

Progress Report (*D4.1.5.*)

Development of an interactive tool for the evaluation of optimal renovation measures

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|------------------------|---|
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1 Progressreport

1.1 Contributors

University of Seville (USE)

1.2 Summary

This deliverable is a summary of the results of activity WP4.1.5. This activity is focused on the development and implementation of the MEDECOSURE web tool. This web tool is accessible at the link <http://tmt2.us.es/Medecosure/src/index.html> (User: **Medecosure**, password: **medecosureabc1979**). There it is possible to use a test case for reviewing the tool.

Deliverable contains four main parts:

- 1) User manual: includes the information about the different screens of the web tool and indications on how the tool should be used, the input data and the results.
- 2) Reference manual: explains the details about the implementation of the algorithm, and the web structure (all the developments done for it). It is meant for the IT technicians, in case it is required to modify the application
- 3) Reference to the work done for selecting the operational condition of the spaces included in the university buildings. An Excel file includes all the figures collected.
- 4) Reference to the work done for gathering climatic data from different locations

2 Content

| | | |
|--------|--|----|
| 1 | Progress report | 1 |
| 1.1 | Contributors..... | 1 |
| 1.2 | Summary | 1 |
| 2 | Content..... | 2 |
| 3 | Accessing the application..... | 6 |
| 4 | Application Main Screen..... | 8 |
| 5 | Walking by the application | 10 |
| 5.1 | The three main buttons | 10 |
| 5.1.1 | ADD | 10 |
| 5.1.2 | OPEN | 11 |
| 5.1.3 | DELETE..... | 11 |
| 5.2 | SELECTING, ADDING AND DELETING ELEMENTS FROM A LIST..... | 13 |
| 5.3 | The Main Menu buttons..... | 14 |
| 5.3.1 | GENERAL DATA | 14 |
| 5.3.2 | GENERAL DATA > BUILDING USE..... | 15 |
| 5.3.3 | ENERGY AND ECONOMY ASPECTS > ENERGY | 20 |
| 5.3.4 | ENERGY AND ECONOMY ASPECTS > ECONOMY..... | 21 |
| 5.3.5 | REFERENCE ENERGY CONSUMPTIONS..... | 22 |
| 5.3.6 | BUILDING SYSTEM > HEATING , COOLING, DHW..... | 26 |
| 5.3.7 | BUILDING SYSTEM > LIGHTING | 29 |
| 5.3.8 | GEOMETRY AND CONSTRUCTION..... | 30 |
| 5.3.9 | OPERATIONAL CONDITIONS | 34 |
| 5.3.10 | SOLVE: INITIAL SITUATION..... | 40 |
| 5.3.11 | BASELINE RESULTS..... | 41 |
| 5.3.12 | MEDECOSURE CATALOGUE..... | 46 |
| 5.3.13 | SOLVE LCC ANALYSIS..... | 58 |



| | | |
|--------|--|----|
| 5.3.14 | LCC RESULTS | 59 |
| 5.3.15 | MEDECOSURE PROPOSAL..... | 64 |
| 6 | Required Programs. | 69 |
| 6.1 | Operating system..... | 69 |
| 6.2 | Database..... | 69 |
| 6.3 | Web server | 69 |
| 6.4 | Backend..... | 69 |
| 7 | Installation..... | 70 |
| 8 | Postgresql..... | 70 |
| 9 | Database..... | 70 |
| 9.1 | Backend..... | 72 |
| 9.2 | NSSM | 73 |
| 9.3 | XAMP | 75 |
| 10 | Technical basis of Medecosure Application | 76 |
| 10.1 | Introducción | 76 |
| 10.2 | Code structure..... | 76 |
| 10.2.1 | Modular Structure: | 76 |
| 10.3 | Frontend..... | 78 |
| 11 | Local folder structure..... | 83 |
| 12 | Calculation program folder structure..... | 84 |
| 13 | Database for operational conditions in university buildings..... | 86 |
| 13.1 | Descripción | 86 |
| 13.2 | Choice of space typess | 1 |
| 13.3 | Types of schedules | 1 |
| 13.4 | DHW..... | 2 |
| 13.5 | Heating and cooling | 3 |
| 13.6 | Incident Notes..... | 3 |



13.7 Definition of generic space..... 4

14 Climatic Data 6

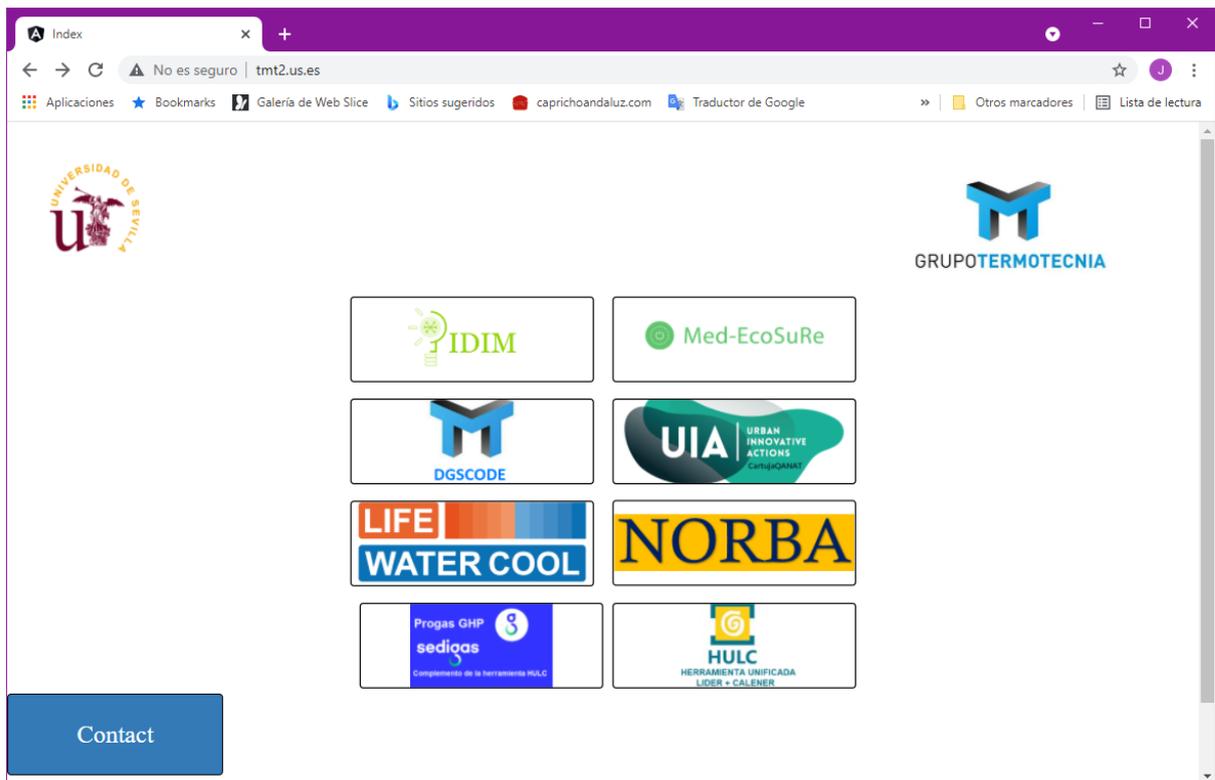


User Manual of interactive tool for the evaluation of optimal renovation measures

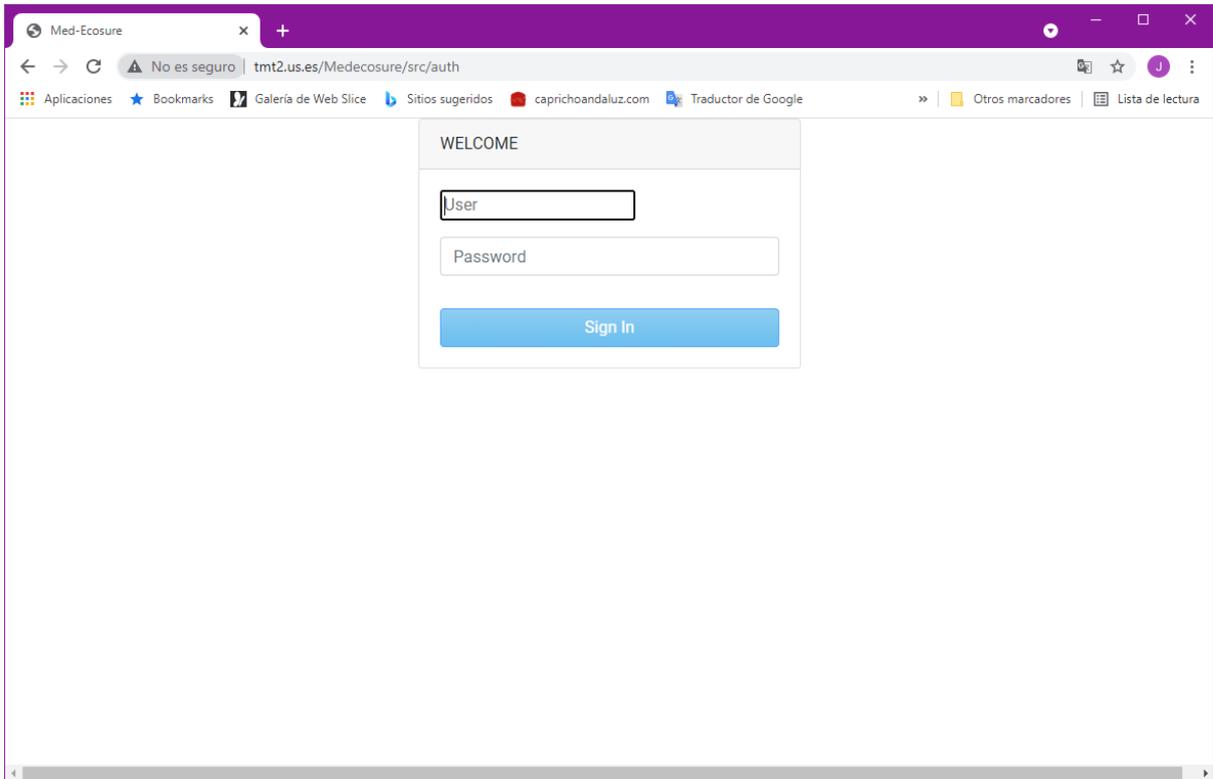


3 Accessing the application

The application can be accessed from the URL <http://tmt2.us.es> a screen like the following is obtained:



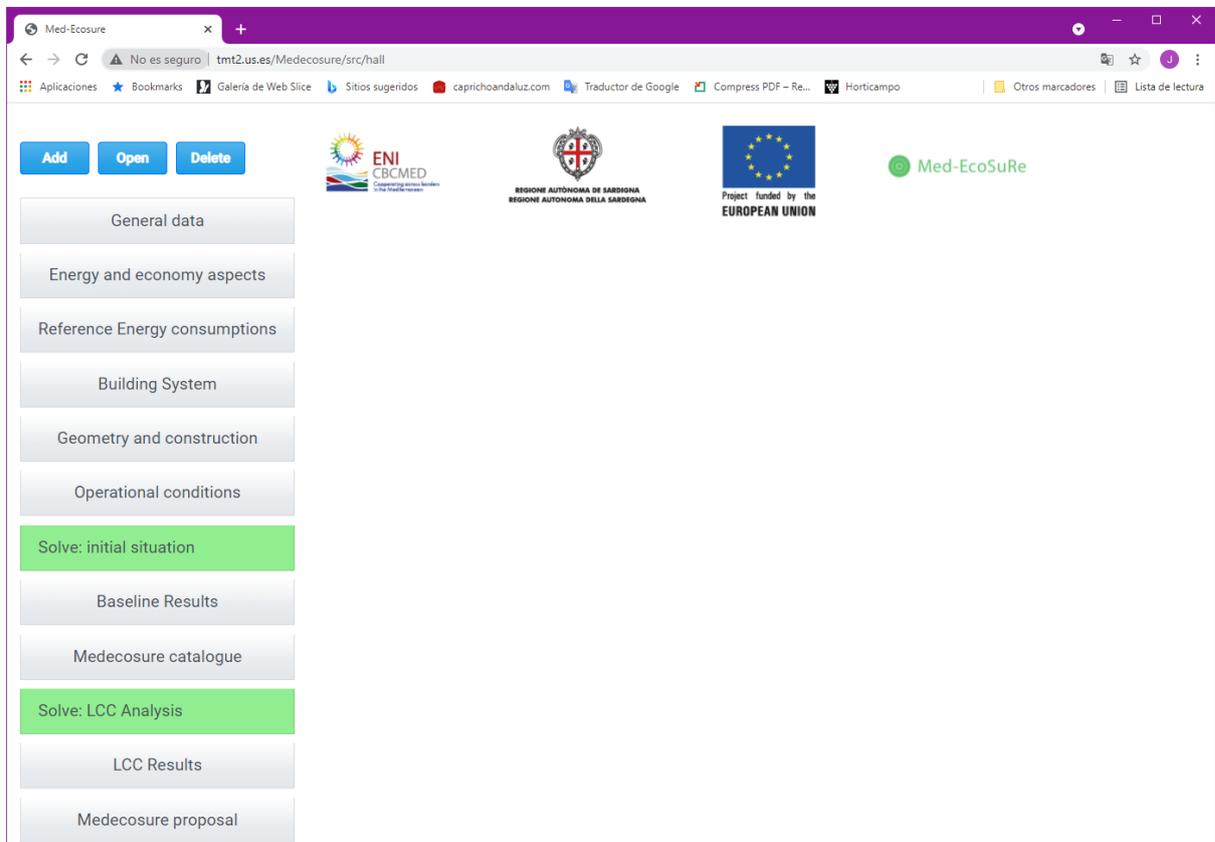
To access the application just click on the upper right button with the caption Med-EcoSuRe
Then, the application asks for identification of the user.



Every partner in the project has been provided with a username and a password.

Once these username and password has been introduced, the user can see the application main format:

4 Application Main Screen



The format is divided in three main parts: The upper left (the upper right is reserved for the logos of the project), The center left and the rest.

The upper left contains three buttons:

Add: It is used for adding a new case-study to the application data base

Open: it is used for opening a case-study already in the database. All the cases studied remains in the data-base until they are deleted using the next button.

Delete: used for selecting a case-study to be removed from the database. This option is not reversible

The center-left, contains the buttons composing the application MENU: they give access to the different features included in the application, allowing to the user to define the case-study, calculate it, analyse the refurbishing options, etc. Next the general purpose of every button is introduced. All of them will be described in full detail in next pages.

General data: Used for introducing in the database the general data, like size of the building, the location, the definition of the building usage, etc.



Energy and economy aspects: The user must visit this button for introducing the energy prices and the economic factors, like interest, or inflation ratios.

Reference Energy consumptions: The data corresponding to the energy consumptions recorded in the energy bills are introduced using this button.

Building System: The actual building technical systems for heating, cooling, domestic hot water (D.H.W.), and lightning.

Geometry and construction: The building geometry and construction are introduced here. The building is considered as unizone, and only the global building envelope is detailed.

Operational conditions: The user behaviour during a typical year is introduced usgin this button. A few preselected hourly patterns are offered and all of them can be changed by the user for fitting the actual building operating conditions.

Solve: initial situation: When clicking in this button, the application calls the calculation engine, for determining the energy consumptions (hourly, monthly and annual values for the four main services: heating, cooling, D.H.W. and lightning), that matches the energy consumptions introduced in the Reference Energy consumption.

Baseline Results: Using this button, the user can review the results obtained by the calculation engine, corresponding to the actual situation. The results can be seen in graphical or table formats.

Medecosure catalogue: A set of energy conservation measures is shown to the user, and it is possible to select a combination of measures to be evaluated by the applicaton. The measures can be conventional or innovative. The innovative ones have been selected by the project partners.

Solve: LCC Analysis: The calculation engine is used now for the evaluation of the LCC of every combination of the conservation measures. The number of combination analysed can be very high (thousands!)

LCC Results: The used can access to the LCC analysis with this button. A table is shown in which the results of every combination calculated can be compared with all of the others, in order to select a few (some three) to be finally proposed.

Medecosure proposal: With this button the user can access the better combinations and print (PDF format) a report which includes the actual situation and the savings obtained with every one of the conservation measures combinations.

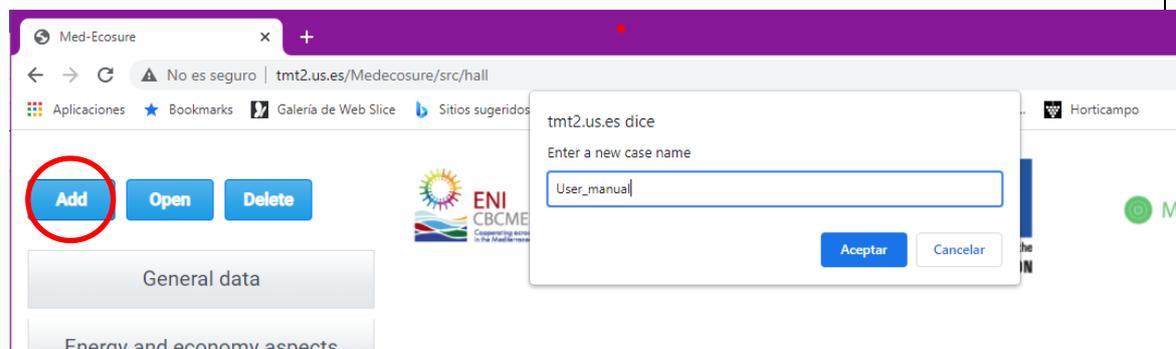


5 Walking by the application

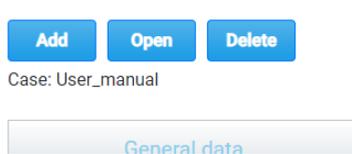
A common format will be used in which the image of every screen will appear at the top of the pages, and a description of the data or the instructions to be followed by the users will be included below the image, when it is required a description. Very often, the data are self-descriptive.

5.1 The three main buttons

5.1.1 ADD

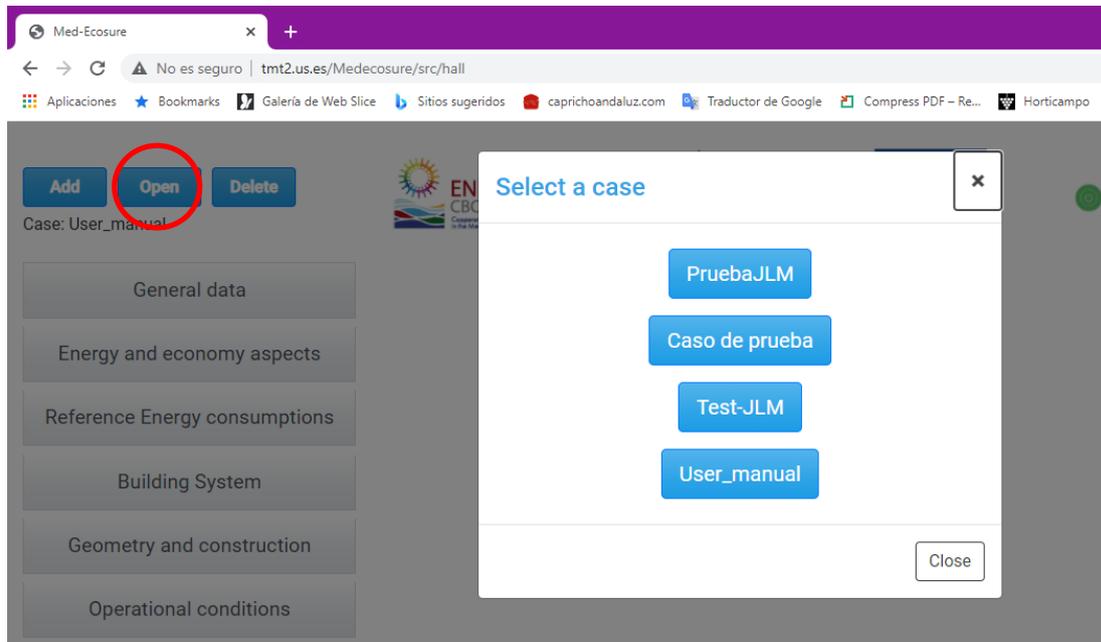


When the user clicks on the **Add** button, a new case-study is added. Once the name of the case is introduced, it is automatically opened:



The name of the active case is indicated underneath the three blue buttons.

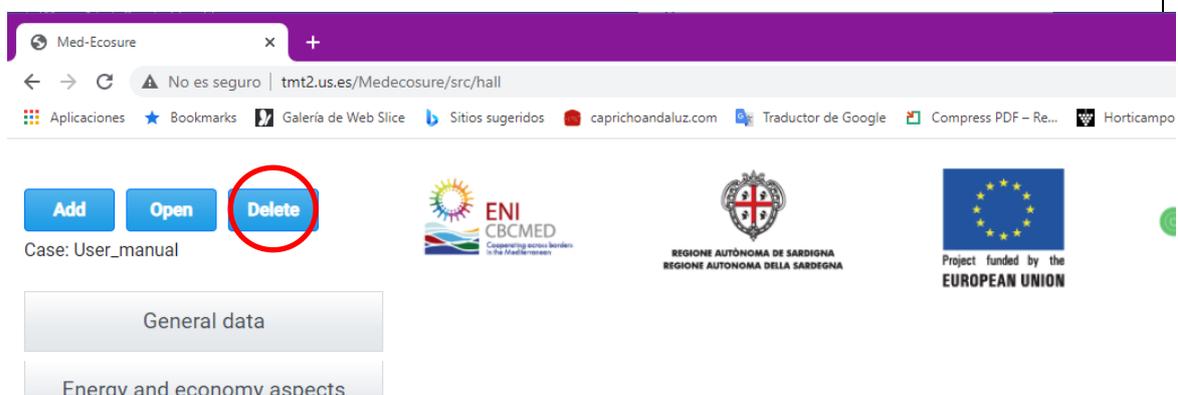
5.1.2 OPEN



The screenshot shows a web browser window with the URL `tmt2.us.es/Medeclosure/src/hall`. The page has three buttons: 'Add', 'Open', and 'Delete'. The 'Open' button is circled in red. A modal dialog box titled 'Select a case' is open, displaying four buttons: 'PruebaJLM', 'Caso de prueba', 'Test-JLM', and 'User_manual'. A 'Close' button is at the bottom right of the dialog. The background shows a sidebar with categories like 'General data', 'Energy and economy aspects', etc.

When the user clicks on the **Open** button, a list of the existing cases in the database is shown, for the user to select the one to be opened, just clicking on the button with its name.

5.1.3 DELETE



The screenshot shows the same web browser window as in the previous image. The 'Delete' button is now circled in red. The 'Select a case' dialog box is no longer visible. The sidebar categories are partially visible.



The button **Delete** removes from the database the opened case. The application asks for confirmation.

Next, every one of the buttons integrated in the main menu will be described in detail.

5.2 SELECTING, ADDING AND DELETING ELEMENTS FROM A LIST

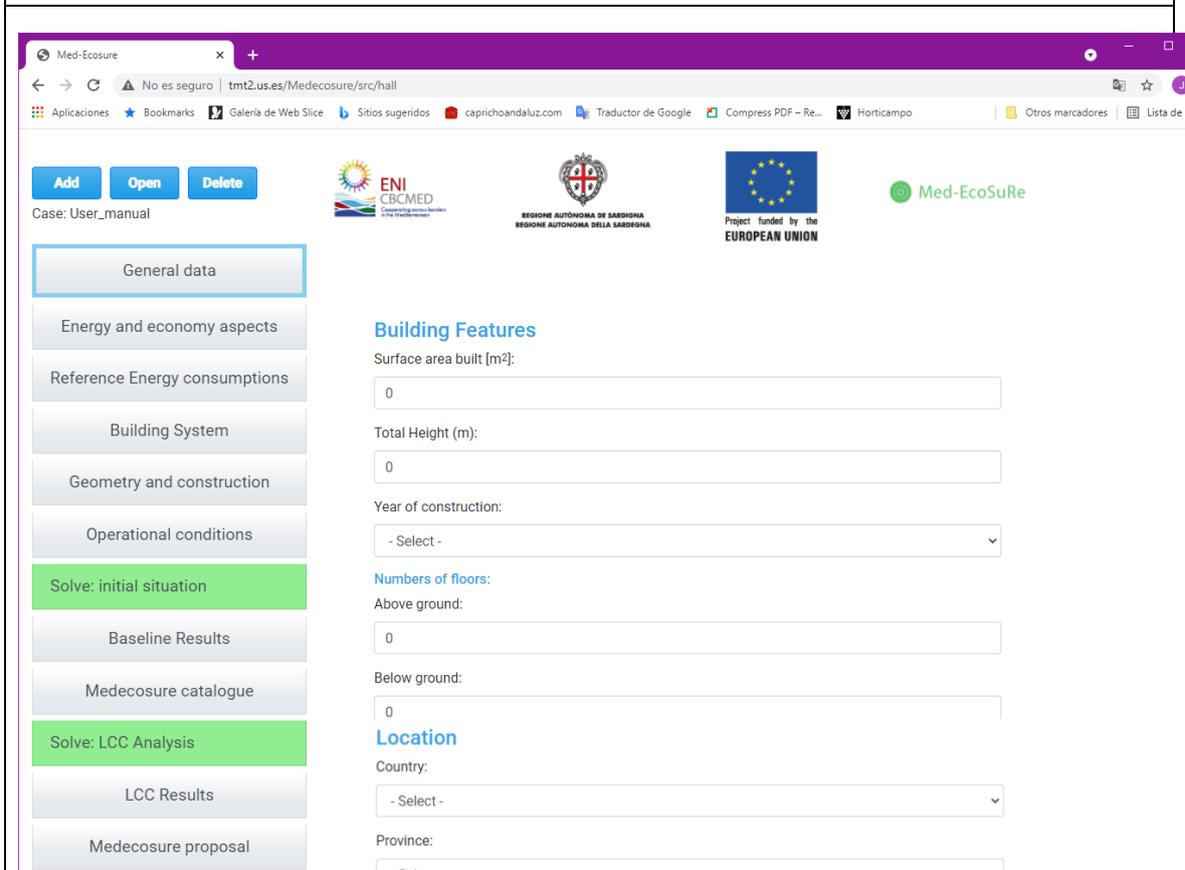


In this section, we will describe a common pattern used along the application, for selecting elements from a list, or adding new elements to the existing list, or removing elements from the list.

| | |
|---------------|--|
| Select | The user clicks on the Select button, and a list of elements is offered for the user to select one of them. The list could be empty for the first time |
| Add | If the list is empty, or the user wants to add a new item, the Add button must be clicked, then an auxiliary form is shown for the new value to be introduced. When this is done, the new item must be selected from the list offered clicking on the Select button. |
| Delete | The selected item is deleted when the user clicks on this button |

5.3 The Main Menu buttons

5.3.1 GENERAL DATA



The screenshot shows a web browser window with the URL `tmt2.us.es/Medeclosure/src/hall`. The page features a navigation menu on the left with buttons for 'Add', 'Open', and 'Delete'. Below the menu, the 'Case: User_manual' is displayed. The main content area is titled 'Building Features' and includes the following input fields:

- Surface area built [m²]:
- Total Height (m):
- Year of construction:
- Numbers of floors:
 - Above ground:
 - Below ground:
- Location:
 - Country:
 - Province:
 - City:
- Other data:

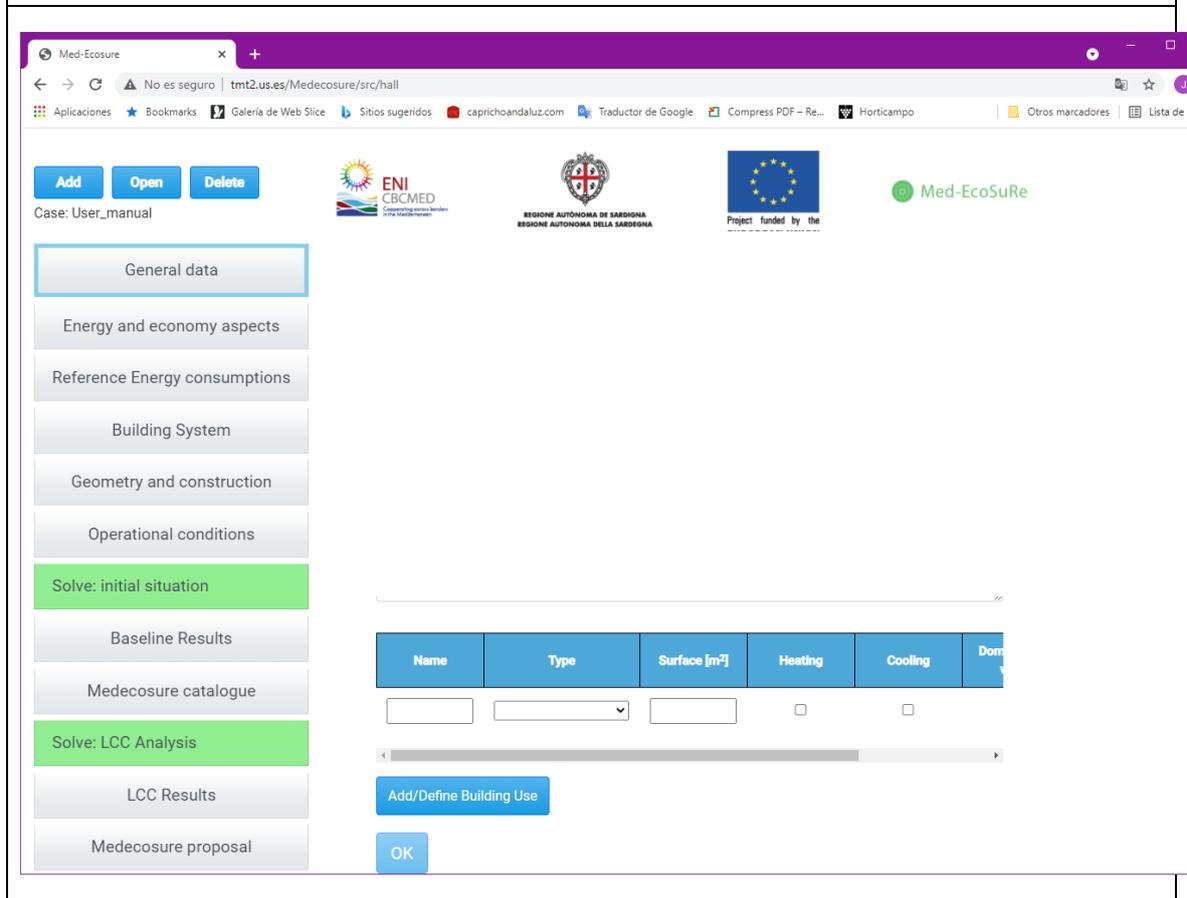
Building Features:

The data integrated in this area are:

Surface area built : area of the building in sq. meter. Is a reference area. In a two floor building with 500 sqm each, this number would be 1000.

| | |
|--------------------------|--|
| | <p>Total Height: total height of the building envelope, in m.</p> <p>Year of construction: a list is offered, for the user to select the constructive period. It is referred to the default value given to the building materials, depending on the constructive period.</p> <p>Number of floors: above and below ground.</p> |
| <p>Location</p> | <p>The Country is selected from a list offered by the application. Almost all of the European countries are included. In case any partner wants to include his own climatic data, they are welcome.</p> <p>Once the Country is selected, the user must select the Province, or the region, and last the City.</p> |
| <p>Other data</p> | <p>This is a place for the user to write some descriptive text or whatever information is relevant for the case-study</p> |

5.3.2 GENERAL DATA > BUILDING USE



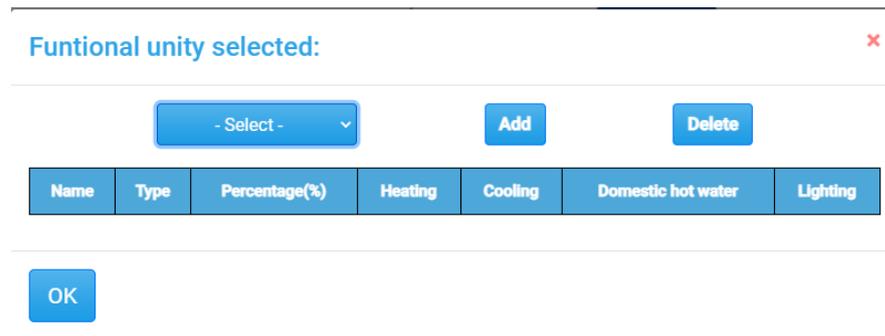
The screenshot shows the Med-Ecosure web application interface. The browser address bar indicates the URL is `tmt2.us.es/Medeclosure/src/hall`. The page features a navigation menu on the left with the following items: "General data", "Energy and economy aspects", "Reference Energy consumptions", "Building System", "Geometry and construction", "Operational conditions", "Solve: initial situation" (highlighted in green), "Baseline Results", "Medeclosure catalogue", "Solve: LCC Analysis" (highlighted in green), "LCC Results", and "Medeclosure proposal".

The main content area displays the "Add/Define Building Use" form. At the top, there are three buttons: "Add", "Open", and "Delete". Below them, the case name is "Case: User_manual". The form includes a table with the following columns: "Name", "Type", "Surface [m²]", "Heating", "Cooling", and "Dom". The "Name" and "Surface" columns have input fields, and the "Type" column has a dropdown menu. The "Heating" and "Cooling" columns have checkboxes. Below the table, there is a blue button labeled "Add/Define Building Use" and an "OK" button.

5.3.2 GENERAL DATA > BUILDING USE

Building Use

The last part of the general data is very important as it is introduced the known use of the building. The application includes a set of typical operating conditions for different parts of university buildings. The user clicks on the button **Add/Define Building Use** and obtain an auxiliary form:



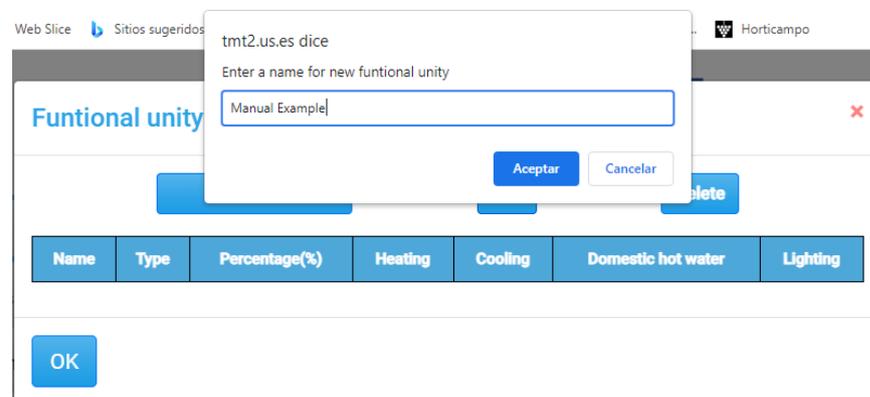
Funtional unity selected:

- Select - Add Delete

| Name | Type | Percentage(%) | Heating | Cooling | Domestic hot water | Lighting |
|------|------|---------------|---------|---------|--------------------|----------|
| | | | | | | |

OK

Once some data has been introduced, it can be selected from a list obtained clicking on the button **Select**. For the first time, the user must click on the **Add** button, and another auxiliary form allows the introduction of the name given to the Functional unit to be defined.



tmt2.us.es dice

Enter a name for new funtional unity

Manual Example

Aceptar Cancelar

Funtional unity

Name Type Percentage(%) Heating Cooling Domestic hot water Lighting

OK

Once the name is introduced it must be selected from the list offered when the **Select** button is clicked:

5.3.2 GENERAL DATA > BUILDING USE

Functional unity selected: Manual Example

Manual Example ▼ Add Delete

| Name | Percentage(%) | Heating | Cooling |
|----------------|---------------|--------------------------|--------------------------|
| Manual Example | Surface | <input type="checkbox"/> | <input type="checkbox"/> |

Add unity

OK

And now, the user can select from the database of occupancy types:

Functional unity selected: Manual Example

Manual Example ▼ Add Delete

| Name | Type | Percentage(%) | Heating | Cooling |
|---------------|---------------|---------------|-------------------------------------|-------------------------------------|
| Assembly Hall | Assembly Hall | Surface | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

Add unity

OK

Then, for every type selected it must be introduced a reference name (we used n1 and n2), and the percentage of the building area affected. In the next figure we have selected 20% of Offices and 80% of Classrooms:

5.3.2 GENERAL DATA > BUILDING USE

Funtional unity selected: Manual Example ✕

Manual Example ▾
Add
Delete

| Name | Type | Percentage(%) | Heating | Cooling | | |
|------|------|---------------|---------|-------------------------------------|-------------------------------------|--|
| ✕ | n1 | Offices ▾ | 20 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| ✕ | n2 | Classrooms ▾ | 80 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |

Add unity

OK

After the first item, the button **Addunity** must be clicked for adding more.

Click on the **OK** button when finished the selection of items.

Clicking on the red **X** on the left of every line removes that line. The services offered, heating, cooling, DHW and lighting, are eligible, but the default values are the common selection.

When returned to the previous form, the user can select the recently defined Functional Unit from the list offered in the Type column:

| Name | Type | Surface [m ²] | Heating | Cooling | Dom |
|------|------------------|---------------------------|-------------------------------------|-------------------------------------|-----|
| b1 | Manual Example ▾ | 1000 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |

Add/Define Building Use

OK

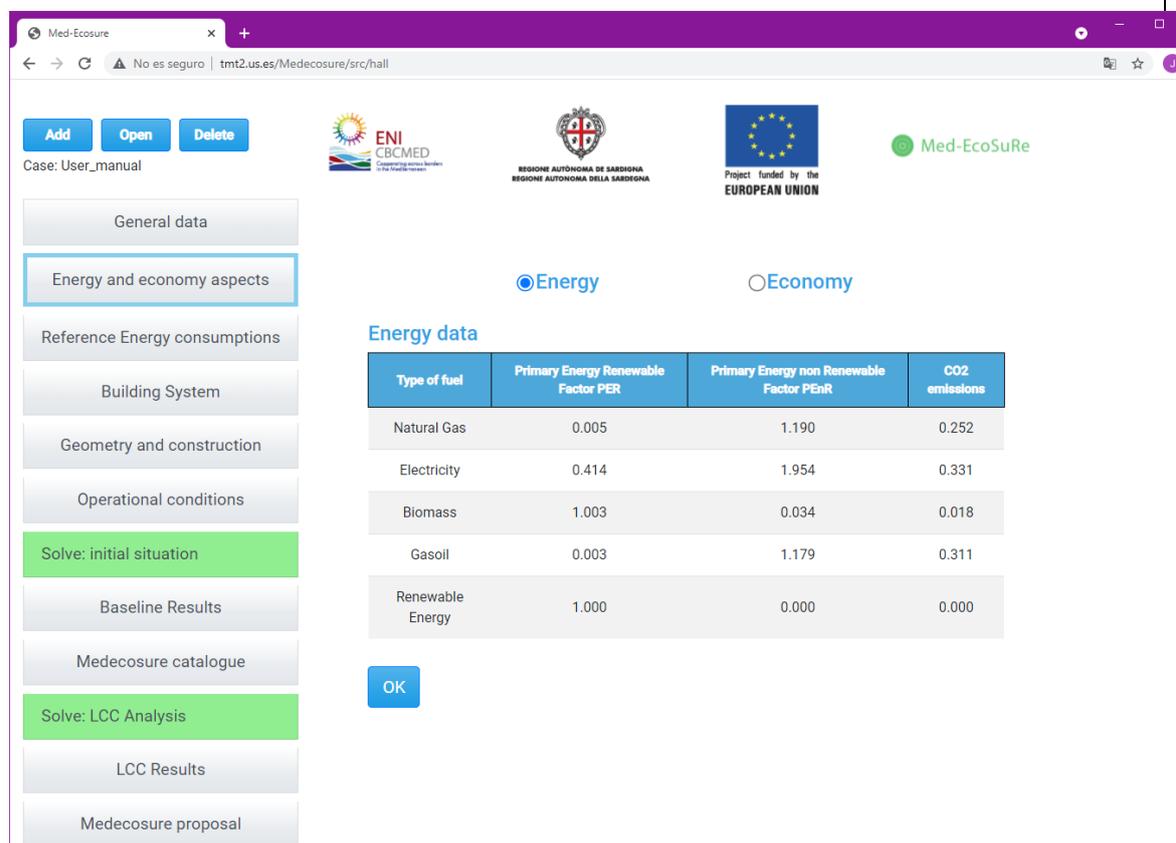
A new reference name (b1) and the number of sqm of the building affected by this operating conditions must be introduced.

Last, the user can click on the OK button for storing the data introduced in the database.

A confirmation message is sent.



5.3.3 ENERGY AND ECONOMY ASPECTS > ENERGY



The screenshot shows the Med-Ecosure web application interface. On the left is a vertical menu with buttons for 'Add', 'Open', and 'Delete'. Below the menu are several tabs: 'General data', 'Energy and economy aspects' (highlighted), 'Reference Energy consumptions', 'Building System', 'Geometry and construction', 'Operational conditions', 'Solve: initial situation', 'Baseline Results', 'Medecosure catalogue', 'Solve: LCC Analysis', 'LCC Results', and 'Medecosure proposal'. The main content area features logos for ENI CBCMED, REGIONE AUTÓNOMA DE SARDIGNA, and EUROPEAN UNION. Below the logos are radio buttons for 'Energy' (selected) and 'Economy'. A table titled 'Energy data' is displayed with the following content:

| Type of fuel | Primary Energy Renewable Factor PER | Primary Energy non Renewable Factor PEnR | CO2 emissions |
|------------------|-------------------------------------|--|---------------|
| Natural Gas | 0.005 | 1.190 | 0.252 |
| Electricity | 0.414 | 1.954 | 0.331 |
| Biomass | 1.003 | 0.034 | 0.018 |
| Gasoil | 0.003 | 1.179 | 0.311 |
| Renewable Energy | 1.000 | 0.000 | 0.000 |

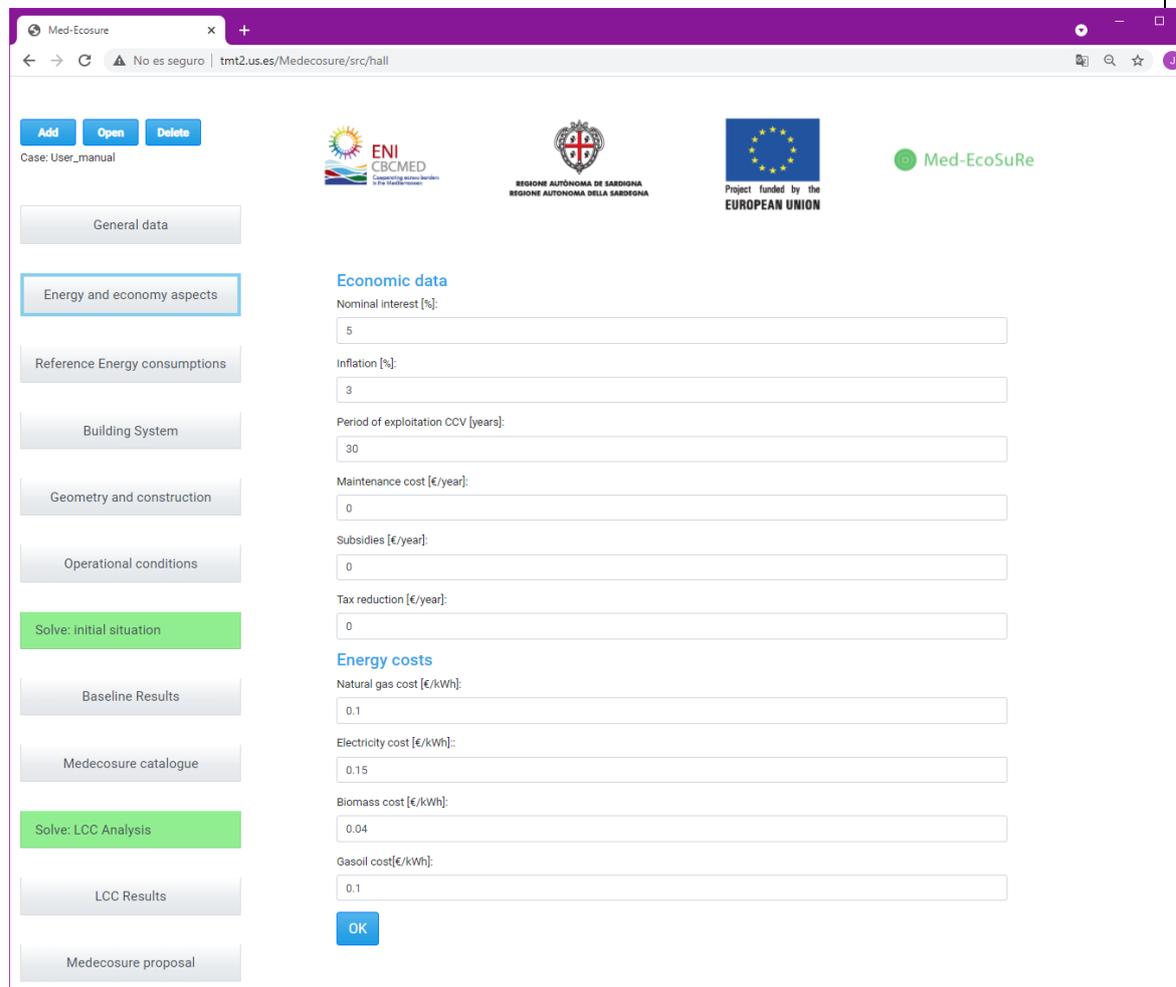
Below the table is an 'OK' button.

In this Menu button, in the radio button option **Energy**, the user can introduce the coefficients that define the different energy vectors considered (Natural Gas , Electricity, Biomass, Gasoil and Renewable Energy), in terms of Primary Energy Renewable Factor PER, Primary Energy non-Renewable Factor PEnR, and CO2 emissions. All the cells can be modified by the user. The default values shown are the last values from the UE documents.

When all the values are updated, the user must click on the OK button.

These values are saved for every case-study (they can be different for every case-study)

5.3.4 ENERGY AND ECONOMY ASPECTS > ECONOMY



The screenshot shows a web browser window with the URL `tmt2.us.es/Medeclosure/src/hall`. The page title is "Med-Ecosure". On the left, there is a navigation menu with buttons: "Add", "Open", "Delete", "Case: User_manual", "General data", "Energy and economy aspects" (highlighted), "Reference Energy consumptions", "Building System", "Geometry and construction", "Operational conditions", "Solve: initial situation", "Baseline Results", "Medeclosure catalogue", "Solve: LCC Analysis", "LCC Results", and "Medeclosure proposal". The main content area displays the "Economic data" form with the following fields:

- Nominal interest [%]:
- Inflation [%]:
- Period of exploitation CCV [years]:
- Maintenance cost [€/year]:
- Subsidies [€/year]:
- Tax reduction [€/year]:

Below these are the "Energy costs" fields:

- Natural gas cost [€/kWh]:
- Electricity cost [€/kWh]:
- Biomass cost [€/kWh]:
- Gasoil cost [€/kWh]:

An "OK" button is located at the bottom of the form.

In this Menu button, in the radio button option **Economy**, the user can introduce the different values of the economic evaluation and for the calculation of the Life Cycle Cost of the building.

Economic data

The required parameters, which include default reasonable values are:

Nominal interest [%]:

Inflation [%]:

Period of exploitation CCV [years]:

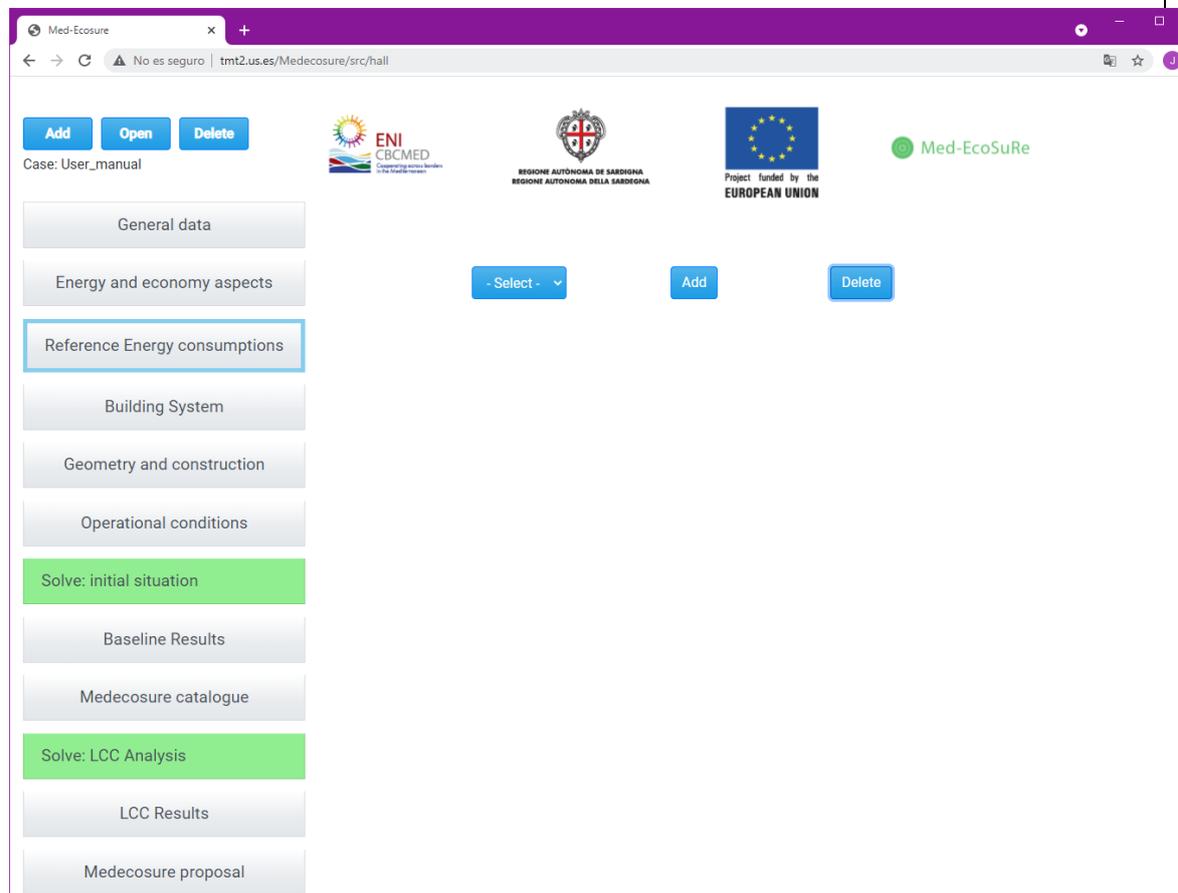
Maintenance cost [€/year]:

Subsidies [€/year]:

| | |
|--------------|--|
| | <p>Tax reduction [€/year]:</p> <p>No especial explanations are required for these well known economic parameters. Notice that these values must be averaged over the Life Cycle of the building.</p> |
| Energy costs | <p>The costs of the different energy products are required:</p> <p>Natural gas cost [€/kWh]:</p> <p>Electricity cost [€/kWh]:</p> <p>Biomass cost [€/kWh]:</p> <p>Gasoil cost[€/kWh]:</p> <p>Again, notice that these values must be averaged over the Life Cycle of the building.</p> |

5.3.5 REFERENCE ENERGY CONSUMPTIONS

5.3.5 REFERENCE ENERGY CONSUMPTIONS



The Reference Energy Consumptions Menu button allows the user to introduce the values of the energy meters used in the building. Annual values must be introduced for every energy product consumed in the building. Very important: the user must split the energy consumption of every energy product among the different services, i.e., in case Natural Gas is used for Heating and DHW, the user must distribute the consumption between these two services.

Using the pattern of selection of items in a list, the user must introduce the name of the meter, the type of energy product, the service associated, the year(s) of reference and finally the value of the meter.

Name of the meter

Using the select-add-delete pattern define the name, for instance, M1

5.3.5 REFERENCE ENERGY CONSUMPTIONS

M1

Energy source:

Use:
 Heating
 Cooling
 Domestic heat water
 Lighting

- Select -

Next the energy product and the service associated to the meter must be introduced:

M1

Energy source:

Use:
 Heating
 Cooling
 Domestic heat water
 Lighting

- Select -

Then, also with the same pattern of select-add-delete, the year is introduced, and finally, the annual value and the degree days for climate characterisation of the period. Various years can be introduced:

M1

Energy source:

Use:
 Heating
 Cooling
 Domestic heat water
 Lighting

2020

Energy consumption [kWh/year]:

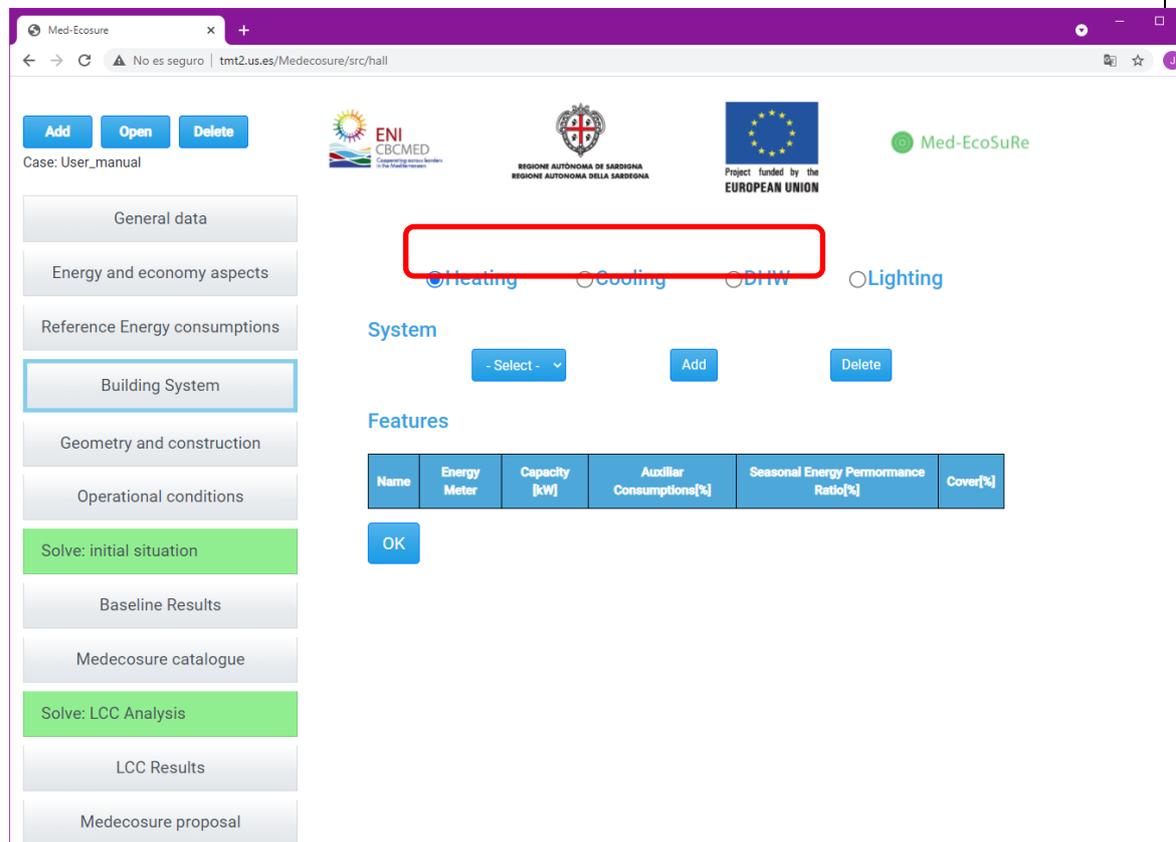
Seasonal Degree day in base temperature 20°C:



5.3.5 REFERENCE ENERGY CONSUMPTIONS

Terminate the introduction clicking on the OK button. A confirmation message is obtained.

5.3.6 BUILDING SYSTEM > HEATING , COOLING , DHW



The screenshot shows the Med-Ecosure web application interface. On the left is a vertical navigation menu with buttons for 'Add', 'Open', and 'Delete'. The main content area has a header with logos and a 'Case: User_manual' label. Below the header, there are radio buttons for 'Heating', 'Cooling', 'DHW', and 'Lighting'. The 'Heating' radio button is selected and highlighted with a red rectangular box. Below the radio buttons, there is a 'System' section with a dropdown menu and 'Add' and 'Delete' buttons. Underneath is a 'Features' section with a table and an 'OK' button.

| Name | Energy Meter | Capacity [kW] | Auxillar Consumptions[%] | Seasonal Energy Pormornance Ratio[%] | Cover[%] |
|------|--------------|---------------|--------------------------|--------------------------------------|----------|
| OK | | | | | |

The Service is selected with the radio button on the top for the form.

For **Heating**, **Cooling** and **DHW** the application behaves exactly the same. After selection of the service, a table is shown with the different equipment installed in the building. The equipments are selected-added-deleted using the already well know pattern (the images shown the case of Heating).

Once added the equipment appear on the table:

5.3.6 BUILDING SYSTEM > HEATING , COOLING , DHW

Heating
 Cooling
 DHW
 Lighting

System

- Select -
H1

Add

Delete

Features

| Name | Energy Meter | Capacity [kW] | Auxiliar Consumptions[%] | Seasonal Energy Performance Ratio[%] | Cover[%] |
|------|--------------|---------------|--------------------------|--------------------------------------|----------|
| H1 | M1 | 0 | 0 | 0 | 0 |

OK

The edition of its properties is allowed when the equipment is selected from the list:

Heating
 Cooling
 DHW
 Lighting

System

H1

Add

Delete

Energy meter:

M1

Features

Capacity [kW]:

0

Auxiliary consumptions[%]:

0

Seasonal Energy Performance Ratio[%]:

0

Cover[%]:

0

First, the **Energy Meter** previously defined associated to this service must be selected. The energy consumption is shared by all the equipment defined.

Then, the rest of the Features are introduced (only the not obvious properties are described):

Capacity [kW]:

Auxiliary consumptions[%]:

Seasonal Energy Performance Ratio[%]:

Cover[%]: is the percentage of the net energy demand (for heating) that is supplied by this equipment.

5.3.6 BUILDING SYSTEM > HEATING , COOLING , DHW

Once the values are introduced and the OK button is clicked, the properties appear in the table:

Energy meter:

M1

Features

Capacity [kW]:

100

Auxiliary consumptions[%]:

5

Seasonal Energy Performance Ratio[%]:

90

Cover[%]:

100

| Name | Energy Meter | Capacity [kW] | Auxiliar Consumptions[%] | Seasonal Energy Performance Ratio[%] | Cover[%] |
|------|--------------|---------------|--------------------------|--------------------------------------|----------|
| H1 | M1 | 100 | 5 | 90 | 100 |

5.3.7 BUILDING SYSTEM > LIGHTING

The Lighting systems are introduced in exactly the same way as the rest of systems in the building. The only difference lies on the properties that are used:

Heating
 Cooling
 DHW
 Lighting

System

L1

Add

Delete

Energy meter:

M4

Features

Average illuminance at working level [lux]:

0

Energy Efficiency Lighting [-]:

0

Cover[%]:

0

| Name | Energy Meter | Average Illuminance at working level [lux] | Energy Efficiency Lighting [-] | Cover[%] |
|------|--------------|--|--------------------------------|----------|
| L1 | M4 | 0 | 0 | |

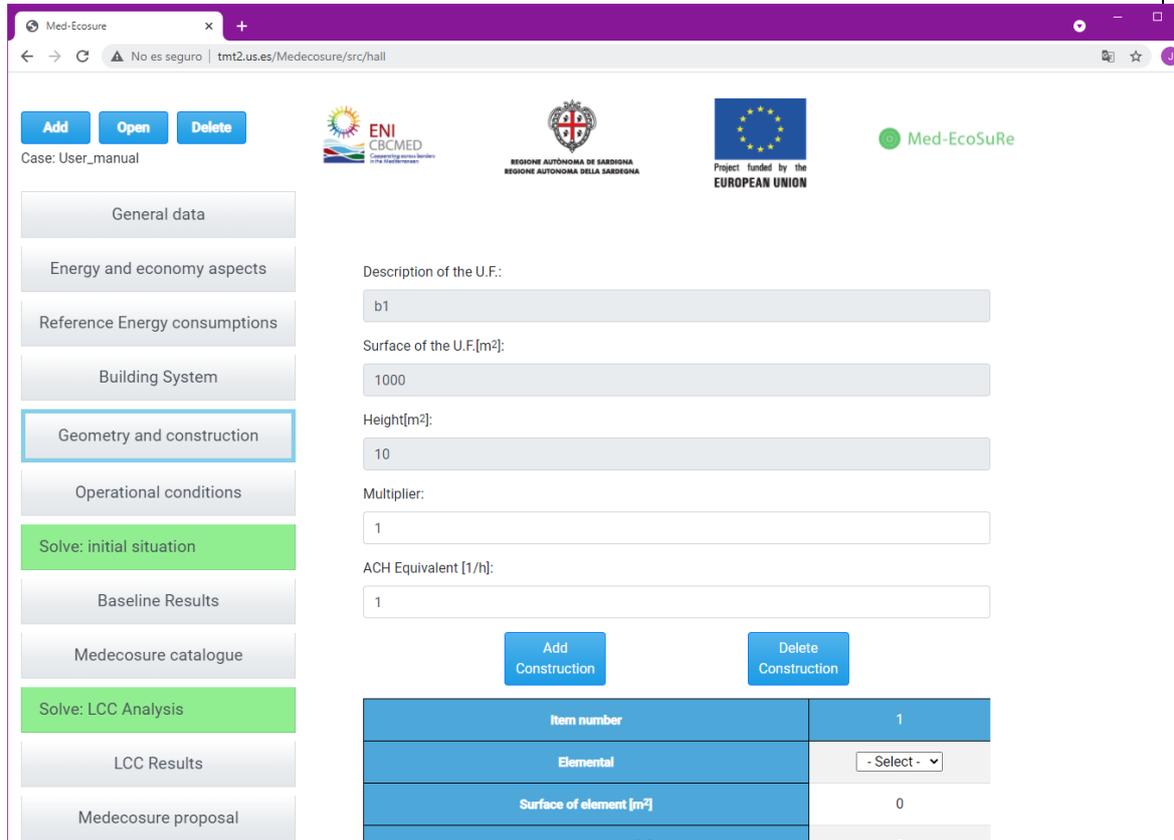
These properties are:

Average illuminance at working level [lux]:

Energy Efficiency Lighting [-]:

Cover[%]:

5.3.8 GEOMETRY AND CONSTRUCTION



Case: User_manual

General data

Energy and economy aspects

Reference Energy consumptions

Building System

Geometry and construction

Operational conditions

Solve: initial situation

Baseline Results

Medecosure catalogue

Solve: LCC Analysis

LCC Results

Medecosure proposal

Description of the U.F.:
b1

Surface of the U.F.[m²]:
1000

Height[m²]:
10

Multiplier:
1

ACH Equivalent [1/h]:
1

Add Construction Delete Construction

| Item number | 1 |
|-------------------------|------------|
| Elemental | - Select - |
| Surface of element [m²] | 0 |
| Minimum Perimeter [m] | 0 |

With this button, the user can introduce the **geometric and constructive definition** of the building envelope. Notice that the definition only affects the exterior walls, roofs, windows, ground floors pertaining to the envelope of the building. Inside walls or windows can not be defined.

There are a few global data, and the actual constructive and geometric definition.

Global data

Description of the U.F.: the reference label introduced in the general data is repeated here as a default value. It can be changed as required.

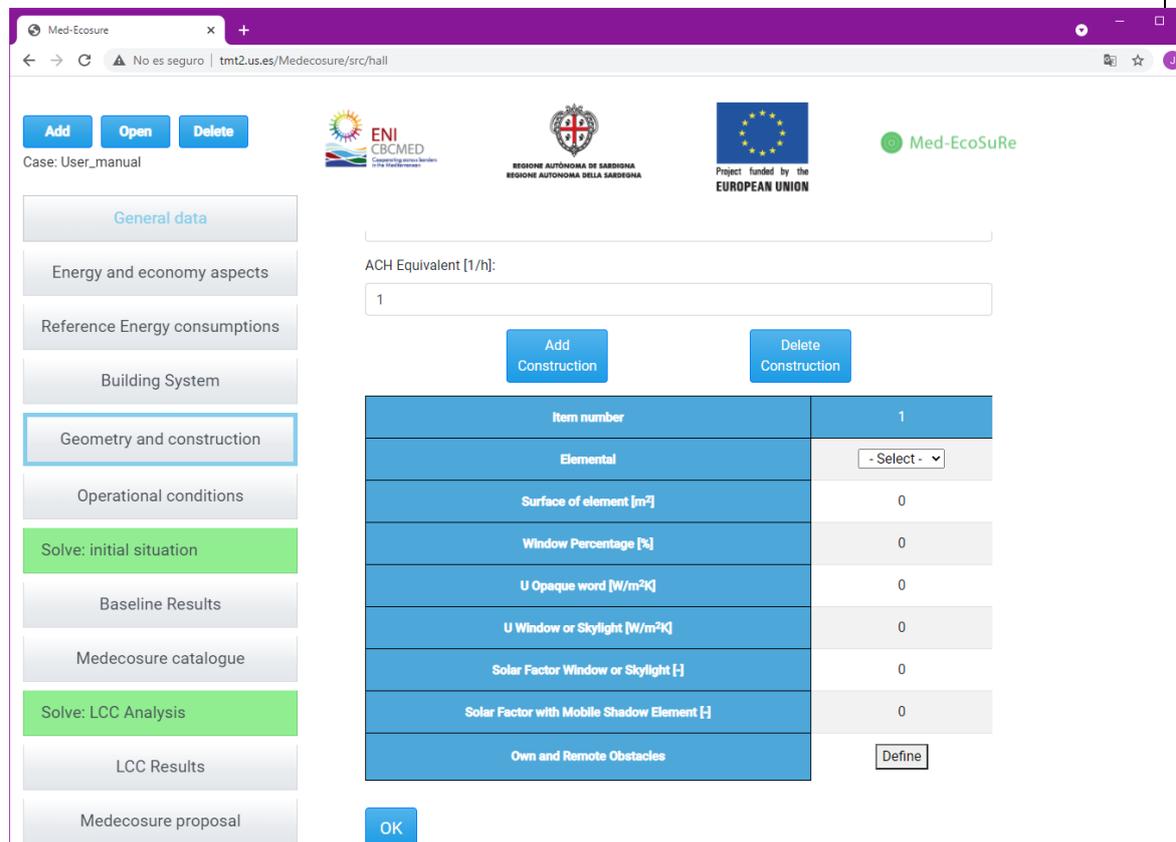
Surface of the U.F.[m²]: the default value is the one given in the general data. Both numbers should be the same.

Height[m]: the default value is the one given in the general data.



| | |
|--|---|
| | <p>Both numbers should be the same</p> <p>Multiplier: Number of buildings the same as the one described. This should be always one, as it is a future option.</p> <p>ACH Equivalent [1/h]: Equivalent Air changes per hour, a constant value which should be the average of the possibly hourly variable ratio of air renovation in the building.</p> |
|--|---|

4.3.8. GEOMETRY AND CONSTRUCTION



Case: User_manual

ACH Equivalent [1/h]:
1

Add Construction Delete Construction

| Item number | 1 |
|---|------------|
| Elemental | - Select - |
| Surface of element [m ²] | 0 |
| Window Percentage [%] | 0 |
| U Opaque wall [W/m ² K] | 0 |
| U Window or Skylight [W/m ² K] | 0 |
| Solar Factor Window or Skylight [-] | 0 |
| Solar Factor with Mobile Shadow Element [-] | 0 |
| Own and Remote Obstacles | Define |

OK

The second part of the form is devoted to the geometric and constructive definition. As it can be seen in the previous image, the form contains a table, with only a column, but more columns can be added, using the button **Add Construction**. Every column is used for a single constructive element of the building (remember, only external elements). The data to introduce are:

Orientation: A list is offered in which the user can select the 8 main compass directions, Horizontal, for roofs, and Floor for Ground floors. Also, it can be selected Interior, for walls in contact with other buildings. These walls are considered adiabatic.

Surface of element [m²] Area of the complete wall, including any window.

Window Percentage [%] Percentage of the total area occupied by the window

U Opaque wall [W/m²K] Default U values are given, but it can be changed by the user. If the user add a new element, the default values offered will be the last introduced in that category.

U Window or Skylight [W/m²K] When the percentage of Window is greater than zero, average values for the glass and the window frame are introduced. Default U values are given,

but they can be changed by the user. If the user adds a new element, the default values offered will be the last introduced in that category.

Solar Factor Window or Skylight [-] The g value for the combination of window and frame must be introduced here.

Solar Factor with Mobile Shadow Element [-] The g value when the shade is installed. It must include both the glazing and the shading element.

Own and Remote Obstacles: future option.

After adding three elements, the table looks like this image:

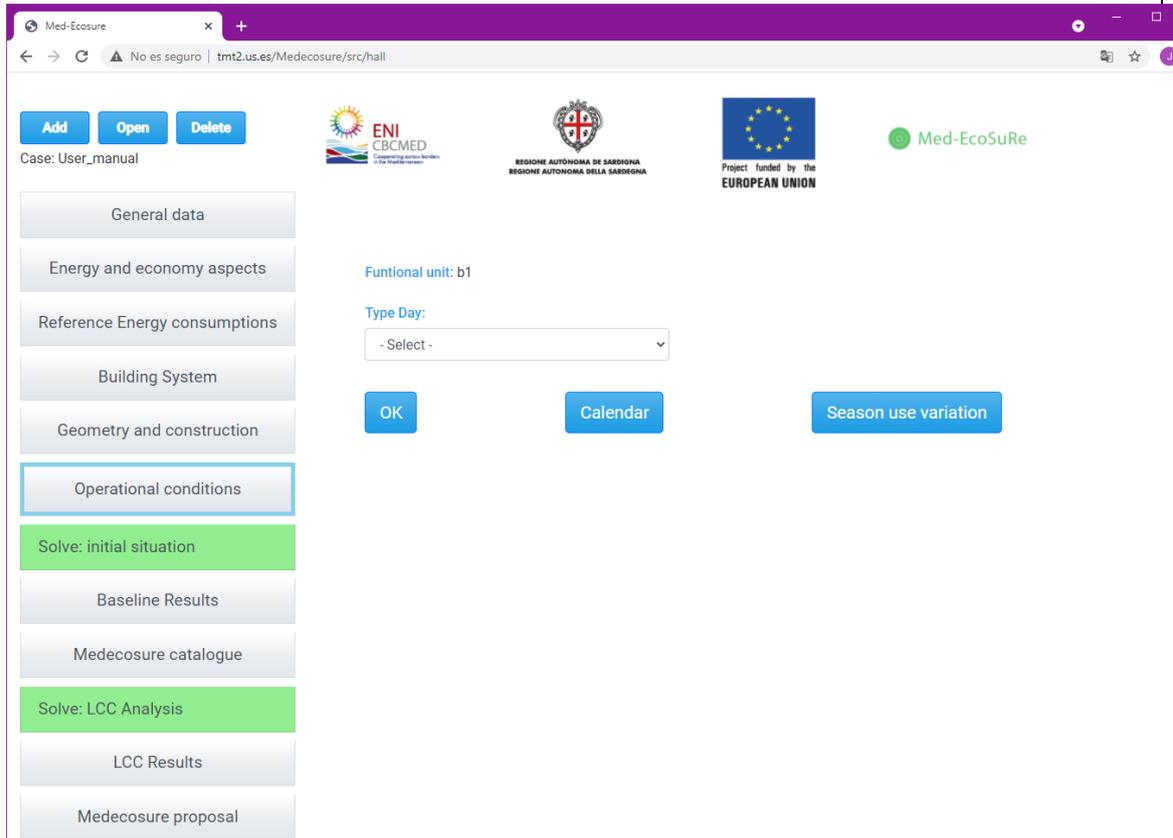
Add Construction
Delete Construction

| Item number | 1 | 2 | 3 |
|---|---------|--------|--------|
| Elemental | South ▾ | East ▾ | Roof ▾ |
| Surface of element [m ²] | 120 | 120 | 500 |
| Window Percentage [%] | 20 | 15 | 0 |
| U Opaque word [W/m ² K] | 0.94 | 0.94 | 0.5 |
| U Window or Skylight [W/m ² K] | 5.7 | 5.7 | 0 |
| Solar Factor Window or Skylight [-] | 0.7 | 0.7 | 0 |
| Solar Factor with Mobile Shadow Element [-] | 0 | 0 | 0 |
| Own and Remote Obstacles | Define | Define | Define |

In case of 0% of windows, the values corresponding to that part of the element are not enabled.

For deleting any element click on the column header and then in the **Delete Construction** button.

5.3.9 OPERATIONAL CONDITIONS



The screenshot shows a web browser window with the URL `tmt2.us.es/Medecosure/src/hall`. The page features a navigation menu on the left with buttons for 'Add', 'Open', and 'Delete'. The main content area is titled 'Case: User_manual' and contains a sidebar with menu items: 'General data', 'Energy and economy aspects', 'Reference Energy consumptions', 'Building System', 'Geometry and construction', 'Operational conditions' (highlighted), 'Solve: initial situation', 'Baseline Results', 'Medecosure catalogue', 'Solve: LCC Analysis', 'LCC Results', and 'Medecosure proposal'. The main content area displays 'Funtional unit: b1' and 'Type Day: - Select -' with a dropdown menu. Below this are three buttons: 'OK', 'Calendar', and 'Season use variation'.

Using this button the user can define the operation of the building. The operation is defined by means of a set of typical days. For every type of day, the user must introduce its details. Then, a calendar is defined, indicating what type of days is applied to every day. The typical days are shown in the selection box under Type Day:

Type 1: Regular (8-19h)
Type 2: Intensive (8-14h)
Type 3: Split schedule (8-14h; 17-22h)
Type 4: Extended (8-22h)
Type 5: Regular Reduced occupation (50%)
Type 6: Closed

A typical example would be: days from Monday to Friday of Type 1, Saturdays and Sundays of Type 6. The details of Type 1 and Type 6 must be defined, in terms of hours of operation of Heating and Cooling, and Internal Heat Gains. In addition, the DHW consumption, if any, must be defined.



5.3.9 OPERATIONAL CONDITIONS

Then in the calendar the user assigns Type 1 to every week day, and Type 6 to every weekend day.

Furthermore, it is possible to modulate the internal heat gains according to occupation, when it is variable during the year.

Let's see the case of day Type 1: Regular, with operation from 8 to 19 hours. The Type 1 day is selected in the selection box. The following information must be introduced:

4.3.9. OPERATIONAL CONDITIONS

Operating hours

Operating hours:

| HEATING | | | | | | | | | | | | | | | | | | | | | | | |
|---------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

| COOLING | | | | | | | | | | | | | | | | | | | | | | | |
|---------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

The selected operating hours appear with a value of 1. Non-operating hours with a value of 0. It is possible to change them as required.

Internal sources

Internal sources:

Max. Occupancy [m²/person]:

0.53

| Occupational Time Fraction | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 64 | 91 | 91 | 73 | 73 | 83 | 83 | 55 | 31 | 23 | 18 | 0 | 0 | 0 | 0 | 0 |

Max. Lighting [W/m²]:

14.21

Max. power system [W/m²]:

11.84

| Hourly fraction of lighting and system | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 85 | 95 | 95 | 95 | 80 | 80 | 80 | 70 | 50 | 50 | 35 | 0 | 0 | 0 | 0 | 0 |

The values appearing in the cells are calculated from the mix of typical days selected when the user defined the Functional Unit in the General Data. Nevertheless, any change is possible.

Notice, the occupancy is given as sqm per person and not as number of persons.

D.H.W.

DHW:

Energy needs a L/Day person [L/day person]:

Setpoint temperature °C:

| Daily fraction [-] | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

There is no default values for the DHW consumption, except for the reference temperature.

4.3.9. OPERATIONAL CONDITIONS

Calendar

Once every typical day in the building has been defined, it is required to assign to every day in the year to any of the Type Days defined.

It is possible to select a particular day (for instance a Fest in the middle of the week), a week (horizontal row, a complete week of holiday), or a column (all the Mondays, for instance).

Click on the Calendar Button, then, select the range of days. A list of days is shown for the user to select one of them:

Type days: ×

Type 1: Regular (8-19h)

Type 2: Intensive (8-14h)

Type 3: Split schedule (8-14h; 17-22h)

Type 4: Extended (8-22h)

Type 5: Regular Reduced occupation (50%)

Type 6: Closed

When the user select one of them, the range selected is coloured with the same color. In the example two different days has been selected:

| Color legend days type | |
|---|--|
|  | Type 1: Regular (8-19h) |
|  | Type 2: Intensive (8-14h) |
|  | Type 3: Split schedule (8-14h; 17-22h) |
|  | Type 4: Extended (8-22h) |
|  | Type 5: Regular Reduced occupation (50%) |
|  | Type 6: Closed |

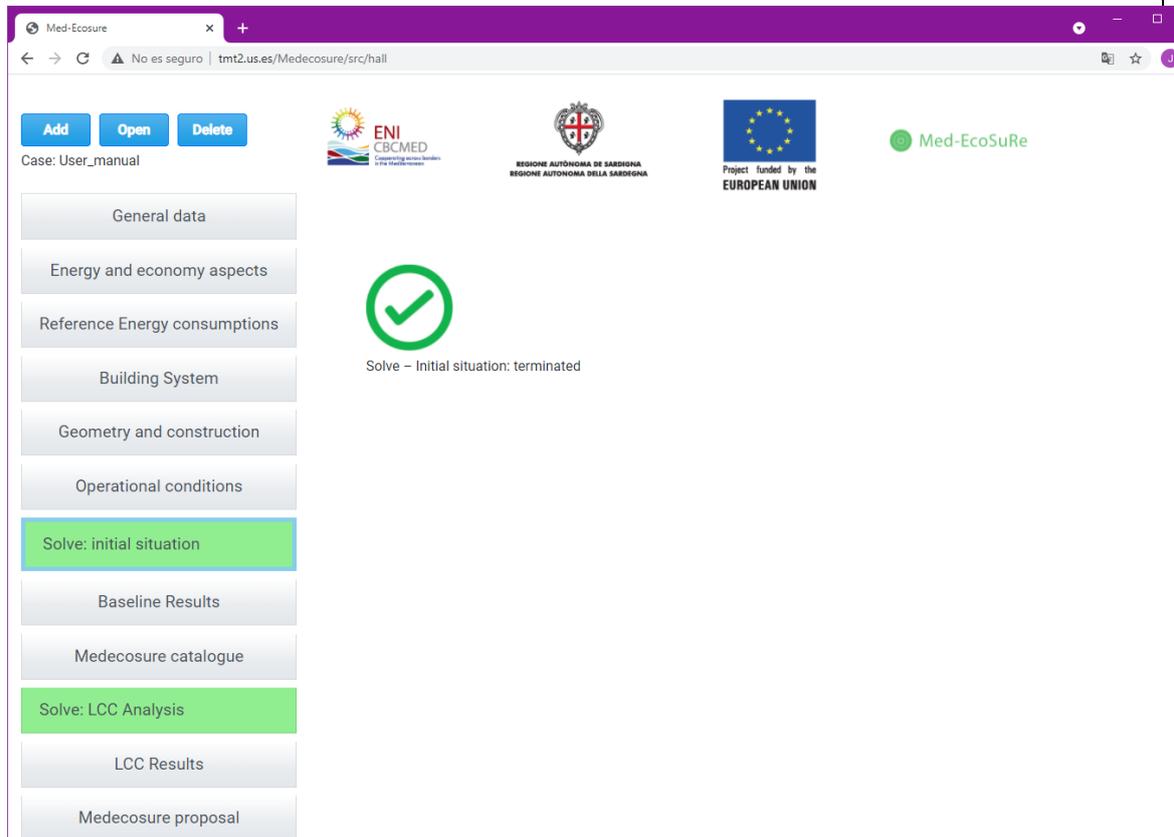
| | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|----------------|--------|---------|-----------|----------|--------|----------|--------|
| Week 1 | 1/1 | 2/1 | 3/1 | 4/1 | 5/1 | 6/1 | 7/1 |
| Week 2 | 8/1 | 9/1 | 10/1 | 11/1 | 12/1 | 13/1 | 14/1 |
| Week 3 | 15/1 | 16/1 | 17/1 | 18/1 | 19/1 | 20/1 | 21/1 |
| Week 4 | 22/1 | 23/1 | 24/1 | 25/1 | 26/1 | 27/1 | 28/1 |
| Week 5 | 29/1 | 30/1 | 31/1 | 1/2 | 2/2 | 3/2 | 4/2 |
| Week 48 | 29/11 | 27/11 | 28/11 | 29/11 | 30/11 | 1/12 | 2/12 |
| Week 49 | 3/12 | 4/12 | 5/12 | 6/12 | 7/12 | 8/12 | 9/12 |
| Week 50 | 10/12 | 11/12 | 12/12 | 13/12 | 14/12 | 15/12 | 16/12 |
| Week 51 | 17/12 | 18/12 | 19/12 | 20/12 | 21/12 | 22/12 | 23/12 |
| Week 52 | 24/12 | 25/12 | 26/12 | 27/12 | 28/12 | 29/12 | 30/12 |
| Week 53 | 31/12 | | | | | | |

OK

Back

For finishing the definition click on the OK button. A confirmation message is shown.

5.3.10 SOLVE: INITIAL SITUATION



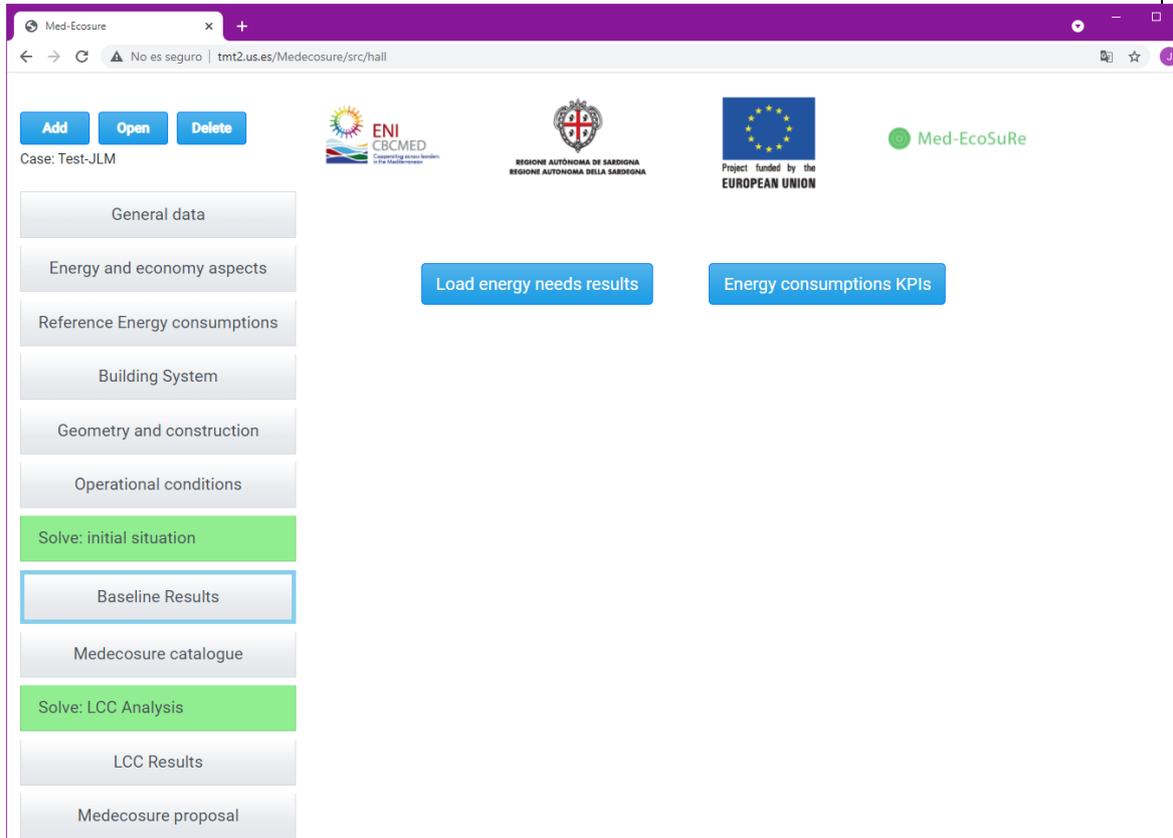
The screenshot shows a web browser window with the URL `tmt2.us.es/Medecosure/src/hall`. The page header features logos for ENI CBCMED, Regione Autonoma de Sardinia, and the European Union. Below the header, there are buttons for 'Add', 'Open', and 'Delete', and the text 'Case: User_manual'. A sidebar on the left contains a list of menu items: 'General data', 'Energy and economy aspects', 'Reference Energy consumptions', 'Building System', 'Geometry and construction', 'Operational conditions', 'Solve: initial situation' (highlighted in green), 'Baseline Results', 'Medecosure catalogue', 'Solve: LCC Analysis' (highlighted in green), 'LCC Results', and 'Medecosure proposal'. In the center of the page, a large green checkmark icon is displayed above the text 'Solve - Initial situation: terminated'. The top right of the browser window shows standard navigation icons and a security warning.

Once the definition of the building in its actual situation is finished, clicking in this button starts the calculation of the hourly values of net energy demand and energy consumptions adapted to the meters introduced by the user.

The green icon is obtained when the calculation is finished.

The next step is to see the results.

5.3.11 BASELINE RESULTS



The screenshot shows a web browser window with the URL `tmt2.us.es/Medeclosure/src/hall`. The page features a navigation menu on the left with the following items: General data, Energy and economy aspects, Reference Energy consumptions, Building System, Geometry and construction, Operational conditions, Solve: initial situation, **Baseline Results** (highlighted with a blue border), Medeclosure catalogue, Solve: LCC Analysis, LCC Results, and Medeclosure proposal. At the top of the main content area, there are three buttons: 'Add', 'Open', and 'Delete'. Below these, the text 'Case: Test-JLM' is displayed. The main content area contains two blue buttons: 'Load energy needs results' and 'Energy consumptions KPIs'. The page header includes logos for ENI CBCMED, the Region of Sardinia, the European Union, and Med-EcoSuRe.

Two type of results can be analysed: **Energy needs** results and **Consumption KPI's**

Energy needs

Results

Table has no columns.

Initial date

dd/mm/yyyy

Final date

dd/mm/yyyy

Annual values

Monthly values

Select

OK

The results can be seen selecting the **Annual values**, and see hourly graphs, or by **Monthly values**, which are shown in tables. In any case the period to be shown must be selected, and the variables to be shown:

Select

Select All

Search

Heating needs [kW]

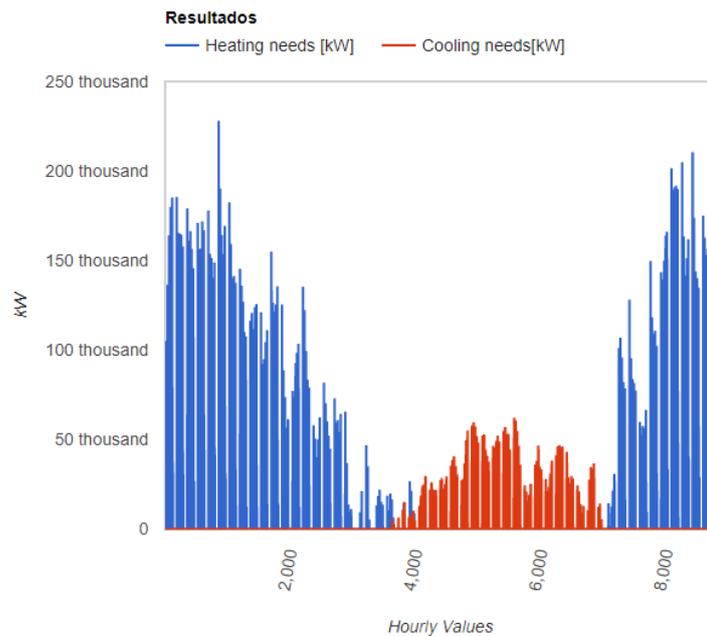
Cooling needs[kW]

DHW[kW]

Lighting[kW]

For instance, we can see heating and cooling needs during the whole year:

First the hourly values:



Initial date

01/01/2021

Final date

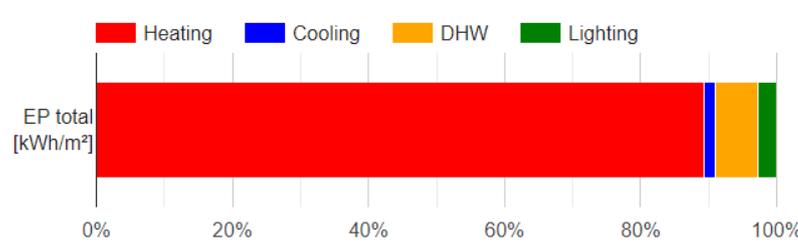
31/12/2021

Annual values

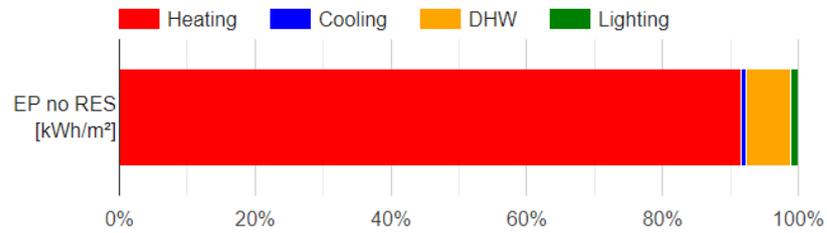
Monthly values

Heating needs [kW] x

Cooling needs[kW] x

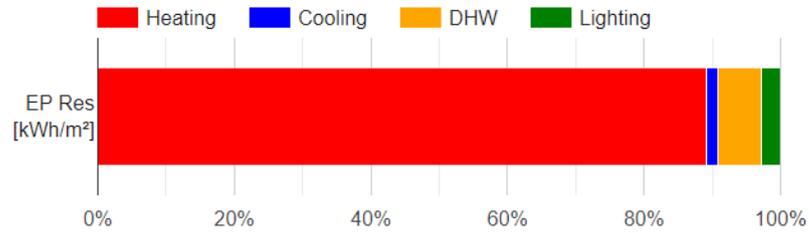
| <p>Consumption KPI's</p> | <p>The consumption of Primary Energy, can be analysed in the three aspects:</p> <p>Primary energy consumption</p> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid blue; padding: 5px; background-color: #007bff; color: white; text-align: center;">Total primary energy</div> <div style="border: 1px solid blue; padding: 5px; background-color: #007bff; color: white; text-align: center;">Non renewable primary energy</div> <div style="border: 1px solid blue; padding: 5px; background-color: #007bff; color: white; text-align: center;">Renewable primary energy</div> </div> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|---------|---------|----------|-----|----------|--|--------|-------|-------|--------|--|--------|-------|-------|-------|--|-------|-------|-------|-------|--|---------|-------|-------|-------|--|-------|-------|-------|-------|--|--------|-------|-------|-------|-----------------------------------|--------|--------|--------|--------|---|-------|-------|-------|-------|
| | <p>Total primary energy</p> <div style="text-align: center; margin-bottom: 10px;">  </div> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr style="background-color: #007bff; color: white;"> <th></th> <th>Heating</th> <th>Cooling</th> <th>DHW</th> <th>Lighting</th> </tr> </thead> <tbody> <tr style="background-color: #e9ecef;"> <td>Energy needs [kWh/m²-year]</td> <td>86.512</td> <td>5.902</td> <td>6.172</td> <td>10.929</td> </tr> <tr> <td>Final energy consumption [kWh/m²-year]</td> <td>96.124</td> <td>1.967</td> <td>6.858</td> <td>3.123</td> </tr> <tr style="background-color: #e9ecef;"> <td>Seasonal coefficient of performance [-]</td> <td>0.900</td> <td>3.000</td> <td>0.900</td> <td>3.500</td> </tr> <tr> <td>Total primary energy [kWh/m²-year]</td> <td>106.990</td> <td>2.040</td> <td>7.633</td> <td>3.238</td> </tr> <tr style="background-color: #e9ecef;"> <td>Non-renewable primary energy [kWh/m²-year]</td> <td>8.171</td> <td>0.067</td> <td>0.583</td> <td>0.106</td> </tr> <tr> <td>Renewable primary energy [kWh/m²-year]</td> <td>98.816</td> <td>1.973</td> <td>7.050</td> <td>3.132</td> </tr> <tr style="background-color: #e9ecef;"> <td>Renewable energy ratio [-]</td> <td>92.363</td> <td>96.721</td> <td>92.363</td> <td>96.721</td> </tr> <tr> <td>CO2 emissions [kg CO₂/m²-year]</td> <td>1.730</td> <td>0.035</td> <td>0.123</td> <td>0.056</td> </tr> </tbody> </table> | | Heating | Cooling | DHW | Lighting | Energy needs [kWh/m²-year] | 86.512 | 5.902 | 6.172 | 10.929 | Final energy consumption [kWh/m²-year] | 96.124 | 1.967 | 6.858 | 3.123 | Seasonal coefficient of performance [-] | 0.900 | 3.000 | 0.900 | 3.500 | Total primary energy [kWh/m²-year] | 106.990 | 2.040 | 7.633 | 3.238 | Non-renewable primary energy [kWh/m²-year] | 8.171 | 0.067 | 0.583 | 0.106 | Renewable primary energy [kWh/m²-year] | 98.816 | 1.973 | 7.050 | 3.132 | Renewable energy ratio [-] | 92.363 | 96.721 | 92.363 | 96.721 | CO2 emissions [kg CO₂/m²-year] | 1.730 | 0.035 | 0.123 | 0.056 |
| | Heating | Cooling | DHW | Lighting | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Energy needs [kWh/m²-year] | 86.512 | 5.902 | 6.172 | 10.929 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Final energy consumption [kWh/m²-year] | 96.124 | 1.967 | 6.858 | 3.123 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seasonal coefficient of performance [-] | 0.900 | 3.000 | 0.900 | 3.500 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total primary energy [kWh/m²-year] | 106.990 | 2.040 | 7.633 | 3.238 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Non-renewable primary energy [kWh/m²-year] | 8.171 | 0.067 | 0.583 | 0.106 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Renewable primary energy [kWh/m²-year] | 98.816 | 1.973 | 7.050 | 3.132 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Renewable energy ratio [-] | 92.363 | 96.721 | 92.363 | 96.721 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CO2 emissions [kg CO₂/m²-year] | 1.730 | 0.035 | 0.123 | 0.056 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Non renewable primary energy



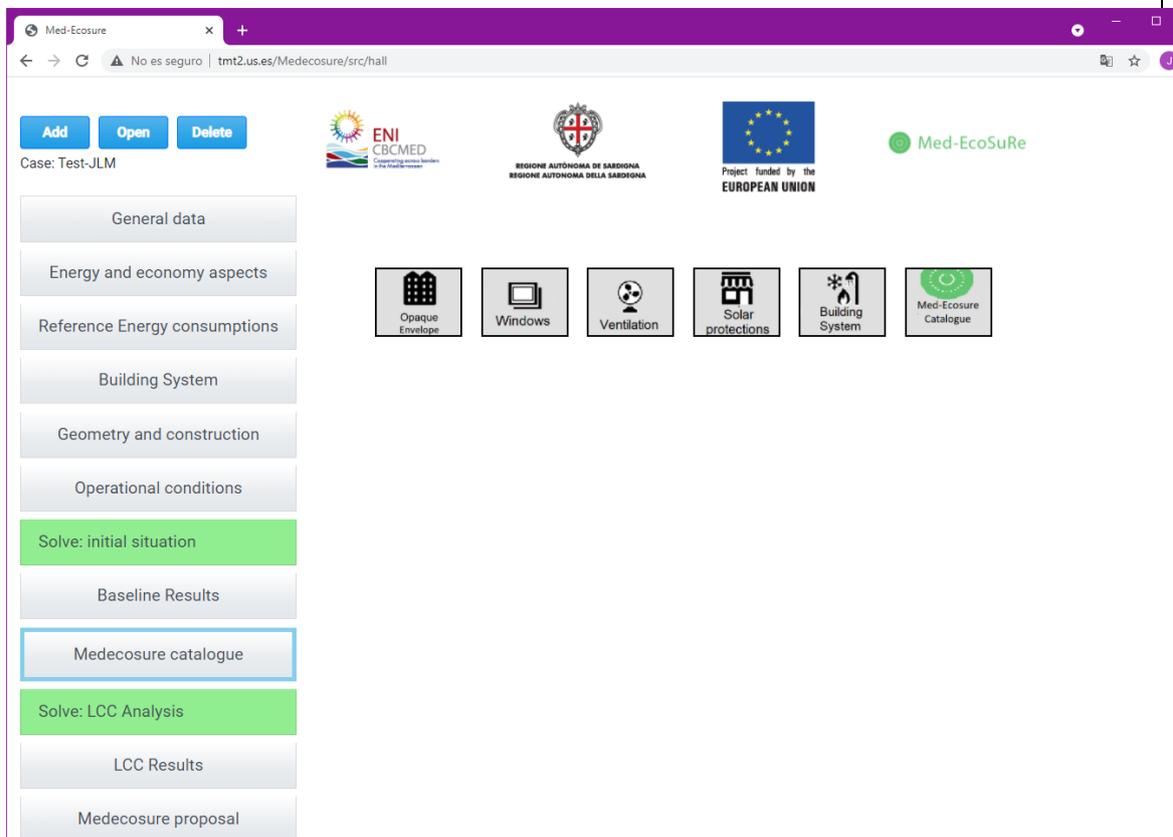
| | Heating | Cooling | DHW | Lighting |
|--|---------|---------|--------|----------|
| Energy needs [kWh/m²-year] | 86.512 | 5.902 | 6.172 | 10.929 |
| Final energy consumption [kWh/m²-year] | 96.124 | 1.967 | 6.858 | 3.123 |
| Seasonal coefficient of performance [-] | 0.900 | 3.000 | 0.900 | 3.500 |
| Total primary energy [kWh/m²-year] | 106.990 | 2.040 | 7.633 | 3.238 |
| Non-renewable primary energy [kWh/m²-year] | 8.171 | 0.067 | 0.583 | 0.106 |
| Renewable primary energy [kWh/m²-year] | 98.816 | 1.973 | 7.050 | 3.132 |
| Renewable energy ratio [-] | 92.363 | 96.721 | 92.363 | 96.721 |
| CO2 emissions [kg CO2/m²-year] | 1.730 | 0.035 | 0.123 | 0.056 |

Renewable primary energy



| | Heating | Cooling | DHW | Lighting |
|--|---------|---------|--------|----------|
| Energy needs [kWh/m ² -year] | 86.512 | 5.902 | 6.172 | 10.929 |
| Final energy consumption [kWh/m ² -year] | 96.124 | 1.967 | 6.858 | 3.123 |
| Seasonal coefficient of performance [-] | 0.900 | 3.000 | 0.900 | 3.500 |
| Total primary energy [kWh/m ² -year] | 106.990 | 2.040 | 7.633 | 3.238 |
| Non-renewable primary energy [kWh/m ² -year] | 8.171 | 0.067 | 0.583 | 0.106 |
| Renewable primary energy [kWh/m ² -year] | 98.816 | 1.973 | 7.050 | 3.132 |
| Renewable energy ratio [-] | 92.363 | 96.721 | 92.363 | 96.721 |
| CO ₂ emissions [kg CO ₂ /m ² -year] | 1.730 | 0.035 | 0.123 | 0.056 |

5.3.12 MEDECOSURE CATALOGUE



The screenshot shows a web browser window with the URL `tmt2.us.es/Medecosure/src/hall`. The interface includes a navigation menu on the left with the following items: General data, Energy and economy aspects, Reference Energy consumptions, Building System, Geometry and construction, Operational conditions, Solve: initial situation, Baseline Results, **Medecosure catalogue** (highlighted), Solve: LCC Analysis, LCC Results, and Medecosure proposal. At the top right, there are logos for ENI CBCMED, Regione Autonoma de Sardinia, European Union, and Med-EcoSuRe. Below the logos, there are six icons representing different conservation measures: Opaque Envelope, Windows, Ventilation, Solar protections, Building System, and Med-Ecosure Catalogue.

Once the user has analysed the situation of the building in the present status, it is possible to see the impact of different conservation measures. These are classified in the groups shown in the image by the buttons. When the user clicks on the buttons the application shows the following forms:

Opaque envelope

There are two sections: Opaque walls and thermal bridges:

Opaque envelope

- Select -

Add

Delete

Features

| Name | Orientations | Total Surface [m ²] |
|------|--------------|---------------------------------|
|------|--------------|---------------------------------|

OK

5.3.12 MEDECOSURE CATALOGUE

Value of $\phi \cdot L$ due to thermal bridges

- Select -

Features

| Name | Initial value of $\phi \cdot L$ [W/K] | New value of $\phi \cdot L$ [W/K] | Cost [€/m ²] |
|-------|---------------------------------------|-----------------------------------|--------------------------|
| pptt1 | 0 | 130 | 1 |

The operation of these forms is the same: first select the option of changes using the select-add-delete pattern. Once one of the options is selected the actual changes are introduced. For instance, for the opaque envelope of one of the examples, the application shows the present elements, its surface and the U value. Then the user can introduce the new U value, and the cost of the change. The elements to be changed are selected clicking on the checkbox on the right.

Opaque envelope

Type1

| Orientation | Surface [m ²] | Initial Value U [W/m ² K] | Modified U [W/m ² K] | Cost [€/m ²] |
|---|---------------------------|--------------------------------------|---------------------------------|--------------------------|
| <input checked="" type="checkbox"/> Roof | 1200 | 0.5 | 0.3 | 0 |
| <input type="checkbox"/> Floor | 1200 | 0.53 | 0 | 0 |
| <input checked="" type="checkbox"/> North | 150 | 0.94 | 0.6 | 0 |
| <input type="checkbox"/> South | 150 | 0.94 | 0 | 0 |
| <input type="checkbox"/> East | 200 | 0.94 | 0 | 0 |
| <input type="checkbox"/> West | 200 | 0.94 | 0 | 0 |

The user can introduce as many groups of changes as is convenient

The same for the thermal bridges:

5.3.12 MEDECOSURE CATALOGUE

Value of φ -L due to thermal bridges

Initial value: 286.39

New value of φ -L [W/K]:

Cost [€/m²]:

Features

| Name | Initial value of φ -L [W/K] | New value of φ -L [W/K] | Cost [€/m ²] |
|-------|-------------------------------------|---------------------------------|--------------------------|
| pptt1 | 0 | 130 | 1 |

The user finishes the definition clicking on the OK button. A confirmation message is shown and the group of changes is shown in the list.

Windows

The operation is the same as before: first select the option of changes using the select-add-delete pattern. Once one of the options is selected the actual changes are introduced.

Windows

Features

| Name | Orientations | Total Surface [m ²] |
|------|--------------|---------------------------------|
|------|--------------|---------------------------------|

For instance, for the opaque envelope of one of the examples, the application shows the present elements, its surface and the U and g values. Then the user can introduce the new U and g values, and the cost of the change. The elements to be changed are selected clicking on the checkbox on the right.

5.3.12 MEDECOSURE CATALOGUE

Windows

W1

Add

Delete

| Orientation | Surface [m ²] | Initial Value U[W/m ² K] | Solar factor winter | Solar factor summer | New value of U [W/m ² K] | New value of solar factor |
|---|---------------------------|-------------------------------------|---------------------|---------------------|-------------------------------------|---------------------------|
| <input type="checkbox"/> Roof | 1200 | 0 | 0 | 0 | 0 | 0 |
| <input type="checkbox"/> Floor | 1200 | 0 | 0 | 0 | 0 | 0 |
| <input checked="" type="checkbox"/> North | 150 | 10 | 0.7 | 0.7 | 3.5 | 0.6 |
| <input checked="" type="checkbox"/> South | 150 | 20 | 0.7 | 0.7 | 3.5 | 0.6 |
| <input type="checkbox"/> East | 200 | 15 | 0.7 | 0.7 | 0 | 0 |
| <input type="checkbox"/> West | 200 | 15 | 0.7 | 0.7 | 0 | 0 |

Notice the horizontal scroll bar to see all the columns (cost, on the right).

The user finishes the definition clicking on the OK button. A confirmation message is shown and the group of changes is shown in the list.

Features

| Name | Orientations | Total Surface [m ²] |
|------|--------------|---------------------------------|
| W1 | North, South | 300 |

OK

Ventilation

The ventilation definition is including two parts: **Ventilation and Infiltration** and **Night ventilation**.

Ventilation

Ventilation and infiltrations Night ventilation

When selecting the Ventilation and infiltrations radio button, the present

5.3.12 MEDECOSURE CATALOGUE

values of the governing parameters is shown:

Ventilation

Ventilation and infiltrations

Night ventilation

Winter ACH [1/h]:

Summer ACH [1/h]:

Cost [€/year]:

- Select - ▾

Add

Delete

Features

| Name | ACH Winter | ACH summer | Operational cost [€/year] | Cost [€] |
|------|------------|------------|---------------------------|----------|
|------|------------|------------|---------------------------|----------|

OK

The operation is the same as before: first select the option of changes using the select-add-delete pattern. Once one of the options is selected the actual changes are introduced:

5.3.12 MEDECOSURE CATALOGUE

Ven1 ▾
Add
Delete

ACH equivalent winter [1/h]:

ACH equivalent summer [1/h]:

New operation cost [€/year]:

Cost [€]:

Features

| Name | ACH Winter | ACH summer | Operational cost [€/year] | Cost [€] |
|------|------------|------------|---------------------------|----------|
| Ven1 | 0.5 | 0.5 | 1500 | 500 |

OK

The user finishes the definition clicking on the OK button. A confirmation message is shown and the group of changes is shown in the list.

Features

| Name | ACH Winter | ACH summer | Operational cost [€/year] | Cost [€] |
|------|------------|------------|---------------------------|----------|
| Ven1 | 0.5 | 0.5 | 1500 | 500 |

OK

The night ventilation option operates in the same way: When selecting the radio button, a form is shown for introducing the values of the governing parameters:

5.3.12 MEDECOSURE CATALOGUE

Ventilation and infiltrations

Night ventilation

NV1 ▾

Add

Delete

Start month:

- Select - ▾

End Month:

- Select - ▾

Time period:

- Select - ▾

ACH [1/h]:

0.00

Cost [€]:

0.00

Maintenance operation cost [€/year]:

0.00

The operation is the same as before: first select the option of changes using the select-add-delete pattern. Once one of the options is selected the actual changes are introduced:

5.3.12 MEDECOSURE CATALOGUE

Ventilation and infiltrations
 Night ventilation

NV1 ▾

Add

Delete

Start month:

June ▾

End Month:

September ▾

Time period:

00:00 - 08:00 ▾

ACH [1/h]:

1

Cost [€]:

500

Maintenance operation cost [€/year]:

1500

Features

| Name | ACH | Cost [€] | Operational cost [€/year] |
|------|-----|----------|---------------------------|
| NV1 | 1 | 500 | 1500 |

OK

Solar protections

The changes in solar protections are defined in a similar way, using the select-add-delete pattern:

Solar protections

- Select - ▾

Add

Delete

Features

| Name | Orientations | Total Surface [m ²] | Solar factor | Cost [€/m ²] |
|------|--------------|---------------------------------|--------------|--------------------------|
|------|--------------|---------------------------------|--------------|--------------------------|

OK

When selecting one of the groups it is possible to define the new solar factor, modified by the shading system installed. The user selects the orientations where a type of shading is installed. Then the type of shading device is selected

5.3.12 MEDECOSURE CATALOGUE

from the list of selection:

Modified Solar Factor:

- Select -

- Vertical fins
- Aluminum Grid Screens
- Awning
- Horizontal sunshade
- Dense grid screen
- Trees
- Venetian blinds
- Horizontal slats
- Vertical slats
- Roller blinds
- Others

And next the value of modified solar factor and the cost:

Solar protections

SH1 ▾

Add

Delete

| | Orientation | Surface [m ²] |
|-------------------------------------|-------------|---------------------------|
| <input type="checkbox"/> | Roof | 1200 |
| <input type="checkbox"/> | Floor | 1200 |
| <input type="checkbox"/> | North | 150 |
| <input checked="" type="checkbox"/> | South | 150 |
| <input checked="" type="checkbox"/> | East | 200 |
| <input checked="" type="checkbox"/> | West | 200 |

Modified Solar Factor:

Awning ▾
0.25

Cost [€/m²]:

1200

Features

| Name | Orientations | Total Surface [m ²] | Solar factor | Cost [€/m ²] |
|------|--------------------|---------------------------------|--------------|--------------------------|
| SH1 | Roof, Floor, North | 2550 | 0.25 | 1200 |

OK

5.3.12 MEDECOSURE CATALOGUE

Building Systems

There are four types of systems in the building:

Building System

Heating
 Cooling
 DHW
 Lighting

For every one of them, the operation is the same as in other sections of the application: first select the option of changes using the select-add-delete pattern. Once one of the options is selected the actual changes are introduced.

Heating
 Cooling
 DHW
 Lighting

heat1 ▾

Add

Delete

Energy Meter:

Natural gas ▾

Features

Cover [%]:

50

Seasonal Energy performance ratio [%]:

95

Operational and maintenance cost [€/year]:

1500

Initial cost [€]:

3000

| Name | Energy meter | Cover [%] | Seasonal energy performance ratio [%] | Operational and maintenance cost [€/year] | Initial cost [€] |
|-------|--------------|-----------|---------------------------------------|---|------------------|
| heat1 | Natural gas | 50 | 95 | 1500 | 3000 |

OK

5.3.12 MEDECOSURE CATALOGUE

Heating
 Cooling
 DHW
 Lighting

cool1 ▾

Add

Delete

Energy Meter:

Electricity ▾

Features

Cover [%]:

50

Seasonal Energy performance ratio [%]:

350

Operational and maintenance cost [€/year]:

1200

Initial cost [€]:

4500

| Name | Energy meter | Cover [%] | Seasonal energy performance ratio [%] | Operational and maintenance cost [€/year] | Initial cost [€] |
|-------|--------------|-----------|---------------------------------------|---|------------------|
| cool1 | Electricity | 50 | 350 | 1200 | 4500 |

OK

Heating
 Cooling
 DHW
 Lighting

ACST ▾

Add

Delete

Energy Meter:

Natural gas ▾

Features

Cover [%]:

100

Seasonal Energy performance ratio [%]:

95

Operational and maintenance cost [€/year]:

1500

Initial cost [€]:

1000

| Name | Energy meter | Cover [%] | Seasonal energy performance ratio [%] | Operational and maintenance cost [€/year] | Initial cost [€] |
|------|--------------|-----------|---------------------------------------|---|------------------|
| ACS1 | Natural gas | 100 | 95 | 1500 | 1000 |

OK

5.3.12 MEDECOSURE CATALOGUE

Heating
 Cooling
 DHW
 Lighting

LT1 ▾

Add

Delete

Energy Meter:

Electricity ▾

Features

Cover [%]:

100

Energy efficiency lighting [€]:

3

Operational and maintenance cost [€/year]:

1500

Initial cost [€]:

1000

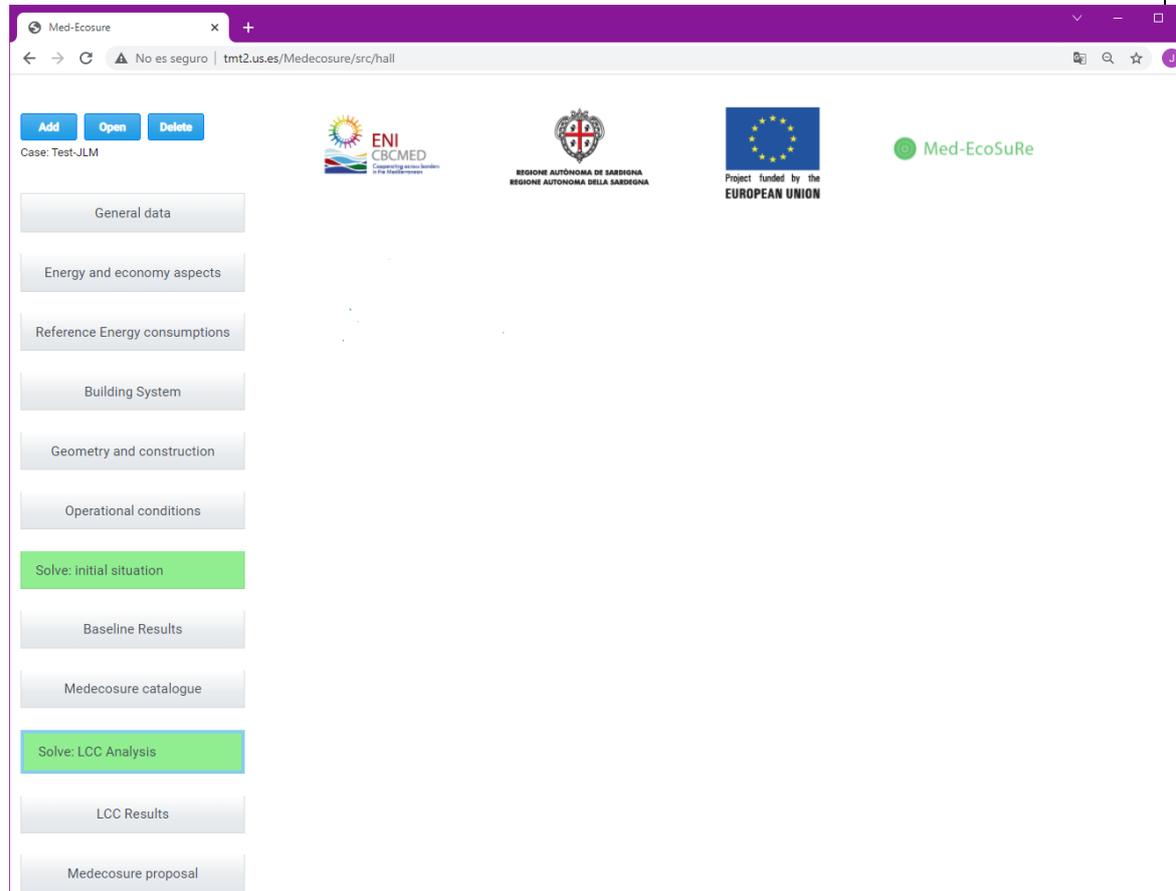
| Name | Energy Meter | Cover[%] | Energy Efficiency Lighting [€] | Operational and maintenance cost [€/year] | Initial cost [€] |
|------|--------------|----------|--------------------------------|---|------------------|
| LT1 | Electricity | 100 | 3 | 1500 | 1000 |

OK

**Med-
Ecosure
Catalogue
of
innovative
systems**

By the time of writing this manual, the manufacturers did not send their innovative systems to be included in this part of the application. The idea is to have a classification in systems for heating, cooling, DHW and Lighting.

5.3.13 SOLVE LCC ANALYSIS



The screenshot shows a web browser window with the URL `tmt2.us.es/Medecosure/src/hall`. The page features a navigation menu on the left with buttons for 'Add', 'Open', and 'Delete'. Below these are several menu items: 'General data', 'Energy and economy aspects', 'Reference Energy consumptions', 'Building System', 'Geometry and construction', 'Operational conditions', 'Solve: initial situation', 'Baseline Results', 'Medecosure catalogue', 'Solve: LCC Analysis' (highlighted in green), 'LCC Results', and 'Medecosure proposal'. The top of the page displays logos for ENI CBCMED, the Region of Sardinia, the European Union, and Med-EcoSuRe.

Once the user has defined all of the conservation measures to be considered in the case study, this main menu button must be clicked. Then the calculation engine makes the LCC calculation for all of the combinations obtained from the different groups of changes introduced.

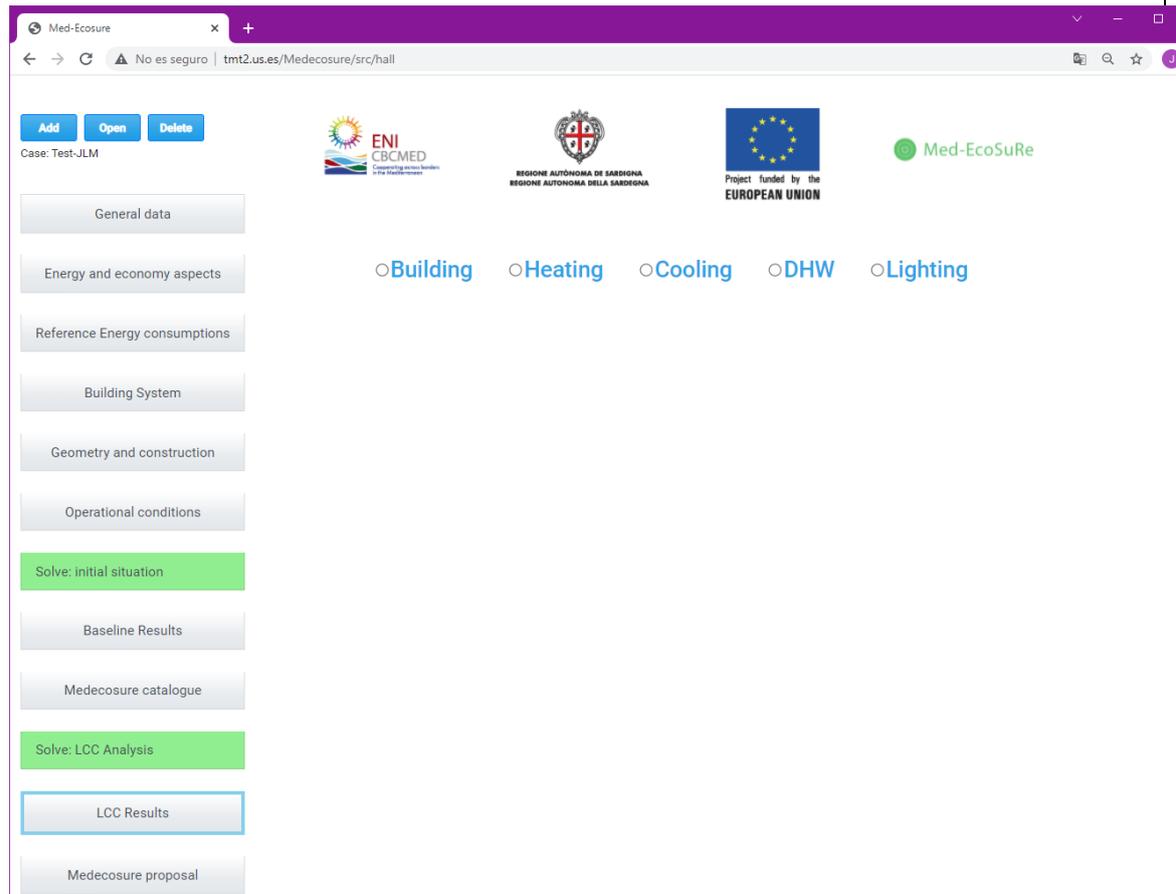
When the calculation is finished (they do not take too long, in spite of the number of combinations could be very high) the application shows a success message.



Solve – LCC Analysis: terminated.

5.3.14 LCC RESULTS

The LCC results can be analysed for the whole building, or for every individual system: heating, cooling, DHW and Lighting



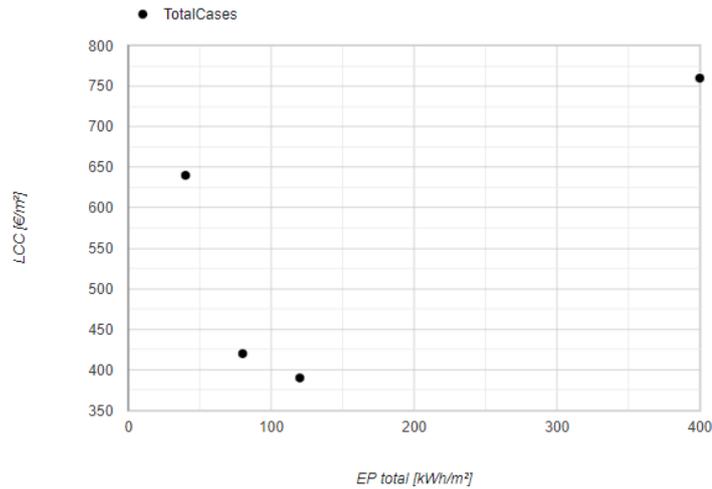
The screenshot shows a web browser window with the URL `tmt2.us.es/Medecosure/src/hall`. The page features a navigation sidebar on the left with buttons for 'Add', 'Open', and 'Delete'. Below these are several menu items: 'General data', 'Energy and economy aspects', 'Reference Energy consumptions', 'Building System', 'Geometry and construction', 'Operational conditions', 'Solve: initial situation', 'Baseline Results', 'Medecosure catalogue', 'Solve: LCC Analysis', 'LCC Results' (highlighted with a blue border), and 'Medecosure proposal'. The main content area displays the same logos as the header and a set of radio buttons for selecting analysis categories: 'Building', 'Heating', 'Cooling', 'DHW', and 'Lighting'. The 'Building' radio button is currently selected.

Building

When selecting the Building radio button, the application shows a X-Y plot of LCC cost vs the Total Primary Energy consumption.

Building Heating Cooling DHW Lighting

Total cases: 4



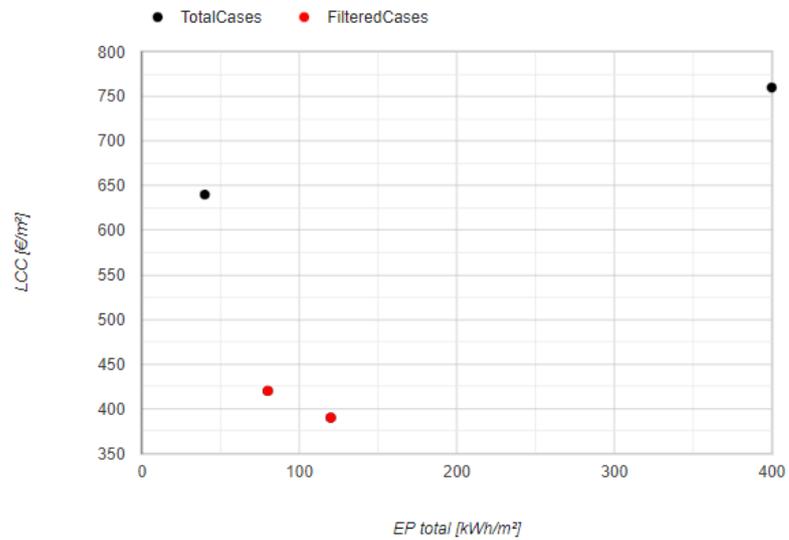
Filters

- Total primary energy consumption[kWh/m²]
- Investment [€/m²]:
- Payback [year]:

Apply filters

It is possible to change the abscis variable, and also to select the range of values to be applied as a filter.

When the filters are applied, the cases selected are changed to red colour:



Filters

Total primary energy consumption[kWh/m²]

Minimum:

Maximum:

Underneath the plot a table is show, with information of the selected cases:

Filtered cases: 2

Results

| # | ID | Total primary energy consumption[kWh/m²] | Primary Energy savings [k] | Investment [€/m²] | Payback [year] | Information |
|--------------------------|----|--|----------------------------|-------------------|----------------|---|
| <input type="checkbox"/> | 2 | 80.00 | | 39.00 | 29.00 |  |
| <input type="checkbox"/> | 3 | 120.00 | | 42.00 | 28.00 |  |

OK

And for every onef them, a button on the right side allow to see a form with the definition of the case:

ID : 2

×

| Building | |
|------------------------------|-------------------------------------|
| Envelope – opaque walls | <input type="checkbox"/> |
| Envelope – thermal bridges | <input type="checkbox"/> |
| Envelope – windows | <input type="checkbox"/> |
| Ventilation and infiltration | <input type="checkbox"/> |
| Night Ventilation | <input type="checkbox"/> |
| Solar control | <input type="checkbox"/> |
| HVAC | |
| Heating | <input type="checkbox"/> |
| Cooling | <input type="checkbox"/> |
| DHW | <input type="checkbox"/> |
| Lighting | <input checked="" type="checkbox"/> |

| | |
|--|-------|
| ID | 2 |
| Total primary energy consumption [kWh/m ²] | 80.00 |
| Primary Energy savings [%] | |
| Investment [€/m ²] | 39.00 |
| Payback [year] | 29.00 |

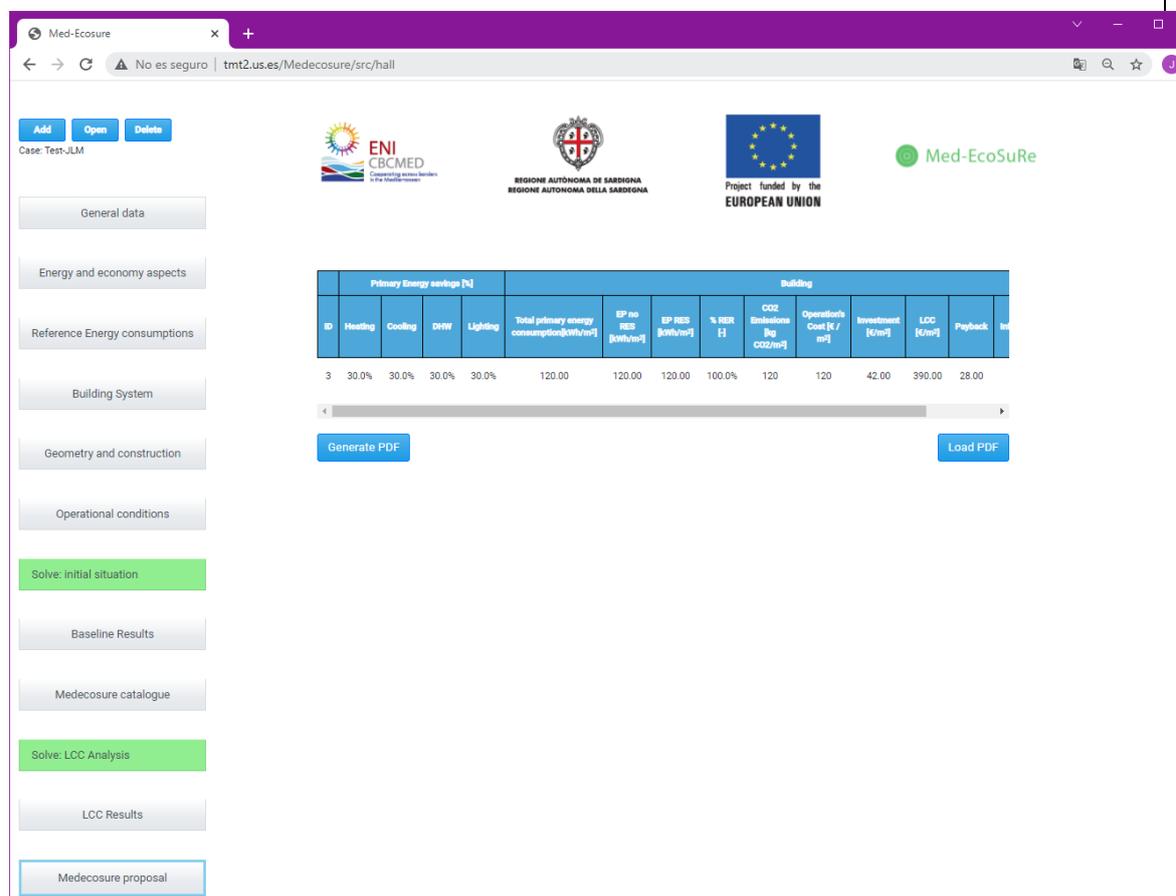
| | Heating | Cooling | DHW | Lighting |
|--|---------|---------|--------|----------|
| Energy needs [kWh/m ² -year] | 20.00 | 20.00 | 20.00 | 20.00 |
| Final energy consumption [kWh/m ² -year] | 20.00 | 20.00 | 20.00 | 20.00 |
| Primary energy consumption [kWh/m ² -year] | 20.00 | 20.00 | 20.00 | 20.00 |
| Seasonal coefficient of performance [%] | 20.00 | 20.00 | 20.00 | 20.00 |
| Renewable energy ratio [%] | 100.0% | 100.0% | 100.0% | 100.0% |
| CO ₂ [kg CO ₂ /m ² -year] | 20.00 | 20.00 | 20.00 | 20.00 |

OK



| | |
|---|--|
| Heating, Cooling, DHW, Lighting | The same type of results can be obtained and analysed for every single system. |
| One, or more (but one at a time), of the cases analysed can be selected as the Application Proposal for the case study. For that, the user must select the selection box on the left of the desired case. | |

5.3.15 MEDECOSURE PROPOSAL



The screenshot shows the Med-Ecosure web application interface. The browser address bar indicates the URL is `tmt2.us.es/Medecosure/src/hall`. The sidebar on the left contains several menu options, with 'Medecosure proposal' highlighted in blue. The main content area displays a table of results for a case study, with columns for energy savings, energy consumption, and building costs. Below the table are two buttons: 'Generate PDF' and 'Load PDF'.

| ID | Primary Energy savings [%] | | | | Building | | | | | | | | |
|----|----------------------------|---------|-------|----------|--|---------------------------------|------------------------------|-----------|---|--------------------------------------|--------------------------------|-------------------------|-------------|
| | Heating | Cooling | DHW | Lighting | Total primary energy consumption [kWh/m ²] | EP no RES [kWh/m ²] | EP RES [kWh/m ²] | % RES [%] | CO ₂ Emissions [kg CO ₂ /m ²] | Operative's Cost [€/m ²] | Investment [€/m ²] | LCC [€/m ²] | Payback [a] |
| 3 | 30.0% | 30.0% | 30.0% | 30.0% | 120.00 | 120.00 | 120.00 | 100.0% | 120 | 120 | 42.00 | 390.00 | 28.00 |

When the user clicks on this menu option, the application shows a table with the selected cases in the previous LCC Results.

Two buttons underneath the table allow the user to obtain a report on the proposed solution for the case study. First it is generated, and second it is loaded in a PDF reader application.

The report contains a first page with the general data of the case, and one additional page for every solution selected in the LCC results button. Next, it can be seen an example:

Project's name : Test-JLM

| Building features | | | |
|---------------------------|------|----------|-----------|
| Surface (m ²) | 1200 | Location | |
| Height (m) | 5 | Country | Spain |
| Year of construction | | Province | Andalucia |
| Floors underground | 1 | City | Granada |
| Floors above ground | 0 | | |

Alternatives

Number of cases : 1

Recorte rectangular

Alternative number 1

Case ID 3

| Building Table | | | |
|--------------------------------|--------------------------------------|---|------------------------------------|
| ID | EF Consumption (kWh/m ²) | EP total (kWh/m ²) | EP no RES (kWh/m ²) |
| 3 | 120.00 | 120.00 | 120.00 |
| EP RES (kWh/m ²) | % RER (-) | Emissions (kg CO ₂ /m ²) | Operation cost (€/m ²) |
| 120.00 | 100.0% | 120 | 120 |
| Investment (€/m ²) | | Payback | |
| 42.00 | | 28.00 | |
| Saving EF (%) | Increase % RER (%) | Emissions reduction (%) | Operating cost reduction (%) |
| | | | |

| Kpis Table | Heating | Cooling | DHW | Lighting |
|--|---------|---------|--------|----------|
| Energy needs (kWh/m ²)·year | 30.00 | 30.00 | 30.00 | 30.00 |
| Final energy consumption (kWh/m ²)·year | 30.00 | 30.00 | 30.00 | 30.00 |
| Primary energy consumption (kWh/m ²)·year | 30.00 | 30.00 | 30.00 | 30.00 |
| Seasonal coefficient performance (%) | 30.00 | 30.00 | 30.00 | 30.00 |
| Renewable energy ratio (%) | 200.0% | 200.0% | 200.0% | 200.0% |
| CO ₂ (kg CO ₂ /m ²)·year | 30.00 | 30.00 | 30.00 | 30.00 |

| | | | |
|------------------------------|-------------------------------------|---------------|-------------------------------------|
| Envelope – opaque walls | <input checked="" type="checkbox"/> | Solar control | <input type="checkbox"/> |
| Envelope – thermal bridges | <input type="checkbox"/> | Heating | <input type="checkbox"/> |
| Envelope – windows | <input type="checkbox"/> | Cooling | <input type="checkbox"/> |
| Ventilation and infiltration | <input type="checkbox"/> | DHW | <input type="checkbox"/> |
| Night Ventilation | <input type="checkbox"/> | Lighting | <input checked="" type="checkbox"/> |

Med-EcoSuRe –Output 4.1
Policy and Project tools for Energy-Efficiency retrofit in Higher Education Buildings
Activity 4.1.5
Development of an interactive tool for the evaluation of optimal renovation measures





Technical Reference Manual

6 Required Programs.

6.1 Operating system

Windows 10

6.2 Database

-Postgresql

<https://www.enterprisedb.com/downloads/postgres-postgresql-downloads>

Optional:

-Pgadmin 4

<https://www.pgadmin.org/download/pgadmin-4-windows/>

It is the graphical interface of the database, this program is not necessary but it is useful for easy use of it.

6.3 Web server

-XAMPP

<https://www.apachefriends.org/download.html>

(Any other web server software can be used)

6.4 Backend

-NodeJS

<https://nodejs.org/en/>

Optional:

-NSSM (auto-service)

<https://nssm.cc/download>

It is a windows service, it is not necessary for the application to work, you can create the service manually, this script helps to create services that run at the start of the server, we use it to load the backend server to access the database.

7 Installation

The installation of the application requires the following programs, the order of installation does not matter. Keep all options during default installation.

8 Postgresql

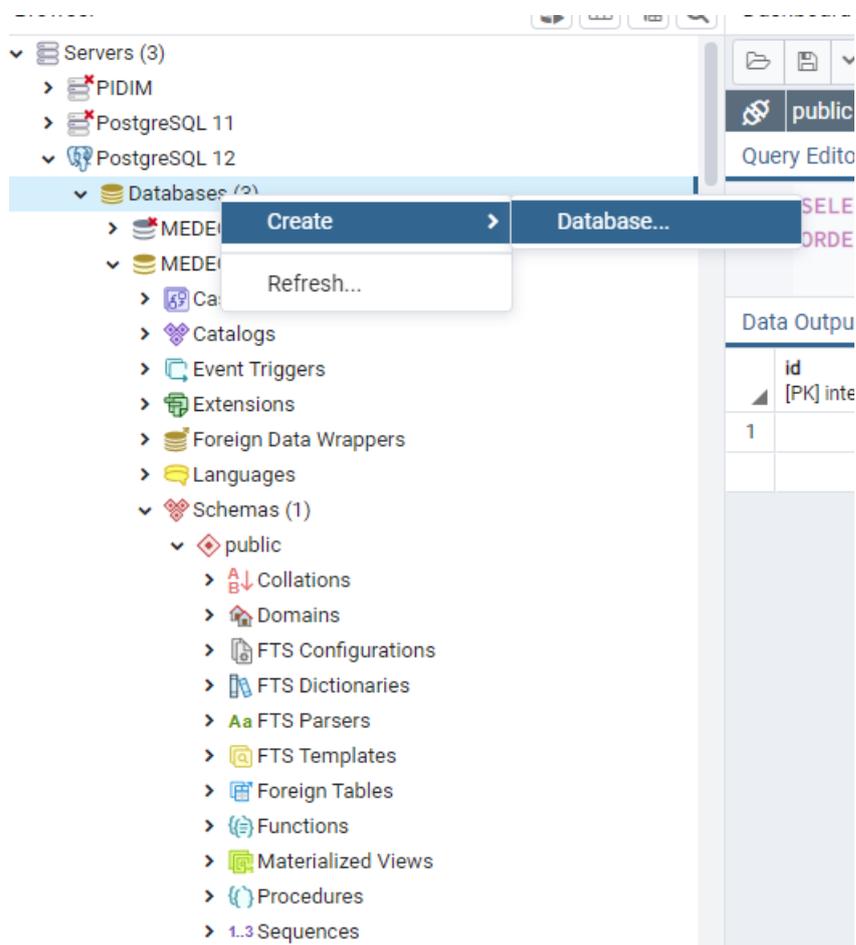
When we install Postgresql, during the installation it asks us for a password to manage the databases, we use the password 1234.

This password must be referenced in the application archive called .env with the variable " db_password = 1234 "

9 Database

To configure the database for ease we use the graphical program PGADMIN4.

Open the program, type the password entered during the installation and select a server (PostgreSQL X.X version). In the databases folder we create a new database.

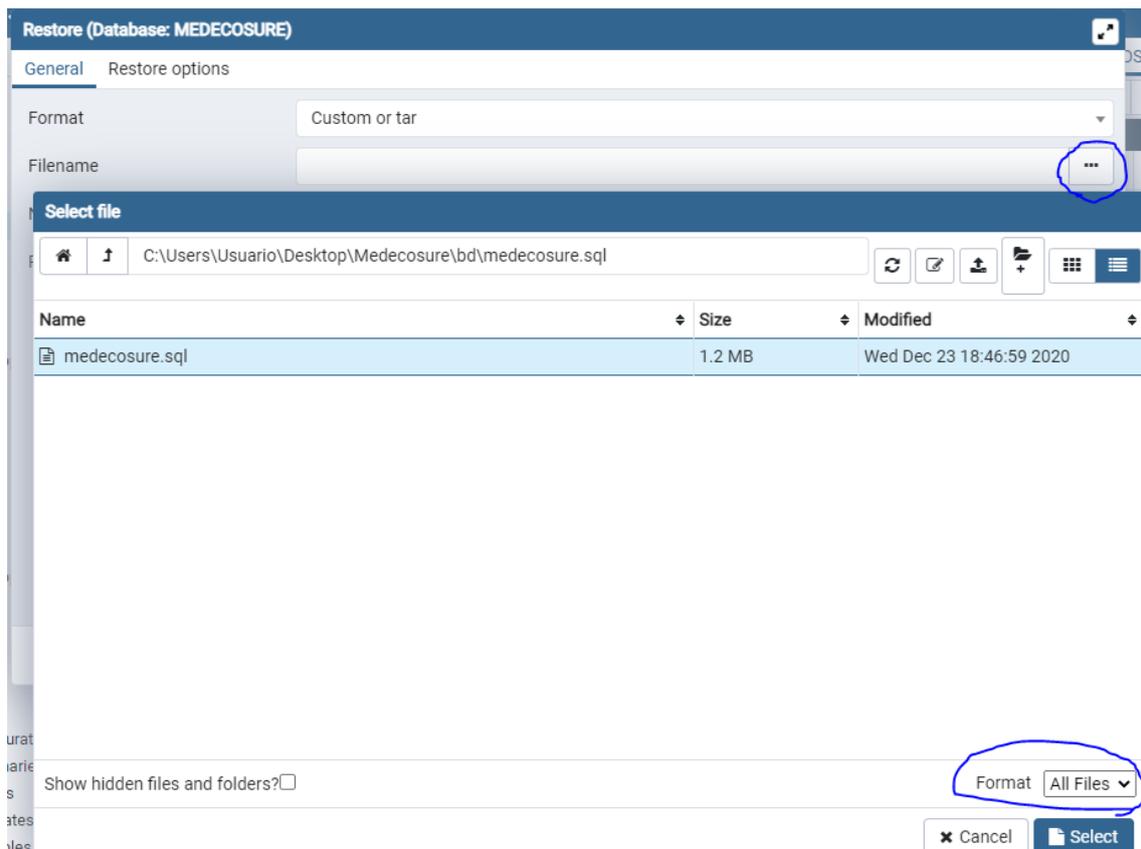


The database name must be MEDECOSURE1. Otherwise, we must change the .env file the line DB_DATABASE = MEDECOSURE1 by the name we have given it.

We select the database with the right button and give it the option restore / restore / recover.

In the recovery window, we select the database file (backup) located in the application folder.

If this file does not appear, we click on all formats.



9.1 Backend

First of all, check that the Nodejs program is installed and working.

We open CMD and write:

```
node -v
```

```
npm -v
```

The version of node and npm installed must appear.

```
C:\Users\Usuario>node -v  
v12.18.0  
  
C:\Users\Usuario>npm -v  
6.14.5
```

Once verified we navigate to the Backend folder in the CMD

```
cd C:\Program Files\Medecosure\Backend
```

and we write:

```
npm install
```

When I finish we write:

```
npm audit fix.
```

Later:

```
npm run dev
```

The message should appear: 'server on port 3000'.

We close the CMD window.

The configuration with the database can be changed in the .env file. if there is any problem with the connection to the database, we must check the parameters in this file.

9.2 NSSM

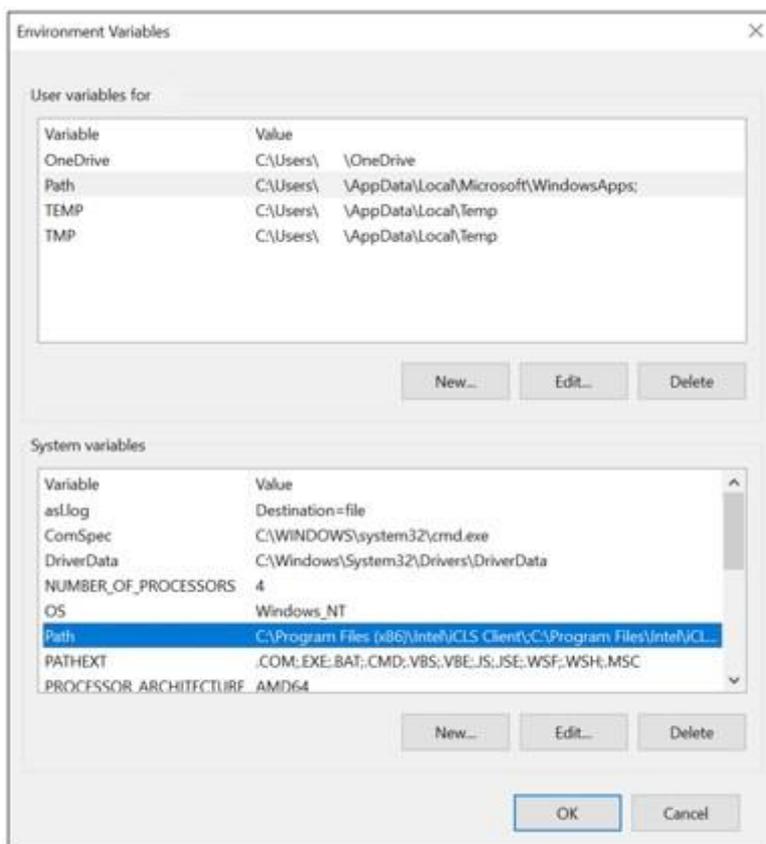
We can see a guide to the use of this software on this page:

<https://nssm.cc/usage>

We use the following installation path:

C:\Program Files\nssm-2.24\win64

We edit the local environment variables to add the previous installation path.



We open a new CMD window with administrator privileges and type:

```
nssm install medecosureBackend "C:\Program Files\nodejs\node.exe"
```

Then we wrote:

```
nssm set medecosureBackendAppDirectory "C:\Program Files\Medecosure\backend\src"
```

Once you're done:

```
nssm set medecosureBackendAppParameters index.js
```

to finish we write:



nssm start medecosureBackend

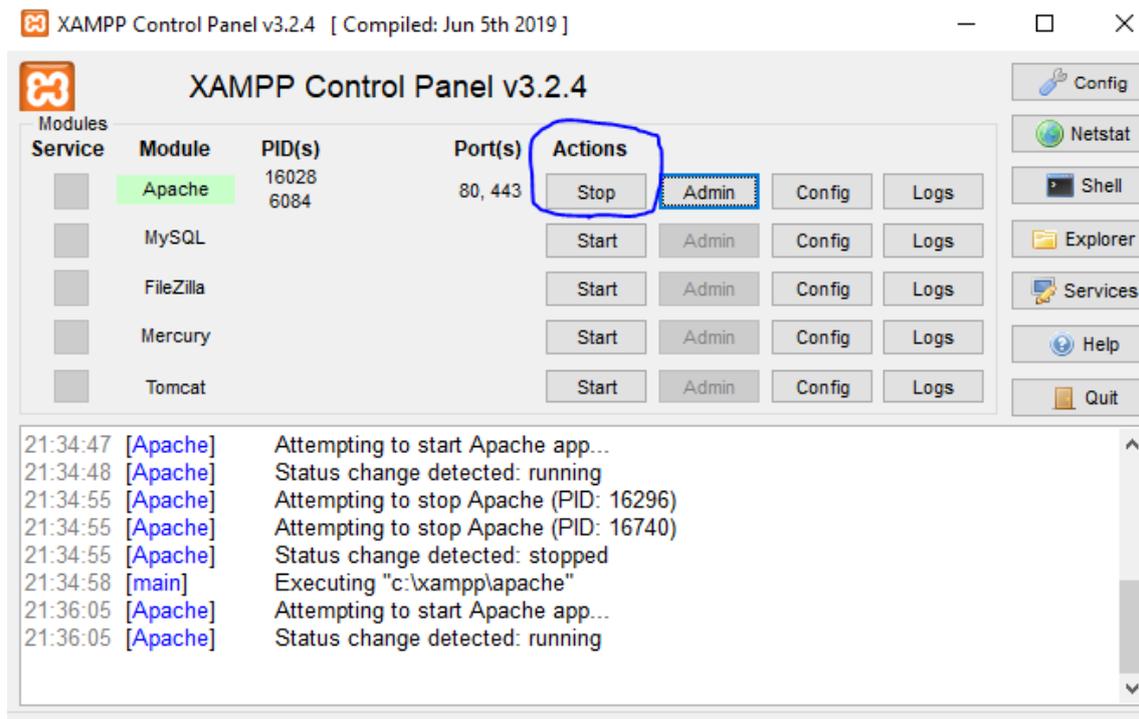
9.3 XAMP

Once XAMP is installed, we access its folder and delete all the contents in C:\xampp\htdocs.

We copy the entire contents of the frontend folder of the application to

C:\xampp\htdocs

Start the apache server:



XAMPP Control Panel v3.2.4 [Compiled: Jun 5th 2019]

| Service | Module | PID(s) | Port(s) | Actions |
|--------------------------|-----------|---------------|---------|-------------------------|
| <input type="checkbox"/> | Apache | 16028 6084 | 80, 443 | Stop Admin Config Logs |
| <input type="checkbox"/> | MySQL | | | Start Admin Config Logs |
| <input type="checkbox"/> | FileZilla | | | Start Admin Config Logs |
| <input type="checkbox"/> | Mercury | | | Start Admin Config Logs |
| <input type="checkbox"/> | Tomcat | | | Start Admin Config Logs |

21:34:47 [Apache] Attempting to start Apache app...
21:34:48 [Apache] Status change detected: running
21:34:55 [Apache] Attempting to stop Apache (PID: 16296)
21:34:55 [Apache] Attempting to stop Apache (PID: 16740)
21:34:55 [Apache] Status change detected: stopped
21:34:58 [main] Executing "c:\xampp\apache"
21:36:05 [Apache] Attempting to start Apache app...
21:36:05 [Apache] Status change detected: running

In the browser we write the address of the apache server (localhost)

For successful access (login) the backend server must be powered on.



10 Technical basis of Medecasure Application

10.1 Introducción

The Medecasure web application is based on the MEAN Stack (MongoDB, Express, Angular, Nodejs) modifying the database by Postgresql.

Database Choice:

The reason is that handling "queries" (requests, queries ...) as well as receiving and manipulating data in MongoDB can be complex and intricate. The amount of data that the application processes is not of great volume (big data) and the construction of the database was already done in Postgresql so it opted for this database with a simpler use.

Choice of the rest of the software used:

Since there was a web development team (full-stack) for the project, it was decided to simplify using a single programming language for the entire application (javascript)

NodeJS is used to carry it out on the server side, this software is well understood with the frontend and has easy implementation and great scalability.

For the management of the server, Express is used, which provides a wide set of functions to create server-side web applications. (such as HTTP requests).

For the frontend, the Angular framework has been used, known for having a good programming environment in SPA applications (single page application). It is characterized by using the controller view model (MVC) to develop quickly while allowing and enabling modifications, code maintenance, refactoring and updating.

10.2 Code structure

The application code is structured in two main blocks: Frontend and Backend.

Each contained is contained in a folder of the same name.

10.2.1 Modular Structure:

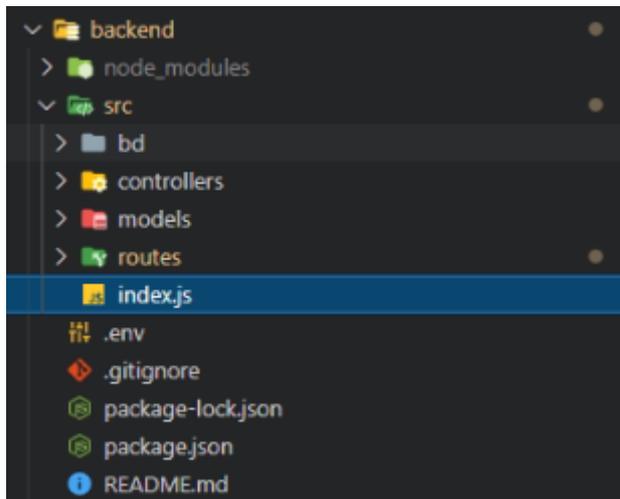
For the development of the entire code, a modular structure has been carried out, delimited by the different sections of the application:



Including some more modules such as Login, Cases.

Such modules are reflected in the code in different folders with a related name.

Backend



Within this folder we find the following files:

Node_modules: contains multiple files with the internal libraries of the application. This folder should not be copied/modified/alterd. To use it on another device is installed using the npm install command. The libraries are referenced in the package.json files. The npm program will read these configuration files and create and install all the necessary files.

.env: Here is the configuration file for proper access to the database.

Index.js: This is the main node.js file. Here we declare and use express, the software in charge of making the CRUD requests and the measurer between the application and the database.

BD Folder: It is an information folder. Contains files with the implementations made to the database. This code is not used.

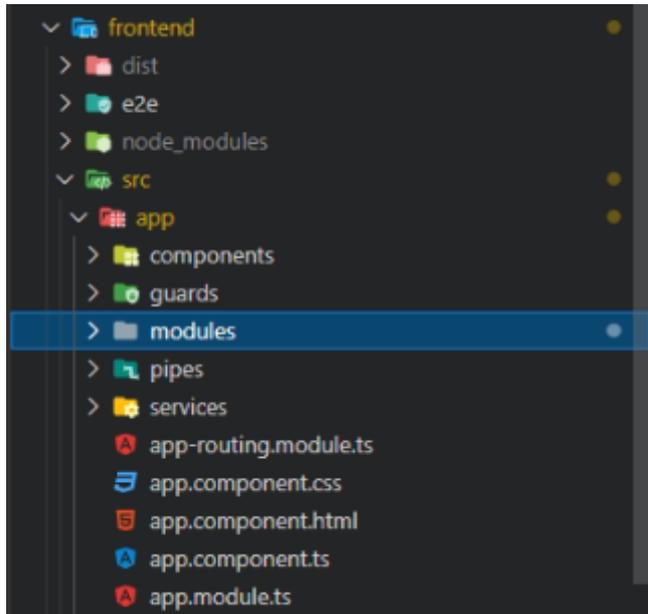
Controllers folder: File where the connection to the database is carried out. This file implements the variables collected in the .env file.

Models: Folder that contains the different queries that run in the database. They are separated by modules.

Routes: Folder that contains the different files that receive the CRUD requests from the frontend and manage them with the Models. This folder is also separated by modules.

10.3 Frontend

The frontend part has the following structure:



In it we observe the APP folder. Containing the entire application, within it we break down the following subfolders:

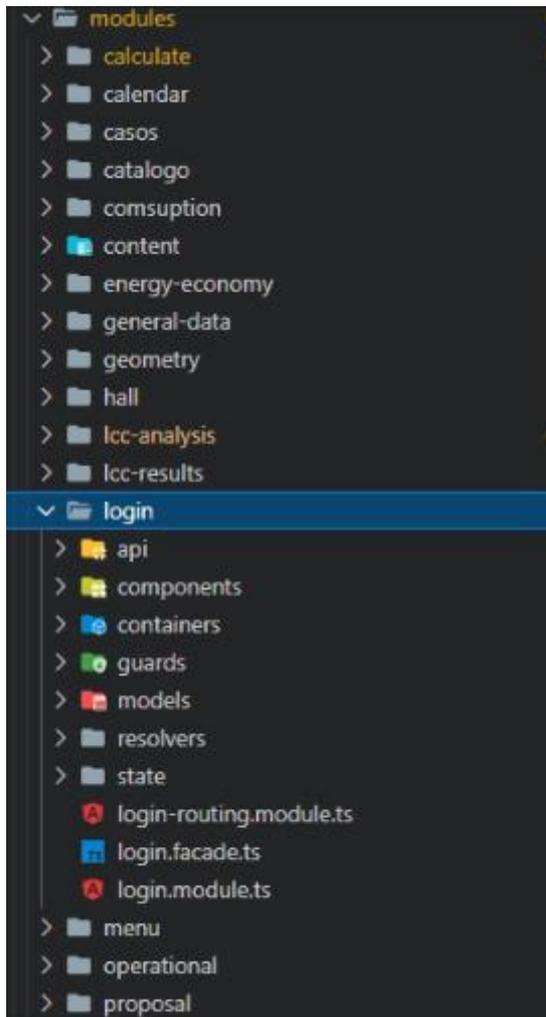
Components: Contain code files of reusable components, such as the counter selector / delete button / add button. All recyclable or recurring code is placed here. This code is shared between the different modules, so that any module can make use of it.

Modules: Folder where all the modules of the frontend are hosted. Next, we will see it in more detail.

Pipes: Contains interface correction files. Such as changing dot by comma

Services: Contains recurring application logic. It is like a library with multiple data processing tools that the application uses. An important file to highlight from this folder is url.service. This file contains only one variable with the URL of the backend server. Here we will replace localhost with the IP address of the server, otherwise the application will only run locally and we will not have access to it over the internet.

Modules folder:



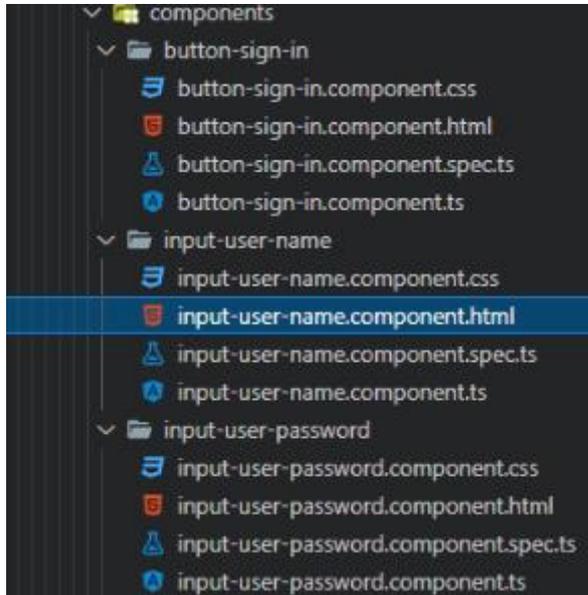
As seen in the image the folder has a subfolder for each section of the application. Each one inside has the same internal structure:

API Folder: Contains a single .api file. In this file the different CRUD requests to the backend server of the module are collected. These requests have an address /an address, which is collected in the backend in the routes folder of the corresponding module. These files are responsible for bringing and saving data in the database.

Components Folder: It is the folder that contains the different components of the module. A component of a module consists of 3 files in which the aesthetics, logic and composition are defined in each file separately. Components are the most irreducible piece of code. They contain almost no logic. For example, in the login module, the components are the field to enter the username, another component is the password field and another the access button. Such components only have structural and aesthetic part, the logic is implemented in another file, so that the programming is modular and descending.

Below, we'll break down a basic component:

Component: We will break down the components of the previously seen login module.



Diferenciamos 3 componentes :button-sign-in. Input-user-name. Input-user-password.

Each of them has the same file structure:

Files with CSS extension: they are aesthetic files, here we can change the size, color, alignment ... to the component.

Files with HTML extension: these are content files. Here the essence of the component is defined; if it is a radio button, a text box, an input...

Files with TS extension. It is where the logic that the component will use is collected. As explained before, the components are the simplest elements of the application, all the logic is implemented in other files and only in these files are input and output data collected.

Files with spec extension are unit tests that are not used.

Containers folder: In this folder the container-components (they are also components) that contain the components of simple elements are collected. Some modules only have a single container where all components are housed. Other more complex modules have several containers to group the components-elements in different sections and favor the ordinance and organization of the code.

These components similar to the previous ones have the same file structure: CSS, HTML, and TS.

Guards folder: Here we find files of type guard. These files prevent the user from accessing/viewing/interacting with the different components until a certain condition is met. For example, the login module save prevents the user from accessing the application without a correct user.



Models Folder: Contain the definition of the data structure that is used in the module. For example, the login module defines the set of user data it contains: name, password and id. Once the data structure is defined, it is used in all the logic of the module.

State Folder: Contains a single state file, where here the different variables of the module are defined and collected. It is a definition and configuration file. This file works with observables. For example: A variable associated with the data coming from the database is defined. Until these are loaded (request and response) the variable will not have such data. Once the data is obtained it is loaded into this variable and the observable call from the component automatically renders the data.

Below we see several files inside the module folder but without being associated with any folder:

Files with .module extension: These are module configuration files by the application. They contain imports and exports. They are critical configuration files. Each module has a separate file.

Files with .facade extension: It is the file that contains all the logic of the module. This file in turn makes a gateway between the State file, API, etc ... with the components.

How to modify interface appearance

To modify the appearance of an interface element, the first thing we must do is locate that element in the code.

For example: To change the color of the general data table:

| Name | Type | Surface [m ²] | Heating | Cooling | Domestic hot water | Lighting |
|--------|--------|---------------------------|-------------------------------------|-------------------------------------|--------------------------|-------------------------------------|
| ufname | UF_JLM | 500 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

Add/Define Building Use

We must access the general data module ... \frontend\src\app\modules\general-data

Once there and as explained above we must find the component of the table. The components folder of the general-data module is where all the components (items that appear on the general data page) are hosted.

... \frontend\src\app\modules\general-data\components\table-ufg

The table in question is called by table-ufg.

Once inside we observe 3 files of the component:



HTML: What defines the component as a table

CSS: Component Aesthetics

TS: Component functionality logic.

We access the HTML file and see the line that defines the table

```
<table #tablaUf style='width:100%;' class='table' id='tablaFuncional2'>
```

As we can see this table has a table class (which is the attribute that gives it color, centers the headers etc ...) and an id that is called functional table2.

Once identified we go to the CSS file.

To change the color of the headboards for example we can write the following

```
#tablaFuncional2 th  
  
{  
  
    Background-color:red;  
  
}
```

As the programming is divided into components and this CSS file only refers to the table, we can directly access the headers (TH) since it will not affect any additional table.

```
th  
  
{  
  
    Color: black;  
  
}
```

With this second instruction we change the color of the letters of the headers of the table to black.

An attached page with programming information is left in CSS

<https://www.w3schools.com/Css/>

11 Local folder structure

We have already seen how the application is structured inside. Let's see the operating structure it has on the outside.

The application is mounted on a web server that runs using xampp software. So our application must be hosted in the folder of this software. By default this software is installed on C://xampp,



inside your folder, we access the htdocs folder, and this is where our Medecosure application is in a separate folder.

When accessing the application folder we see the previously explained structure of frontend / backend.

In the frontend folder we find the following folder structure:

Src: Contains the compiled code of the application. Inside we break down:

The dist folder contains the code of the application already compiled and is the one that is loaded into it. This folder contains a series of files that are automatically generated by the angular cli software with the application in production. These files are the result of compiling all the developed code. It is optimized and impossible for a human to read. To highlight is the index file.html. this file is the header of the application. In it we observe a path with a bar / . **IMPORTANT:** When angular compiles this file the default path is the bar / , for the application to work after each compilation we must modify this file and add a point before the bar, leaving the line like this: ./

Another folder to highlight is that of assests. Here are all the image files and resources that the application requires.

The MedecosureLocal folder: Contains all the code made by the development team. This is the folder structure described above.

12 Calculation program folder structure

Here are the calculation programs, as well as the files to be calculated and those already calculated.

C:\ProgramasTMT\MEDECOSURE

In it we observe 3 files

AlmacenCasos: It is the folder where the calculated and to be calculated files are hosted. It is divided into

- CasosPendientes: Where the files are hosted as a calculation, the service that manages these programs automatically deletes the file when it is calculated.
- CasosTerminados: Where the calculated files are hosted. The application accesses these files.
- LOG: A txt file with information from the service that calls calculation programs.

Programas: this folder hosts the application's calculation programs.

Config: It is a txt file with the configuration of the service for the call to the calculation programs.



The application generates the first file to calculate with an encrypted name in md5. This name is formed by encrypting the username + case name. So there cannot be two files with the same code (name). calculation programs return the results with the same name obtained

Database for operational conditions



13 Database for operational conditions in university buildings

13.1 Descripción

Considerations made for the elaboration of the database with 37 different types of spaces for university buildings.

To complete the database of the different types of buildings (each with its corresponding functional units), each type of functional unit has been assigned occupancy schedules, lighting, DHW, heating, and cooling, in addition to a certain occupancy density, installed lighting power, electrical power of equipment and daily DHW demand.

Occupancy and lighting schedules, occupancy density, lighting power and equipment power have been obtained from the REVIT database, while DHW consumption profile data have been obtained from ASHRAE and DHW demands from the technical code.

An Excel file is included in the digital deliverable with all of the information collected.

13.2 Choice of space types

For Schools and University Buildings, and Residences, we have identified the following type of spaces:

| SCHOOLS & UNIVERSITY BUILDINGS | UNIVERSITY RESIDENCES |
|---|---|
| Lobby | Lobby |
| Classroom/Lecture/Training | Living Quarters - Dormitory |
| Office - Enclosed | Dormitory Bedroom |
| Conference/Meeting/Multipurpose | Dormitory Study Hall |
| Audience/Seating Area - Convention Center | Conference/Meeting/Multipurpose |
| Exercise Area - Gymnasium | Audience/Seating Area - Convention Center |
| Lounge or Recreation | Exercise Area - Gymnasium |
| Restrooms | Dining Area |
| Dining Area | Food Preparation |
| Food Preparation | Laundry - Ironing and Sorting |
| Hospital - Nursery - Hospital/Healthcare | Lounge or Recreation |
| Parking Area - Parking Garage | Office - Enclosed |
| Corridor/Transition | Parking Area - Parking Garage |
| Stairway | Corridor/Transition |
| Stairs - Inactive | Reading Area - Library |
| Dressing/Locker/Fitting Room - Gymnasium | Library - Audio Visual - Library - Audio Visual |
| Library - Audio Visual - Library - Audio Visual | Restrooms |
| Reading Area - Library | Stairway |
| | Stairs - Inactive |



13.3 Types of schedules

The different types of schedules have been defined as follows:

- Type 1: normal operating days from Monday to Friday
- Type 2: Intensive day
- Type 3: Holidays
- Type 4: normal operating days from Monday to Friday, 8h
- Type 5: days of normal operation from Monday to Friday, 12h
- Type 6: days of normal operation from Monday to Friday, 16h

In the hours of occupation and lighting:

- Type 1: Values are obtained from REVIT.
- Type 2: The ratio is obtained by dividing the value of Saturdays by that of the working days of the ASHRAE database for the type of building, and applied to the hourly data taken from REVIT for the space in question.
- Type 3: The ratio is obtained by dividing the value of Sundays by that of the working days of the ASHRAE database for the type of building, and applied to the hourly data taken from REVIT for the space in question.
- Types 4, 5 and 6: Analogous to the occupation schedules, they are obtained from the values of type 1 (REVIT) multiplied by the working hours of 8, 12 and 16 hours respectively.

13.4 DHW

Depending on the type of space, you will be assigned DHW demand values and their corresponding profiles or not.

As for the profiles of hourly consumption of DHW, they have been obtained from the values provided by ASHRAE for each type of building, distinguishing between work, Saturdays and Sundays, but considering these values only when there is occupation in the space. An example of ASHRAE data for schools is shown.

Table G-M—School Occupancy

| Hour of Day (Time) | Schedule for Occupancy | | | Schedule for Lighting Receptacle | | | Schedule for HVAC System | | | Schedule for Service Hot Water | | | Schedule for Elevator | | |
|-----------------------|----------------------------|-------------|-----|-------------------------------------|-------------|-----|-----------------------------|-------------|-----|-----------------------------------|-------------|-----|----------------------------|-------------|-----|
| | Percent of Maximum Load | | | Percent of Maximum Load | | | | | | Percent of Maximum Load | | | Percent of Maximum Load | | |
| | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun | Wk | Sat | Sun |
| 1 (12-1 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 2 (1-2 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 3 (2-3 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 4 (3-4 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 5 (4-5 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 6 (5-6 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 7 (6-7 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 5 | 3 | 3 | 0 | 0 | 0 |
| 8 (7-8 am) | 5 | 0 | 0 | 30 | 5 | 5 | On | Off | Off | 10 | 3 | 3 | 0 | 0 | 0 |
| 9 (8-9 am) | 75 | 10 | 0 | 85 | 15 | 5 | On | On | Off | 34 | 3 | 5 | 30 | 0 | 0 |
| 10 (9-10 am) | 90 | 10 | 0 | 95 | 15 | 5 | On | On | Off | 60 | 5 | 5 | 30 | 0 | 0 |
| 11 (10-11 am) | 90 | 10 | 0 | 95 | 15 | 5 | On | On | Off | 63 | 5 | 5 | 30 | 0 | 0 |
| 12 (11-12 pm) | 80 | 10 | 0 | 95 | 15 | 5 | On | On | Off | 72 | 5 | 5 | 30 | 0 | 0 |
| 13 (12-1 pm) | 80 | 10 | 0 | 80 | 15 | 5 | On | On | Off | 79 | 5 | 5 | 30 | 0 | 0 |
| 14 (1-2 pm) | 80 | 0 | 0 | 80 | 5 | 5 | On | Off | Off | 83 | 3 | 5 | 30 | 0 | 0 |
| 15 (2-3 pm) | 80 | 0 | 0 | 80 | 5 | 5 | On | Off | Off | 61 | 3 | 3 | 30 | 0 | 0 |
| 16 (3-4 pm) | 45 | 0 | 0 | 70 | 5 | 5 | On | Off | Off | 65 | 3 | 3 | 15 | 0 | 0 |
| 17 (4-5 pm) | 15 | 0 | 0 | 50 | 5 | 5 | On | Off | Off | 10 | 3 | 3 | 0 | 0 | 0 |
| 18 (5-6 pm) | 5 | 0 | 0 | 50 | 5 | 5 | On | Off | Off | 10 | 3 | 3 | 0 | 0 | 0 |
| 19 (6-7 pm) | 15 | 0 | 0 | 35 | 5 | 5 | On | Off | Off | 19 | 3 | 3 | 0 | 0 | 0 |
| 20 (7-8 pm) | 20 | 0 | 0 | 35 | 5 | 5 | On | Off | Off | 25 | 3 | 3 | 0 | 0 | 0 |
| 21 (8-9 pm) | 20 | 0 | 0 | 35 | 5 | 5 | On | Off | Off | 22 | 3 | 3 | 0 | 0 | 0 |
| 22 (9-10 pm) | 10 | 0 | 0 | 30 | 5 | 5 | On | Off | Off | 22 | 3 | 3 | 0 | 0 | 0 |
| 23 (10-11 pm) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 12 | 3 | 3 | 0 | 0 | 0 |
| 24 (11-12 am) | 0 | 0 | 0 | 5 | 5 | 5 | Off | Off | Off | 9 | 3 | 3 | 0 | 0 | 0 |
| Total/Day | 710 | 50 | 0 | 990 | 170 | 120 | 1500 | 500 | 0 | 691 | 80 | 84 | 285 | 0 | 0 |
| Total/Week | | 36.00 hours | | | 52.40 hours | | | 80.00 hours | | | 36.19 hours | | | 14.25 hours | |
| Total/Year | | 1877 hours | | | 2732 hours | | | 4171 hours | | | 1887 hours | | | 743 hours | |

Wk = Weekday

The values of the daily demand of DHW have been obtained from table 4.1 (in spanish) of the spanish technical code, distinguishing between the different types of buildings and choosing the following criteria:

- School: school with shower.
- University residences: residence

Tabla 4.1. Demanda de referencia a 60 °C⁽¹⁾

| Criterio de demanda | Litros/día-unidad | unidad |
|-------------------------------|--------------------------|---------------|
| Vivienda | 28 | Por persona |
| Hospitales y clínicas | 55 | Por persona |
| Ambulatorio y centro de salud | 41 | Por persona |
| Hotel ***** | 69 | Por persona |
| Hotel **** | 55 | Por persona |
| Hotel *** | 41 | Por persona |
| Hotel/hostal ** | 34 | Por persona |
| Camping | 21 | Por persona |
| Hostal/pensión * | 28 | Por persona |
| Residencia | 41 | Por persona |
| Centro penitenciario | 28 | Por persona |
| Albergue | 24 | Por persona |
| Vestuarios/Duchas colectivas | 21 | Por persona |
| Escuela sin ducha | 4 | Por persona |
| Escuela con ducha | 21 | Por persona |
| Cuarteles | 28 | Por persona |
| Fábricas y talleres | 21 | Por persona |
| Oficinas | 2 | Por persona |
| Gimnasios | 21 | Por persona |
| Restaurantes | 8 | Por persona |
| Cafeterías | 1 | Por persona |

(1) Los valores de demanda ofrecidos en esta tabla tienen la función de determinar la fracción solar mínima a abastecer mediante la aplicación de la tabla 2.1.

13.5 Heating and cooling

The schedules are given by the occupation: if there is occupation the air conditioning system would be in operation.

13.6 Incident Notes

There a couple of adjustments required by the lack of better data:

- Inside the university residence, the room + bathroom, has a lighting schedule of 24 hours.
- In the university residence the room without bathroom is the same as the room with bathroom in the nursing home.

13.7 Definition of generic space

For the determination of the internal sources and schedules of the generic space of each type of building, we have proceeded, first, to the choice of the most representative spaces and their weight within each building.

The chosen spaces are part of the database of functional units. The values of the weights considered in each case are indicated in the following table.

| SCHOOLS & UNIVERSITY BUILDINGS | | UNIVERSITY RESIDENCES | |
|--------------------------------|-----|-----------------------|-----|
| Classes | 50% | Room with bathroom | 60% |
| Offices | 8% | Gymnasium | 2% |
| Gymnasium | 5% | Restaurant | 5% |
| Common areas | 12% | Common areas | 20% |
| Restaurant | 10% | Parking | 5% |
| Parking | 5% | Corridors | 8% |
| Bathrooms | 5% | | |
| Corridors | 5% | | |

Once the spaces present in each type of building and their weight have been selected, the calculations of the internal sources of the generic space have been made as follows:

- Density of occupancy, lighting and equipment: its value will be the weighted average according to the chosen spaces and their corresponding weights.
- DHW: Since the values at the space level came from the Spanish technical code table and these were at the building level, the same values have been maintained in $l/(\text{day} \cdot \text{person})$.
- Occupancy schedules, lighting, equipment, and others: the hourly value will be the weighted average of the chosen spaces.
- Heating and cooling schedules: the hourly value will be the weighted average of the chosen spaces.

DHW schedule: the values will be those of the heaviest space within the building with DHW consumption



Database for climatic data

14 Climatic Data

Climate files for 753 European locations have been included in the Application database. Partners from the project, from the Mediterranean area, have been invited to contribute climatic data for their main locations. US team is ready for inclusion of these files as soon as received.

Data have been obtained from METEONORM application.

The hourly climatic data is stored in ASCII text files, with the following fields:

A record with Location name

A record with Latitude, longitude, altitude, reference longitude

8760 records containing each:

Month, day, hour,
 ambient temperature (°C),
 sky temperature (°C),
 direct solar radiation on horizontal surface (W/m²)
 diffuse solar radiation on horizontal surface (W/m²)
 absolute humidity (kg water/kg dry air)
 relative humidity (%)
 wind velocity (m/s)
 wind direction (deg. Referred to North, east positive)
 solar zenith (deg)
 solar azimuth (deg)

This is an extract of the first records of one of the files. All of the files are included in a archive included in the digital format of the deliverable:

| Luebeck | | | | | | | | | | | | |
|-----------|-------|---|-----|------|---|---|---------|----|-----|-----|---|----|
| 53.869999 | 10.67 | 5 | 15 | | | | | | | | | |
| 1 | 1 | 1 | 8.7 | 0.4 | 0 | 0 | 0.00637 | 91 | 2.8 | 263 | 0 | 90 |
| 1 | 1 | 2 | 8.5 | 0.2 | 0 | 0 | 0.00635 | 92 | 2.4 | 252 | 0 | 90 |
| 1 | 1 | 3 | 8.3 | 0 | 0 | 0 | 0.00633 | 93 | 2.1 | 249 | 0 | 90 |
| 1 | 1 | 4 | 8 | -0.4 | 0 | 0 | 0.00627 | 94 | 2.4 | 265 | 0 | 90 |
| 1 | 1 | 5 | 7.8 | -0.6 | 0 | 0 | 0.00625 | 95 | 2.2 | 263 | 0 | 90 |
| 1 | 1 | 6 | 7.5 | -0.9 | 0 | 0 | 0.00619 | 96 | 2.5 | 252 | 0 | 90 |

At the present time, the locations are as follows:

| | |
|---------------------|----|
| TIRANA | AL |
| Graz | AU |
| Innsbruck | AU |
| Linz | AU |
| Salzburg | AU |
| WIEN | AU |
| Antwerpen_(Anvers) | BE |
| Brugge | BE |
| BRUXELLES_(BRUSSEL) | BE |

| | |
|--------------|----|
| Charleroi | BE |
| Genk-Hasselt | BE |
| Gent_(Gand) | BE |
| Kortrijk | BE |
| La_Louvière | BE |
| Liège_(Luik) | BE |
| Mons | BE |
| Namur | BE |
| Banja_Luka | BK |
| Doboj | BK |
| Mostar | BK |
| Prijedor | BK |

| | |
|----------------|----|
| SARAJEVO | BK |
| Tuzla | BK |
| Zenica | BK |
| Baranovichi | BO |
| Bobruisk | BO |
| Borisov | BO |
| Brest | BO |
| Gomel | BO |
| Grodno | BO |
| MINSK | BO |
| Mogilev | BO |
| Mozir | BO |
| Orsha | BO |
| Pinsk | BO |
| Solegorsk | BO |
| Vitebsk | BO |
| Bourgas | BU |
| Choumen | BU |
| Dobritch | BU |
| Plévène | BU |
| Roussé | BU |
| Slivène | BU |
| SOFIA | BU |
| Stara_Zagora | BU |
| Varna | BU |
| Alborg | DA |
| Arhus | DA |
| KOBENHAVN | DA |
| Odense | DA |
| Cork | EI |
| DUBLIN | EI |
| TALLINN | EN |
| Tartu | EN |
| Brno | EZ |
| Hradec_Králové | EZ |
| Liberec | EZ |
| Olomouc | EZ |
| Ostrava | EZ |
| Pizen | EZ |
| PRAHA | EZ |
| Ústí_nad_Labem | EZ |
| Espoo | FI |

| | |
|----------------------|----|
| HELSINKI | FI |
| Oulu | FI |
| Tampere | FI |
| Turku | FI |
| Vantaa | FI |
| Aix-en-Provence | FR |
| Amiens | FR |
| Angers | FR |
| Besancon | FR |
| Bordeaux | FR |
| Boulogne-Billancourt | FR |
| Brest | FR |
| Caen | FR |
| Clermont-Ferrand | FR |
| Dijon | FR |
| Grenoble | FR |
| Le_Havre | FR |
| Le_Mans | FR |
| Lille | FR |
| Limoges | FR |
| Lyon | FR |
| Marseille | FR |
| Metz | FR |
| Montpellier | FR |
| Mulhouse | FR |
| Nantes | FR |
| Nice | FR |
| Nimes | FR |
| Orléans | FR |
| PARIS | FR |
| Perpignan | FR |
| Reims | FR |
| Rennes | FR |
| Rouen | FR |
| Saint-Etienne | FR |
| Strasbourg | FR |
| Toulon | FR |
| Toulouse | FR |
| Tours | FR |
| Trappes | FR |
| Troyes | FR |
| Valence | FR |

| | |
|----------------------|----|
| Valenciennes | FR |
| Villeurbanne | FR |
| Aachen | GM |
| Augsburg | GM |
| Bergisch_Gladbach | GM |
| BERLIN | GM |
| Bochum | GM |
| Bonn | GM |
| Bottrop | GM |
| Braunschweig | GM |
| Bremen | GM |
| Bremerhaven | GM |
| Chemnitz | GM |
| Cottbus | GM |
| Darmstadt | GM |
| Dortmund | GM |
| Dresden | GM |
| Duesseldorf | GM |
| Duisburg | GM |
| Erfurt | GM |
| Erlangen | GM |
| Essen | GM |
| Frankfurt_am_Main | GM |
| Freiburg_im_Breisgau | GM |
| Fuerth | GM |
| Gelsenkirchen | GM |
| Gera | GM |
| Goettingen | GM |
| Hagen | GM |
| Halle | GM |
| Hamburg | GM |
| Hamm | GM |
| Hannover | GM |
| Heidelberg | GM |
| Heilbronn | GM |
| Herne | GM |
| Hildesheim | GM |
| Ingolstadt | GM |
| Jena | GM |
| Kaiserslautern | GM |
| Karlsruhe | GM |
| Kassel | GM |

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|-----------------------|----|
| Kiel | GM |
| Koblenz | GM |
| Koeln | GM |
| Krefeld | GM |
| Leipzig | GM |
| Leverkusen | GM |
| Ludwigshafen_am_Rhein | GM |
| Luebeck | GM |
| Magdeburg | GM |
| Mainz | GM |
| Mannheim | GM |
| Moenchengladbach | GM |
| Moers | GM |
| Muelheim_a.d._Ruhr | GM |
| Muenchen | GM |
| Muenster_(Westf.) | GM |
| Neuss | GM |
| Nuernberg | GM |
| Oberhausen | GM |
| Offenbach_am_Main | GM |
| Oldenburg | GM |
| Osnabrueck | GM |
| Paderborn | GM |
| Pforzheim | GM |
| Potsdam | GM |
| Recklinghausen | GM |
| Regensburg | GM |
| Remscheid | GM |
| Reutlingen | GM |
| Rostock | GM |
| Saarbruecken | GM |
| Salzgitter | GM |
| Schwerin | GM |
| Siegen | GM |
| Solingen | GM |
| Stuttgart | GM |
| Ulm | GM |
| Wiesbaden | GM |
| Witten | GM |
| Wolfsburg | GM |
| Wuerzburg | GM |
| Wuppertal | GM |

| | |
|----------------|----|
| Zwickau | GM |
| ATHINAI | GR |
| Calithèa | GR |
| Iraclion | GR |
| Larissa | GR |
| Patrai | GR |
| Péristéri | GR |
| Piraiévs | GR |
| Salonika | GR |
| Volos | GR |
| Osijek | HR |
| Rijeka | HR |
| Split | HR |
| ZAGREB | HR |
| BUDAPEST | HU |
| Debrecen | HU |
| Gyoer | HU |
| Kecskemet | HU |
| Miskolc | HU |
| Nyiregyhaza | HU |
| Pécs | HU |
| Székesfehérvár | HU |
| REYKJAVIK | IC |
| Allessandria | IT |
| Ancona | IT |
| Bari | IT |
| Bologna | IT |
| Bolzano | IT |
| Brescia | IT |
| Cagliari | IT |
| Catanzaro | IT |
| Cosenza | IT |
| Ferrara | IT |
| Firenze | IT |
| Foggia | IT |
| Forli | IT |
| Genova | IT |
| La_Spezia | IT |
| Latina | IT |
| Lecco | IT |
| Livorno | IT |
| Messina | IT |

| | |
|--------------------|----|
| Milano | IT |
| Modena | IT |
| Monza | IT |
| Napoli | IT |
| Novara | IT |
| Padova | IT |
| Palermo | IT |
| Parma | IT |
| Perugia | IT |
| Pescara | IT |
| Piacenza | IT |
| Pisa | IT |
| Prato | IT |
| Ravenna | IT |
| Reggio_di_Calabria | IT |
| Reggio_nell_Emilia | IT |
| Rimini | IT |
| ROMA | IT |
| Salerno | IT |
| Sassari | IT |
| Siracusa | IT |
| Taranto | IT |
| Terni | IT |
| Torino | IT |
| Torre_del_Greco | IT |
| Treviso | IT |
| Trieste | IT |
| Udine | IT |
| Venezia | IT |
| Verona | IT |
| Vicenza | IT |
| Daugavpils | LG |
| Liepaja | LG |
| RIGA | LG |
| Kaunas | LH |
| Klaipeda | LH |
| Panevezhis | LH |
| Shauliai | LH |
| VILNIUS | LH |
| BRATISLAVA | LO |
| Kosice | LO |
| Beltsy | MD |

| | |
|-------------------|----|
| Bendery | MD |
| KISHINEV | MD |
| Tiraspol | MD |
| SKOPJE | MK |
| Podgorica | MW |
| Almere | NL |
| Amersfoort | NL |
| AMSTERDAM | NL |
| Apeldoorn | NL |
| Arnhem | NL |
| Breda | NL |
| Dordrecht | NL |
| Eindhoven | NL |
| Enschede | NL |
| Geleen-Sittard | NL |
| Groningen | NL |
| Haarlem | NL |
| Haarlemmermeer | NL |
| Heerlen-Kerkrade | NL |
| Hilversum | NL |
| Leiden | NL |
| Maastricht | NL |
| Nijmegen | NL |
| Rotterdam | NL |
| s-Gravenhage | NL |
| s-Hertogenbosch | NL |
| Tilburg | NL |
| Utrecht | NL |
| Velsen-Beverwijk | NL |
| Zaanstad | NL |
| Zaanstreek | NL |
| Zoetermeer | NL |
| OSLO | NO |
| Stavanger | NO |
| Trondheim | NO |
| Bialystok | PL |
| Bielsko_ - _Biala | PL |
| Bydgoszcz | PL |
| Bytom | PL |
| Chorzów | PL |
| Czestochowa | PL |
| Dabrowa_ Górnicza | PL |

| | |
|----------------------|----|
| Elblag | PL |
| Gdansk | PL |
| Gdynia | PL |
| Gliwice | PL |
| Gorzów_Wielkopolski | PL |
| Grudziadz | PL |
| Jastrzebie_ - _Zdrój | PL |
| Kalisz | PL |
| Katowice | PL |
| Kielce | PL |
| Koszalin | PL |
| Kraków | PL |
| Legnica | PL |
| Lódz | PL |
| Lublin | PL |
| Olsztyn | PL |
| Opole | PL |
| Plock | PL |
| Poznan | PL |
| Radom | PL |
| Ruda_Slaska | PL |
| Rybnik | PL |
| Rzeszów | PL |
| Slupsk | PL |
| Sosnowiec | PL |
| Tarnów | PL |
| Torun | PL |
| Tychy | PL |
| Walbrzych | PL |
| WARSZAWA | PL |
| Wloclawek | PL |
| Wroclaw | PL |
| Zabrze | PL |
| Zielona_Góra | PL |
| Amadora | PO |
| Funchal | PO |
| LISBOA | PO |
| Porto | PO |
| Setubal | PO |
| Arad | RO |
| Bacau | RO |
| Baia_Mare | RO |

| | |
|-------------------------|----|
| Botosani | RO |
| Braila | RO |
| Brasov | RO |
| BUCURESTI | RO |
| Buzau | RO |
| Cluj-Napoca | RO |
| Constanta | RO |
| Craiova | RO |
| Drobeta_Turnu-Severin | RO |
| Focsani | RO |
| Galati | RO |
| Iasi | RO |
| Oradea | RO |
| Piatra_Neamt | RO |
| Pitesti | RO |
| Rimnicu_Vilcea | RO |
| Satu-Mare | RO |
| Sibiu | RO |
| Suceava | RO |
| Timisoara | RO |
| Tirgu-Mures | RO |
| LJUBLJANA | SI |
| Marebor | SI |
| Albacete | SP |
| Alicante | SP |
| Almería | SP |
| Ávila | SP |
| Badajoz | SP |
| Barcelona | SP |
| Bilbao | SP |
| Burgos | SP |
| Cáceres | SP |
| Cádiz | SP |
| Castellón | SP |
| Ceuta | SP |
| Ciudad Real | SP |
| Córdoba | SP |
| Cuenca | SP |
| Gerona | SP |
| Granada | SP |
| Guadalajara | SP |
| Hospitalet_de_Llobregat | SP |

| | |
|--------------------------|----|
| Huelva | SP |
| Huesca | SP |
| Jaen | SP |
| La Coruña | SP |
| Las Palmas | SP |
| León | SP |
| Lérida | SP |
| Logroño | SP |
| Lugo | SP |
| Madrid | SP |
| Málaga | SP |
| Melilla | SP |
| Murcia | SP |
| Orense | SP |
| Oviedo | SP |
| Palencia | SP |
| Palma de Malorca | SP |
| Pamplona | SP |
| Pontevedra | SP |
| Salamanca | SP |
| San Sebastián | SP |
| Santa_Coloma_de_Gramanet | SP |
| Santander | SP |
| Segovia | SP |
| Sevilla | SP |
| Soria | SP |
| Tarragona | SP |
| Tenerife | SP |
| Teruel | SP |
| Toledo | SP |
| Valencia | SP |
| Valladolid | SP |
| Vitoria | SP |
| Zamora | SP |
| Zaragoza | SP |
| BEOGRAD | SR |
| Kragujevac | SR |
| Nis | SR |
| Novi_Sad | SR |
| Pristina | SR |
| Subotica | SR |
| Boras | SW |

| | |
|-------------|----|
| Goeteborg | SW |
| Helsingborg | SW |
| Joenkoeping | SW |
| Linkoeping | SW |
| Malmoe | SW |
| Norrkoeping | SW |
| Oerebro | SW |
| STOCKHOLM | SW |
| Uppsala | SW |
| Vaasteras | SW |
| Basel | SZ |
| BERNE | SZ |
| Genève | SZ |
| Lausanne | SZ |
| Luzern | SZ |
| Winterthur | SZ |
| Zuerich | SZ |
| Adana | TU |
| Adapazari | TU |
| Adiyaman | TU |
| Afyon | TU |
| ANKARA | TU |
| Antakya | TU |
| Antalya | TU |
| Aydin | TU |
| Balikesir | TU |
| Batman | TU |
| Bursa | TU |
| Denizli | TU |
| Diyarbakir | TU |
| Edirne | TU |
| Elazig | TU |
| Erzurum | TU |
| Eskisehir | TU |
| Gaziantep | TU |
| Gebze | TU |
| Hatay | TU |
| Içel | TU |
| Iskenderun | TU |
| Isparta | TU |
| Istanbul | TU |
| Izmir | TU |

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|----------------------|----|
| Kahramanmaras | TU |
| Karabuk | TU |
| Kayseri | TU |
| Kilis | TU |
| Kirikkale | TU |
| Konya | TU |
| Kütahya | TU |
| Malatya | TU |
| Manisa | TU |
| Ordu | TU |
| Osmaniye | TU |
| Sakarya | TU |
| Samsun | TU |
| Sivas | TU |
| Sultanbeyli | TU |
| Tarsus | TU |
| Trabzon | TU |
| Urfa | TU |
| Usak | TU |
| Van | TU |
| Zonguldak | TU |
| Aberdeen | UK |
| Amber_Valley | UK |
| Arun | UK |
| Ashfield | UK |
| Aylesbury_Vale | UK |
| Barking_and_Dagenham | UK |
| Barnsley | UK |
| Basingstoke__Deane | UK |
| Bassetlaw | UK |
| Bedford | UK |
| Belfast | UK |
| Beverley | UK |
| Bexley | UK |
| Birmingham | UK |
| Blackpool | UK |
| Bolton | UK |
| Bournemouth | UK |
| Bracknell_Forest | UK |
| Bradford | UK |
| Braintree | UK |
| Breckland | UK |

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|--------------------|----|
| Brent | UK |
| Brighton | UK |
| Bristol | UK |
| Broadland | UK |
| Bromley | UK |
| Broxtowe | UK |
| Bury | UK |
| Calderdale | UK |
| Cambridge | UK |
| Camden | UK |
| Canterbury | UK |
| Cardiff | UK |
| Carlisle | UK |
| Charnwood | UK |
| Chelmsford | UK |
| Cheltenham | UK |
| Cherwell | UK |
| Chester | UK |
| Chesterfield | UK |
| Chichester | UK |
| Colchester | UK |
| Coventry | UK |
| Crewe__Nantwich | UK |
| Croydon | UK |
| Cunninghame | UK |
| Dacorum | UK |
| Darlington | UK |
| Derby | UK |
| Derry | UK |
| Doncaster | UK |
| Dover | UK |
| Dudley | UK |
| Dundee | UK |
| Dunfermline | UK |
| Ealing | UK |
| East_Devon | UK |
| East_Hampshire | UK |
| East_Hertfordshire | UK |
| East_Lindsey | UK |
| Eastleigh | UK |
| Edinburgh | UK |
| Elmbridge | UK |

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|--------------------------|----|
| Enfield | UK |
| Epping_Forest | UK |
| Erewash | UK |
| Exeter | UK |
| Falkirk | UK |
| Fareham | UK |
| Gateshead | UK |
| Gedling | UK |
| Glasgow | UK |
| Gloucester | UK |
| Greenwich | UK |
| Guildford | UK |
| Hackney | UK |
| Halton | UK |
| Hamilton | UK |
| Hammersmith_and_Fulham | UK |
| Haringey | UK |
| Harrogate | UK |
| Harrow | UK |
| Havant_and_Waterloo | UK |
| Havering | UK |
| Hillingdon | UK |
| Horsham | UK |
| Hounslow | UK |
| Huntingdonshire | UK |
| Ipswich | UK |
| Islington | UK |
| Kensington_and_Chelsea | UK |
| Kings_Lynn__West_Norfolk | UK |
| Kingston_upon_Hull | UK |
| Kingston_upon_Thames | UK |
| Kirkcaldy | UK |
| Kirklees | UK |
| Knowsley | UK |
| Kyle_and_Carrick | UK |
| Lambeth | UK |
| Lancaster | UK |
| Langbaugh-on-Tees | UK |
| Leeds | UK |
| Leicester | UK |
| Lewisham | UK |
| Lisburn | UK |

| | |
|----------------------|----|
| Liverpool | UK |
| LONDON | UK |
| Luton | UK |
| Macclesfield | UK |
| Maidstone | UK |
| Manchester | UK |
| Mansfield | UK |
| Merton | UK |
| Mid_Bedfordshire | UK |
| Mid_Sussex | UK |
| Middlesbrough | UK |
| Milton_Keynes | UK |
| Monklands | UK |
| Motherwell | UK |
| New_Forest | UK |
| Newark_and_Sherwood | UK |
| Newbury | UK |
| Newcastle_upon_Tyne | UK |
| Newcastle-under-Lyme | UK |
| Newham | UK |
| Newport | UK |
| North_Hertfordshire | UK |
| North_Tyneside | UK |
| North_Wiltshire | UK |
| Northampton | UK |
| Northavon | UK |
| Norwich | UK |
| Nottingham | UK |
| Nuneaton__Bedworth | UK |
| Ogwr | UK |
| Oldham | UK |
| Oxford | UK |
| Perth_and_Kinross | UK |
| Peterborough | UK |
| Plymouth | UK |
| Poole | UK |
| Portsmouth | UK |
| Preston | UK |
| Reading | UK |
| Redbridge | UK |
| Reigate_and_Banstead | UK |
| Renfrew | UK |

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|-----------------------|----|
| Rhymney_Valley | UK |
| Richmond_upon_Thames | UK |
| Rochdale | UK |
| Rochester-upon-Medway | UK |
| Rotherham | UK |
| Rushcliffe | UK |
| Salford | UK |
| Salisbury | UK |
| Sandwell | UK |
| Scarborough | UK |
| Sedgemoor | UK |
| Sefton | UK |
| Sevenoaks | UK |
| Sheffield | UK |
| Slough | UK |
| Solihull | UK |
| South_Bedfordshire | UK |
| South_Cambridgeshire | UK |
| South_Kesteven | UK |
| South_Lakeland | UK |
| South_Norfolk | UK |
| South_Oxfordshire | UK |
| South_Ribble | UK |
| South_Somerset | UK |
| South_Staffordshire | UK |
| South_Tyneside | UK |
| Southampton | UK |
| Southend_on_Sea | UK |
| Southwark | UK |
| St._Albans | UK |
| St._Helens | UK |
| Stafford | UK |
| Stockport | UK |
| Stockton-on-Tees | UK |
| Stoke_on_Trent | UK |
| Stratford-on-Avon | UK |
| Stroud | UK |
| Suffolk_Coastal | UK |
| Sunderland | UK |
| Sutton | UK |
| Swale | UK |
| Swansea | UK |



| | |
|-----------------------|----|
| Taff-Ely | UK |
| Tameside | UK |
| Teignbridge | UK |
| Tendring | UK |
| Test_Valley | UK |
| Thamesdown | UK |
| Thanet | UK |
| The_Wrekin | UK |
| Thurrock | UK |
| Tonbridge_and_Malling | UK |
| Torbay | UK |
| Tower_Hamlets | UK |
| Trafford | UK |
| Tunbridge_Wells | UK |
| Vale_of_Glamorgan | UK |
| Vale_of_White_Horse | UK |
| Vale_Royal | UK |
| Wakefield | UK |
| Walsall | UK |
| Waltham_Forest | UK |
| Wandsworth | UK |

| | |
|------------------------|----|
| Warrington | UK |
| Warwick | UK |
| Waveney | UK |
| Waverley | UK |
| Wealden | UK |
| West_Lancashire | UK |
| West_Lothian | UK |
| West_Wiltshire | UK |
| Westminster_City_of | UK |
| Wigan | UK |
| Winchester | UK |
| Windsor_and_Maidenhead | UK |
| Wirral | UK |
| Wokingham | UK |
| Wolverhampton | UK |
| Woodspring | UK |
| Wrexham_Maelor | UK |
| Wychavon | UK |
| Wycombe | UK |
| Wyre | UK |
| York | UK |