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Smart Financing for Smart Buildings

Virtual One Stop Shops and IT tools

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Contents

Abstract

Within the framework of the initiative Smart Financing for Smart Buildings, the Joint Research Centre is supporting DG ENERGY in identifying the different Technical Assistance needs for households, ranging from basic information to tailored advice, Energy Performance Certificates to implementation support and finally by identifying the existing IT tools that could be used by financial institutions, public authorities or energy agencies in order to do a preliminary analysis of the most relevant projects, before engaging more resource intensive Technical Assistance services.

The report starts by giving an overview of best practices in virtual One Stop Shops where it evaluates the type of information needed for a homeowner or a financial institution to assess the best way to tackle a renovation project. Then, it goes into assessing publicly available IT tools that can be utilized by users in their renovation projects in order to help them to gather the most amount of information and the path to take in their renovation process. For this, an evaluation of both the contents and the user experience while using these IT tools has been made.

1 Introduction

The European Commission and the EIB are working together to establish financing platforms at a national (or multi-regional) level. To support the deployment of these platforms, the Commission aims to provide technical assistance support, especially to help households develop their renovation projects. In this context, the JRC prepared a study to advise financial institutions, public authorities and other aggregators about the most effective and efficient ways to reach and advise households in the context of the SFSB initiative.

Therefore, recent reports and other published material, e.g. articles, website, and relevant databases were analysed.

The following topics are covered in this report:

- The different Technical Assistance (TA) needs for households identified, ranging from basic information to tailored advice, Energy Performance Certificates to implementation support, and estimate the associated costs. Identification and analysis of best practices of IT-based One Stop Shops.
- Identification of existing IT tools that could be used by financial institutions, public authorities or energy agencies in order to do a preliminary identification of the most relevant projects, before engaging more resource intensive TA services.

Technical Assistance Working Definition:

The following is the definition of Technical Assistance used in this report:

Technical assistance is protocols/tool used to help a customer decide whether to invest in energy efficiency upgrades to their house. TA is provided as a decision- making support only and therefore halts at the time the decision is taken. A range of players may provide technical assistance - banks, energy agencies, developers, technical providers etc.

This report provides a high level detailed analysis on the technical assistance services and tools that are currently active. Included market players, are ESCOs, financial institutions, governmental agencies, and utility providers. The different actors providing TA services have been represented in terms of the TA tools that they use: IT tools, Excel, websites, one-on-one meetings, site visits, internal non-public credit calculations, etc.

2 One-stop-shop analysis

2.1 Introduction

This chapter is the result of an augmented analysis performed on "One-stop-shops" (OSS). In the report on one-stop-shops for energy renovations of buildings[1] prepared by the JRC in 2018, TA services were analysed and case studies were presented. The study was performed to gain further knowledge on what is available to households in terms of TA services, and what household needs are.

The analysis in this report was carried out by looking at the OSS sites in question from the customers' point of view (i.e. a homeowner). The work analysed the services offered, the manner in which the information was provided, the ease of access and process, and to what degree the sites satisfied a set of pre-established criteria. Further analysis was then done regarding whether there is a common denominator among successful operations, and if so, what was that denominator.

This was carried out not only to establish that TA services exist, but the extent to which they are user-friendly, what they offer, how they offer it. This aids in assessing how to provide future technical assistance support to help households develop their renovation projects. These best practices can then be adopted by financial institutions, public authorities or other aggregators, in order to educate them on the most effective and efficient ways to advise households, in the context of the SFSB initiative.

2.2 Methodology

The sites analysed were one-stop-shops (OSS). An OSS is a website, (office or a business) where the customer can acquire multiple services/products, and is provided with a solution for every step of the engagement process. This section will look at energy improvements and financing offered to households through these OSSs. For the sake of this report, the One Stop Shops evaluated only concern OSSs that are developed in an IT environment as for other types of OSS are covered in previous work made by the JRC.

2.2.1 Customer needs

One-stop-shops, ultimately target residential customers or their service providers. One of the primarily goals is providing information to customers so that they can then take action, therefore information is provided by creating or maintaining trust and in a simplified way. This report analyses OSS platforms within these parameters.

When information campaigns fail, it is relevant to go back and review where in the process these failures occurred. Below is a short explanation of the factors impacting actionable information campaigns:

Trust: People might not automatically trust the information provided by decontextualized interventions (Palmer et al. 2013). This is often an issue in the energy industry, for example, where utilities in some countries are not trusted players. This is why it is crucial to tailor the delivery of advice based on the target context. As an example, a trusted community (Scott et al. 2016) or institution (DellaValle et al. 2018) representative can facilitate the provision of information, complemented by events aimed to develop trust and energy culture

[1] https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/jrc113301_jrc113301_reportonones topshop_2017_v12_pubsy_science_for_policy_.pdf

In the case of OSSs, therefore, it is important that the information provider is respected and trusted in the target context. This can be a challenge when banks are looking to run platforms, unless they succeed at creating a trust relationship with members of the target context. Conversely, trusted local energy partners or independent public bodies, might have a competitive advantage.

Relevance: Information must be relevant to the user, throughout the whole process preceding the final decision. This entails taking the customer on a journey where all the steps are simplified. A variety of information strategies can help accomplish this goal:

- **Knowing your customer(s).** To increase the relevance of the information, it is critical to know the target audience. For example, some current OSSs aim to reach customers already knowledgeable about finance. Other OSSs might want to reach other types of customers, such as vulnerable households. Therefore, once defined the target audience, the OSS designers should tailor the language in a way that is easily understood.
- **Segmentation.** Even within the same target category, there will inevitably be many types of customers. Customers must therefore be grouped into relevant segments through the use of key variables (i.e., age, education, priorities, etc.)
- **Directed messaging.** In the marketing/outreach phase, it is important that marketing is directed to the customer segments. This is standard practice within industry. The same car will be sold using different sales messages in different countries, as well as within the same country. This allows a campaign to reach the maximum number of relevant customers.
- **Creating a journey.** Once customers are engaged, it is important that engagement lasts throughout the whole journey. An OSS site does not aim to merely inform customers, but rather to motivate them to take action. This can only be achieved if all information provided is relevant and adequate for all targeted customers. The first dedicated web-pages should therefore be intuitive and allow the customer to get immediate feedback about the stage of the process. In addition, alternative strategies should be designed to account for the different needs that different customers might have throughout the journey. These might include a more technically detailed FAQ section, specific descriptions, and means for the customer to request support directly. As an example, the customer support request form should include a telephone service, or a well-monitored "info@" email address, where customers will receive answers within a few hours of submitting their questions, as well as home visits. Such support measures require funding and must be included in the budget.
- **Motivate Action.** The aim of OSS sites is to enable customers to take actions that improve the efficiency of their homes, and provide guidance on the best practices and investment returns. To accomplish this goal, the information provided must be actionable. The fulfilment of each step should lead directly to the next step, not to lose the interest or the understanding of the customer. People fail to invest in energy efficiency not only because they do not have enough technical information, but also because the format of the information does not focus their attention on the relevant elements to make the investment decision. For example, the front page should inform the customer about the potential of home improvements by highlighting that is a way to avoid future losses (i.e. high energy bills) (Frederiks et al. 2015). In addition, it should provide a simplified space for them to add their own inputs. If the process to acquire and provide information has hassle and friction factors (Bertrand et al., 2004), it is likely that customers will interrupt or break off their journey. The site designers, therefore, must be mindful of how to present and request information.
- **Safety:** OSS sites aim to advise customers in making important financial decisions for themselves and their families. It is critical that all sites include robust and transparent quality assurance measures. This includes not pressuring customers to take out loans they cannot afford, and ensuring

that project developers, technology or providers are qualified to perform at the highest standards, at competitive rates. It is not obvious that quality assurance will be provided. A review of TA and OSS sites suggests that significant disparities in quality do exist. Some sites have no clearly-defined sponsors, for example, and no transparent process in place for qualifying either providers or technologies, or for ensuring accurate energy savings quotes. This should be a concern to Member States if sites are further promoted to the public, in order to protect customers from potentially unethical practices.

Given the above, when analysing OSS sites, the following information was retrieved:

- The target clients
- Technology/product is offered
- Type of finance offered
- Source and type of financing
- Transparency of the site

2.2.2 Excel template

The Excel spreadsheet below is the analysis tool created as a template for determining the application of key measures. Various criteria are graded based on fulfilment of these measures.

2.2.3 Background

This section of the Excel spreadsheet gives an introduction to the more general information on the site in question. What is the site's purpose, who will it benefit, and insight into how they measure their success and to what extent they are meeting their own goals.

Figure 1- Background information to collect

Subject	Grade	Result	Comments
Background			
Activities			
Sponsored by			
Summary			
Available information on how they measure their own success			
If so, what do they measure			
Main challenges and successes			
Target clients			
Meeting their own stated goals			
Renovation rates in number of homes or apartments			
Energy saved in MWHs			
Total finance provided through program			
Cost/benefit analysis			
Customer responses			
Telephone and email.			

Source: own elaboration

2.2.4 Comprehension

Layout, information, and functionality of the site all impact comprehension. Ease of navigation, clarity (target audience appropriate language), and the quality of graphics etc. were reviewed. How informative is it? Is there any necessary information missing and how hard is it to find the information you are looking for? Regarding functionality: how actionable is it, and are there clear steps from beginning to end? In analysing any sort of simulation tool or calculator, one must determine how much was needed for input and what was received as output. How much and how complicated was this process? It should also be mentioned that the question on social media presence did not have a grading function. It was simply

analysed how frequently the site uploaded content on various online platforms and then compared to the answer the interviewee provided, by how many of their customers come through this channel.

Figure 2- Comprehension of the websites for the users

Comprehension	Grade	Result	Comments
Home page layout, a target appropriate language, clear uncluttered layout.50s and not 100s of workds			
Clear and easily navigated			
Sollutions offered			
Easily foung/search engin optimization			
Ease of accessing the call service			
Yes or Not, To be tested			
Videos, instructions			
On topit (talking about the services on the site, to correct audience			
understandable			
good quality			
Exemples/case studies			
Social media presence			
energy savings calculator input			
if you just have to apply address			
non tech questions			
tech questions and excessive			
savings calculator output			
Clear % or € given			
Offered tech specified			
actonable			
payback time			

Source: own elaboration

2.2.5 Finance/Offering

This looks at the financial aspect of the site, if any financing is offered at all. What type of financing is offered, where does it come from, how is the process of applying, input and output. This section also deals with the contractor selection process, what are the requirements, do they validate the contractors. This also covers quality assurance and what kind of guarantees and or insurance is offered.

Figure 3 - Finance Offering of the websites

Finance/Offering			
Source of finance			
Type of finance offered			
Process of gaining access to their service			
Actionable, is there a clear next step to take at every turn until the whole process is done			
Offering			
variety of offerings			
clarity/user friendly language			
actionable/directions for next step			
Process of applying			
Understandable			
Actionable			
easy to contact			
one stop quote/bank provides info			
Always aware of where you are			
What do you need in terms of documentation and information to be financed			
Process			
Contractor selection process			
is there an application process for the contractors			
How complicated is it to apply			
comparison of offers			
costs			
payback time			
energy saving			
Do they track their own accuracy?			
Do they track their results?			
Requirements of installer, certified?			
Process			
How clear are they on the business model behind the site			
yes=Very clear			
med=figure it out with some research			
no=nothing			
Financial terms which impact how the project is treated post instalation			
is payment connected to results			
tech guarantees			
insurance			

Source: own elaboration

2.2.6 The Grading

The following sections of the analysis had grading systems:

- Videos/instructions
- Calculator input
- Calculator output
- Finance offering

The grades were based on a separate set of criteria; the questions could be answered on a numerical scale depending on to what extent the OSS site fulfilled the criteria.

The researcher began by answering questions with “Yes, No, or Partially.” “Yes” represented a numerical value of either 9 or 10. “Partially” represented a numerical value of either 7 or 8. And “No” represented either a 5 or a 6. The decision of choosing a grade of e.g. either 9 or 10 would then be decided by the researcher based on his/her experience of the process in attaining the answers. Finally, an average of these numerical values would be calculated to decide the final grade for the question at hand.

This was the grading system for all sections except one: “calculator input,” which will be explained in more detail below. Each section is further explained separately below.

2.2.6.1 *Videos and Instructions*

In the videos and instructions, a sample of the site's video was analysed, most often uploaded via YouTube. When judging if it was on topic, the researcher analysed whether or not they were talking about the services on the site and if it was directed towards homeowners. The next category, "understandable," refers to whether or not the content was communicated in a pedagogical way and in terms, i.e. language used, comprehensible for the average homeowner with no technological knowledge. Regarding quality, it was analysed on a general level whether the graphics and sound were of a good standard.

As seen in the example below, all three categories received "Yes" and a 10 as numerical value. Meaning that the researcher had no complaints in any of the categories and felt everything regarding this topic was of sufficient standard.

Yes=it is e.g. on topic. Then defining if it is 9 or 10 based on the comment section to the right.

Partially=it is e.g. partially understandable, meaning that the researcher did not feel that it is entirely clear. Then defining if it is 7 or 8 based on the comment section to the right.

No=it has e.g. bad sound and picture quality and doesn't inform you on the topic. 5 or 6 based on the comment section to the right.

Figure 4 – Videos and instructions on websites

Videos, instructions			at the time of writing 39 videos and 790 subscribers
on topic (talking about the services on the site, to correct audience)	10	Y	All of them clearly directed to homeowners or otherwis people with little to no knowledge of solar
understandable	10	Y	easily understood and ordinary terms/language used
good quality	10	Y	Nice grapihcs, good sound, and informative content

Source: own elaboration

2.2.6.2 *Calculator Input*

This section was graded a bit differently. If the only input required was an address, it would score 9 or 10 depending on the circumstances. If it was required by clients to input their addresses or answer a few standard questions, it would score a 7 or an 8. If technical questions were included, it would score a 5 or a 6, and if there were many technical questions, it would result in 5 or below.

In the case below, the result was a 10. This is due to the fact that you only had to provide your address and your monthly energy bill.

Figure 5 - Calculator input on websites

energy savings calculator input			
if you just have to apply address	10	Y	Your address and an estimation of your monthly electricty bill
non tech questions			
tech questions			
tech questions and excessive			

Source: own elaboration

2.2.6.3 *Calculator output*

Below can be seen the four criteria that were judged important within the output. In this case, all of them were fulfilled with no drawbacks, prompting the researcher to reward it a definite 10.

- Yes=there is a clear monetary potential savings value and or percentage presented, 9 or 10 based. The reasoning behind the choice between these two scores would be clearly motivated in the analysis.
- Partially=it is not entirely clear what tech is being offered. The reasoning behind the choice between these two scores would be motivated in the analysis.

- No=it is not actionable and there is no clear next step to take. The reasoning behind the choice between these two scores would be motivated in the analysis.

Figure 6 – Calculator outputs

Savings calculator output			
Clear % or € given	10	Y	% of annual electricty needs met, monetary savings in %, savings in $
Offered tech specified		Y	rooftop pv
actionable		Y	A big and clear get started "step 2" button
payback time		Y	clearly stated for all 3 recommended options

Source: own elaboration

2.2.6.4 Financing options

Are there multiple options on offer or is there only e.g. a loan attached to the house? Is the language used understandable for the average homeowner or is further explanation needed? Are there clear next steps to take in order to finance the project? In two out of three questions below the answer was yes and in the third partially, leading to this section receiving a grade of 9.

- Yes=there are several different solutions for financing, 9 or 10 based on the comment section to the right.
- Partially=e.g. most of the language but not all is easily understood, 7 or 8 based on the comment section to the right.
- No= there is no clear next step, 5 or 6 based on the comment section to the right.

Figure 7 - Financing options

Offering	9		Energysage's interaction with the customer ends when the customer has made a decision, they do not assist in any form at the financing process
variety of offerings		Y	There are plenty of different loans and different banks to choose from , varying depending on state. Once you choose a bank they have usually have loans varying from 5k to 100k
clarity/user friendly language		Y	It is kept very simple at first and for options that aren't familiar to the customer they offer youtube videos explaining them in detail in common language
actionable/directions for next step		P	It does hold up to the term actionable as long as we are on energysages site, it is when they send us to the banks own sites that it starts to become a bit more unclear

Source: own elaboration

2.3 One-stop-shops analysed

The following operational sites were chosen by the researcher.

This is the list of the sites analysed:

- Energysage
- BetterHome
- Retrofit works
- Energy savings trust
- Stroomversnelling

Of all sites in the OSS report, Energysage was chosen because of its unique features and outstanding customer-friendly usage. Another differentiator between Energysage and the rest is that it is located in the United States, while the rest are located around Europe.

2.3.1 Findings

The following chapter provides an in-depth description of the sites that were part of this research and presents a grading according to the criteria set in chapters 2.2.6 to 2.2.6.4.

The aspects of these sites are evaluated and, in the end, summarized as to which of these aspects was found to be most useful and valuable by the target client. This in turn providing an inclination of where efforts should be put when developing TA for energy efficiency.

The analysis is based on the excel template in chapters 2.2.3 to 2.2.6.4.

2.3.1.1 Energysage - USA

EnergySage gathers competitive energy savings offers of solar refurbishments from pre-screened installers. It gives the customer unbiased guidance to help compare installation options. The platform acts as an online marketplace where the customer can identify what solar solutions could be installed, through the platform's calculator tool, and then allows contractor to bid for the work. The customer is then free to choose a contractor from the range of bids received.

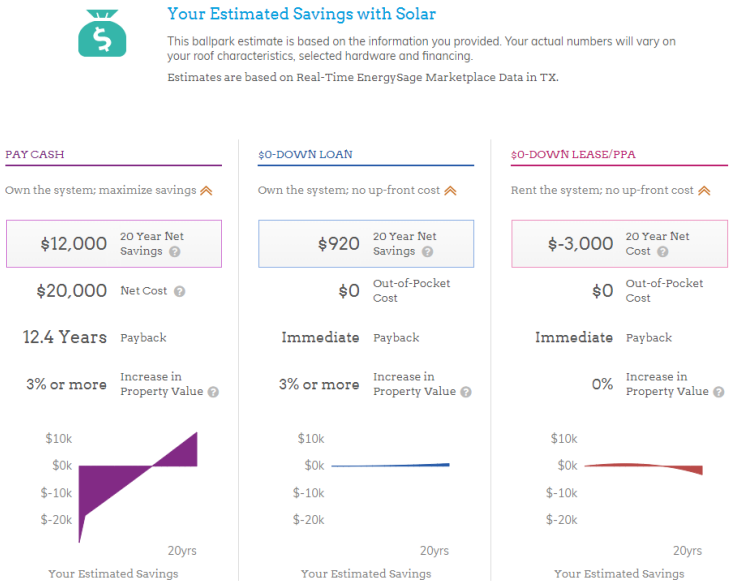
Energysage was selected for this analysis partly as an example of what comprises a highly functional TA tool. As you can see in the analysis below, according to the criteria set by JAE, they rank highly overall.

Final grade

- Videos/instructions=10
- Calculator input=9
- Calculator output=10
- Financing options=9
- Total grade: **9,5**

The Energysage site receives high scores for user-friendliness. The site is easily navigated, and the content provides the customer with value for time. The online tool requires a simple input of address and monthly electricity bill in order to provide value added information. The output as well is distinctly clear and understandable to the average homeowner. As can be seen in figure 1 below, by providing the customer address and average monthly electricity bill, the calculator will produce estimated savings for the client. This presents the client with three different solar-instalment options for their home. The output is displayed in three simple columns showing percentage of electricity needs met, monetary savings in both percentage and cash, what the technology for each option is and clear steps on moving forward. At this stage the customer already understands what, why and how much an installation will cost and earn them. While immediately being guided towards the next step, choosing the PV provider, or rather the who. All installers are pre-screened for the client – ensuring a certain level of quality.

Figure 8 - Calculator output.



Source: Energysage

This output shows the solar installation different options for the customer's home. More specifically they show an estimation of what your electricity bill savings could be and how you can choose to finance it.

The fact that EnergySage has an online marketplace where certified contractors bid for projects makes it even more attractive and creates healthy and easily available competition in the solar market. This site could be seen as an OSS for contractors as well, since it serves a purpose for them by acting as a sales platform, giving the contractor a forum where they can acquire customers. This can be a tool for contractors to shorten the sales process by streamlining outreach.

The only module lacking is the financing aspect. The site does have a page especially devoted to different financing options for the project, but Energysage's part ends there. After that the customer is left on their own to navigate further. Not only that, but this is also where the simplicity and clarity of Energysage disappears. Everything works well up until this point. If Energysage could find a way to be more involved with financing options or even take control of this part, their site would be an extremely well-functioning site.

Energysage's calculator functions well for rooftop PV, and therefore provides an example of a successful technical assistance site. However, in the case of energy efficiency upgrades, it would be necessary to add complexity. For example, the core of this site is the fact that the company is using Google maps to measure and ascertain the slant of rooftops. They then are able to perform a back-end calculation on the size and output of a solar installation. In the case of energy efficiency, there is rarely such a simple means of measuring the energy efficiency potential of a building. Though similar technologies are available to measure heat leakage, for example. This, by necessity, will add to the initial complexity, and require that the client fills in more information concerning their home.

This is the type of service and ease that makes a customer feel like energy renovation is not a big deal and the site could surely work even better if the financing solutions were optimized.

2.3.1.2 Betterhome - UK

Betterhome is an OSS site, which looks to enable a burden-free renovation process, focused on lowering the energy consumption and improving indoor climate at the same time. In order to inspire homeowners, the OSS offers 3 inspirational packages (Energy Package, Comfort Package and Modernization Package). The homeowner uses an online tool to enter details about their homes and energy consumption and

receive a report and recommendations on renovation measures and offers from local suppliers. The local representative comes to the home to discuss the details and fix the offer. After this is accepted, the local craftsmen carry out the implementation. The craftsmen are trained on ensuring the Betterhome standard and can use the digital platforms to structure the work. On the financing side, the customer discusses the renovation project with his/her usual bank, and the bank can use the BetterHome tool to refer to the details. The associated banks trust the Betterhome quality and financial characteristics, therefore though Betterhome does not make finance directly available through the site, their partnerships with banks facilitate the financing process.

Final grade

- Videos/instructions= 9,7
- Calcluator input= 9
- Calculator output= 7,5
- Offered finance= not included
- Final grade = **8,8**

Betterhome has a clean and open first page which makes the navigational process to find what is needed rather easy. On the first page their three package offers are immediately presented, directing the customer to the package of their choice.

Betterhome has two different versions of a calculator, one called “Energy check” and another called “indoor-climate check”.

Figure 9 - Betterhome input.

Source: Betterhome

The one presented below is “energy check”. As can be seen in the figure 2, the customer simply has to enter their address and press a button to check their energy-consumption. So, in this calculator the only required input is street address, which is optimal. This indicates that the Betterhome site is supported by back-end calculation capability and has access to publicly available information on the condition of individual buildings around Denmark. As in the Energysage site above, this indicates the importance of publicly available and accurate information concerning building stock as a back-end support for OSS and similar support tools aiming to improve public understanding and action on energy efficiency question.

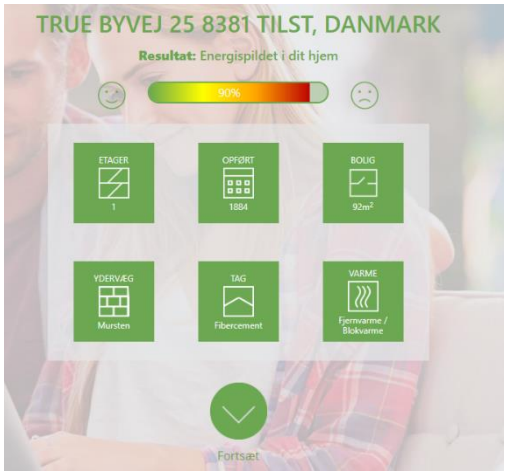
Figure 3 shows the output of the tool which, through the help of public records, indicates to the customer that the house in question has an estimated energy waste of 90%. However in an interview conducted with Betterhomes managing director, Niels Kaare Bruun, he indicated that these first calculations are not **as accurate as an audit**, but provide an estimation accurate enough to decide whether a full audit leading to a possible renovation is applicable or not.

The tool also tells the customer the following information about their own building:

- Number of floors
- Year of construction
- Size in square metres
- Outer-wall material
- Roof material
- Heating method

However, how this data is supposed to support the customer is not known. The perception of the above output is that it is unclear what the customer is to do with the information provided, since it provides the customer with only basic information which the customer reasonably should be aware of, such as number of floors and outer-wall material etc. Indeed, the tool provided no clear next steps for the customer to follow. The customer is informed of potential measures that could be implemented for the customer's home but not automatically lead through to the process. This creates a break at this stage in the OSS site's customer journey.

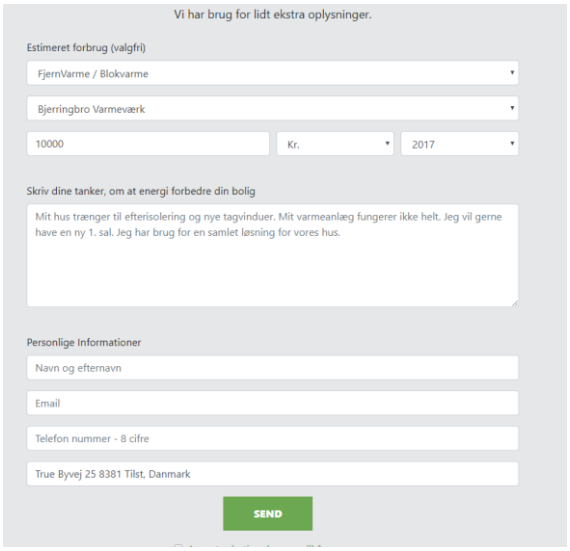
Figure 10 - Betterhome output.



Source: Betterhome

In Figure 4 it can be seen what the site produces after the customer has done the previous steps of entering required information and pressed the continue button. Where the customer can fill in the form and express thoughts and wishes about energy improvements, afterwards Betterhome will use this information when contacting the customer.

Figure 11 - Betterhome contact form.



Source: Betterhome

Figure 12- Betterhome indoor climate report.

Source: Betterhome

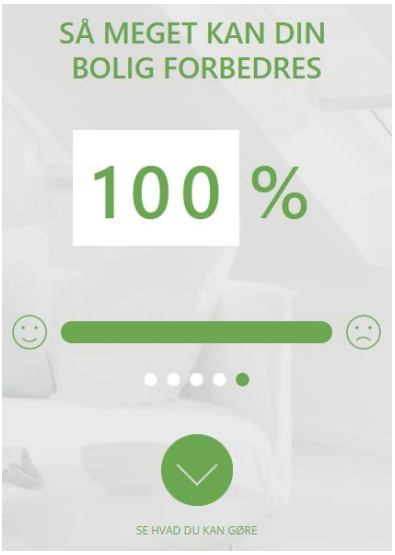
Then there is the second tool, seen above in figure 5, called “indoor-climate check”.

This tool estimates if there could be improvements made to the customer’s indoor climate based on the following questions:

- Do you notice any cold or draft in your building?
- Are there areas of your house that are difficult to heat?
- Are there visible signs of condensation and mold?
- Do you experience problems with the acoustics?

When these questions are answered in the affirmative the site grades the customer’s indoor climate controls needs improvement both through visual cues (the frowning face) and with a percentage grade of need. See figure 6:

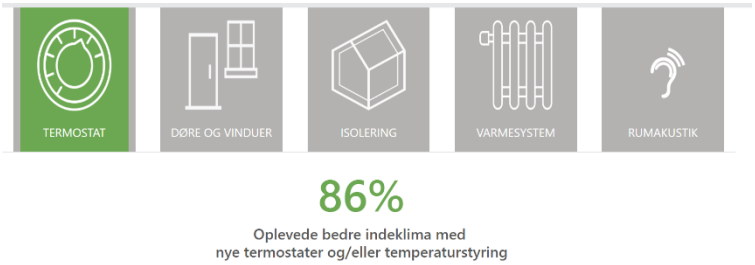
Figure 13 - Betterhome indoorclimate result



Source: Betterhome

Betterhome then suggests several solutions and informs the customer the percentage of customers that have felt an improvement through that specific solution.

Figure 14 - Suggested results.



Source: Betterhome

After this the customer can fill in a form and Betterhome will contact the customer as seen with the previous tool.

These tools are kept simple and do not require a significant amount of customer data. This of course also means that the output produced is kept simple. For example, there are no statements on specific amounts you could save by implementing certain measures, the output points more towards a yes or no for the customer to know if it would be worth his time moving forward and be provided more detail by the Betterhome personnel.

2.3.1.3 Retrofitworks - UK

Retrofitworks is a co-op (cooperative) working as an OSS that assists in creating retrofit schemes. A co-op is an organisation that is owned by several parties and is run jointly. The co-op owners will share profits and work together towards a common goal. They aim to create projects that are replicable in "any geographical area" by using local branding while they work mainly behind the scenes and manage the work and apply financing assistance where possible.

They work on delivering, designing and hosting energy efficiency programmes either in the role of service provider or on behalf of the co-op's members.

Retrofitworks operates by membership model of which there are three:

- Associate (non-trading) membership

    - There is no entry requirement for this membership level. The aim of this level is to support Retrofitworks and have an input on the design of their schemes. The membership cost fifty GBP and allows you to partake in the co-op meetings you will not however have entitlement to any potential profits made by the co-op.
- Practitioner membership
    - This makes your organisation a shareholder of the coop and gives you the availability to offer your services to its customers and other members. They carry out a thorough due diligence on all their practitioner members which assures quality for their and your customers. This membership fundamentally opens customer possibilities for contractors and gives them a voting right in the coop and additionally possible share profits. Membership is a one of payment of 350 GBP
- Advocate membership
    - *"Advocate members are organisations who want to support or drive local retrofit activity. We offer a variety of tools and commercial templates to access a single and locally sourced SME supply chain."*

The OSS acts as an intermediary between SME suppliers and customers. In effect the OSS does not participate in the implementation, but in the preparatory and follow-up work. The service is the following:

- Householders are assessed, in what manner or by which criteria, they are assessed is not made clear on the site. Then 3 quotes are generated from the energy survey from local SME companies via the online tool;
    - All installer Practitioner members are quality vetted and referenced.
- A grant scheme assessment is made according to householders' circumstances

Final grade

- Videos and instructions=8
- Calculator input=Not included
- Calculator output= Not included
- Financing options=9,33
- **Total grade= 8.7 but incomplete**

Though Retrofitworks has an 8.7 average, there are two important services which are not provided by the site at all, a self-assessment calculator and the customer consumption report. Therefore, though the site should in reality be seen as fulfilling only half of the functionalities of a classic OSS site. The TA tool in form of a calculator is such an integral part of this study that it cannot be excluded. And the lack of a tool like this indicates the extent to which the tool could still be expanded and improved.

From the analysis it is concluded that the Retrofitworks site is not what this study would suggest as a best practice example for TA tools for households. Aesthetically and language wise it passes but after going through the site there is a significant lack of information. The site does not provide a transparent understanding of the how their model works and there is little to no information/detail's technology or project wise.

However, though the site does not provide a savings assessment, they do fulfil their role as a project facilitator, acting as a third party between households and contractors, providing potential customers with quality assurance and trustworthiness. Retrofitsworks also succeeds where other sites do not, in that they assist with finding possible financing solutions for the customer.

2.3.1.4 Energy Saving Trust - UK

The Home Energy Check tool provides an evaluation of the current energy performance of a household through the input of several buildings characteristics such as, the postal code, the type of property, the flat location within the building, number of exposed façade sides, number of rooms, age of the building, type of roof, type of main walls, what is the main way to heat the home, etc. The tool then provides, as outputs, an estimate of the energy consumption (with the possibility to correct with actual values), potential savings and associated energy efficiency measures, giving a perspective, measure by measure, on its contribution for the overall savings, the level of work involved, payback time and comfort increase. If desired, after a first simple analysis, the user can go into greater detail on the characteristics of the household to get a more exact evaluation of the energy performance of the house through adding information such as number of occupants, type of lighting, heating systems or renewables.

Final grade

- Videos and instructions=10
- Calculator input=5
- Calculator output=10
- Financing options=8,66
- **Total grade=8,4**

Concerning technical questions, there is a wide range of information for the customer, while the financial information was found to be lacking in substance. The consumption information provided is clear, thorough and understandable for the average person. However the layout during the stage of calculator input could be refined as finding the information needed was found quite difficult. E.g. the calculator tool has not been made easily accessible and could be placed ideally on the front page to attract customers.

As for the actual tool, there are multiple questions to answer in this tool, everything from the year of construction and the number of rooms to the roofing material and if it faces to the south east or south west. It could be overwhelming to some users and requires a significant amount of time to complete. For a customer wanting to get an accurate reading, it will require significant work, especially if the customer must search for the answers. The benefit of providing detailed accurate responses, is that these will increase the accuracy of the results.

As the input requirements are significant so are the outputs. The tool produces a 13-page pdf-report on the building's performance and potential improvements. The information received in this report is extensive, simultaneously there are clear percentages and monetary values of what can be saved and decreased making the extensive information clear to the customer.

Overall the calculator tool is useful and for a customer who is seriously considering refurbishments. The tool provides robust information concerning possible improvements and the basis for educated decision making. The tool could be made more user-friendly and attractive but for the purpose of being a decision assisting tool it does what it is supposed to.

2.3.1.5 Stroomversnelling - NL

Stroomversnelling works on legislation and regulations, innovation, upscaling and quality of zero-on-meter renovations and new construction. Ultimately, this provides energy-neutral, sustainable, comfortable and affordable housing. The OSS is an independent, market development organization. They tackle both refurbishments and new buildings: they are able to support the development of 0 output buildings. A 30-year performance guarantee on both the indoor climate and the energy performance is complementing the service. New financing is organized for the renovation. The OSS also contributes to regulatory changes related to their field. At the time of research their target clients are currently single-family houses with multi-apartment houses being included soon. 1300 Net Zero Energy refurbishments have been realized so far and a further 500 Net Zero Houses are being built.

Final grade

- Videos and instructions=10
- Calculator input=Not included
- Calculator output=Not included
- Financing options=5
- **Total grade=7.5**

It appears that this site is directed towards housing associations, contractors and municipalities. The results should then be used by these parties to the benefit of homeowners. Therefore, it is understandable that when looking at the site from a homeowner's perspective, the site structure and input requirements would not appear appropriate for private individuals.

The videos and general information on Stroomversnelling's services are clear and understandable, however these do not lead the customer as a homeowner to take any action. It appears as this site is rather an OSS aimed towards potential partners and not end customers, which in turn rules the grade above quite irrelevant and unfair.

Nevertheless, the videos and information on financing they do have are excellent and understandable from a homeowner's point of view.

2.4 Summary

During this review of the above OSS sites, it became clear that a core requirement for customer engagement are the calculator tools and simple actionable results. The higher the quality of information, leading to clear, defined possible next steps, the more the site fulfilled its role as an enabling tool likely to increase the uptake of energy efficiency renovations.

Well-designed calculation tools engage and involve the customer allowing them to participate in the assessment of their home and receive an immediate response. A well-designed OSS site is not only informative and educational but streamlines the process from start to purchase-decision in an efficient manner while (optimally) providing all required project information in one location. If a site succeeds at providing an engaging online activity that informs the customer on which measures are possible, as well as at providing the technical means for implementing and financing them, the OSS will likely be fully effective.

It is therefore optimal that the customer should provide inputs concerning their home in a simplified way, while at the same time, receiving salient and actionable information on which to base a renovation decision. There are two enablers that can be leveraged by the site developer: layout and information on building stock.

Layout and design can be instrumental in creating a positive user experience. It is possible to acquire a good amount of detailed information if the layout ensures the process is understandable and the site makes it *easy* to move forward. This means the customer always needs to be aware of the next step. As an example, they should know if they have 1 or 5 more screens of information left, or what percentages of the work they have completed.

The availability of information concerning the quality of building stock is also an important enabler of robust and user-friendly calculator functions. For example, Betterhome and Energysage, both had access to such data and their results are supported by back-end calculation capabilities which can provide actionable outputs by simply using the information of the customer's address. This indicates the importance of publicly available and accurate information concerning building stock as a back-end support for OSS and similar support tools aiming to improve public understanding and action on energy efficiency questions.

Most sites reviewed for this report provide little concrete information concerning financing. Rather, they provide links to various possible capital sources. This could be seen as a weakness on the part of the industry. The payment mode is often a critical deciding point for many home owners. OSSs should not stop supporting customers at this crucial stage. Further support to cross this line and seek finance, as well as clearly defined, clearly represented and viable financing options would be an important development for many OSSs.

OSS sites should be viewed as a public education tool which makes use of lessons learned from marketing and social sciences. Still, certain sites focus on technical aspects more than usability and customer engagement. However, they will unlikely be effective unless they are designed in contextualized way. In this study, Energysage, Betterhome and Energy Savings Trust emerged as sites where insights from marketing and social sciences as well as customer engagement where applied to the technical assistance. These were also the only sites providing a calculator tool, and engaging and educating the customer.

Providing information about energy efficiency measures is not sufficient. For an OSS to be effective at promoting investment actions, a site should also explain why, and how actions can be taken. An essential part of encouraging the uptake of a green product such as energy efficiency, is providing information in a way that is not cognitive demanding, as well as educating and engaging the customer. A customer must understand the details behind the program, the financing options, and possible financial losses from not investing– through a safe and protected framework (e.g. Batley, Colbourne, Fleming & Urwin, 2001). To this end calculator tools, along with actionable advice, access to high quality technicians and adequate financing solutions, are a potentially powerful combination. Overall, only few sites providing such a combination have been found during this research. Therefore, further development and investment in robust national OSS and TA platforms could be promoted to materially improve the public's access to this important touchpoint for investment decisions.

3 IT tools

3.1 Introduction

This chapter aims to identify some of the most relevant IT tools that can be used by homeowners, financial institutions or public authorities when having to decide, in a household renovation process, what type of interventions are worth to implement, based on the current energy performance, potential energy savings and financial instruments available to carry on these interventions.

Within the Smart Finance for Smart Buildings, it is only natural that the tools used to help the interested parties in the process to make a decision on whether or not to advance for a house renovation, should also have "smart" features, i.e., easiness to use with intuitive features, effective feedback and a pleasant user interface. At the same time, making the interaction with energy and financial issues "easy", such as by delegating complex tasks to IT tools, should enable the active user engagement that is required to make investment decisions mindfully (DellaValle et al. 2021).

One of the features of smart homes and smart buildings is the ability for the building users to be proactive, even sometimes taking matters in their own hands before recurring to other technical agents. The same is expected of users when using an IT tool of this sort.

Being in the form of Excel tables, a Webtool or a software application, an IT tool could serve as a first filter before engaging more resource intensive TA services. The following analysis aims to find such tool.

3.2 Methodology

The methodology used in the realization of this report consisted in a desktop analysis and through the contact of international experts on which could IT tools could be used for the different agents involved in the decision making process regarding the construction and renovation of buildings, more specifically regarding the residential sector.

A thorough analysis of the tools existing in the institutional bodies managing energy and buildings efficiency, private sector institutions and the financial sector was made and the results are presented below.

The focus when evaluating the existing tools was to find a tool that could be used mainly by public authorities and financial institutions, but also by household owners considering to renovate their household and looking for the best solutions, both in terms of efficiency measures and financial options at their disposal, considering the measures needed, area of residence, etc.

The main objective when looking for such tools was to find a one-size-fits-all type of solution, that would have a wide coverage, ideally with an EU28 coverage (or ever wider, depending on climatic zones), that could feed from the information given by the user, regarding the features of the building, location, energy performance or energy consumption, with all other sub-items that can be rolled out when modelling the energy performance of a household and the potential financial aids available in a specific market.

Several success criteria were taken into consideration in the analysis process of the tools, with three main aspects considered to be of the upmost importance when using a technical tool like these. The three main aspects can be divided into "Energy information" and "Financial information", both inputs and outputs and User Experience and User Interface (UX/UI).

These three main aspects have been sub-divided into seven indicators that were then evaluated in order to assess the potential for these tools to be used by the stakeholders interested.

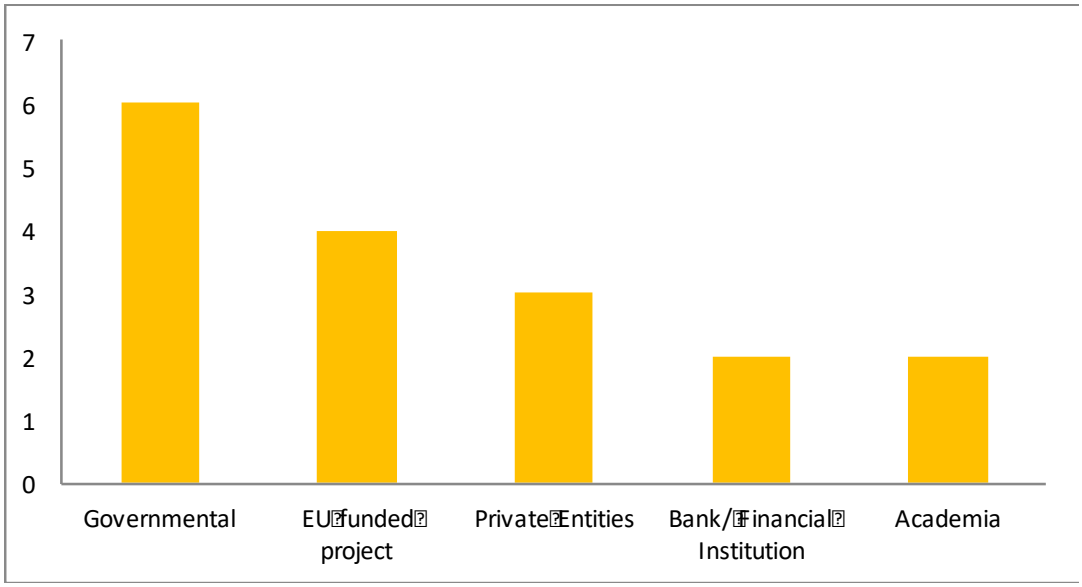
The seven indicators used to evaluate the IT tools were the Coverage of the tool, General Building Inputs, Building Energy Inputs, Financial information inputs, Energy performance outputs, Financial outputs and UX/UI of the tool.

The indicators were used to classify the IT Tools, from 1 to 5 with the following criteria.

- Coverage of the tool: Value 1 for only one country and one language available to choose and 5 for an EU28-wide project with several languages that the user can choose.
- General Building inputs: 1 point for little information or basic information like square meters, number of rooms and 5 points for a large amount of information collected enough to assess the building main characteristics like U values or materials used.
- Building Energy Inputs: 1 point for only one parameter included and 5 points attributed to a full description of the energy systems within the household, like heating and cooling systems, renewable energies, etc.
- Financial inputs: 1 point for little information collected and 5 points for a comprehensive collection of financial information.
- Building Energy Outputs: 1 point for little information on the energy performance of the building and 5 points for the energy performance of the building, proposed energy efficiency measures, savings potential, call for action and the presentation of the Energy Performance Certificate
- Financial Outputs: 1 point for little or none information regarding financial information and 5 points for financial information being given with a clear amount of information, Actionable with the next steps for guaranteeing financial aids fully understandable.
- UX/UI: 1 point for IT tools very hard to use, needing to be downloaded, not user-friendly or too much technical. 5 points for tools with a pleasing look, intuitive and easy to use for both technical and non-technical users.

In the research process there were found 17 IT tools that somehow could serve as an example to be used by institutions or individuals involved in the process of a household renovation and which are presented below. The majority of IT tools evaluated (7/17) have been developed by governmental institution such as energy agencies or ministries. The second main type of promoters of these types of IT tools found and evaluated were coming from EU funded projects (4/17) and only 2 IT tools found were developed and maintained by financial institutions.

Figure 15 - IT tools promoters



Source: own elaboration

3.3 Evaluated IT Tools

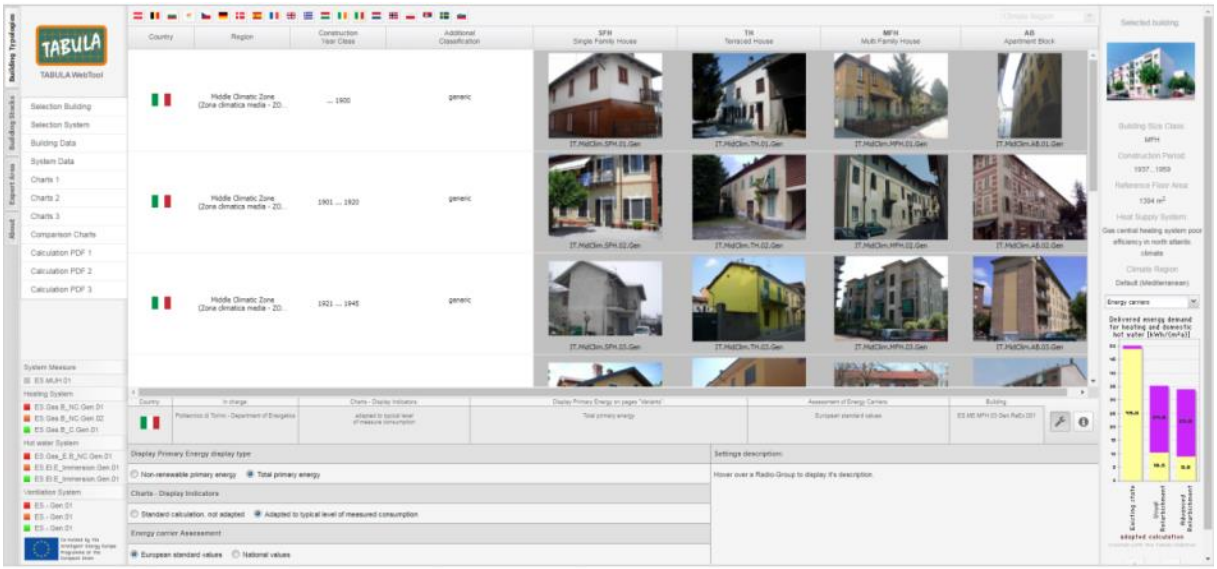
T1. Episcope/Tabula

Episcope is a website that is built upon the "Tabula" (Typology Approach for Building Stock Energy Assessment) Webtool, which was a project developed between 2007 and 2012. The tool has been developed as a consortium where the project partners developed national building typologies representing the residential building stock of their countries, with the following characteristics: a classification concept for existing residential buildings according to age, size and further parameters, a set of example buildings which represent specific building types of the national stocks, typical energy consumption values for the example buildings, showcase calculations of the possible energy savings and statistical data for buildings and supply systems.

With a coverage of 13 countries, the tool has available different residential building stocks divided in size and age, per country; Data of exemplary buildings on appearance, construction elements and U-values; Data of exemplary heat supply systems, Typical values for energy consumption by energy carrier; Energy saving measures on two levels for old buildings and three levels for old buildings.

The website also provides case studies from the implementation of the tool and a set of energy performance indicators for stakeholders to achieve a high quality of refurbishments and the compliance with local regulations

Figure 16 - Tabula Tool. Different Building types.



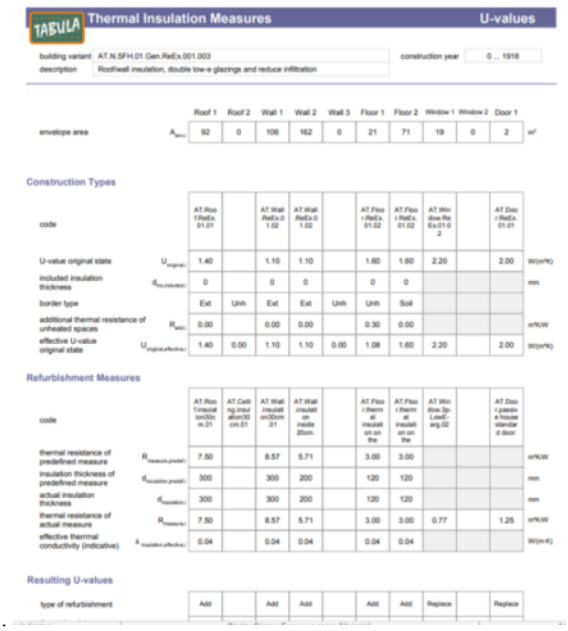
Source: Tabula

Building Energy information: As a result of the building simulation, the tool produces an energy balance calculation document in PDF with information regarding the heat transfer coefficient by transmission, heat transfer coefficient by ventilation, total transfer, solar heat load during heating season, energy needed for heating, etc. Other information include the energy needed for space heating, the usable contribution of hot water system or losses storage.

Also it gives out an assessment by energy carrier for different energy systems like heating system, domestic hot water system, photovoltaic system, electricity generation - direct coverage of electricity demand, summary and expenditure factors.

No information is given regarding a potential Energy Performance Certificate and the measures being pointed out in the simulation results. The tool mentions a standard Reference Calculation - based on: EN ISO 13790 / seasonal method.

Figure 17 - Building simulation output



Source: Tabula

Financial information: Regarding Financial information, the tool gives little information on this matter, with only the general cost of energy being given, after the refurbishment solutions have been implemented.

UX/UI: Overall the tool is well designed and adjusted for building experts that can navigate well within its specific technical features. Although equipped with a strong technical methodology behind it, this tool may be too complex for non-technical people to be using when making a decision on whether to advance or not in a renovation project. Nevertheless, given its multi-country feature and the amount of information available it could serve as a good technical basis for a more user-friendly tool.

T.2. PVP4Grid

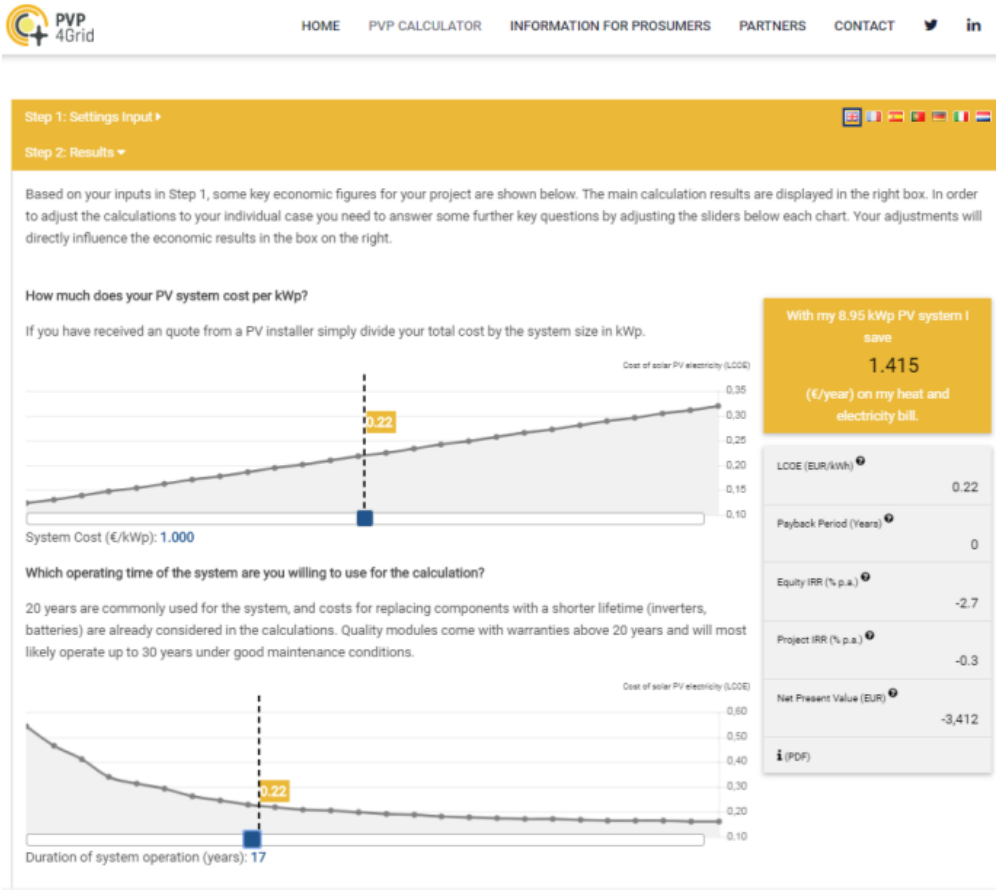
PVP4Grid is a Webtool that provides, with minimal input from the user, an evaluation of the installation potential for photovoltaic projects, aimed at prosumers, and includes the incorporation of electric vehicles, sale of electricity to the grid and an economic analysis within the simulation.

The tool has been developed by PV associations, Academia and Renewables associations with the target groups being building promoters, financial institutions, ESCOs or final energy consumers.

Available in 8 countries (AT, BE, FR, DE, ES, IT, NL, PT) , the tool uses a geographical information system to pinpoint the location for the PV system to be installed, with other inputs being requested like the electric consumption, yearly Heat Consumption, electricity consumption profile, yearly Distance covered by an electric car, heat consumption, PV system parameters like available roof space or the orientation of the PV modules.

Specifically, on the financial information the Webtool asks for the electricity consumption and sales prices and the heating costs.

Figure 18 - PVP4Grid Simulation Results.



Source: PVP4Grid

Building Energy information: As this is not a building simulation tool, no building energy information is being given as an output.

Financial Information: PVP4Grid delivers several indicators of financial information as outputs, such as money saved per year with the installation of PV systems, the Levelized Cost of Electricity[2], the payback period, the Internal Rate of Return or the Net Present Value[3]. Overall the financial information being given is very clear, with information being displayed also in a graphic way (**Error! Reference source not found.**).

UX/UI: Both the User Experience and the User Interface of this tool are very good. With a little amount of inputs and very intuitive workflow, PVP4Grid gives out the sufficient amount of information for the user to act upon it and make a decision on what the next steps should be. It would be interesting a call-for-action of the tool, regarding a further communication with potential financial partners or PV service providers.

T.3 FROnT project

FROnT project is a simulation tool developed by a solar professional federation, consulting companies, energy agencies and NGOs and assesses the competitiveness of renewable energy technologies against traditional fossil fuels. The tool is aimed at Public authorities, building professionals or Energy Services Companies when dimensioning their Heating and Cooling systems and compares it with a reference

[2] The Levelized Cost of Electricity (LCOE) is an economic assessment of the total cost to build and operate a power-generating asset over its lifetime divided by the total energy output of the asset over that lifetime.
[3] The difference between the present value of cash inflows and the present value of cash outflows.

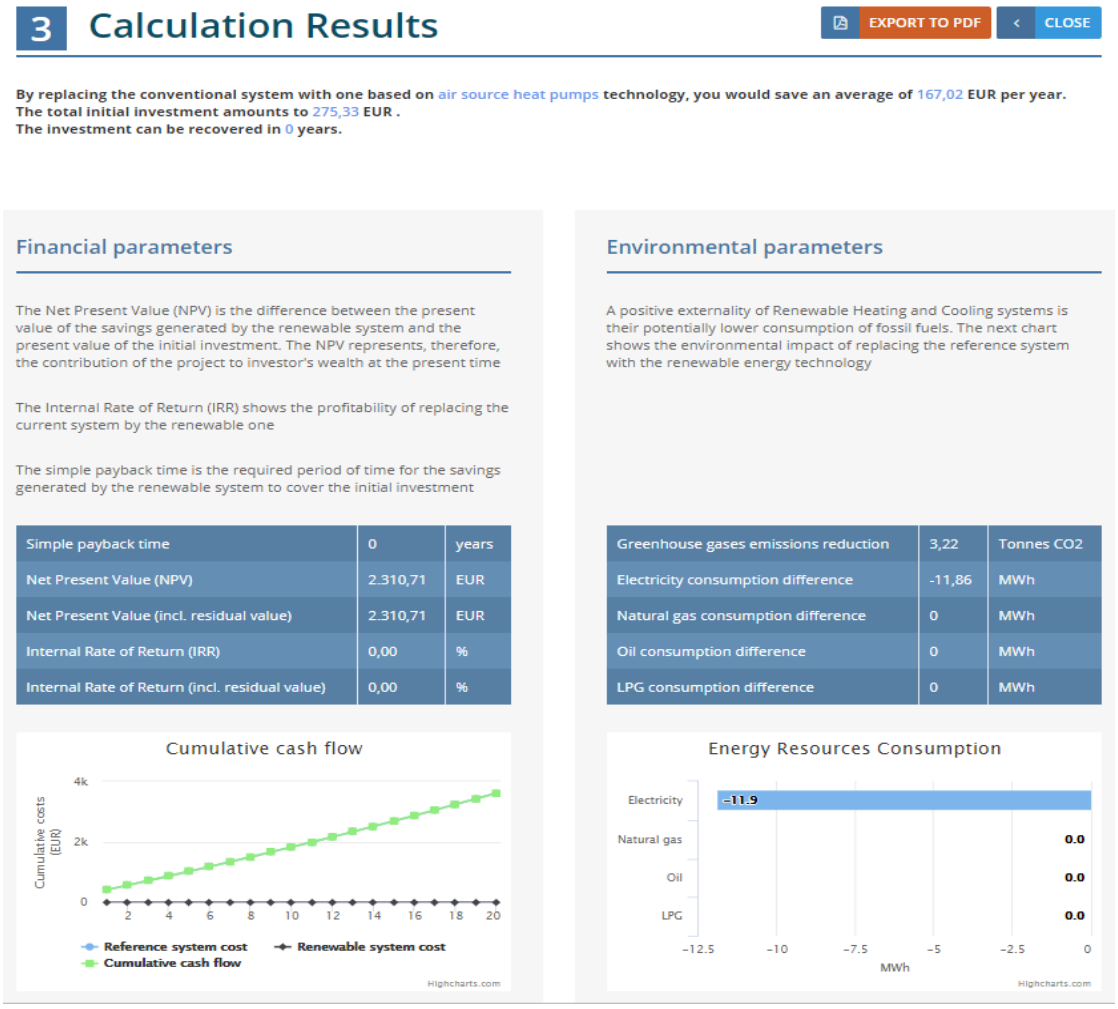
system. The technologies being studied by the tool are Biomass, Solar Thermal, Air source heat pumps and Ground source heat pumps.

Based on the comparison of costs of heating and cooling, it allows to estimate costs, payback period, and the environmental benefits of the above mentioned Renewables Heating and Cooling technologies through a user-friendly interface.

The tool covers 6 Member States and the same number of languages and is based in the savings potential regarding the replacement of heating and cooling technologies, calculated by a number of initial inputs like area, heating, cooling and hot water systems, energy sources, reference system output and efficiency, efficiency of equipment, insulation level of the building, Air source heat pumps power output or the Seasonal Coefficient of Performance (SCOP).

On the Financial part, the tool asks for an estimate of the investment needed to install the heating/cooling technologies, Electricity price or operation costs.

Figure 19 - FROnT project Output report.



Source: FROnT

Building Energy information: Although not great amount of information is being extracted relating with the building itself, but more on energy systems, the tool gives out an estimate for Greenhouse gases emissions reduction, Electricity consumption difference, Natural gas consumption difference, Oil consumption difference and LPG consumption difference

Financial Information: On the financial outputs, the tool delivers a solid and easy-to-read amount of information, such as the Net Present Value (NPV), the Internal Rate of Return (IRR) which shows the profitability of replacing the current system by the renewable one and the simple payback time, which is the required period of time for the savings generated by the renewable system to cover the initial investment.

Other economic results that are provided relate with the Levelized Cost of Heating and Cooling (LCoHC) excluding and including the residual value, which can be defined as the constant and theoretical cost of generating one kWh of heat or cold during the technological lifetime of the system. The lower the LCoHC, the cheaper the technology analysed.

UX/UI: The FROnT tool is a relatively easy to use tool, with not a lot of inputs to be provided, but with also not a lot of outputs to be extracted. The tool produces a web-based output page and via a pdf document with all the information calculated. The report produced by the tool is interesting in the point of view of the final user, but may lack in detail to be used further by the interested parts. Although it presents a rather simple user interface, it would be probably be interesting to see this tool joining forces with other building simulation tools.

T.4 – EDGE - Excellence in Design for Greater Efficiencies

EDGE, is a simulation tool, hosted as a web application, used for designing buildings and implementing energy efficient measures. Promoted by the World Bank Group and International Finance Corporation, is a tool directioned for home owners, building developers and building professionals and can be used to design resource-efficient buildings. By entering the building information and choosing systems and solutions, it is able to pinpoint potential savings to be achieved.

The tool is able to calculate utility savings, extra costs on building a green building and payback time from implementing the energy efficiency measures. The tool is to be used mainly in developing countries, and is available in 5 languages.

As inputs, the tool is very complete and asks for a great amount of information like the actual location of the buiding, square meterage, age and type of building, number of occupants and storeys, what type of materials it has or are planned, energy systems, types of fules used, etc.

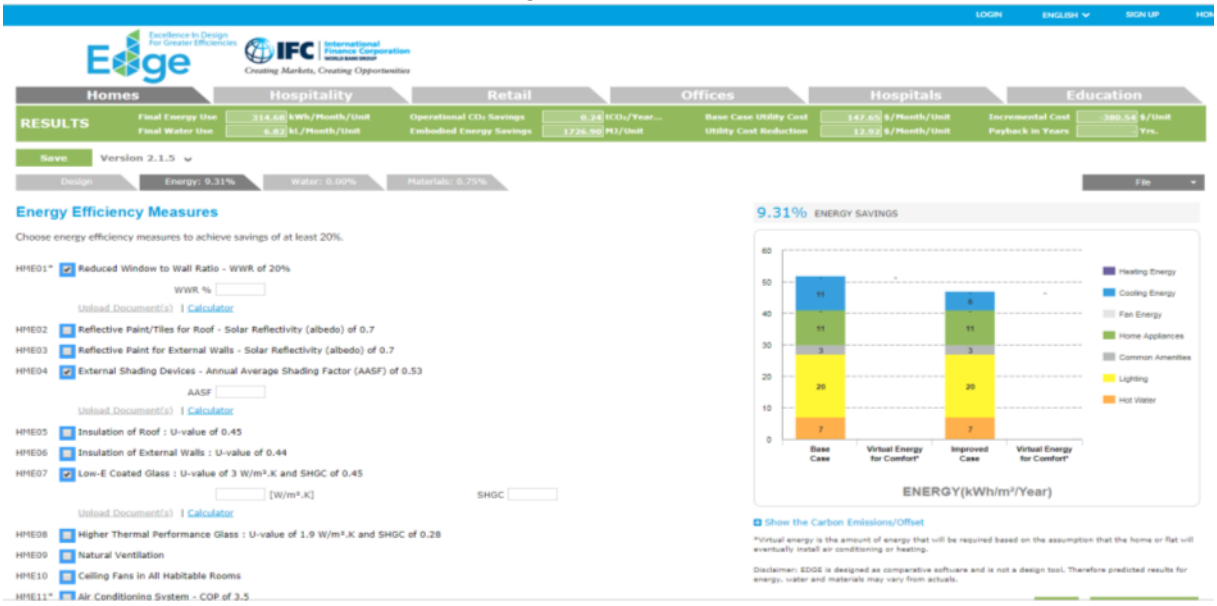
The tool presents a set of measures to achieve savings of at least 20% for energy efficiency, water efficiency and materials efficiency measures. With a very easy to use interface and immediate reponse on the measures chosen, it allows for the user to have a fundamented and easy choice on where to act in the development of a new or renovation project.

Some of the energy efficiency measures include insulation, shading, efficient glass, ventilation, more efficient equipment or water saving measures.

Building Energy Information: The EDGE tool, in its outputs, presents in a graphic way the final energy use, final water use, the operational CO_2 savings, the Embodied Energy savings and the payback time. More specifically on savings, the tool presents Energy Savings (MWh/Year); Water Savings (m^3/Year); Embodied Energy in Materials Savings (GJ); CO_2 Savings (tCO2/Year) and Aggregate Floor Space Including Multiplier (m^2).

Financial Information: The tool presents the estimated overal energy costs, with a Base Case Utility Cost, Utility Cost Reduction and the Incremental cost. If the user saves the calculation in the tool and registers, there is the possibility to submit the project to a certifier and present supporting documents for further steps to be given.

Figure 20 - EDGE tool.



Source: EDGE

UX/UI: In terms of user experience, the EDGE tool is very user friendly, with an immediate response being given to the prompts. The user can easily check the impact of choosing an efficiency measure over another, both in terms of energy savings and costs.

Overall the tool presents a very easy on the eye look, with clear information and explanation on the different aspects of the tool. The main downside of the tool is that it is only limited to non-EU countries, which could be very interesting to evaluate. Also, the building standards used are not clear within the analysis made.

T.5. DOCET

DOCET is a software of diagnosis and Energy Certification of Existing Residential Buildings. It is a Simplified software tool for the certification of existing buildings, up to 200 m2, that drafts the Energy Performance Certificate, gives out a classification for the buildings, including recommendations on how to best improve the energy efficiency of the property. Developed by the Italian Energy Agency and the Construction Technologies Institute, it is available only for Italy and in Italian and is aimed mainly for building professionals and maybe for financial institutions.

The tool asks for the location of the building, square meterage, age, type of building (apartment or independent house, number of storeys, orientation, materials, heating and cooling systems and hot water systems.

The main objective of the tool is to present, to the user, an estimate EPC and evaluates the contributions of PV panels and solar water systems.

Figure 21 - DOCET EPC tool

Source: DOCET

Building Energy information: The simulation tool produces, as outputs, first of all an Energy Performance Certificate, with the monthly energy requirement; annual energy performance indicators (kWh m^2/year); primary energy not renewable (kWh); annual primary energy ; renewable primary energy; total primary energy (kWh m^2/year). Another type of outputs that the tool is able to produce a summary of the interventions to be implemented in order to improve the overall energy efficiency of the building.

Financial Information: No financial information provided.

UX/UI: This is a quite outdated tool that is in the need for some revamping. It is quite simple to use, if the user has the right information on the energy systems installed in the household.

T.6 ENERHAT

ENERHAT is a dwelling energy and investment information that pinpoints to the building exact location its energy performance and to obtain information on energy labels and the state of conservation of residential buildings. The tool allows to compare the energy efficiency of the dwellings with similar dwellings, to assess the investment needed to carry out improvements and finally to apply for subsidies to undertake the reform.

It is based in the Catalonia region in Spain, and with the exact location of the building, it is possible for the user to find out what type of measures can be implemented in order to improve the overall energy performance of the building.

This Web application, developed by the Catalan regional authority has tenants, building developers and homeowners as potential users.

Building Energy Information: The energy consumption of each building or apartment is evaluated in relation to the energy performance of similar buildings on the database. Then, ENERHAT proposes renovation measures to improve the efficiency of the building and reduce the overall energy consumption.

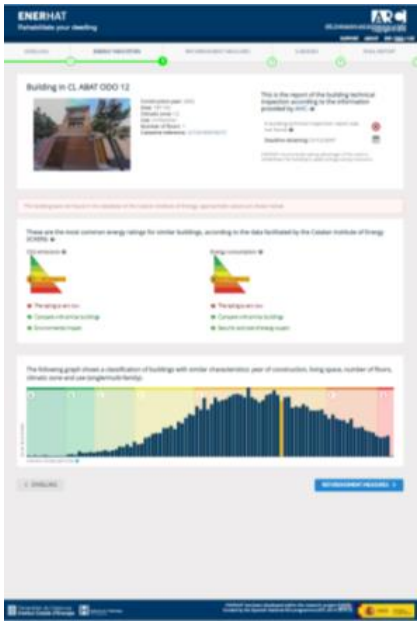
The tool produces an Energy Performance Certificate or proposes one in the case the building does not possess one. Once the data is inserted, a graph with the comparison with similar buildings is generated and an explanation of how the EPC classification and the energy bill of the building.

Other indicators being originated by the tool are the energy consumption estimates and costs, energy efficiency measures are proposed, by the analisys of the dwelling and measures are proposed to improve general energy efficiency. For each of the measures suggested, the application provides a cost estimate for the completion of a given measure.

The calculations are obtained from the EPC's provided by the Catalan Institute of Energy and the building technical inspection are facilitated by the Catalan Agency for Housing along with the geographic comparison with dwelling with similar features.

Financial Information: Although the only information required as input is the municipality and address of the building or appartment, financial recommendations are offered as an output. Besides the information regarding the costs of efficiency measures, the application suggests public subsidies available to reduce the cost of renovation.

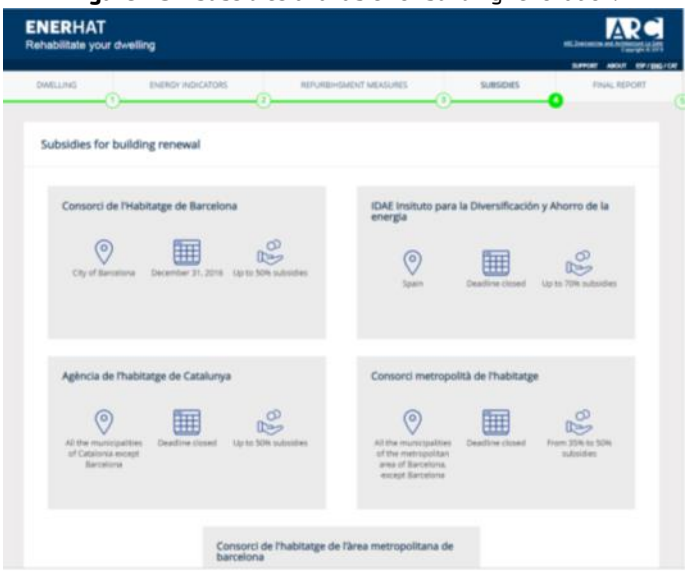
Figure 22 - EPC created by the tool. Based on similar buildings.



Source: ENERHAT

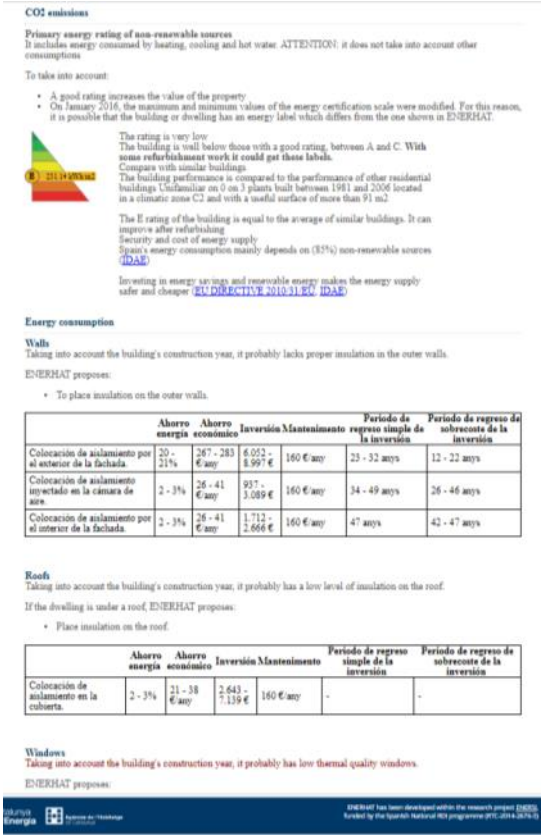
UX/UI – Both the User Experience and the User Interface of ENERHAT are very good. The tool is very easy to use, with a intuitive workflow that starts with the exact location of the building, gives out the current energy performance of the building and carries on to propose energy efficiency measures customized to the specific building while making a call for action for the users to act upon this information by leading them to access directly to subsidy instruments. The tool also has a step-by-step video tutorial and even gives the possibility for users to talk directly with a representative in real-time.

Figure 23 - Subsidies available for building renovation.



Source: ENERHAT

Figure 24 - Final Report produced by ENERHAT



CO2 emissions

Primary energy rating of non-renewable sources
It includes energy consumed by heating, cooling and hot water. ATTENTION: it does not take into account other consumptions

To take into account:

- A good rating increases the value of the property
- On January 2016, the maximum and minimum values of the energy certification scale were modified. For this reason, it is possible that the building or dwelling has an energy label which differs from the one shown in ENERHAT.

The rating is very low
The building is well below those with a good rating, between A and C. **With some refurbishment work it could get those labels.**
Compare with similar buildings
The building performance is compared to the performance of other residential buildings Unifamiliar on 0 on 3 plants built between 1981 and 2006 located in a climatic zone C2 and with a useful surface of more than 91 m2.

The E rating of the building is equal to the average of similar buildings. It can improve after refurbishing
Security and cost of energy supply
Spain's energy consumption mainly depends on (85%) non-renewable sources (IDAE)

Investing in energy savings and renewable energy makes the energy supply safer and cheaper (EU DIRECTIVE 2010/31/EU, IDAE)

Energy consumption

Walls
Taking into account the building's construction year, it probably lacks proper insulation in the outer walls.

ENERHAT proposes:

- To place insulation on the outer walls.

	Ahorro energía	Ahorro económico	Inversión	Mantenimiento	Periodo de regreso simple de la inversión	Periodo de regreso de sobrecoste de la inversión
Colocación de aislamiento por el exterior de la fachada.	20 - 21%	267 - 283 €/any	6.052 - 8.997 €	160 €/any	23 - 32 anys	12 - 22 anys
Colocación de aislamiento inyectado en la cámara de aire.	2 - 3%	26 - 41 €/any	937 - 3.089 €	160 €/any	34 - 49 anys	26 - 46 anys
Colocación de aislamiento por el interior de la fachada.	2 - 3%	26 - 41 €/any	1.712 - 2.666 €	160 €/any	47 anys	42 - 47 anys

Roofs
Taking into account the building's construction year, it probably has a low level of insulation on the roof.

If the dwelling is under a roof, ENERHAT proposes:

- Place insulation on the roof.

	Ahorro energía	Ahorro económico	Inversión	Mantenimiento	Periodo de regreso simple de la inversión	Periodo de regreso de sobrecoste de la inversión
Colocación de aislamiento en la cubierta.	2 - 3%	21 - 38 €/any	2.643 - 7.139 €	160 €/any	-	-

Windows
Taking into account the building's construction year, it probably has low thermal quality windows.

ENERHAT proposes:

Source: ENERHAT

T.7 Genergy

Genergy is a privately developed building simulation tool, lodged in the cloud, based on the EnergyPlus building assessment methodology. It has an international coverage, which can be used in the whole EU and is aimed mainly to building designers, thanks to its technical complexity.

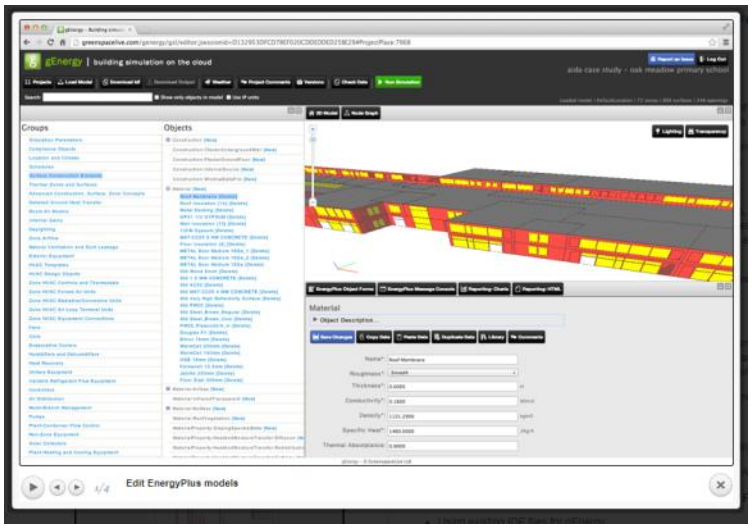
In terms of inputs needed for the tool to run properly, as it is based in EnergyPlus, these are very much complete, from the exact location to the description of type of materials, heating and cooling systems or renewable energy sources.

Building Energy Information: The main innovation of Genergy is that brings the building simulation to the cloud, so that the user can build and access the models online. As a tool based in a complex software like EnergyPlus, Genergy produces a great amount of information regarding the energy performance of the buildings analysed. The amount of output information of the tool is probably too much for the task need in this study, however it should not be overshadowed the potential it has. Although not being comparable with similar or neighbouring buildings, the tool allows for the user to compare different versions of the same building model by iterating the building characteristics.

Financial Information: Genergy is ultimately a building modelling tool, with no room for financial information to be inserted and extrapolated along with the energy measures proposed.

UX/UI: Although maybe too technical for the majority of users that are not building designers with the sufficient technical expertise, the fact that the model data is lodged within the cloud is an interesting feature of the tool. The user enters data in order to simulate a building project and, to model energy efficiency within that building in order to create a more energy efficient building. The user uploads properties of the building in order to create a detailed simulation. After this, energy performance metrics calculated in these simulations can be exported to Excel in the form of charts.

Figure 25 - Genergy Building simulation.



Source: Genergy

T.8 CERtuS SE²T

CERtuS SE2T is an informative tool to be used in the early stages of a building renovation project, being useful to evaluate the projects' financial sustainability. The outputs created can also serve as a facilitator of the discussion between building owners and investors, as it gives useful information on potential financing schemes.

CERtuS SE²T is an Excel tool that receives input like intervention costs, maintenance expenses, expected financial performance and loans' interest rates. Developed in the scope of an European project, promoted by energy agencies, municipalities and research institutes, the tool has a interesting geographical coverage (EL, ES, DK, IT, PT)

Although the tool is mainly directed for municipal buildings, it can be also used for other types of deep renovation.

Building owners that have an estimation of building's costs and expenses needed for an energy retrofitting, can then get estimations of the expected payback period and the desired and/or optimum financial structure.

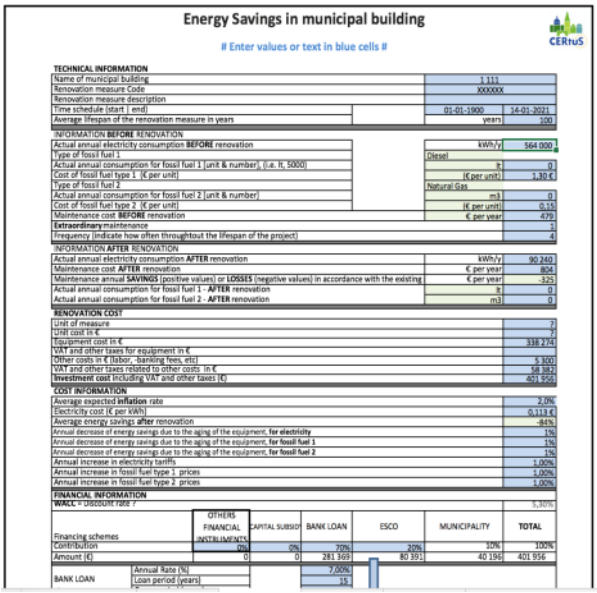
In terms of documentation requested, the CERtuS SE^{2}T tool, asks for indicators like the actual annual energy consumption before renovation, type of fossil fuels, consumption and cost, maintenance costs before the renovation, and the Weight average cost of capital.

Building Energy Information: The outputs created by the tool include the plant power, cost/MW installed, cost/MWh savings, percentage of annual energy savings, kwh annual energy savings, residual energy savings at the end of the projects, useful life, employment creation, CO2 savings/year and the reduced dependence on fossil fuel .

Financial information: On the financial information, the CERtuS tool provides the project IRR, project NPV, municipality IRR, Municipality NPV, WACC, project payback and the municipality payback. After the excel file has been filled, no further action is being requested. Some information is given on what type of finance sources can be used, such as real estate and infrastructure funds, energy efficiency investment funds, crowdfunding, PF4EE, ESIF, EIB and EFSI.

UX/UI – Although relatively easy to fill in, if the user has all the information on hand, the tool is, for a normal user, somewhat complicated, as it obliges to deal with information that is not easily perceivable and does not allow for a common user to draw a great amount of conclusions on what steps need to be taken next.

Figure 26- CERtuS Simulation results.



Source: CERtuS

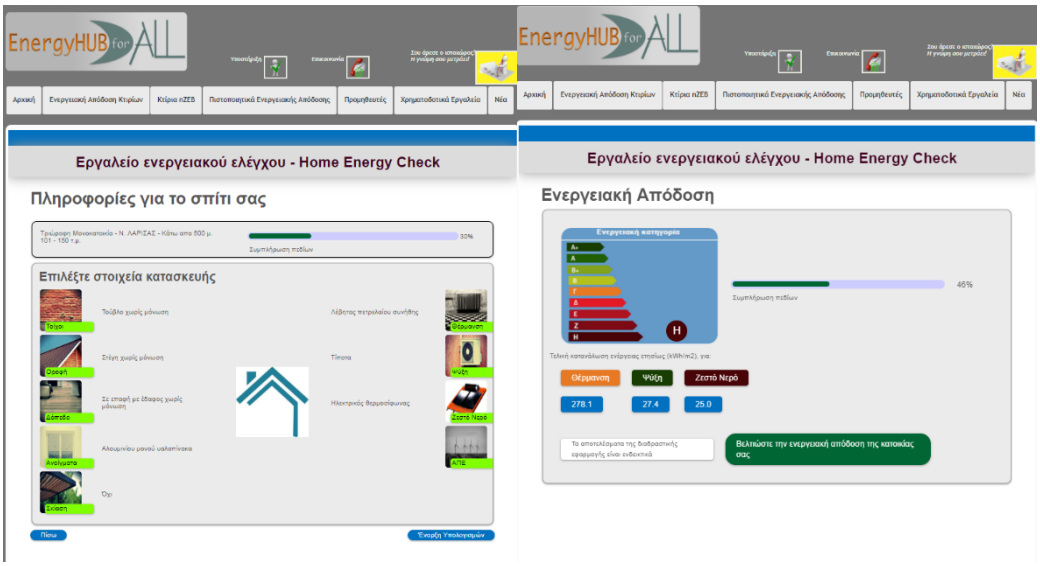
T.9 – Energyhub4all

Energyhub4all is a tool developed by the Greek CRES, the Centre for Renewable Energy Sources and Saving, which is the Greek organisation for Renewable Energy Sources, Rational Use of Energy and Energy Savings. It is a public entity, supervised by the Ministry of Environment and Energy and has financial and administrative independence.

Its main goal is the research and promotion of renewables and energy savings applications at a national and international level, as well as the support of related activities, taking into consideration the principles of sustainable development.

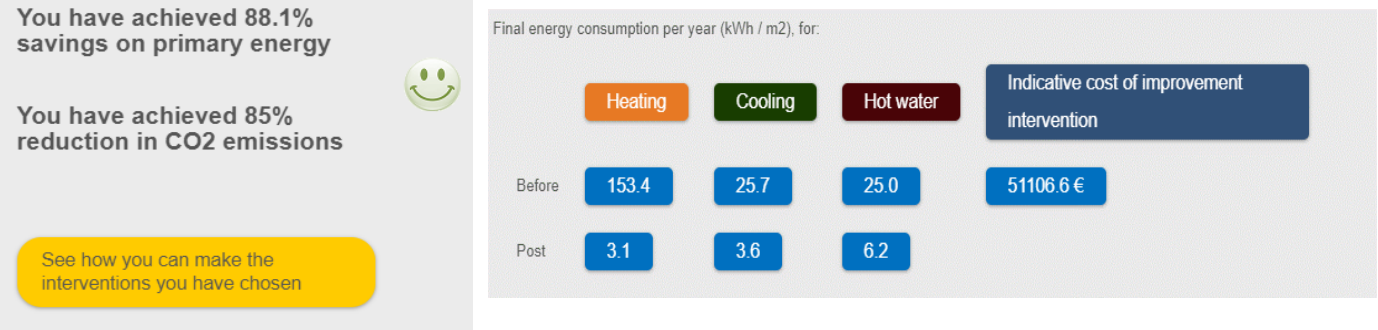
Directed mainly to homeowners, financial agencies or building developers, and only available in Greece and in Greek, the tool demands a considerable amount of information, like the type of house (condominium or detached), the square meterage, its regional location within Greece, construction materials (envelope, insulation and windows materials, water heating system, heating and cooling systems and renewable energy sources - solar water heater, geothermal heat pump, biomass boiler, photovoltaic systems). The tool gives then the estimate EPC with the opportunity to simulate the introduction of energy efficiency measures regarding the improvement of the previously inputted parameters.

Figure 27 - Energyhub 4 all input menu (equipments) and final EPC



Source: Energyhub 4 all

Figure 28 - Energyhub4all outputs



Source: Energyhub 4 all

Building Energy Information: Energyhub 4 all presents, as a main output, an estimate EPC, with an estimate of energy consumption that goes from A+ to H classification, an annual consumption in kwh/m^2 for heating, cooling and hot water and the energy costs. It is also possible to simulate the adoption of the energy efficiency measures proposed, and although it is possible for the tool to simulate the costs per measure, it is possible to get the overall estimated cost of intervention the intervention and get a contact of potential suppliers to perform the energy efficiency measures, per sector (Solar, heating and cooling, envelope, windows, doors and glazing).

Financial Information: Regarding the financial information produced by the tool, besides the monetary savings, as mentioned before, the tool tends to send its users towards the way of suppliers for each

measure where you can contact the contractor separately, without connecting the information of the simulation with the job to be done.

On the possible sources of finance, the tool informs its users of finance plans available, namely European funds like JESSICA, JASPERS, JEREMIE and JASMINE. There is also the indication for national funding and other initiatives considered to be important for the subject like INTERACT, ESPON e URBACT or the Covenant of Mayors, Pact of Islands or Smart Cities programme.

UX/UI: Although the User Interface of the tool does not seem much appealing, with a somewhat outdated look, in terms of User Experience it is a very intuitive and easy to use tool, with simple inputs and quick feedback. There is a positive aspect when choosing the energy efficient measures to be implemented, it is possible to check the impact of each measure and turn back without restarting the whole simulation.

T.10 CasA+

CasA+ is a Webtool developed by ADENE, the Portuguese Energy Agency, aimed mainly for home owners but also for financial agencies or building developers. With a geographical coverage of Portugal and only in Portuguese, the tool asks several inputs from the user, from the location, age of the household, type of building, number or rooms, the positioning of the building, materials used, energy systems present or type of insulation. It then gives out an estimate on the energy consumptions and associated costs for heating (18°), cooling (25°), water heating, and the totals for users to be "comfortable".

Building Energy Information:

The tool gives out potential measures to be implemented and the estimate of costs and energy savings associated with these measures. The tool tells you have much you need to spend annually on heating at 18 degrees, cooling at 25 degrees settings and water heating for daily baths. It also tells you the tCO2/year and the total you spend each year for comfort.

Figure 29 - CasA+ Output.

Source: CasA+

Financial Information:

The tool gives out potential measures to be implemented and the estimate of costs and energy savings associated with these measures. Within the same web environment, there is information available on the governmental financial support to perform the building renovation and information on available funds or programmes for loans. There is no real in-depth information and for further the user needs to access into each funds own site.

UX/UI- First of all the tool is very well designed, with a pleasant look, easy to understand and easy for both experts and non-experts to use. The different menus are well designed in the way that even if the

user is not familiar with some kind of technology, there are images accompanying the choices to be made.

Figure 30 - Impacts of overall measures and per single measure

Source: CasA+

One of the main positive aspects is the simplicity to use of the whole tool, since it isn't too crowded and easy to find what one is looking for. A very nice feature of the tool is how the results are presented. With graphical and colour representation, it is very easy to read and extract the information needed.

T.11 Project Sunroof

Project Sunroof is webtool, developed by Google, that can be used for the calculation of the solar energy production potential for a building. Available for the California region as it is still a tool on a beta stage. The user is asked to locate the exact location of the home as the application allows the user to search for their own home, through Google Earth images, to evaluate the roof shape and local weather patterns to create a personalized solar plan. The electricity costs per month are requested upfront, to calculate the potential savings, throughout the years.

The personalized plan, adjusts the electric energy bill to estimate savings and recommend the number of solar panels to be installed in the home.

Finally, the tool compares finance options like loans, lease and purchase of the solar panels to be installed.

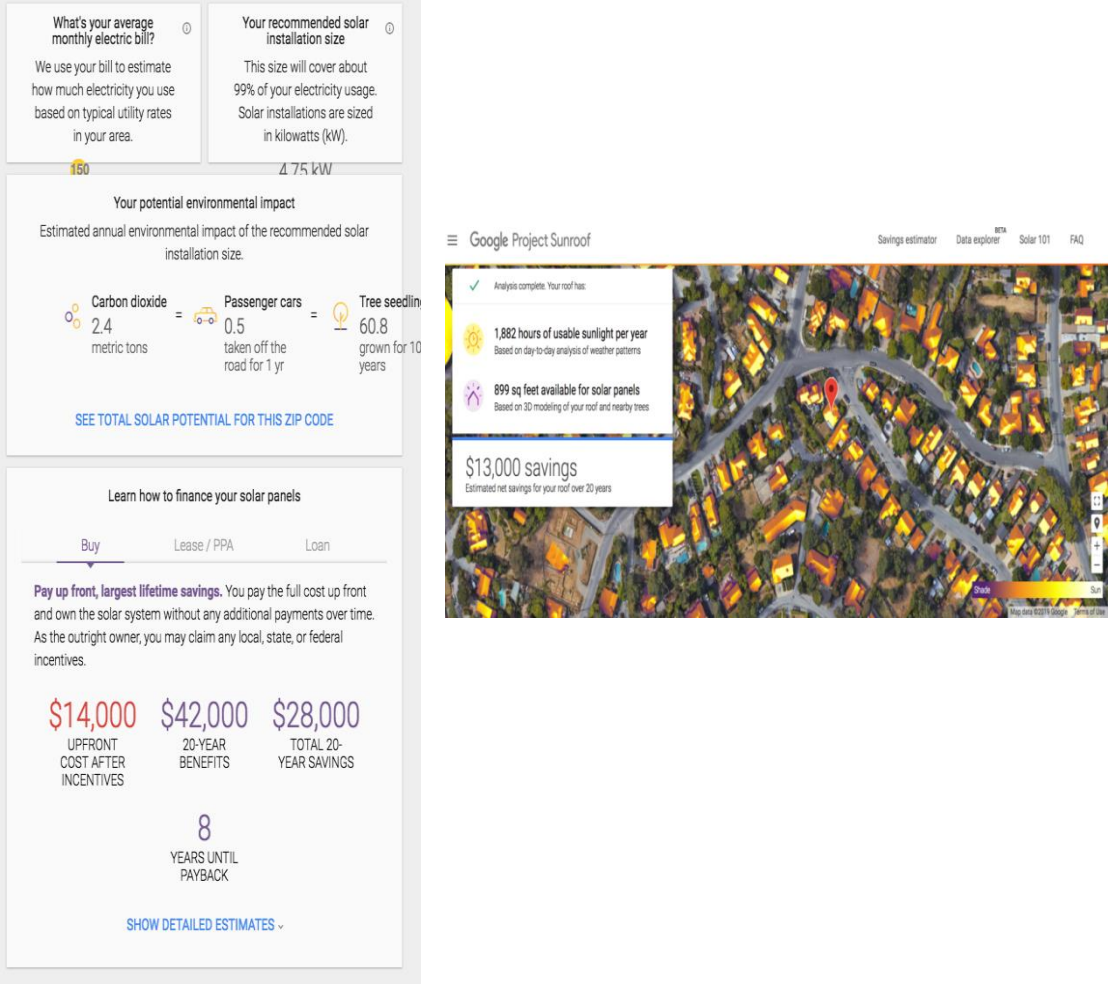
Building Energy Information: The results of the simulation gives out the potential of the environmental impact and the amount of savings possible thanks to the installation of the solar panels in 20 years. The simulation gives out the amount of area available for solar panels in the specific household, the recommended solar installation in terms of area and power.

Financial Information: It gives out the cost for the installation of the solar panels, whether the homeowners wants to buy, lease or loan the solar panels. Costs of installation, costs during the years of the lifecycle of the equipment

Yes. It is possible to choose solar installers through the app. Advice on how to choose the best installer, what to look for, and technical advice are given.

UX/UI: Very clear information on the financial part of the tool. Information related with the up-front cost of installation, total payments over 20 years, State and Federal Incentives, Total 20-year costs with and without solar installation and total 20-year savings. The years until the payback of the investment are also given.

Figure 31 - Project Sunroof simulation results.



Source: Project Sunroof

T.12 Triodos

Triodos is a Housing credit simulation webtool, developed, by a bank, with the objective to give a credit rate simulation for residential buildings improvements, but not directly related to energy savings related to energy efficiency measures.

The tool asks for inputs like what type of project (new construction: passive house, low energy house, energy-efficient home, Renovated house or to be renovated: house with optimal energy score, house with low energy score, ecological renovation, or different type of house, group of houses, intergenerational house, classified (protected) building)

Aimed mainly for home-owners and building developers, the tool is available in French and Dutch and gives an estimation of the credit rate based on the energy performance of the project. Each house options give general information on potential outcome and measures to be implemented.

In terms of financial information required, the tool asks for the amount the user wishes to borrow from Triodos, the duration of the loan, the ratio between the amount of the loan and the value of the home according to an expert estimation recognized by the bank and the frequency of the premium payment

Building Energy Information: As the tool is dedicated to financial information, there are little building outputs originated.

Financial Information: The tool produces several financial information that the user can use to ask for financing like 1) basic interest rate; 2) your interest rate; 3) monthly instalment in X months and 4) annual cost percentage.

After the simulation is run, it can be saved and send the report, which will then originate a contact from a bank representative.

The source of finance in this case is only through bank loans.

UX/UI: Overall the user interface and the user experience of the tool are quite simple, although the information requested is not much and the financial questions are difficult to understand. Nevertheless, it is very interesting that a financial institution in open to enter the option of energy efficiency and its conditionalities into a very traditional and closed industry as banking.

Figure 32 - Triodos financial outputs.

Source: Triodos

T.13 90.1 ECB

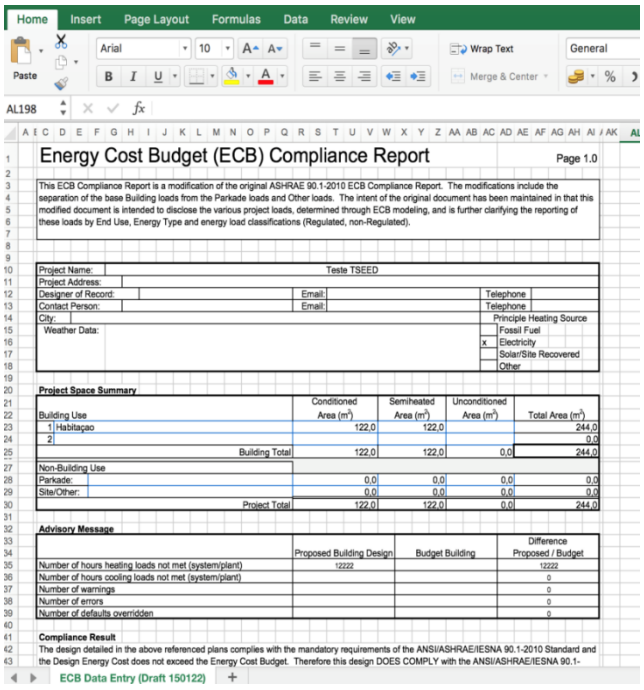
90.1 ECB (Energy Cost Budget) is a building modelling tool based in ANSI/ASHRAE/IES 90.1-2010 Energy Standard for Buildings. 90.1 ECB allows to do the calculations needed to show a building project's compliance with ASHRAE/IES Standard 90.1-2010 using the Energy Cost Budget (ECB) Method described in the standard and collect the outputs via an Excel spreadsheet. Developed by ASHRAE and aimed for Building designers, the tool is in English and aimed mainly for the American market, collects information from the users like what type of use is being given to the building, Project Energy needs by End Uses, the principal heat source, areas of heated/cooled space or the number of hours of heating and cooling proposed.

The project lets the user input their project parameters and then calculate the proposed design's projected performance and compliance with no need to build their own spreadsheet.

Building Energy Information: As it is based on the ASHRAE standard 90.1, all the calculations behind this tool are considering the specifities of the standard. The tool gives out the results via the webpage or can be downloaded as an excel file, providing a calculation of the total energy cost, with the costs broken down by energy type. Another results produced are the virtual rate that divides the total energy cost into the total energy usage and a project Energy Consumption and a Cost Summary.

Financial Information: Regarding the cost, the cost summary section displays a proposed and budget building information broken down by load type, energy type, and it also displays proposed to budget ratios for energy consumption and costs. The tool does not make any predictions of energy consumption or costs of the proposed design choices after construction but gives out an estimate of the costs per measure.
Other types of information originated are virtual rates, project consumption and cost summary, greenhouse gas emissions and savings.

Figure 33 - ECB simulation results.



Source: ECB

UX/UI: The user experience of 90.1ECB tool can be considered simple to use, but only if the user is a building expert and with clear knowledge on how to model a building. Otherwise this is a quite technical tool, that cannot be used by a common user. The overall management of the tool is quite tricky and not very intuitive. The most interesting feature is the ability to download the results in a spreadsheet and the actual model behind the calculations.

T.14 Faire/ Simulaid€s

FAIRE and SIMULAID€S are two tools, developed by ADEME, the French Energy Agency, with two distinct objectives. FAIRE gives out technical information on how to improve the energy efficiency of a household in the process to improve the comfort within the home and gives out three layers of improvement for home owners. To make simple, giving simple energy efficiency advice; to make better, giving advice to improve comfort or to develop a project; or to make more, when bigger renovation projects are foreseen.

With an excellent user interface and easy user experience the website also allows for homeowners to find professionals within their area and gives out information on the financial tools available, namely: L'éco-prêt à taux zéro, Le Crédit d'impôt pour la transition énergétique (CITE), Le programme « Habiter mieux » de l'Anah, La TVA à taux réduit, Les certificats d'économies d'énergie,

SIMULAID€S is a simple tool that gives out a simulation, after the description of a household and its characteristics (location, year, type of building, area, heating systems, number of habitants), and what type of renovation works are foreseen (studies like energy audits, envelope works, equipment installation), that gives out a list of all the financial tools available and the percentage of the funding to be given. After this the user can benefit from free aid from FAIRE consultants.

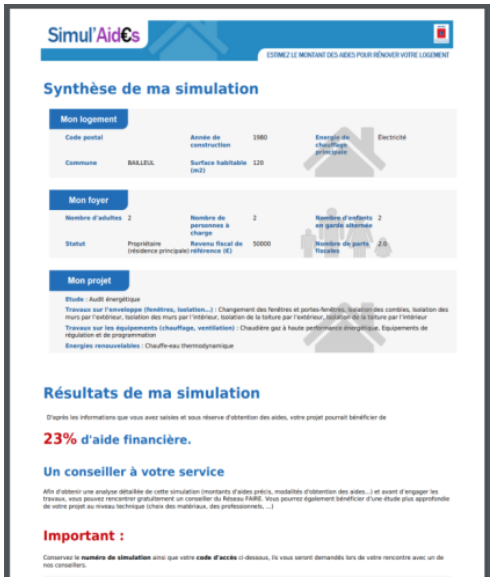
SIMULAID€S is available only in some French regions (Grand Est, Normandie, Occitanie, Centre-Val de Loire and Corse.) It is a financial financial simulation tool, and is aimed for Homeowners and Building professionals and developers.

Building Information: FAIRE provides simple advice on energy efficiency measures that can be performed during a household renovation process, with practical guides, in PDF, that can help the user to make an informed decision. These interesting guides provide technical information on the benefits of installing certain types of technology, what systems to choose, a potential budget, advantages and disadvantages of a certain technology in comparison with another. The information given by the website relates to ventilation, windows, heating systems, hot water systems and insulation. When the user has decided to proceed with the renovation, the website leads the user towards specialists that can perform energy audits or even realize the construction works.

Financial Information: The FAIRE platform only gives general information of the loans, grants and incentives available for homeowners and who is offering them. As it is basically an informative site with the basic information that a homeowner needs to know after reading through the information, the next step is finding a contractor in their reference list.

SIMULAIDES, however, gives out a bigger amount of information that can be used to easily access to the financial tools available for the different works to be realized. Discriminating by type of financial tool, SIMULAIDES informs the user with the main conditions of the aid, the eligibility criteria, the estimate amount aid to be accessed (%) and a contact point for the user to use when deciding to advance with the works.

Figure 34 - SIMULAID€S simulation result.



Source: SIMULAID€S

UX/UI: Overall, both tools are in its own area very well designed, with a pleasant user interface, very easy and intuitive to use. The way the outputs are transmitted towards the final user are very much easy to understand to all interested parties, from experts to normal household owners. The technical information is very clear, simple enough and not too clouded even though there may be sometimes too much of it.

T.15 Enerfund

ENERFUND is a web application that provides, through a webmap, the identification of potential buildings for deep renovation. The tool, developed thanks to an EU-funded project, with partners like Energy Agencies and Academia, is available for 12 countries (BG, CY, DK, FR, EL, IE, IT, RO, SK, SI, ES, UK) and can be used by financial institutions, building promoters, energy service companies or even product companies.

ENERFUND rates and scores deep renovation opportunities, via a Geographical Information system and is based on a set of parameters such as Energy Performance Certificates (EPCs), number of certified installers or governmental schemes running, etc.

By providing a rating for deep renovation opportunities, energy service or product companies can identify customer segments based on their needs, environmental department heads can assess and compare buildings when prioritising deep renovation and deciding on fund allocation and financial institutions can provide targeted loans for building retrofits. The tool provides, through a webmap, the identification of potential buildings and areas suitable for deep renovation. The tool is built upon information collected from different buildings and regions, based on their need for deep renovation and retrofit potential.

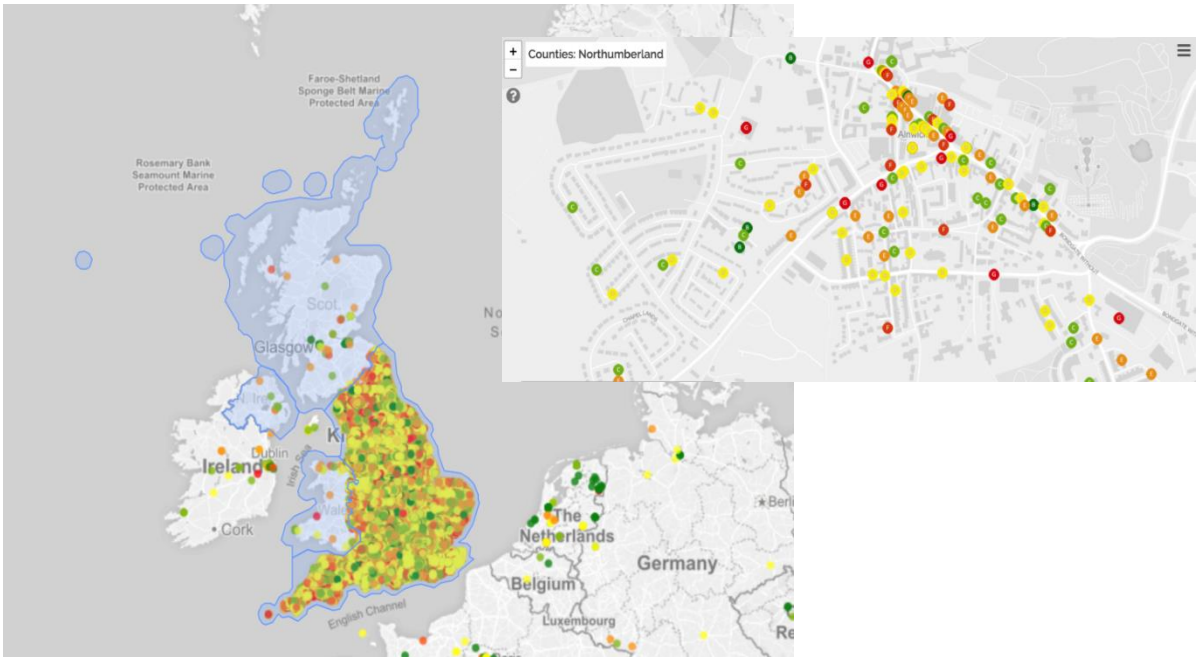
One of the main features of ENERFUND is the comparison between different neighbouring buildings and the fact that all the information can be accessed on a web graph.

Energy Building Information: The tool gives an EPC estimate and indicates which buildings offer opportunities for renovation. Each building in the tool is graded by an A to G system. The website also mentions that each building will also receive an Enerfund score, but this feature of the app is not yet active. There is no suggestion on how to improve the energy efficiency measures based on the data representing the performance of the buildings.

Financial information: At the moment no financial information is provided about individual buildings. The site says that an Enerfund score is “coming soon.” This score will be the result of an equation that will incorporate the building prices.

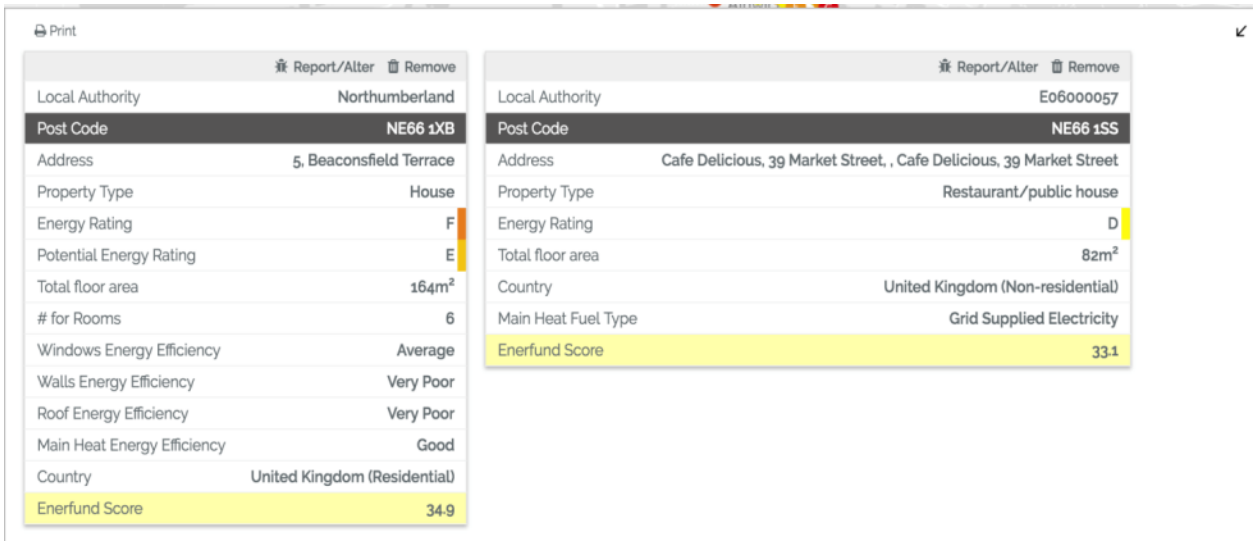
UX/UI: Overall, the information in the website is clear, with video tutorials on how to use the application. The fact that the tool is based in a GIS environment is very positive, since it allows to look for an exact location when choosing a building. There are still some features that need to be developed which will allow for a better overall experience of the tool.

Figure 35 - GIS Building Location.



Source: Enefund

Figure 36 - Enerfund Building Comparison.



Print

	Report/Alter	Remove
Local Authority	Northumberland	
Post Code	NE66 1XB	
Address	5, Beaconsfield Terrace	
Property Type	House	
Energy Rating	F	
Potential Energy Rating	E	
Total floor area	164m²	
# for Rooms	6	
Windows Energy Efficiency	Average	
Walls Energy Efficiency	Very Poor	
Roof Energy Efficiency	Very Poor	
Main Heat Energy Efficiency	Good	
Country	United Kingdom (Residential)	
Enerfund Score	34.9	

	Report/Alter	Remove
Local Authority	E06000057	
Post Code	NE66 1SS	
Address	Cafe Delicious, 39 Market Street, , Cafe Delicious, 39 Market Street	
Property Type	Restaurant/public house	
Energy Rating	D	
Total floor area	82m²	
Country	United Kingdom (Non-residential)	
Main Heat Fuel Type	Grid Supplied Electricity	
Enerfund Score	33.1	

Source: Enerfund

T.16 4ECasa

4ECasa is a webtool developed by ENEA, the Italian Energy Agency, with the purpose to to compare buildings consumptions and potential benefits through improvements. An easy to use webtool, that with simple inputs (Place of residence, Year of construction of the building, type of building, type of heating and energy consumption associated with heating), gives out a comparison with similar buildings in the area and provides potential savings with the replacement of the heating system or the improvement of the envelope of the building. The portal also gives out indication for the fiscal incentives available. The tool is mainly dedicated to homeowners and is only available in Italian and for the Italian market.

With great detail asked in the inputs section, the tool allows for a quite accurate assessment of the energy performance of the building.

Energy Building Information: The simulation gives out a qualitative energy performance indication of the building/household. Also what type of energetic savings and economic savings are possible in consideration with the measures indicated by the user. The measures are mainly qualitative and concern in its great majority the replacement of existing materials or energy systems like boilers, heat pumps, district heating, insulation, etc.

Financial Information: 4ECasa provides clear information on the available tax deductions, which at the moment of analysis were outdated. The information given in the tool is mainly qualitative in terms of the energy savings to be achieved after their implementation.

Figure 37- 4ECasa simulation results.

Source: 4ECasa

UX/UI: Overall the tool is quite easy to use, even for non-technical users, giving a fair perspective on both the energy performance of the building, what type of improvements will make the bigger difference and most of all what would be the deduction percentages that the users could benefit. Unfortunately, the tool seems quite outdated, both in terms of information and visually. It would be interesting to see it updated with information regarding the current fiscal incentives and a quantitative assessment of the energy efficiency measures proposed.

T.17 Home Energy Scotland

Home Energy Check Scotland is a simulation tool designed to help users in the process of residential buildings improvements. This tool provides an evaluation of the current energy performance of a household through the input of several buildings characteristics. The simulation and information tool is developed by the Energy Saving Trust Scotland, funded by the Scottish government and available, in English, for Scotland, England a Wales. The tool starts by asking the exact location of the building, what type of property it is (storey house, flat, storey flat), the location of the flat or the detachment of a storey house, number of bedrooms and living area rooms, the age of the home, the type of roof, main wall and

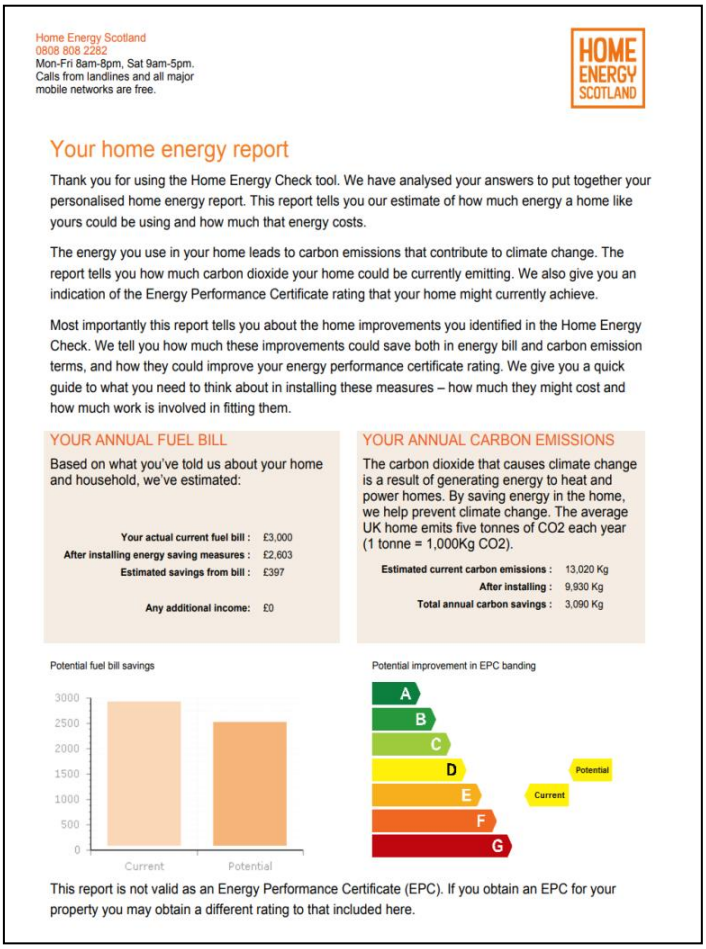
the heating systems. The input of this information will give the user an estimate of the different fuel bills, which can be then corrected by inserting the actual bills of the building.

After the input of these features, the tool allows for the user to go further deeper and specify with even bigger detail the different aspects of construction and occupation of the home, from heating and hot water, floor, wall, roof, windows, doors, occupancy, renewables and lighting.

Building Energy Information: As main outputs, the simulation tool provides an estimate of the energy consumption of the house, potential savings and associated energy efficiency measures, giving a perspective, measure by measure, on its contribution for the overall savings, the level of work involved, payback time and comfort increase. If wished, after a first simple analysis, the user can go into greater detail on the characteristics of the household to get a more approximate evaluation of the energy performance of the house by adding information like number of occupants, type of lighting, heating systems or renewables.

Finally, with greater information, the tool provides a 13-page pdf report on your buildings performance and potential improvements, with the current level of efficiency and the potential, the CO2 savings, what type of measures can be applied in different areas (lighting, insulation, energy systems, renewable systems). For each of the measures there is a description on the projected amount of work involved, the impact in comfort arising from the measure, the payback of the measure, some other practicalities, impact on the appearance of the home.

Figure 38 - Building Simulation report.



Source: Home Energy Scotland

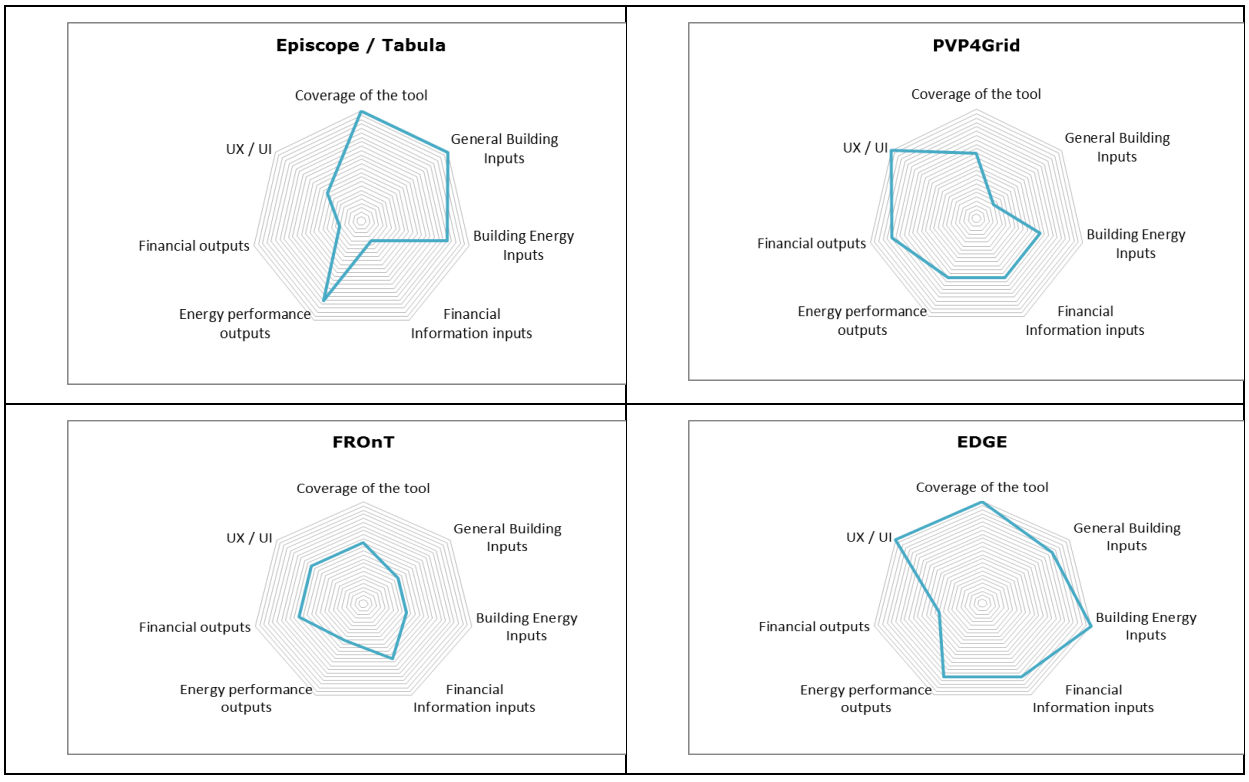
Financial Information: The data regarding the financial information concerns the price of the different measures, what type of income can be originated from exporting generated electricity, feed in tariff incentive, the Domestic Renewable Heat incentive and the Combined annual incentive. For all the energy efficiency measures proposed in the simulation report, the tool gives out an estimate of the cost for each measure. There is also indication on the financial schemes provided by the Scottish government, such as Warmer Homes Scotland and the SC Home Energy Scotland loan.

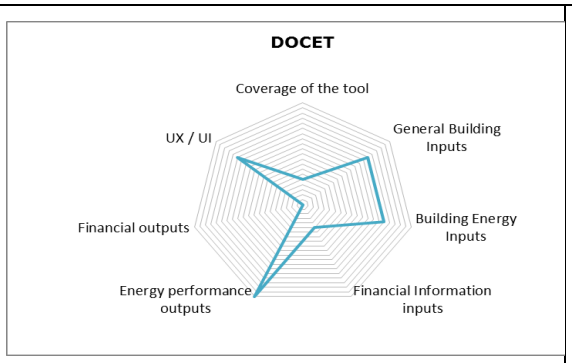
UX/UI: The Home Energy Scotland tool is a very well designed and easy to use tool, which can be operated by any interested party. The graphics of the tool leave very little left for interpretation of the user. All aspects of the house are covered, from the ground to the roof, from insulation and envelope to energy systems. The information given is very clear and can be used by the users to further steps. An interesting feature of the tool is the comparison with the neighbouring buildings. In the end of the simulation activities the next step is to actually call the governmental consultants for further information on how to proceed next.

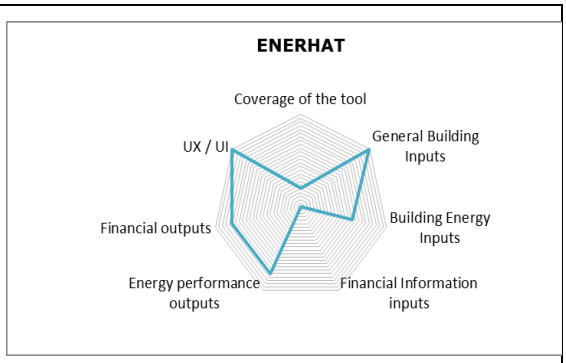
3.4 Analysis

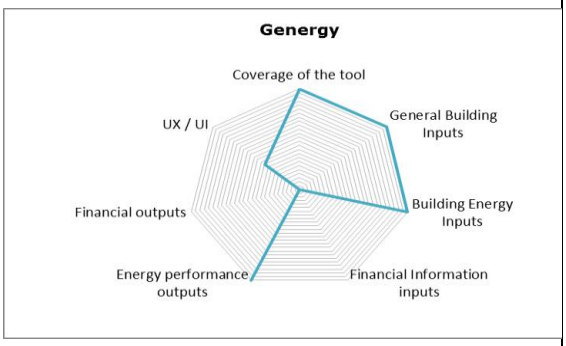
For each of the tools, a graphical representation is presented, taking into consideration the seven indicators described above.

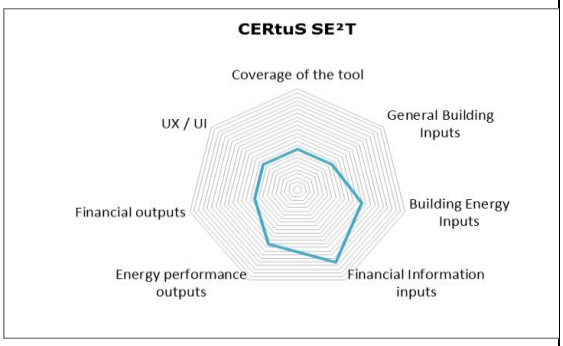
Figure 39 - IT Tools Evaluation

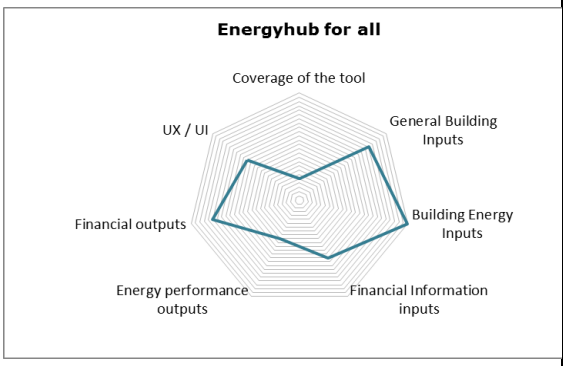


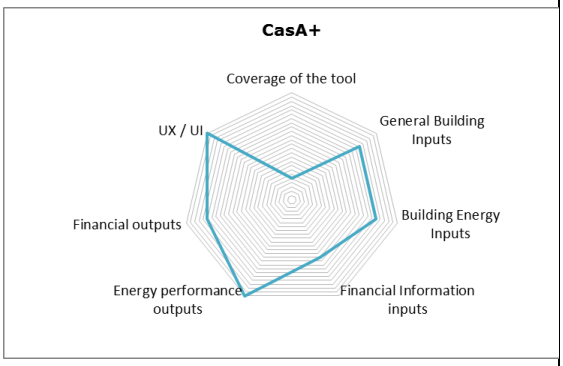

DOCET
Coverage of the tool
General Building Inputs
Building Energy Inputs
Financial Information inputs
Energy performance outputs
Financial outputs
UX / UI

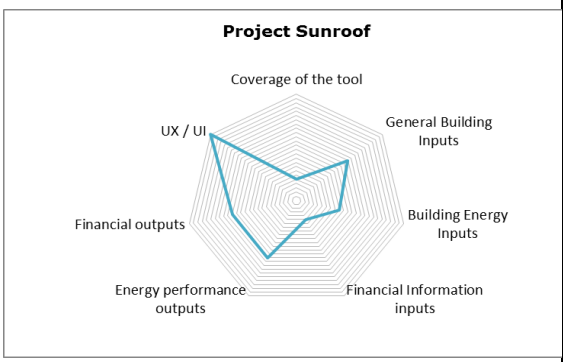

ENERHAT
Coverage of the tool
General Building Inputs
Building Energy Inputs
Financial Information inputs
Energy performance outputs
Financial outputs
UX / UI

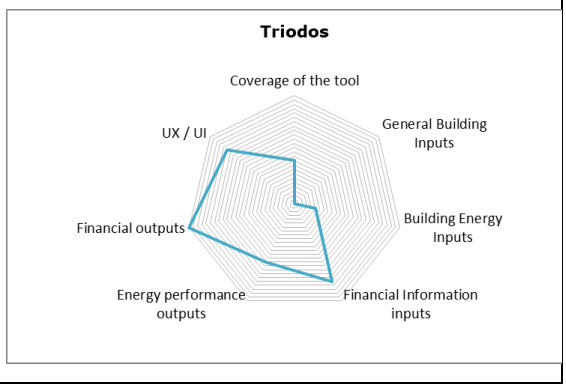

Genergy
Coverage of the tool
General Building Inputs
Building Energy Inputs
Financial Information inputs
Energy performance outputs
Financial outputs
UX / UI

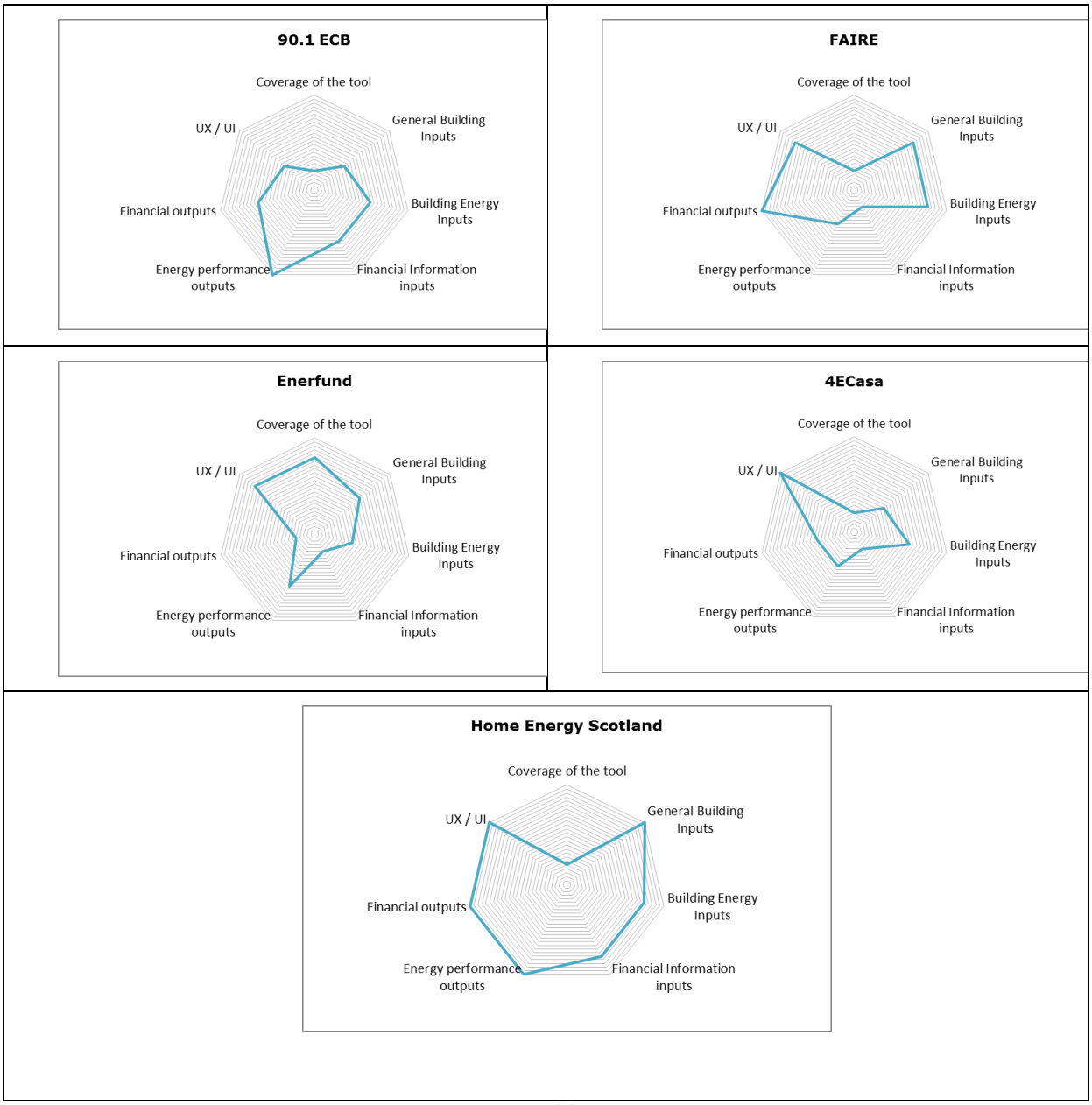

CERtuS SE²T
Coverage of the tool
General Building Inputs
Building Energy Inputs
Financial Information inputs
Energy performance outputs
Financial outputs
UX / UI


Energyhub for all
Coverage of the tool
General Building Inputs
Building Energy Inputs
Financial Information inputs
Energy performance outputs
Financial outputs
UX / UI


CasA+
Coverage of the tool
General Building Inputs
Building Energy Inputs
Financial Information inputs
Energy performance outputs
Financial outputs
UX / UI


Project Sunroof
Coverage of the tool
General Building Inputs
Building Energy Inputs
Financial Information inputs
Energy performance outputs
Financial outputs
UX / UI


Triodos
Coverage of the tool
General Building Inputs
Building Energy Inputs
Financial Information inputs
Energy performance outputs
Financial outputs
UX / UI



Source: own elaboration

Table 1 - IT tools grading

	Episcope	PVP4Grid	FROnt	EDGE	DOCET	ENERHAT	Genergy	CERtuS SE²T	Energyhub for all	Casa A+	Project Sunroof	Triodos	90.1 ECB	FAIRE/ SMULAID€S	ENERFUND	4ECasa	Home Energy Scotland
Coverage of the tool	5	3	3	5	1	1	5	2	1	1	1	2	1	1	4	1	1
General Building Inputs	5	1	2	4	3	5	5	2	4	4	3	0	2	4	3	2	5
Building Energy Inputs	4	3	2	5	3	3	5	3	5	4	2	1	3	4	2	3	4
Financial Information inputs	1	3	3	4	1	0	0	4	3	3	1	4	3	1	1	1	4
Energy performance outputs	4	3	2	4	4	4	5	3	2	5	3	3	5	2	3	2	5
Financial outputs	1	4	3	2	0	4	0	2	4	4	3	5	3	5	1	2	5
UX / UI	2	5	3	5	3	5	2	2	3	5	5	4	2	4	4	5	5
TOTAL	22	22	18	29	15	22	22	18	22	26	18	19	19	21	18	16	29

Source: own elaboration

Just looking at the sum of the 7 indicators, the **Home Energy Scotland** tool was the tool that has gotten the biggest results, with the highest grade in both building, financial and UX/UI features. This tool, has shown to be quite complete, being able to be used by final users and technical experts, with a great user interface and a very simple to use user experience.

The same value was achieved by the **EDGE** tool, promoted by the World Bank, which has shown to be a tool of great value, and could be of interest if transferred to the EU reality, since it does not cover the EU.28 in its area of influence. This tool, also presents a very intuitive and easy to use format, making it quite simple for both technical and non-technical users to simulate their buildings and help to make a decision on what the next steps can be, in terms of renovation and access to finance.

Also the **CasA+** promoted by the Portuguese Energy Agency tool has achieved a quite high value, with its EPC simulator, thanks to the great amount of information arising from the building simulation, giving a very good amount of information on the best measures to be implemented to improve the overall energy performance of the household, costs calculation and access to state funding.

Regarding the Coverage of the tools evaluated, this is the overall indicator that has the lesser ratings. The majority of tools are only working for one country and in one language, making them unsuitable to be used in a EU-28 level. Only Episcope, EDGE and Genergy and Enerfund have reached the higher values by covering several Member States and languages.

On the General Building and Energy Aspects (General Building Inputs, Building Energy Inputs and Energy Performance Outputs), Episcope, EDGE, ENERHAT, Genergy, Energyhub for all, CasaA+ and Home Energy Scotland were the frontrunners with sufficient information being collected as inputs that ultimately produce a good amount of energy performance outputs, leaving the user with a great amount of information to make a conscious and grounded choice on the measures to be implemented in the household.

On the Financial Aspects (Financial Information Inputs and Outputs) the tools PVP4Grid, FROnt, EDGE, CERtuS SE²T, Energyhub for all, Casa A+, Triodos, 90.1 ECB, FAIRE/ SMULAID€S and Home Energy Scotland have been graded as the tools that have requested and consequently provided the greatest amount of financial information for the tool's users to use and decide on what type of costs will they incur and what type of financial aids or instruments are available for the renovation of a household.

Finally, on the User Experience/User Interface category, the most subjective indicator, the tools PVP4Grid, EDGE, ENERHAT, Casa A+, Project Sunroof, 4ECasa and Home Energy Scotland have reached the highest mark, meaning that these are the tools that were found to have the best balance between User Experience, i.e. the way the user interacts with the tool and User Interface - the looks of the tool. Although it may seem unessential, these aspects are of a great importance for the simple fact that this can make or break an IT tool, since it can allow for a user to be motivated and keep on using it step after step or simply give up, due to its complexness.

3.5 Discussion

The main objective when researching and evaluating the existing IT tools that could be used in the residential renovation sector, was to find tools that could serve as a first filter before the interested parties would enter in a more serious and challenging renovation process.

The first findings were that there are three main types of tools available in market:

1) Technical tools: directed for building experts and designers, that demand a great amount of technical building knowledge for them to be used and to extract any kind of conclusion. Usually these types of tools have little to none information on financial subjects.

2) Financial Credit Tools: Tools made by banks and financial institutions with the clear objective to provide a bank loan, with very little content on what concerns energy efficiency of the actual building.

3) EPC Simulator Webtool: Tools, usually promoted by governmental organizations that estimate the energy performance of a household, giving it an energy classification and proposing energy efficiency measures to improve the grade of the building. Often, these tools contain also information on some financial aspects, simply being the energy costs or of the energy efficiency measures to implement, or actual information on available financial instruments.

During the research process, there were also found several websites that summarize information regarding both energy efficiency measures and financial instruments, but these were mainly information sites with little to none interaction and with only information on how to save energy by insulation or changing light bulbs, which falls out of the purpose of this study.

Other types of tools found were tools developed by academia that clearly were to be used by very technical people and were not publically available.

Several barriers for the widespread use of these IT tools were found during this evaluation. One of which is the geographical dimension of the tools, with none of them being able to assess the renovation potentials and financial aids in the whole EU-28. The fact that the tools are, many times, limited to a single language is also very restrictive.

Another barrier found was the activity status of the tools, with several of these tools having been developed several years ago and not being updated ever since. Most of the tools have been created during the first years after the publication of the first version of the Energy Performance of Buildings Directive with the introduction of Energy Performance Certificates into national law, from EU-funded projects, with very few being constantly updated, so that in terms of prices of energy, taxes and even technology prices these may be leading people towards inaccurate results.

Another issue that has been found is that very few of the studied tools actually mention any comparison with similar or neighbouring buildings, which is something that has been proven to being effective with final energy consumers.

In terms of technical issues, it needs to be mentioned that very few tools provide any information on the motor of the methodology, without mentioning the parameters or building standards used, nor the calculations used to achieve the simulation results.

Overall it was not possible to find an ideal solution that can be used by a single person or an institution when starting a residential renovation process. All the tools analysed have some positive indicators, but none of them is capable of giving a complete response to a users' needs.

Ideally, the tool to be used, should be the sum of the best features in all of the IT tools analysed. A tool with the Episcope capacity of having EU-wide standards building database that could run the simulation, the most accurately possible, along with a GIS interface like in PVP4Grid or Project Sunroof, which makes it very easy and with minimal input from the user to locate and identify the building features.

Another item that could be interesting to have would be a two-level technicality, with a first level being for a regular user with little technical knowledge, with a click-and-go type of functionality and another level being a more complex modelling tool like Genergy, based in EnergyPlus and hosted in the cloud, so that building experts could simulate the building in hand.

A very important feature for a successful IT tool would be, of course, the amount of financial information and how this information is transmitted. The ideal tool should present information on prices of all the measures proposed, along with their impact in terms of energy performance and the potential for not losing tax benefits within the country.

Besides the technical mechanism that needs to be the heart of the IT tool there are several other usability issues that need to be taken into consideration when designing such a tool. Firstly, the multinationality and multi-language level that needs to be present in such a tool.

A constant update and maintenance with real market values and an accessible technical assistance (via message or telephone) should be a pre-requisite when designing a tool. The user should always feel supported and trust the process while using the tool.

A great attention needs to be given to the User Experience and the User Interface of such a tool. Where the UX is the "how it works" and the UI is the "how it looks", a successful tool should be designed so that these two features meet in the middle. The user should be able to use intuitively the IT tool, and should be easy enough to use for all visitors, without discrimination of technical knowledge or age, for example. The tool shouldn't have a steep learning curve so that users can easily use it in the first time visiting.

Finally, another matter that needs to be taken into attention is that the tool should always provide constant feedback in all the issues in hand, being in terms of energy consumption, energy savings or financial information. Overall the visitor using with the IT tool should, at all times be validated with the choices made and the results should be relatable, giving information that can be used along the building renovation process.

3.6 Conclusion and Recommendations

In conclusion, firstly the report looked into the financiers' perspective on the provisions of energy efficiency investments for households, focusing on technical assistance. Secondly, the different assistance needs for household have been identified as well the existing IT tools that could be used by financial institutions, public authorities in order to do a preliminary identification of the most relevant projects before engaging in more resource intensive TA services. It looked also into how these tools can be used by the general public in the process of renovating their homes.

Overall, it needs to be said that none of the tools studied gives out a solution for all the actors working in this area, being financial institutions or the public sector. Nevertheless, final energy consumers are able to find better solutions tailored to their needs, even with flaws.

Two main problems were identified on why there is still some resistance on the development of financing for energy efficiency projects for households. Firstly the increase of debt in Europe that will come from the renovation expenses needed to achieve the European targets and secondly the lack of interest and adoption of such financial mechanisms from banks themselves. More ambition and a push from supranational authorities is needed in order to change the banks' approach that must come not only from the multinational and national brands, but also needs to reach the local bank managers that give out the loans to final energy consumers.

Two proposals are outlined that could help changing this paradigm: on-tax financing, which is a mechanism used to collect the repayment of money that was lent for building improvements that meet a 'valid public purpose,' and On-Bill Financing that uses a similar mechanism as on-tax financing. There are two main types of on-bill programmes: on-bill financing and repayment. In both options an utility or private lender supplies capital to a customer to fund energy efficiency and is repaid through regular payments on an existing utility bill. The core benefit of on-bill and on-tax financing is that the loan sits with the house and is not taken by the individual.

From the analysis of both One Stop Shops websites and IT tools no single tool was able to answer to all the questions asked. For a tool to be used thoroughly and efficiently by both financial institutions, public authorities and homeowners, it needs to effectively check very different boxes.

These tools need to be very well designed and engage the users by allowing them to participate in the assessment of the building with immediate gratification. It needs to be user-friendly and require as little information as possible and give as much information as needed, via simple and actionable actions, both in terms of finance instruments and technical solutions that can help financial institutions, local authorities and homeowners to decide to advance towards a renovation.

In order for the tools to be effective, the information on which the tools are based needs to be updated and locally harvested. Different regions have different climate characteristics and different construction years also mean different building materials and efficiency.

Also the financial information needs to be locally gathered and constantly updated. The majority of sites and IT tools lack information concerning financing. The simple provision of web links is not enough for someone to take an informed decision.

The informative character of the IT tools needs to be always present. If someone is thinking of renovating their home, needs to know how, how much and why. Energy efficiency is all about educating the customer, which must understand the details behind the measures being proposed and their possible financial benefits.

When developed, these tools must not cease to exist with a final result and should continue giving support to the user, via technical aid from local experts that can help the final user make the best decision and follow-up on the next steps, from the choice of the best financial instruments to the technical solutions.

The geographical dimension of the Technical assistance tools is also something of great importance. Ideally, a tool should be able to work at different geographical levels, from municipality to region and even at a country level, depending from the type of user they are targeting, the different tools should have different geographical areas of interest. Only then it would be able to serve the majority of users.

Ultimately, Technical Assistance through IT tools can be a powerful instrument for the renovation wave at the EU level. With a global literacy on internet and the use of computers, there is a chance to reach the

majority of people at the distance of a click. These tools can be a true ally for all the actors in the process of the renovation and the involvement of public, private and financial sectors equally is key to reach this success.

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ANNEX 1 Excel Template

General Information	
Name	
Website	
General Scope	
Description	
Type of Tool	
Promoter	
Target Groups	
Geographical Coverage	
Languages	
Status of Activity	
Inputs	
Location	
Altitude	
Square meterage	
Number of rooms	
Age of Building	
Type of Building	
Number of occupants	
Number of Storeys	
Orientation	
Positioning	
Type of materials	
U values	
Heating System	
Cooling System	
Hot Water systems	

Renewable energy sources	
Documentation requested	
Outputs	
Results of building simulation	
EPC estimate	
Estimated energy consumption	
Estimated overal energy costs	
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Energy Efficiency Measures	
Estimated costs per measure	
Results of building simulation after the application of measures	
Comparison with neighbouring buildings	
Comparison with reference buildings	
Fiscal incentives indication	
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Financial information	
Type of financial information	
Actionable	
Source of finance	
Calculation methodology behind information given	
Clearness of information	
Contacts	

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