(10.0 - inf)
Air	Mechanical ventilation and heated	22	22	Class I	Class I	[21.0 - 23.0]	[21.0 - 23.0]
Air	No mechanical ventilation and heated	22	22	Class I	Class I	(21.0 - 23.0)	(21.0 - 23.0)
Air	Mechanical ventilation and not heated	24	24	Class I	Class I	(23.5 - 25.5)	(23.5 - 25.5)
Air	No mechanical ventilation and not heated	20	20	Class III	Class III	[19.8 - 28.8]	[19.8 - 28.8]
Poverty	Net Income	2,000	2,000				

DESIGN STAGE PRUEBA

Axis	Indicator	Value of current situation	Value of design stage	Class of current situation	Class of design stage	Range of current situation	Range of design stage
Poverty	Ten Percent	5	2.5	Class I	Class I	[0.0 - 10.0]	[0.0 - 10.0]
Poverty	Energy Expenditure	100	100				

DESIGN STAGE PRUEBA