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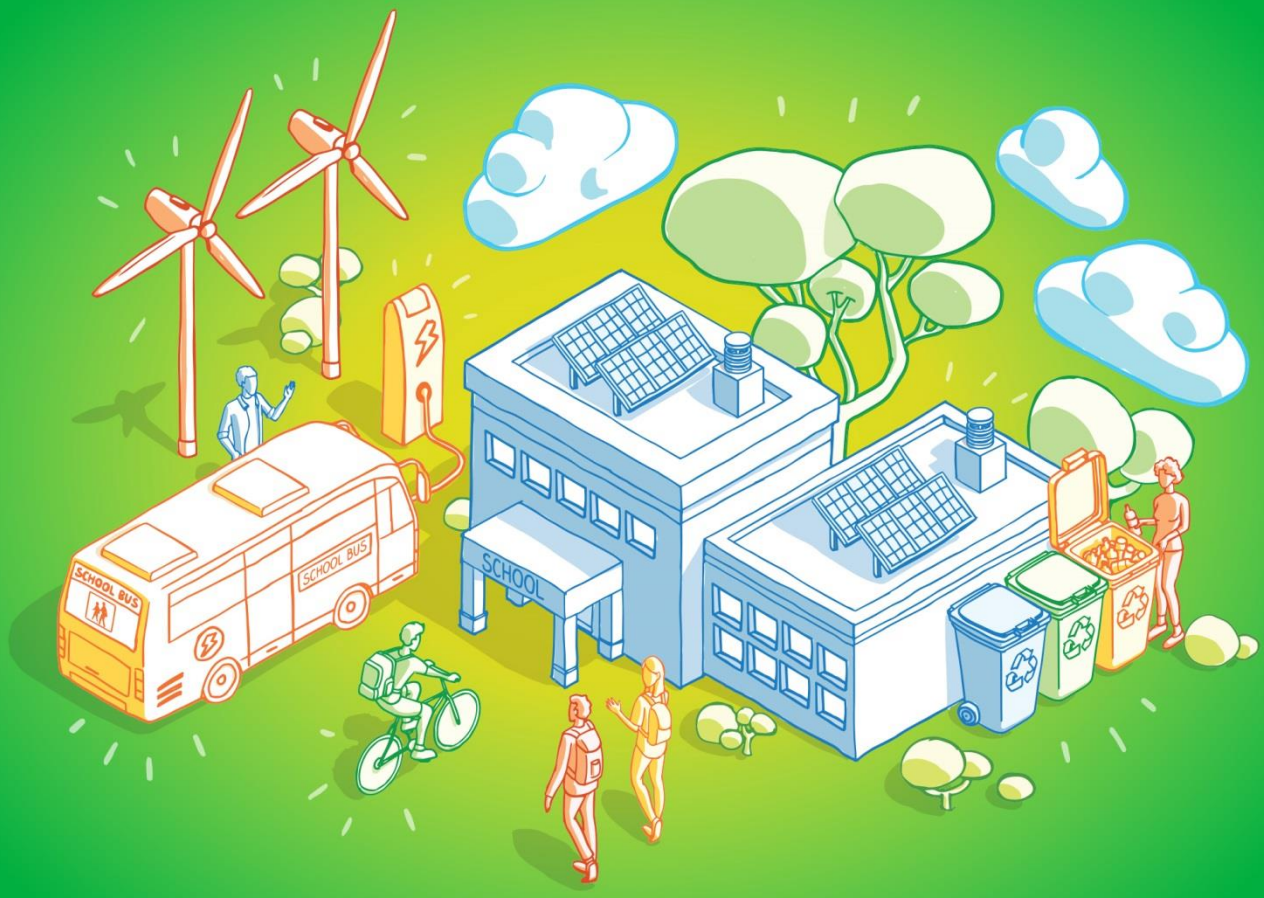

CLIMACT - ACTING FOR THE TRANSITION TO A LOW CARBON ECONOMY IN SCHOOLS – DEVELOPMENT OF SUPPORT TOOLS

E1.5.1 – ClimACT Financing Platform

October 2018

WWW.CLIMACT.NET

Document history

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0.2	01-10-2018	ISQ	Update of chapters 4, 6,7 and 8

Document details

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Acronym	Full name
ECM	Energy Conservation Measure
EE	Energy Efficiency
EPC	Energy Performance Contract (same as ESPC)
ESCO	Energy Service Company
EU	European Union
HVAC	Heating, Ventilation and Air Conditioning
IPMVP	International Performance Measurement and Verification Protocol
M&V	Measurement and Verification
O&M	Operation and Maintenance
UK	United Kingdom

Executive Summary

This deliverable is part of Activity *1.5 – ClimACT Resource-Matching Platform* and this task focuses on developing a platform that matches a building with potential for the implementation of energy conservation measures with an ESCO, to overcome barriers of investment in energy efficiency solutions. The platform will be open to any type of building but the focus is to engage public schools in this platform and provide them with guidelines and help on ESCO contracts.

The main outcome of this document is to define the architecture of the platform and specify the requirements that lead to the end product. Also, the platform user manual, that is going to be present in the end product, is described in this document.

1 Introduction

Retrofitting is commonly viewed as an end of life solution to extend a building useful period, however old buildings often have high energy consumptions due to an inefficient building envelope and obsolete equipment. These high energy consumptions can be reduced with retrofitting, making it a profitable action.

To engage in retrofitting actions, it is necessary to have financial resources available which is the main barrier to these actions. Often what happens is that building owner acknowledges that energy savings could be obtained through retrofitting but, without the means to finance those measures by themselves, the measures are never implemented.

ESCOs are commercial business companies providing a range of energy solutions including retrofitting and energy savings projects. Usually they develop, implement and provide or arrange financing for upfront energy efficiency investments. They also provide a broad range of energy services to final energy users, such as energy audits, feasibility studies, design and implementation of retrofitting projects, equipment procurement, measurement and verification (M&V), operation and maintenance (O&M) and project financing. To amortize the investment and make a profit, the ESCO business model consists on taking a cut of the energy savings obtain through the projects for themselves. This provides a win-win situation to building owners because, without any investment on their part they can obtain savings and even improve the comfort of their buildings with the retrofitting strategies.

The use of ESCOs can play a critical role in promoting energy efficiency at the market level. Over the last years, the awareness and understanding of energy efficiency services has led to an increase of this market and to reduce the mistrust of customers. These were caused by the growing importance of the environmental impacts associated with energy consumption and also the rising cost of energy. However, these are still barriers that prevent building owners from taking full advantage of ESCOs, meaning that this market has still room to grow.

Public administration buildings are even less prone to engage in a partnership with an ESCO because the different business models used by ESCOs are not regulated by a decree-law in most countries, hence public administration buildings have to overcome a series of legal barriers to engage in an EPC or similar type of contract.

The platform detailed in this document aims to approach building owners and ESCOs by allowing an easier interaction which should overcome some of the barriers identified.

1.1 Scope of the document

This deliverable aims to provide a document with a detailed description of the technical component of the ClimACT Resource-Matching Platform and also provide the user manual for the platform recommendations for governments for the adoption of Energy Performance Contracts (EPC) by the scholar sector.

1.2 Deliverable structure

This document starts with a brief introduction. Then the motivation for the adoption of EPC is analysed, followed by the implementation process of EPC and the best practices to develop this type of contracts.

The document is structured as follows:

- **Chapter 2** explores the ESCO market and evaluates the stakeholders' necessities and energy savings potential;
- **Chapter 3** presents the use cases for a platform user;
- **Chapter 4** describes the high-end architecture of the platform;
- **Chapter 5** presents the platform requirements;
- **Chapter 6** details the platform user manual, that teaches all types of users on how to interact with the platform;
- **Chapter 7** presents the market reception;
- **Chapter 8** the main conclusions of the present work.

2 Market Analysis

2.1 Platform motivation and objective

In the SUDOE region school buildings are usually old, meaning that the construction techniques used in their construction are far from the today's standard as far as energy efficiency. Also, the use of inefficient equipment for space heating, water heating, cooking and lighting was verified during the school audits conducted within the ClimACT project. If we combine this factor with the incorrect energy management of schools, it is possible to identify why schools are good targets for the implementation of energy efficiency measures.

The ESCO market is the perfect market to solve this issue, providing the financial resources and expertise to implement energy conservation measures. This was the main motivation for this platform, to increase the proximity between schools and ESCO in order to facilitate the engagement in EPCs. The platform should also allow to increase the understanding of ESCO contracts and consequently diminish the mistrust in ESCOs.

On the ESCO side, the platform should allow them to find new buildings to develop business with and reducing the mistrust should also help to boost the ESCO market.

2.2 Stakeholders' needs

The identified stakeholders for the ClimACT financing platform are the building owners/managers and the ESCOs. Building owners/managers need to reduce cost and energy efficiency might be a solution to consider when thinking about possible ways to reduce cost. On the other hand, ESCOs need a boost to their market since it is a market that it is not yet consolidated in the SUDOE region. The platform might help to increase the business volume and the visibility.

2.3 Positive payback ECMs for schools

ECMs can go from major façade retrofitting to changing the light bulbs. This different levels of complexity make that some ECMs have quicker paybacks than others.

Because schools are buildings with very long time spawn, it is possible to say that most of ECMs are applicable in schools because the payback period is reachable within the life spawn of the building. However, schools lack the money for large investments and that is where ESCOs can come in and use their own means to finance these projects.

So, a positive payback ECM for schools can be defined as an easily applicable ECM which can use simple measurement and verification procedures to assess the savings obtain. These are the measures that make the most profit for ESCOs. Usually, the most applied measure by ESCOs is the replacement of the lighting systems for a LED technology.

Two additional measures were identified which are not ECMs but are measures that allow to save money in the energy bill, a consequently improve the payback period for ESCOs. These measures are the implementation of capacitor banks, which supply reactive energy eliminating

the need of using reactive energy from the grid, and photovoltaic panels, that allow to produce cheaper energy for self-consumption.

2.4 Requirements for investment in ECMs

To invest on the three measures mentioned before (LED lighting, capacitor banks and photovoltaic panels) it is necessary that the building will provide conditions that enable a short to medium term payback.

For example, LED lighting is a very efficient lighting technology that will most likely reduce energy consumption. However, it must be assured that the LED lighting that is replacing the existing one has the same characteristics and provides the same amount of lighting intensity. Also, if the lighting system of a certain building works few hours a day, the payback of this investment is extended and in some cases it may not be an attractive investment.

Capacitor banks are the measure that presents the quickest payback between all measures assessed. Even if the reactive component of a building is very small, the installation of capacitor banks has very interesting payback times.

Solar power is the most complex of the three measures. Photovoltaic panels can be the cheapest way to produce electric energy but it needs very specific conditions to work. A plant sized for self-consumption provides a more attractive investment but also requires more specific consumption characteristics in the target building. Independently of it being a self-consumption plant or selling to grid, both need to be located in a place with sufficient sun exposure, which can be limited because of shades, and can also be limited to certain geographical places.

2.5 Transparency and payback guarantee

In order to have a transparent process of measurement and verification of savings it is essential to follow international protocols that standardize these processes. The standardization facilitates the comprehension of procedures as building managers only need to specialize in one M&V procedure.

The most common M&V protocol used is the International Performance Measurement and Verification Protocol (IPMVP). IPMVP aims to be accessible to both suppliers and buyers of M&V services. The structure of the protocol describes two different methods and four different approaches, that are implemented according with the scope of the ECMs and the measurements performed.

One of the IPMVP methods is called Retrofit Isolation Method and it is applied when the objective is to measure the consumption difference of a single ECM. The other method is called Whole Facility Method and it is aims at measuring the effects of several ECMs at a time. This means that the consumption differences are measured at building level.

Other necessity of building managers is to make sure that the measures that are being applied will translate into savings, in other words, building managers do not want to take the risk associated with performance contracts. To provide this type of guarantee, ESCOs can deploy a guaranteed savings project which will leave all uncertainty of the project on the ESCO side. To do this type of projects ESCO end up taking a bigger portion of the obtained savings in order to compensate any deviations to the projected scenario. This means that if building managers are willing to take some of the risk they can get a better deal.

3 Use Cases Definition

3.1 Original approach

As defined in the project proposal, the platform should accommodate in a single online space schools with financing needs and the ESCOs/investors. The first step in defining the appropriate use cases for the platform is to aim at solving stakeholders needs. Through a stakeholders meeting the first use cases of the platform were defined.

First, the platform should have areas that correspond to the activities of each stakeholder. The most obvious areas are the client area, the ESCO area and financing entities area. Also, regular clients can be differentiated in two types, which are clients with a performed energy audit and clients without any project.

For the ESCO area, ESCOs must be able to choose if they are able to finance the project by themselves or if they need extra financial means provided by a financial entity. This means that financial entities will only interact with the platform in the case that ESCOs cannot finance a project.

The following scheme was proposed by stakeholders present at a focus group:

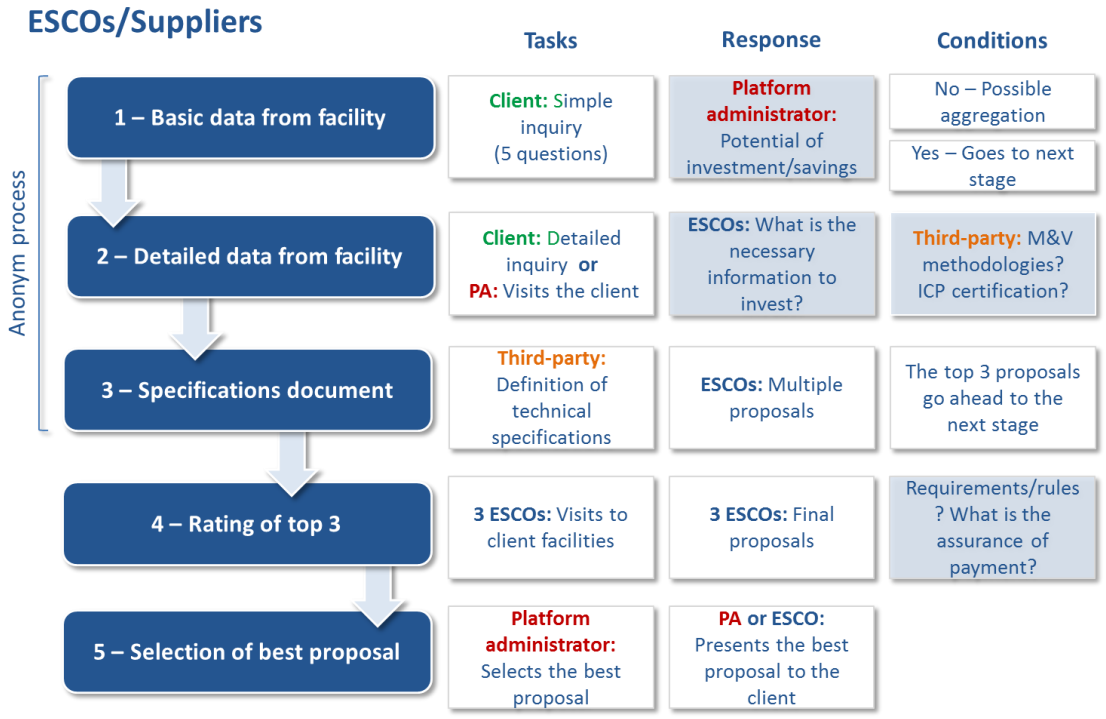

Figure 1 – Scheme of web portal functionalities (discussed in the focus group).

The scheme presented in figure 1 was the written summary of the focus group with stakeholders and it aimed to describe how the platform should work and who would be the intervenient at each stage.

3.1.1 Original Business Cases

The following use cases were defined based on the original scheme of the platform. These use cases represent the steps that different users have to take in order to successfully use the platform.

3.1.1.1 Implementation or financing of project with previous study

This business case divides itself in two different possibilities:

1. The client has a previous study that identifies the savings potential and wants to find an ESCO to advance with the project;
2. The client has a previous study that identifies the savings potential and wants to find a financial entity that funds the project.

If a third cases happens, where the client wants both an ESCO and the financial entity what happens is that the project reaches the ESCO with the indication that there are no funds for the project.

This use case was latter replaced due to the fact that in most cases the client needs both the expertise to implement the project and the funds to advance with the project. Also, it is difficult to find a client with a high-level study performed. To make the platform more user-friendly, the client only has to submit enough data that allows ESCO and financial entities to evaluate the project and submit a proposal.

In case number 1, the ESCO will be responsible for the implementation of the project. The investment needed will be provided by the ESCO, by the client or by a third-party. The process, in this case, will be the following:

- Client: Enter the website;
- Client: Accesses the “Client Area”;
- Client: Choose the option of “I want to find an ESCO to implement the project”;
- Client: Answers some questions about the current state of the building;
    - Lighting – Questions regarding installed power, technology, etc.
    - Photovoltaic – Questions regarding peak power consumption, space available, etc.
- Client: Answers some questions about the potential identified by the ESCO
- Third-party: Makes an estimate of the savings potential (based on the current building situation reported by the client) and compares it with the potential identified in the client’s previous study. The objective of this step is to check if the savings assessed in the previous study are in the same order of magnitude as the savings estimated based on the clients’ feedback. This leaves out the possibility of savings being over or underestimated;
- Third-party: Treats the data of the building and elaborates a measurement and verification plan;
- Third-party: Schedules a meeting and a facilities visit to verify the data introduced by the client in the portal;

    - Maybe the visit to clients' facilities can be replaced by answering a detailed questionnaire in the web page;
- Third-party: Calculates the potential savings with the information extracted on the facility visit and shares it with the client;
- Third-party: Writes a specifications document to publish in the "ESCO" area of the portal in order to obtain a proposal;
    - All registered entities will be warned, via email, about the publishing of the specifications document;
- The next steps are described in the ESCO business case.

In the second business case, the client only wants to find an entity that is willing to finance its project. In this case it will be the client themselves, or a third-party hired by the client. The process will be the same as in the previous case except that, on step 3 the client chooses the option that only needs the financing. The steps after the specifications document is completed are also different and will be detailed in the Financial Entity business case.

3.1.1.2 Implementation or financing of project without previous study

In this business case the first step is to evaluate the potential for energy savings in the clients' facilities. For that purpose, the client can go to the platform and follow these steps:

- Client: Enters the web page;
- Client: Accesses the Client area;
- Client: Can choose two options: Being contacted (if he does not know how to describe his facilities with enough detail) or to describe the facility (where he must answer an inquiry giving every detail that the ESCOs need to elaborate a proposal);
    - In the case the client wants to be contacted, a third-party will schedule a visit to the facilities and assess the savings potential.
    - In case that the client wants to describe his facilities he must answers some questions about the current state of the building as in the previous use cases but with more details;
- Third-party: Makes an estimate of the savings potential based on the data collected during the visit to the facilities.
- After performing the previous steps, the next steps are similar to the development of the M&V plan and all steps that follow, in the previous use case.

3.1.1.3 Implementation of project with an ESCO

This business case can be divided in two distinct possibilities:

1. The ESCO wants to implement projects;
2. The ESCO wants to implement and finance projects;

In the first case, the ESCO registers only to the ESCO area of the platform but in the second case the ESCO registers to the ESCO and Financial Entity areas. The following steps are the steps that ESCOs must follow:

- ESCO: Enters the website;
- ESCO: Accesses the ESCO area and registers in the proper areas (where they intend to act);
- ESCO: After login-in, ESCO will be able to access the specification documents from every project available;
- ESCO: Can send a proposal to any project;
- ISQ: Chooses the three best proposals and contacts the respective ESCOs;
- ESCO: Visits the clients' facilities and can make changes to the original proposal in order to adapt to any discrepancies noticed between the details provided by the client and the situation observed on-site;
- Client: Chooses one of the final proposals;
- ESCO: Implements the project and pays a fee to ISQ, in order to cover the costs of the audits performed.

3.1.1.4 Financing of project by a financial entity

- Financing entity: Enters the portal and accesses the Financing Entity Area;
- Financing entity: If the user is logged in the platform it will be able to access the specifications documents of all available projects at the moment;
- Financing entity: Can submit a proposal to any project;
- ISQ: Chooses the three best proposals;
- Financing entity: If the proposal was one of the approved proposals, the financing entity can ask to visit the client facilities and based on the information gathered on the visit the financing entity can make small changes to the original proposal;
- Client: Chooses the best proposal;
- Financial entity: Finances the project and pays a fee to ISQ, in order to cover the costs of the audits performed.

3.2 Refined approach

After the focus group some weak points were found in the original idea. Behind the original idea was the view that some building owners will not be able to provide the necessary details for ESCOs to see the building's potential for ECMs and that all project and proposal have to be evaluated by the platform administrator. The problem with this is that it requires a lot of intervention of third-parties (being an independent third-party or the platform administrators) which will increase the amount of work hours spent on each project and consequently increasing the prize of the EPCs to the clients.

If the goal is to promote EPCs and make them more appellant to the clients it is paramount that some of these costs are reduced. To do that, the evaluation of project and proposals can be done by software, leaving only the platform administrator with a top three proposals validation role.

As for the supply of details about the building, this role will have to stay with the building owners in order to reduce costs, but the platform will provide contacts in the event that the building owner finds that help is required in this stage. The same happens with the selection between the final proposals, the client will be responsible for choosing the proposal but a third-party can be contacted to oversee this process and assure that clients get the best possible deal.

The only process that building owners cannot be responsible for is the ICP certification or a similar certification. This certification is not mandatory but it could be a way to attract more ESCOs to a certain project. The entity that would perform the certification could them be included in the final contract so that there is no upfront cost of the certification for the client.

The second problem that was identified was the existence of the ESCO and the financing entity. This is a problem because the evaluation method of the proposals is partially based on financial parameters, such as return of investment. If there is separate proposal of an ESCO and financial entity, it will be harder to judge these parameters and thus, a partial proposal might be apparently more attractive than a full proposal, because it is ignoring additional costs that will be brought by the other party.

The platform will allow financial entities to partner with the platform and after the partnership is established the financial entity will be recommended to ESCOs, in the case that they need third-party financing. To register and become a platform partner, financial entities should follow the same registry procedure as ESCOs. Despite that, it is recommended that ESCOs include financing in their proposals so that it can achieve a higher rating in the scoreboard.

According to this information, the new use cases are based on the existence of four different types of users: non-authenticated user, authenticated user type 1, authenticated user type 2 and administrator.

The non-authenticated user is the common user that opens the portal and does not log-in as another type of user. This user can see the main page of the platform but he does not have access to any specifications of on-going projects or access to submitting any type of project. This level of access is intended to teach the user how to use the platform and its objectives, as well as stimulate this user into the possibility of engaging in the platform by submitting a project or a proposal.

Type 1 authenticated user is a user with access to the project submission module (will be specified in the next chapter) where it is possible to submit a new project. This user also has the access to see the current status of his own projects. The most typical “Type 1 user” will be building owners or building energy/systems managers.

Type 2 authenticated user is the user that has access to every project that was submitted and that can submit proposals to each project. The typical “Type 2 user” will be ESCOs.

Finally, the administrators are the users that, besides having access to all submitted projects and proposals, he has the contacts of every user and can make slight changes in projects (not proposals). If an administrator changes something in a project, the user that submitted the project will be notified. The administrator also has to approve the registry of "type 2 users". On the other hand, "type 1 users" can register on the platform without any sort authorization needed.

The following scheme explains the idea proposed after the identification of weak points on the scheme created by the focus group:

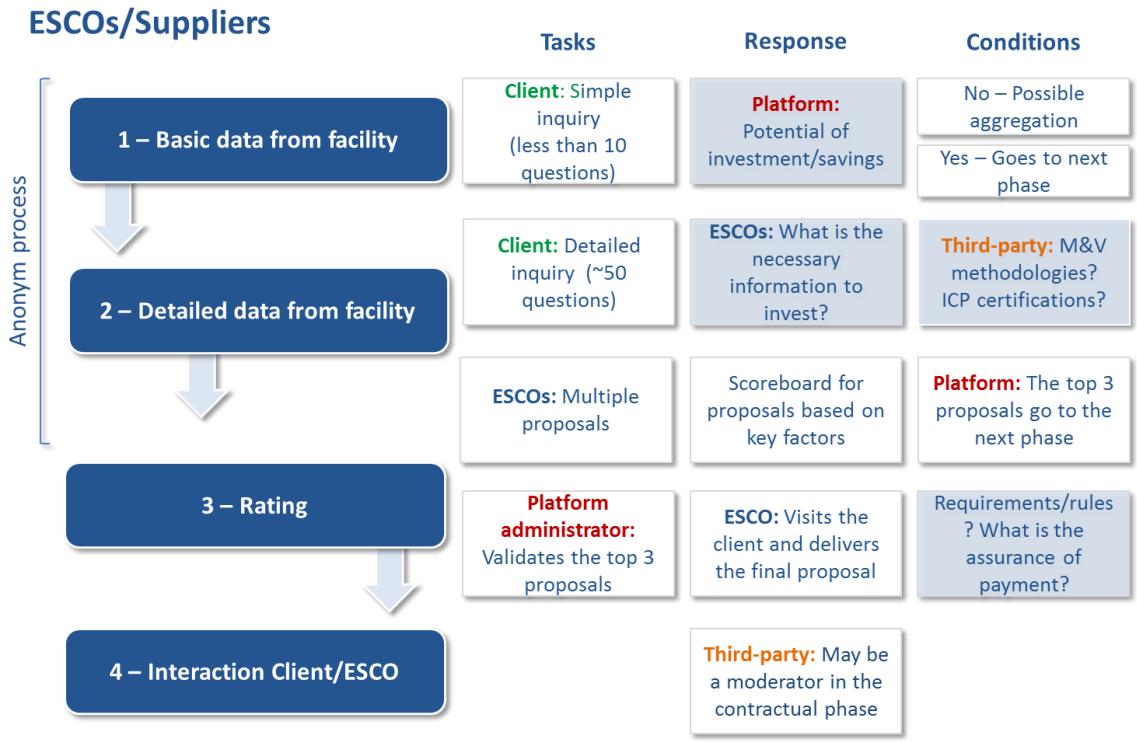

Figure 2 – Scheme of web portal functionalities (simplification of focus group scheme).

3.2.1 Refined Business Cases

The following use cases were based on the original use cases with the difference that the new use cases try to address every problem identified after the definition of the original use cases.

3.2.1.1 Submission of project

This business case is common to all building managers/owners that access the platform. When one of these stakeholders access the platform it is expected that they already know what the platform offer. The following steps must be taken by these users in order to submit a project:

- Client: Enters the web page;
- Client: Registers as a building manager/owner;
- Client: Enter the "Project Submission" area;
- Client: Enters the first stage of submission but giving some details about the building;

- Platform: Delivers an automatic message with the potential of savings in the client facilities;
- Client: Enters the second stage of submission where the client can submit more details about two different areas:
    - Lighting – Questions regarding installed power, technology, etc.
    - Photovoltaic – Questions regarding peak power consumption, space available, etc.
- The next steps are described on the ESCO business case.

3.2.1.2 Implementation of project as an ESCO

The ESCO business case is the only business case that remained equal to the original idea. ESCOs should follow the steps described in 3.1.1.3, which describe how ESCOs submit a proposal to a project and how they must proceed in the case of having one of the best proposals.

3.2.1.3 Financing projects without the implementation

The financing entity business cases main difference to the original idea is that these type of entities are no longer able to submit a proposal for financing a project. The reason for this is that the original system would cause confusion, for ESCOs and clients, about who should finance the project. In the current state of the platform, financing entities can communicate with the platform administrator and form a partnership for financing projects. After this, every project without financing details will be forward to these entities and all ESCOs will be informed that if they need a financing partner they can speak directly to these entities.

After contacting the platform administrator and a partnership is established, financing entities will be provided a username and a password to gain access to the platform with the same level of access as ESCOs.

4 Development Strategy

ESCO markets have being receiving promotion support from the EU in the last 10-15 years. These efforts translated into an expansion trend in ESCO markets, especially the growth of the Energy Performance Contracting scheme. The platform developed follows this trend by disseminating these type of contracts and, very importantly, increasing the confidence of the potential clients. This chapter presents the drivers focused strategy used to develop the matching platform.

4.1 Technical architecture

The platform was developed on .NET Framework, which provides guidelines for the programming. Upon this framework, C# programming language was used to set the instruction that will comprise of the platform's back-end. The back-end of the platform will also interact with a SQL server database, that stores and provides the data requested by the application itself.

To provide the front-end, a syntax view engine was used (Razor). This enables to optimize the syntax of the front-end by making a transition between the C# code and the HTML front-end.

Finally, the platform will be hosted on a virtual machine provided by Microsoft cloud services (Azure). Azure's policy of "pay as you go" allows that the platform as enough room to grow in terms of user accesses and database size without compromising the user experience.

4.2 Platform components

The platform was divided into 9 different modules so that it is easier to define the authorizations of each user and also easier to separate the different tasks that the platform has to perform.

The **Generic** module is the module that includes the generic functionalities of the platform. These functionalities will be specified as platform requirements (Chapter 5).

Home is the module that corresponds to the initial page of the platform. This is the information that will be accessible to all type of users, giving some information about on-going projects and how the platform works.

Profile is a module that is different for each user. The objective of this module is allowing registered users to edit their personal information and see some statistics of their projects or proposals.

Project Submission is where type 1 users submit their project by answering a couple of key questions that allow to determine the savings potential.

The **Project Analysis** module is the module that calculates the savings potential. Administrators can slightly adjust this calculation in case that it is suspected that savings are being over or underestimated and are the only users with access to the module.

Project Display is a module only fully accessible to type 2 users and administrators and is where all current projects are displayed during the tender period. Type 1 users can also access this module but they can only consult projects that they submitted themselves.

The **Proposal Submission** module is the module that type 2 users access to submit a proposal to a certain project.

Proposal Visualization allows type 2 users to consult the proposal that they have submitted and their current status.

Proposal Analysis is a back-end module that does an automatic analysis to the proposals and creates a ranking with the best ones. The only user that can access this module is the administrator and only as a "read only" user, which means that they can see the rating of the proposal but they cannot edit anything in this module.

Project Analysis and Proposal Analysis are probably the two more complex modules since these are the only modules with back-end automatic calculations.

Project Analysis uses four sets of equations on the back-end. Two of those are to calculate the project potential and the others are to calculate the expected reduction in the monthly bills.

The following equation is used for the assessment of potential of a lighting replacement project:

$$X_{lighting} = \int Lamps_{type\ X} * \left(Power_{Lamp\ Type\ X} - Power_{LED\ replace}\right) * WorkHours_{per\ year}$$

$$Y_{lighting} = \int Lamps_{type\ X} * Price_{per\ lamp}$$

$$if\ \left(X_{lighting} * Payback\ Period_{typical} > Y_{lighting}\right)\ and\ \left(Y_{lighting} > Investment_{minimun}\right):$$

$$FEASIBLE\ PROJECT$$

$$else: THE\ PROJECT\ MIGHT\ NOT\ BE\ FEASIBLE$$

Eq. 1

Type X corresponds to the different type of lamps; $Power_{LED\ replace}$ corresponds to the typical power of the LED replacement for that type of lamp; $WorkHours_{per\ year}$ is an estimate of the amount of hours that the lights are on, given by the user; The remaining variables correspond to typical values of power, prices, payback periods and minimum investment values.

$$Savings_{Lighting} = \int Lamps_{type\ X} * \left(Power_{Lamp\ Type\ X} - Power_{LED\ replace}\right) * WorkHours_{per\ month} * Electricity\ Price_{typical}$$

Eq. 2

Equation 2 gives an estimate for potential savings and it is similar to the equation 1, except that it adds a typical value for electricity price in order to calculate savings in euros/pounds.

Equation 3 is the assessment of potential of a self-consumption photovoltaic project:

$$X_{pv} = Power\ penalty * Energy\ Cost_{yearly} * A$$

Eq. 3

$$Y_{pv} = \frac{Energy\ Consumption_{monthly}}{B} * A * PV\ implementation\ cost_{typical}$$

$$if\ \left(X_{pv} * Payback\ Period_{typical} > Y_{pv}\right)\ and\ (Available\ Area > Minimun\ Area):$$

$$FEASIBLE\ PROJECT$$

$$else: THE\ PROJECT\ MIGHT\ NOT\ BE\ FEASIBLE$$

The power penalty is value that depends on how close the energy consumption is to the maximum energy that could be consumed; A is a ratio between energy consumption during the day and energy consumption during the night; B is the photovoltaic production potential of each region; PV implementation cost is a typical value for these type of projects and it is variable according to the installed peak power; Payback period and minimum area are based on typical values.

Additionally, equation 4 provides the formula for the calculation of savings in the photovoltaic projects:

$$Savings_{pv} = Energy\ Cost_{monthly} * A * Power\ penalty \qquad \text{Eq. 4}$$

The Project Analysis module also uses a set of equation for producing the rating of received proposals. The ranking is made based on several economical and technical parameters, which have different weights according to their relevance for the evaluation.

The raking values range from 0 to 200 and all proposals are ordered by the value obtain from the equation. This equation evaluates the following parameters:

- For every type of project
  - Payback period
  - Estimated savings
  - Initial investment
  - Maintenance
  - Subcontracting
  - Work deadlines
  - Elevation platforms
  - Administrator proposal evaluation
- For photovoltaic projects
  - Monitoring
  - Estimated production
  - Number of panels
  - Panel warranty
  - Peak power installed
- For lighting projects
  - Installation works
  - LED power installed

- Lights warranty

High scores mean that the proposal was evaluated as a good proposal. This evaluation methodology is not comparative, meaning that it is possible for several proposals to achieve the highest score. As a rule, the platform will provide the contact of the three ESCOs with the respective higher score proposals, however in the case of a score tie the platform can provide more than three contacts.

4.3 Front-end interaction

Based on the modules defined above some schemas were created, to show what are the actions that the different users can perform on each module. The description of each action can be found on chapter 5, with the respective requirements.

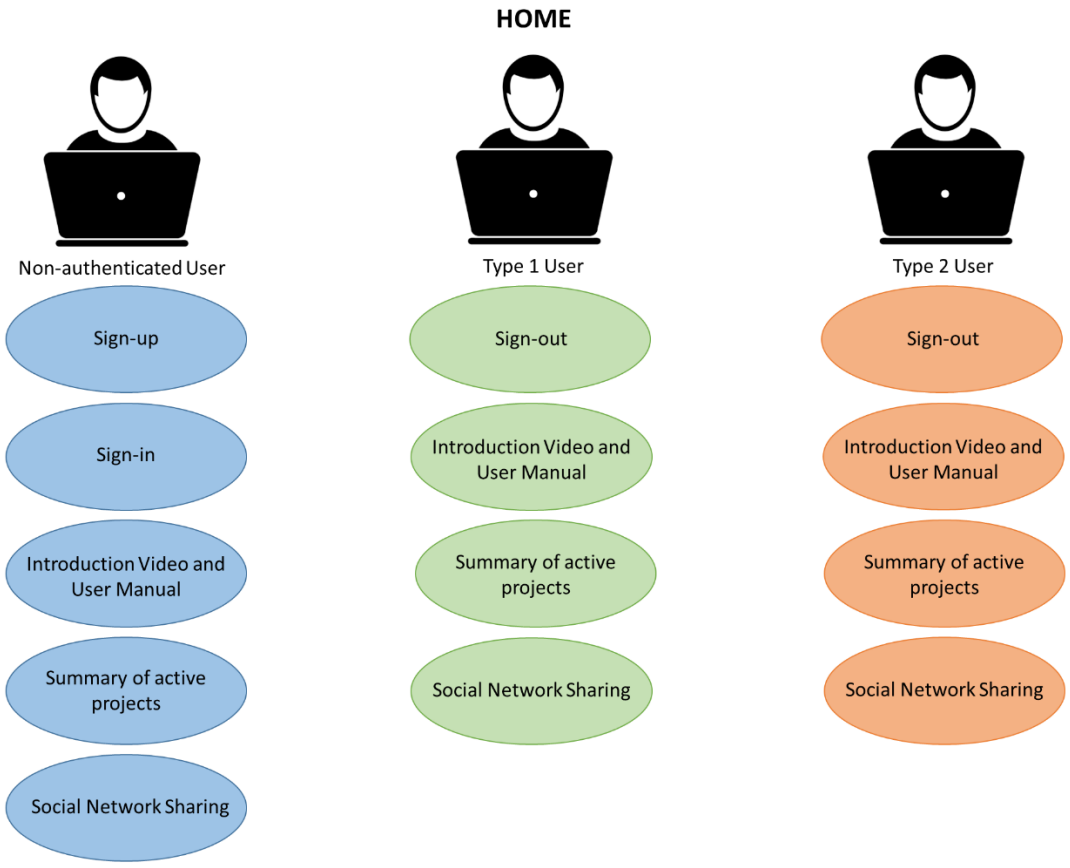

Figure 3 – Functionalities available on the HOME module.

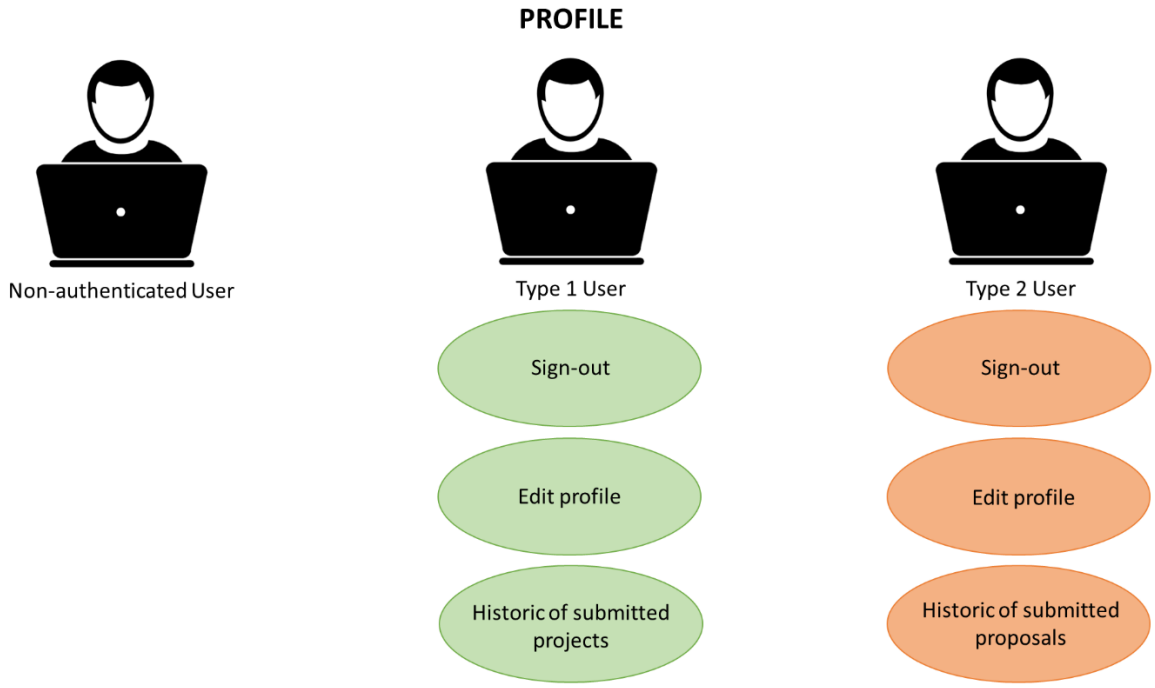

Figure 4 – Functionalities available on the HOME module.

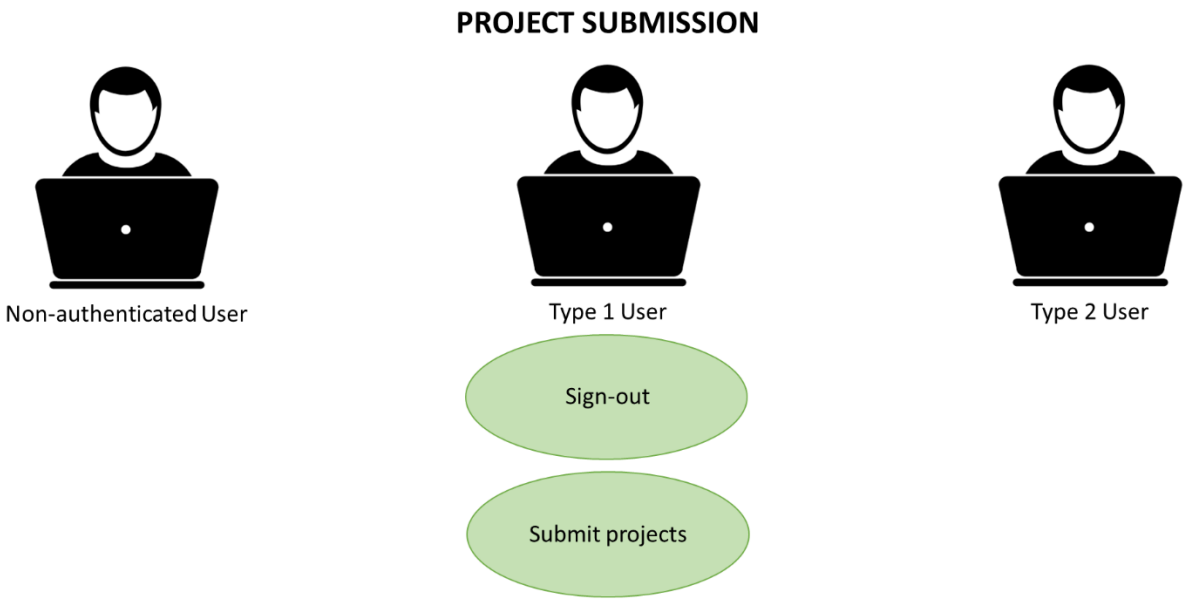

Figure 5 – Functionalities available on the HOME module.

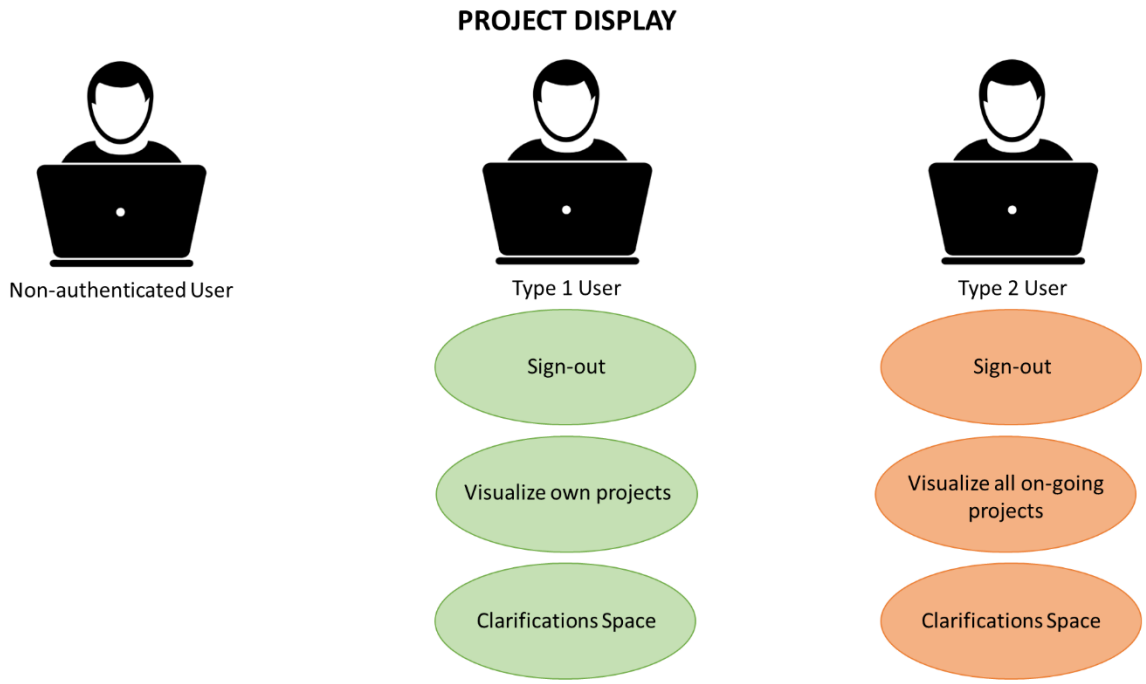

Figure 6 – Functionalities available on the HOME module.

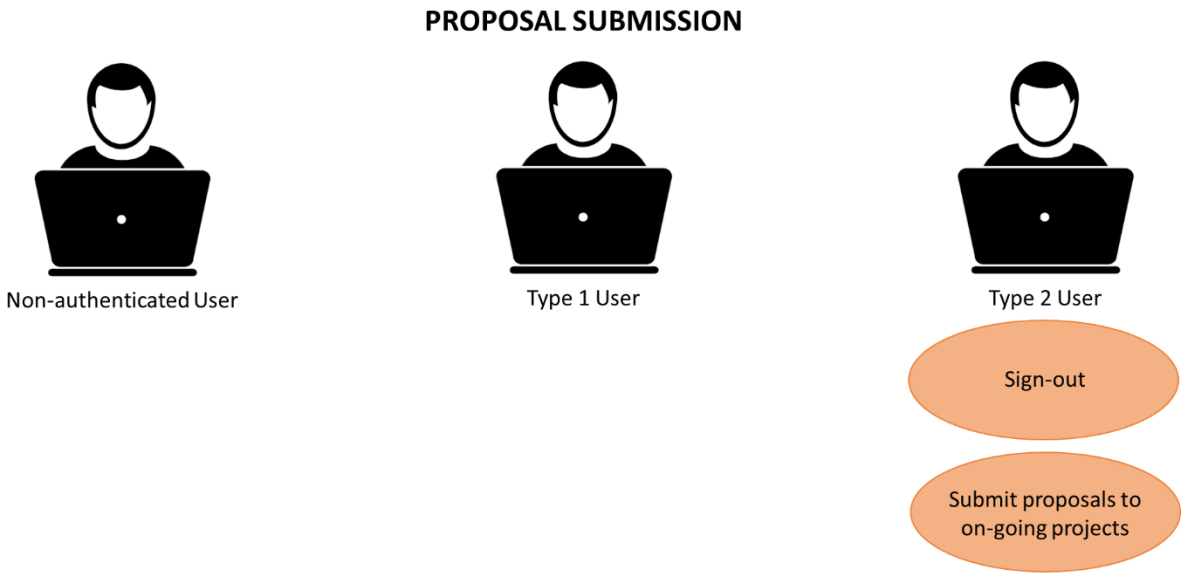

Figure 7 – Functionalities available on the HOME module.

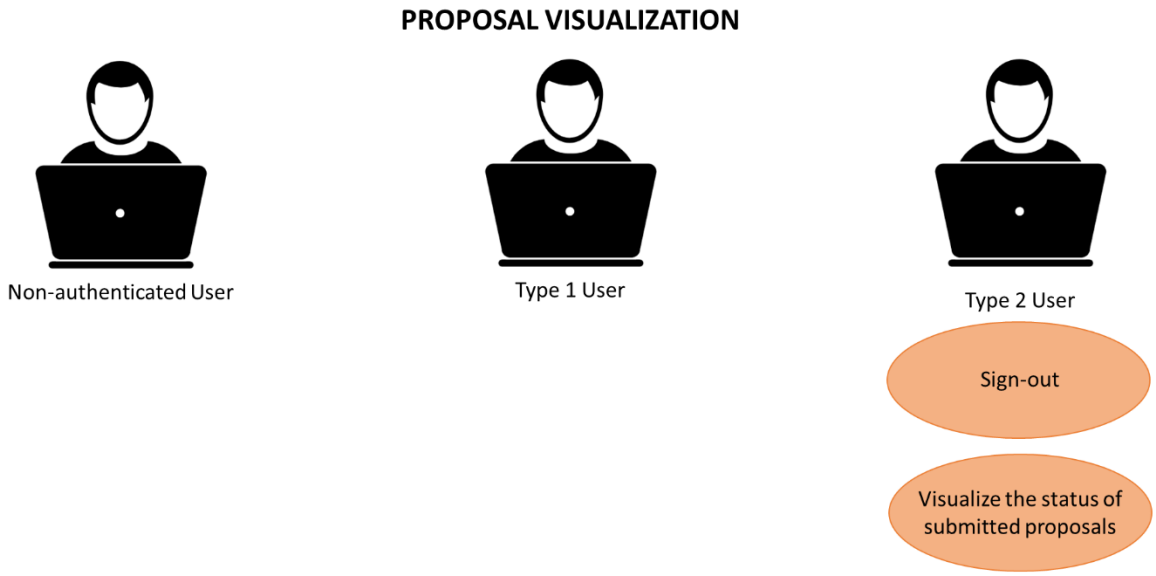

Figure 8 – Functionalities available on the HOME module.

5 Platform requirements

The platform requirements are features that the platform must include to be able to perform the function that was built for. These requirements are identified previously to the start of the platform development and ensure it is ready to serve its purposes.

Requirements can be divided between functional, non-functional and design. The difference between these is that functional requirements should answer to what the system should do, while non-functional requirements should answer to how the system should perform. Design requirement are related to the necessities of end-user interactions with the platform.

5.1 Functional requirements

The functional requirements match the actions that were specified in chapter 4. The defined functional requirements and descriptions are:

ID	HOME_001
Name	Introduction Video
Description	Video introducing what the platform is and how it works.
Module	HOME

ID	HOME _002
Name	User Manual
Description	In a simple way, the home page should include a user manual that shows how new users can interact with the platform.
Module	HOME

ID	HOME _003
Name	Platform Sign-up
Description	The home page should have a feature that allows users to sign-up to the platform.
Module	HOME

ID	HOME _004
Name	Platform Sign-in
Description	The home page should have a feature that allows users to sign-in.
Module	HOME

ID	HOME_005
Name	Sign-up limitation
Description	Each user can only sign-up once per email account.
Module	HOME

ID	HOME_006
Name	Password Recovery
Description	Every user should be able to recover its password using their respective email address.
Module	HOME

ID	GENERIC_001
Name	Footer
Description	Every page of the platform should have a footer with brief information about the ClimACT project and other relevant information.
Module	GENERIC

ID	GENERIC_002
Name	Social Networks Sharing
Description	The platform should allow to share the HOME page on social networks (such as Facebook or LinkedIn), through an appropriate feature in the footer..
Module	GENERIC

ID	GENERIC_003
Name	Platform Sign-out
Description	The platform should allow all users that have signed-in to end their current session.
Module	GENERIC

ID	GENERIC_004
Name	Access limitation to non-authenticated users
Description	The platform should only allow non-authenticated users to access the HOME page.
Module	GENERIC

ID	GENERIC_005
Name	Access limitations to type 1 users
Description	The platform should allow type 1 users to access the following modules: HOME; PROFILE; PROJECT SUBMISSION; PROJECT DISPLAY (limited).
Module	GENERIC

ID	GENERIC_006

Name	Access limitations to type 2 users
Description	The platform should allow type 2 users to access the following modules: HOME; PROFILE; PROJECT DISPLAY; PROPOSAL SUBMISSION; PROPOSAL VISUALIZATION..
Module	GENERIC

ID	PROFILE_001
Name	Visualization and editing of personal data
Description	The platform should allow to visualize and edit the personal data that users submitted.
Module	PROFILE

ID	PROFILE_002
Name	Projects/Proposals Counter
Description	Shows users how much projects/proposals they have submitted.
Module	PROFILE

ID	PROFILE_003
Name	Historic of submitted proposals
Description	The user should be able to see his record of submitted proposals. Connected to the module PROPOSAL VISUALIZATION.
Module	PROFILE; PROPOSAL VISUALIZATION

ID	PROFILE_004
Name	Historic of projects submitted
Description	The user should be able to see his record of submitted projects. Connected to the module PROJECT DISPLAY.
Module	PROFILE; PROJECT DISPLAY

ID	PROJECT_SUBMISSION_001
Name	Project data upload
Description	Type 1 users must be able to access tables where they should upload the relevant data for the project. This upload will be divided in two stages. The first stage requires only 7 details about the user's building. The second stage is a more detailed table which is editable during 24 hours and after that the project is automatically submitted.
Module	PROJECT SUBMISSION

ID	PROJECT_ANALYSIS_001

Name	Project feasibility
Description	The platform should do a first assessment of the project feasibility based on the data provided from the first stage of project submission and give an alert to inform the user about the apparent level of feasibility of his project.
Module	PROJECT ANALYSIS

ID	PROJECT ANALYSIS_002
Name	Data Coherence
Description	The platform must guarantee that the data submitted in the module PROJECT SUBMISSION is coherent.
Module	PROJECT ANALYSIS; PROJECT SUBMISSION

ID	PROJECT_DISPLAY_001
Name	Project data publishing
Description	Type 2 users should have open access to this module where he can consult project details. Type 1 user should also have access to this module but he must only be able to see project submitted by himself.
Module	PROJECT DISPLAY

ID	PROJECT_DISPLAY_002
Name	Clarifications space
Description	Type 2 users may ask for clarifications about the projects so in the page of each project there should be an open question/answer box that will be available to all type 2 users. There should be a limited time to submit questions and answers in this space.
Module	PROJECT DISPLAY

ID	PROJECT_DISPLAY_003
Name	Clock Visualization
Description	In this module, users should be able to see a clock that shows how much time is left until the end of the tendering phase of a project.
Module	PROJECT DISPLAY

ID	PROJECT_DISPLAY_003
Name	Search and filters
Description	It should be possible to search a project, within this module, by keywords and insert filters by country and by type of project.
Module	PROJECT DISPLAY

ID	PROPOSAL_SUBMISSION_001
Name	Upload of proposal in PDF format
Description	Type 2 users have to submit the proposal in PDF format. They can overwrite this proposal until the end of the tendering period.
Module	PROPOSAL SUBMISSION

ID	PROPOSAL_SUBMISSION_002
Name	Proposal example file
Description	The platform should provide a template for a typical proposal in an editable file (docx) for all type 2 users.
Module	PROPOSAL SUBMISSION

ID	PROPOSAL_SUBMISSION_003
Name	Proposal data upload
Description	Besides the upload of the proposal PDF file, type 2 users should provide data to some specific answers, necessary to evaluate the proposal. This data will also be editable until the end of the tendering phase.
Module	PROPOSAL SUBMISSION

ID	PROPOSAL_SUBMISSION_004
Name	One proposal for multiple projects
Description	The type 2 user is allowed to selected more than one project when submitting a proposal. This means that he as to submit only one PDF file but needs to answer questions regarding individual buildings. To be considered a top proposal this proposal will have to compete with proposals from multiple projects, meaning that it will be statistically harder to have a top proposal.
Module	PROPOSAL SUBMISSION

ID	PROPOSAL_VISUALIZATION_001
Name	Submitted Proposals
Description	Type 2 users can use this module to access every detail of every proposal that they have submitted and also to edit the details of on-going projects.
Module	PROPOSAL VISUALIZATION; PROPOSAL SUBMISSION

ID	PROPOSAL_ANALYSIS_001
Name	PDF file analysis
Description	The platform should evaluate the PDF file submitted by search for specific keyword. These keywords can be edited by the administrator.
Module	PROPOSAL ANALYSIS

ID	PROPOSAL_ANALYSIS_002
Name	Scoreboard
Description	Only the administrator should have access to the scoreboard, which shows the rank of proposals according to the algorithm that ranked the proposals automatically. Once the tendering period is finished the top 3 proposals will be revealed.
Module	PROPOSAL ANALYSIS

ID	PROPOSAL_ANALYSIS_003
Name	End of tendering period
Description	At the end of the tendering period, the users that submitted the top 3 proposal will be revealed in the HOME page, next to the respective project details.
Module	PROPOSAL ANALYSIS; HOME

5.2 Non-functional requirements

The following non-functional requirements were defined:

ID	NFR_001
Name	System Availability
Description	The system should have a high availability (98%).
Module	GENERIC

ID	NFR_002
Name	System Portability
Description	The platform should work on the main web browsers: Chrome and Firefox.
Module	GENERIC

ID	NFR_003
Name	System Efficiency
Description	The platform should process any service in no more than 20 seconds.
Module	GENERIC

ID	NFR_004
Name	Social Networks

Description	The platform should allow to share public information on social networks such as: Facebook or LinkedIn.
Module	GENERIC

ID	NFR_005
Name	Platform Easy Use
Description	The user should be able to operate the platform after reading the user manual.
Module	GENERIC

ID	NFR_006
Name	Sign-up confirmation e-mail
Description	The user should receive an e-mail to confirm his registration to the platform.
Module	HOME

ID	NFR_007
Name	Project submission confirmation e-mail
Description	The system should send an e-mail to confirm the submission of a project.
Module	PROJECT ANALYSIS

ID	NFR_008
Name	Monthly e-mail of on-going projects
Description	The system should send an e-mail to all type 2 users every month, with the list of on-going projects.
Module	PROJECT DISPLAY

ID	NFR_009
Name	Proposal submission confirmation e-mail
Description	The system should send an e-mail to confirm the submission of a proposal.
Module	PROPOSAL ANALYSIS

ID	NFR_010
Name	Proposal status e-mail

Description	There are three possible statuses: accepted; not accepted and does not fulfill the requirements. The system should send an e-mail with the correct status of a proposal after the end of the deadline to submit a proposal and/or after the validation of the administrator.
Module	PROJECT ANALYSIS

ID	NFR_011
Name	Password Recovery E-mail
Description	The users are able to reset the password through their e-mail address if needed.
Module	HOME

ID	NFR_012
Name	Project submission optional e-mail
Description	This option can be selected in the PROFILE module and it will send a warning e-mail every time a project is submitted. The user can also use a filter to only receive e-mail notifications if a project is submitted in a specific country..
Module	PROFILE

ID	NFR_013
Name	Project “Follow” option
Description	An option can be selected on PROJECT DISPLAY to give an alert to every clarification requested. Also, this e-mail can warn about changes of project deadlines, and other relevant information.
Module	PROJECT DISPLAY

ID	NFR_014
Name	Notification system in PROFILE
Description	The system should provide a notification to every alerts described in NFR_012 e NFR_013
Module	PROFILE

ID	NFR_015
Name	Type 2 user validation need
Description	After the sign-up, type 2 users cannot be automatically active. To be active, these accounts need to be validated by an administrator.
Module	PROFILE

5.3 Design requirements

The design requirements are the following:

ID	DES_001
Name	Navigation between platform pages
Description	The platform must have a menu that allows users to navigate between the different modules.
Module	GENERIC

ID	DES_002
Name	Auxiliary Messages
Description	Auxiliary messages should be shown in appropriate places and when needed (i.e. success notifications, error when filling in a form, etc.).
Module	GENERIC

ID	DES_003
Name	Additional clarifications
Description	A chat (bot or similar) window should allow users to clarify simple doubts without the use of an email or phone number
Module	GENERIC

ID	DES_004
Name	Language
Description	The platform should be written in two different languages: English and Portuguese.
Module	GENERIC

6 User Manual

The user manual is a guide that any type of user can follow to learn how to navigate through the web page. This chapter will be included within the platform as a question and answer section, so that users can have an available guide map to use when they first access the platform. The user manual should be really simple but has to communicate all necessary information about how use the platform.

6.1 Building owner/manager

If you are a building owner/manager the first time you should register. After clicking the "Login" button in the centre of the page you should choose the option "Register new user", as it shows in the figure below. When registering you must select the option of registering as a building owner/manager, on the "Role" box.

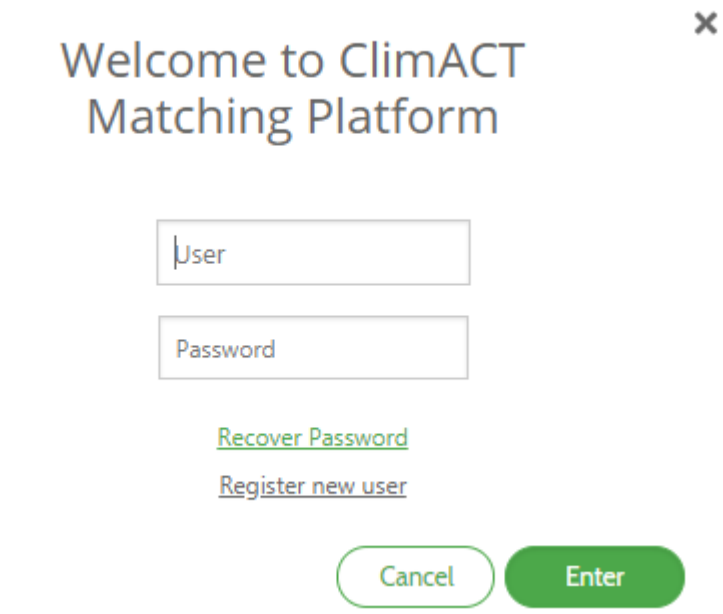

Figure 1 – Login pop-up

After validating your account through the email that was sent to your in-box, you can sign-in and search through the building owner/manager menu. In this new menu (figure 2), that became available after signing in, you can look into your user profile and use the project page where you can submit and see details of your project.

Figure 2 – Menu of type 1 user on the top right corner of the page

In the user profile it is possible to edit the personal information that was given during the registration and look into your record of submitted projects.

The project page is where you can submit new projects. To do that you have to use the “Create Project” button and give the necessary details about your building. After this first stage, a pop-up will appear saying the level of potential of your building. Even if you have a high or low potential for the application of energy efficiency measures you automatically proceed to the next stage, where you have to provide more details about your building in order to allow ESCOs to use that data to build a proposal for your project. If you are unable to fill-in the required fields, the platform has the option to contact a third-party that will evaluate the potential of your building (this third-party can charge you the evaluation or can ask for a percentage of the savings that you obtain in the future to cover the costs of the evaluation).

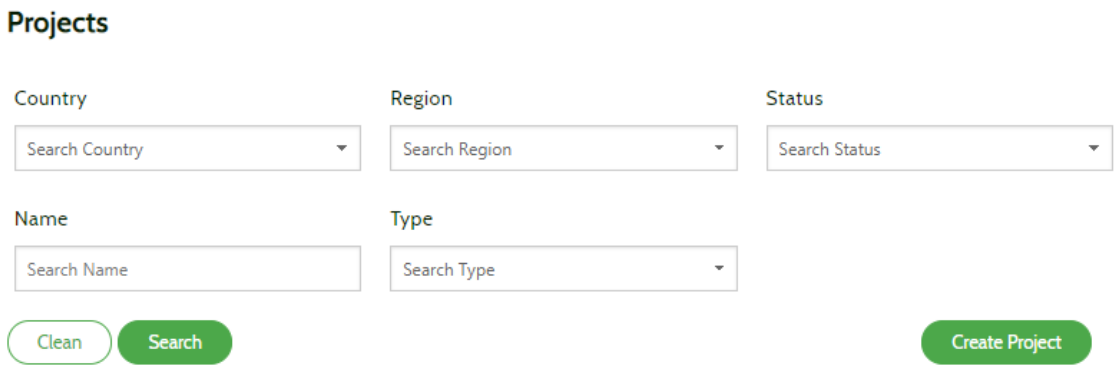

Figure 3 – Project submission feature of platform

If you finish to fill-in the field with success, your project will be put on hold for 24 hours and after that period will be submitted automatically. This period of 24 hours in meant to leave you room to make changes because after the project is submitted you will not be allowed to make changes. To consult the status of your project you can use the Project tab on the menu. Your project will them be open to proposals during the period of 25 workdays and during the first 10 workdays ESCOs can submit question about your building, which you should answer within 48 hours to maximize your chances of receiving competitive proposals. After the closing of the proposal phase you will be contacted by the platform managers, which will provide you access to the three proposals that were evaluated as best on the technical and financial categories.

To finalise the proposal ESCOs will need an on-site visit and, as the building owner/manager you should provide this access. After the ESCO visit you should choose one of the proposals. If you require any third-party assistance during this phase, the platform can indicate a company that will perform a third-party evaluation and give you an impartial opinion on the proposals.

6.2 ESCO

If you are an ESCO, your first step should be to register in the “Register new user” button, the same as for the other users. However, as you are registering, you should choose the ESCO option in the “Role”, which will require you to provide some additional information. Since ESCO users have to be approved by an administrator you will have to wait until you receive your confirmation email to be able to login.

After the login you will be faced with a new menu, that provides you access to new features such as: Profile, Project Display, Proposal Submission and Proposal Visualization.

In the profile it is possible to edit the personal information that was provided during the registry and also see a record of submitted proposals.

The project display module is where ESCO can visualize every project that is in tendering phase. During a specific time, ESCOs can also submit questions about the projects and ask for additional details that are considered relevant to build a proposal.

Proposal module is where ESCOs can go to submit a proposal to a project. After creating a new proposal, ESCOs must choose which project they want to add to the proposal, fill in some of the proposal details in specific fields and submit the full proposal file. Also, you may see the current state of your proposals. After the closing of the tendering phase, the platform will automatically rate the proposals and if your proposal is within the top three proposal that will be reflected in the project visualization module.

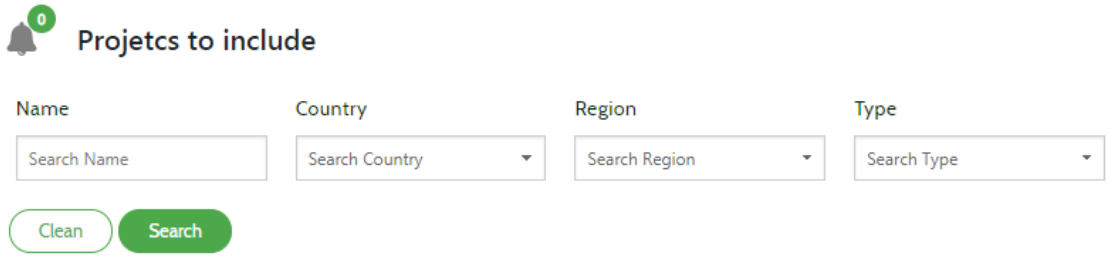

Figure 4 – Feature of platform to choose projects to add when submitting a proposal

7 Conclusion

The ClimACT platform is online since November 2018 but we are still lacking numbers/metrics to show the successfulness of the platform. Besides, the platform success is heavily dependent on direct dissemination to stakeholders, and since the platform is only the has only been a small event with stakeholders. More dissemination action is needed to reinforce the advantages of this platform and get more users. We estimate the platform to have an exponential growth as we need a large portfolio of projects to attract ESCO but also we need many ESCOs to increase the competitively and consequently, provide better deals for users.

From the information collected in the brief period that the platform is online it is possible to say that the users' reaction has been very positive, as they classify the platform as easy to use, interesting and different from other current platforms, that have the same goals but usually require sources such as crowd funding for financing projects.

8 References

ClimACT (2017) – ClimACT (2017), E2.7.1 – Easy Guide on EPC Business Models, Project ClimACT, Interreg SUDOE.

ClimACT (2017) – ClimACT (2017), E2.7.2 – Guidelines for Governments for the Adoption of EPC, Project ClimACT, Interreg SUDOE.

EC-JRC (2017), Boza-Kiss Benigna, Bertoldi Paolo, Economidou Marina, *Energy Service Companies in the EU - Status review and recommendations for further market development with a focus on Energy Performance Contracting*, EUR 28716 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-71475-7, doi:10.2760/12258, JRC106624.

Polzin et al (2016) – Polzin, F. von Flotow, P. Nolden, C. (2016), *What encourages local authorities to engage with energy performance contracting for retrofitting? Evidence from German municipalities*, Energy Policy 94 (2016) 317–330.

Shonder et al (2010) – Shonder, J. Morofsky, E. Schmidt, F. Morck, O. Himanen, M. (2010), *Best Practice Guidelines for Using Energy Performance Contracts to Improve Government Buildings*, Energy Conservation in Buildings and Community Systems Programme, IEA ECBCS Annex 46.

Transparense (2013), Szomolanyiova, J., Sochor, V. D3.1 Energy Performance Contracting Manual. Tranparense Project.

Trust EPC South (2016), Bišćan, M., Karan, M. D2.2 Overview EPC Market Insight Report. Trust EPC South Project.