

## **GRASPINNO**

Transnational model, strategies and decision support for innovative clusters and business networks towards green growth, focusing on green e-procurement in EE/RES for energy refurbishment of public buildings.

# **Deliverable: 3.10.3 Platform Improvements and Additional Technical Evaluation Report**

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**Date: 31/03/2018**



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## 1. INTRODUCTION

### 1.1 Scope of this deliverable

This report represents the "Platform improvements and additional technical evaluation report" of GRASPINNO unified platform", the Deliverable 3.10.3 for the GRASPINNO project and describes part of the work undertaken in WP3 "Testing". The Report is also part of the Activity 3.10 "Evaluation of the Pilots", which aims to evaluate all the steps of GRASPINNO pilots, including the technical evaluation of the platform, the users' evaluation of the platform, the improvements of the platform, the evaluation of the tender winner with the use of the LCC tool and the evaluation of the pilot site after the refurbishment of the public buildings. This report concerns the 3<sup>rd</sup> step of the evaluation procedure and consists platform improvements and the additional technical report, which has been developed by GRASPINNO technical team, in accordance to the feedback received by the users' evaluation and the initial technical review of the functionalities of the platform.

Thus, the main scope of this report is the presentation of the platform improvements and the evaluation of GRASPINNO unified platform. For the optimization of the evaluating procedure, GRASPINNO unified platform is tested in all the individual tools (Databases, electronic Green Public Procurement - eGPP tool and Life Cycle Cost - LCC tool), after the implementation of the improvements.

### 1.2 Structure of the deliverable

This deliverable is structured in 5 chapters:

Chapter 2, "GRASPINNO Databases Improvements and Technical Evaluation", provides a brief description of the decision made for the necessary improvements on GRASPINNO databases and presents the platform improvements. Finally, this chapter provides a brief technical evaluation conducted by the GRASPINNO Technical Team and the respective results, regarding the platform's databases after the platform improvements.

The Chapter 3, “GRASPINNO eGPP tool improvements”, provides the description of the evaluation parameters, which were tested with the use of Technical Indicators and Simple Confirm Indicators. Moreover, this chapter presents the improvements of the eGPP Tool, which were based on the findings of the technical evaluation. In Chapter 4, “Additional Brief eGPP Technical Evaluation”, the evaluation with the use of Technical Indicators and Simple Confirm Indicators is provided. This session shows the success or failure of all the individual functionalities of GRASPINNO eGPP Tool, after the eGPP improvements.

Chapter 5, “GRASPINNO LCC Tool Improvements and Additional Technical Evaluation”, provides the description of the improvements of the LCC tool, which is part of GRASPINNO Unified Platform. More specifically, this analysis includes also the presentation of the new ex ante tool, which can be used as a pre-audit system. Thus, this chapter presents the characteristics of this new tool, which helps not only in the comparison of a “green” product and a “non green” product, but also in the whole preparation of the tender.

## 2. GRASPINNO DATABASES IMPROVEMENTS AND TECHNICAL EVALUATION

The technical evaluation results for GRASPINNO Databases, with the use of Technical Performance Indicators and the results of the users' evaluation, derived from the questionnaires analysis, revealed the needs for some improvements on GRASPINNO Databases and on the Unified Platform. After improving the Databases, the new Technical Evaluation has been conducted in order to ascertain the technical impact of the applied improvements.

The technical evaluation of the system was mainly based on: a) the reliability of the system's operations, and b) the time response of the system for certain user requests. The brief technical evaluation was made with the use of "Technical Indicators" for the most important technical parameters.

The brief technical evaluating procedure includes the following individual steps:

- Identification of the Technical Indicators.
- Measurement of the Technical indicators, following the proper tests and the record of the final results.
- Evaluation of the Results.

### 2.1 Improvements on GRASPINNO Databases

The questionnaire analysis of the Del. 3.10.2-Users Evaluation Report, shows quite encouraging results for GRASPINNO Databases and for the Unified Platform. Nevertheless, the users expressed their thoughts for some minor interventions on the Unified Platform, which can be concluded as follows:

- ✚ Better graphics for approaching more and more users.
- ✚ Motivation to SMEs for inserting their products in GRASPINNO Databases.
- ✚ Reconsideration of the registration procedure.

The Technical Evaluation with the use of Technical Indicators for GRASPINNO Databases showed the high level of reliability of the Databases and its operations. More specifically, the evaluation results

were encouraging, since the success rate of all the individual functions overcome the acceptable values. Moreover, the time needed for completing an individual function was quite low, thus ensuring the time-effectiveness of the system.

Finally, the technical team focused on minimising the time needed for the registration of a new member on GRASPINNO Unified Platform, by offering more concrete details on the new users. Thus, the following improvements (presented on the chapters: 2.1.1 and 2.1.2) will facilitate the registration procedure.

### 2.1.1 Registration Procedure

During the registration procedure, the new user is called to fill in all the necessary fields in order to create an account in GRASPINNO Unified Platform. Before the improvements, the registration form didn't clarify if all the fields were required and some users were confused if they have to fill in all the fields for creating their accounts. Thus, the 1<sup>st</sup> improvement was developed in order for the users to have all the clarification they need for proceeding with the creation of their account. The 1<sup>st</sup> screenshot presents the initial registration form, before the applied improvements.

Home > GRASP > [Create new account](#)

- > Login
- > Restore Password
- > Register
- > Registered SMEs list

## Sign Up for a GRASP account

Enter your Organization information below:

Are you an PA or SME?

Organization Name

your vat# here...

your Company registration number# here...

Select country..

Enter your account details below:

full name..

Email..

Password..

☒ Re-type Your Password

☐ I agree to the Terms of Service and Privacy Policy

Cancel

Sign Up

### Important Information

Please provide a valid e-mail address in order to validate your account.

[More details](#)

*Figure 1. Registration Form before the Improvements*

The second screenshot (Figure 2) shows the registration form after the application of the 1<sup>st</sup> improvement. Comparing to the previous screenshot, the 1<sup>st</sup> improvement includes the comments and remarks for all the required fields. Thus, the new users are well guided to the registration procedure and they have no doubts on the necessary information they have to fill in for creating their accounts.



[Home](#) > [GRASP](#) > [Create new account](#)

[> Login](#)  
[> Restore Password](#)  
[> Register](#)  
[> Registered SMEs list](#)

## Sign Up for a GRASP account

Enter your Organization information below:

Are you an PA or SME? \*  
 Organization Name \*  
 your vat# here... \*  
 your Company registration number# here... \*  
 Select country.. \*

Enter your account details below:

full name.. \*  
 Email.. \*  
 Password.. \*  
 Re-type Your Password \*

☐ I agree to the Terms of Service and Privacy Policy

(\*) All fields are required.

[Cancel](#)

[Sign Up](#)

### Important Information

Please provide a valid e-mail address in order to validate your account.

[More details](#)

Figure 2. Registration Form after the Improvement #1 (Required Fields)

## Sign Up for a GRASP account

Enter your Organization information below:

Are you an PA or SME?

Please select an item in the list.

your vat# here...

your Company registration number# here...

Select country...

Enter your account details below:

full name..

Email..

Password..

Re-type Your Password

☐ I agree to the Terms of Service and Privacy Policy

(\*) All fields are required.

Cancel

Sign Up

### Important Information

Please provide a valid e-mail address in order to validate your account.

[More details](#)

Figure 3. Registration Form after the Improvement #2 (Dropdown List)

The third screenshot (Figure 3) shows the registration form after the application of the 2<sup>nd</sup> improvement. This addition guides the new users on how they have to select from the dropdown list if they are "PAs" or "SMEs".

- > Login
- > Restore Password
- > Register
- > Registered SMEs list

### Sign Up for a GRASP account

Enter your Organization information below:

PA \*

Organization Name \*

Please fill out this field. \*

your Company registration number# here... \*

Select country.. \*

Enter your account details below:

full name.. \*

Email.. \*

Password.. \*

Re-type Your Password \*

☐ I agree to the Terms of Service and Privacy Policy

(\*) All fields are required.

Cancel

Sign Up

#### Important Information

Please provide a valid e-mail address in order to validate your account.

More details

Figure 4. Registration Form after the Improvement #3 (Required Field Message)


The fourth screenshot (Figure 4) shows the registration form after the application of the 3<sup>rd</sup> improvement. This improvement shows the overall guidance during the registration procedure. All the fields are now offering detail description of all the information needed in each field of the registration form. The comments on the fields of the registration form are quite clear, in order for the users to create their accounts without delays and doubts.

The final improvement of the registration procedure (see Figure 5) offers guidance to the users on the field 4 of the registration form. In this field the new users are requested to fill in his company registration number. Some of the users can fill in this information, whilst some others are confused due to the fact that they don't have this

information. Thus, a new comment has been added in this field: “If a company doesn’t have registration number, fill the input text with the number 0000”.

+1 456 6717 | info@grasp.com Log In | Registration

---


Home About US FAQ Blog Contact Q

---

Home > GRASP > [Create new account](#)

- > Login
- > Restore Password
- > Register
- > Registered SMEs list

### Sign Up for a GRASP account

Enter your Organization information below:

Are you an PA or SME? \*

Organization Name \*

your vat# here... \*

your Company registration number# here... \*

If a company doesn't have registration number, fill the input text with the number 0000.

Select country.. \*

**Important Information**

Please provide a valid e-mail address in order to validate your account.

[More details](#)

Enter your account details below:

full name.. \*

Email.. \*

Password.. \*

Re-type Your Password \*

☐ I agree to the Terms of Service and Privacy Policy

(\*) All fields are required.

Cancel

Sign Up

*Figure 5. Registration Form after the Improvement #4 (Company Registration Number Field Message)*

After the improvements, the registration form offers all the needed clarification to the new users for creating their accounts on GRASPINNO Unified Platform. These improvements were designed in order to minimize the time needed for the users to create their accounts.

### 2.1.2 Frequently Asked Questions\_Useful Links Addition

In the HELP session of GRASPINNO Databases, the users can browse on the general questions and on the “how to” sessions. After evaluating GRASPINNO Databases on its technical aspects and on the level of satisfaction, it was found out that a new session “useful links” have to be added for the completeness of the FAQ (Frequently Asked Questions) session. The 1<sup>st</sup> screenshot (Figure 6) shows the initial FAQ session, before the application of the improvement.

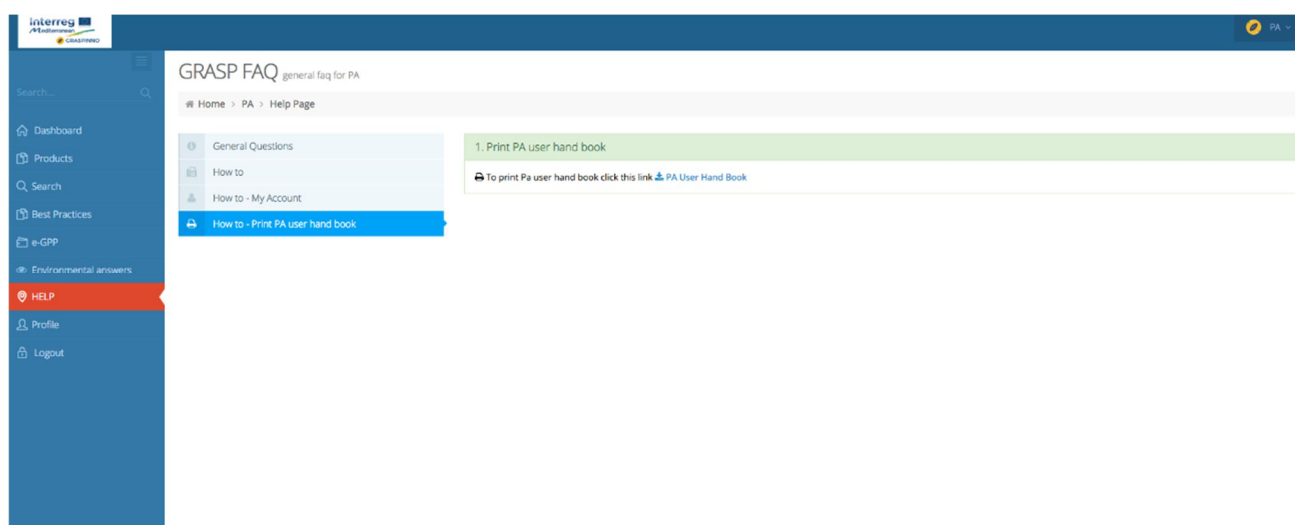


Figure 6. GRASP FAQ Session before the improvement

This improvement was developed in order for the users to have all the information for GRASPINNO project gathered on the Databases. The 2<sup>nd</sup> screenshot (Figure 7) presents the FAQ session after the application of the improvement.

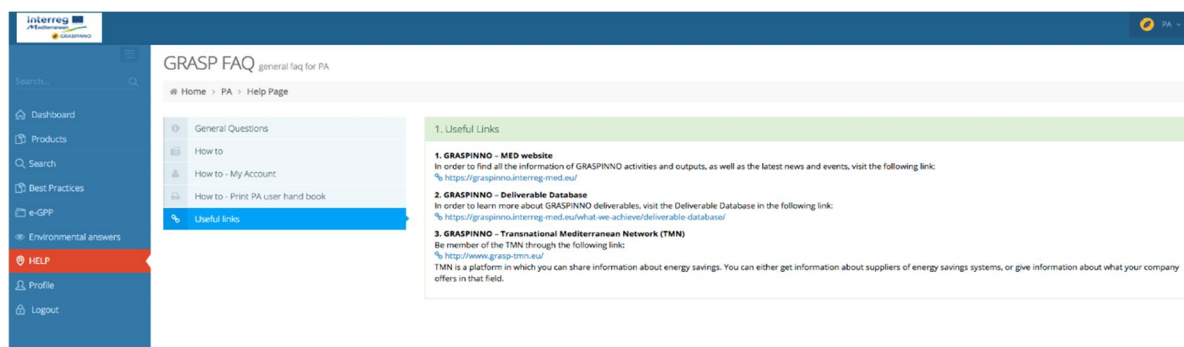


Figure 7. GRASP FAQ Session after the improvement

## 2.2 Brief evaluation of the Databases with the use of Technical Indicators

The evaluation with the use of technical indicators GRASPINNO Databases is based on the indicators, which represent all the functions of the databases. The indicators have been shared to the two different types of users of the Database. More specifically, the Public Authorities (PAs) and the Small and Medium Enterprises (SMEs) have access to different functions of the databases, thus the indicators were adapted to those categories of users. The same methodology was used in Del. 3.10.1-Technical Evaluation Report, where the technical team presented the results of the technical evaluation of GRASPINNO Unified Platform. This Chapter includes a brief evaluation of the Databases after the application of the improvements. The scope of this additional technical evaluation is to present the influence of the improvements on the technical characteristics of the Databases. For this reason, the same indicators were checked, in order to identify the differences of the initial condition of the Databases and the Databases after the application of the improvements.

Thus, the technical indicators for the PAs are focused on the: registration procedure, search products function, list of products function, time needed for the product list results, view product function and time needed for this function, compare of products and time needed for this function, best practices and time needed for implementing this function. All the indicators are measured within rate and time limits.

Whilst, the technical indicators for the SMEs are focused on the: registration procedure, add key element function, list of products function, view a product function, edit/update product function, add service function, search products function, search key elements function and search tenders function. Moreover, all the above mentioned functions have their own indicators for the time needed for completing them.

The evaluation procedure of the Graspinno databases was performed with the method of technical testing and the certification of the proper functioning of the system's software, by performing iterative user

trials. The achieved value for each indicator that was calculated as the average value of the sum of results of the iterative user trials for each specific indicator is presented in the table 1 and table 2.

### Evaluation Results for PAs functions

*Table 1: Databases Evaluation Results of Technical Indicators for PAs Functionalities*

| Technical Indicator  | Acceptable Value | Achieved Value (after evaluation) |
|--|------------------|-----------------------------------|
| TI-1: Time needed for Registering in the Unified Platform                          | 4 min            | 2 min                             |
| TI-2: Success rate (%) for user identification (Login)                             | 95%              | 100,00%                           |
| TI-3: Search success rate (%) in the "Search Products" section, by using key-words | 95%              | 100,00%                           |
| TI-4: Time needed for the display of TI3 search results                            | 5 sec            | 0.4 sec                           |
| TI-5: Success rate (%) in the "List of Products" section.                          | 95%              | 100,00%                           |
| TI-6: Time needed for the display of TI5 list results                              | 5 sec            | 0.74 sec                          |
| TI-7: Success rate (%) in the "View of a Product" section.                         | 95%              | 100,00%                           |
| TI-8: Time needed for the display of TI7 view of product                           | 5 sec            | 0,32 sec                          |
| TI-9: Success rate (%) in the "Compare of Products" section.                       | 95%              | 100,00%                           |
| TI-10: Time needed for the display of TI9 list results                             | 5 sec            | 0,8 sec                           |
| TI-11: Success rate (%) in the "Best Practices" section.                           | 95%              | 100,00%                           |
| TI-12: Time needed for the display of TI9 list results                             | 5 sec            | 0,96 sec                          |

## Evaluation Results for SMEs Functions

*Table 2: Databases Evaluation Results of Technical Indicators for SMEs Functionalities*

| Technical Indicator  | Acceptable Value | Achieved Value (after evaluation) |
|--|------------------|-----------------------------------|
| TI-1: Time needed for Registering in the Unified Platform    | 4 min            | 2 min                             |
| TI-2: Success rate (%) for user identification (Login)       | 95%              | 100,00%                           |
| TI-3: Success rate (%) in the "Add Key element" section      | 95%              | 100,00%                           |
| TI-4: Time needed for add key element of TI3                 | 5 sec            | 0.34 sec                          |
| TI-5: Success rate (%) in the "List of Products" section.    | 95%              | 100,00%                           |
| TI-6: Time needed for the display of TI5 list results        | 5 sec            | 0,64 sec                          |
| TI-7: Success rate (%) in the "View of a Product" section.   | 95%              | 100,00%                           |
| TI-8: Time needed for the display of TI7 view of the product | 5 sec            | 0,32 sec                          |
| TI-9: Success rate (%) in the "Edit/Update Product" section. | 95%              | 100,00%                           |
| TI-10: Time needed of TI9 Edit/Update product                | 15 sec           | 9,8 sec                           |
| TI-11: Success rate (%) in the "add service" section.        | 95%              | 100,00%                           |
| TI-12: Time needed of TI11 add service.                      | 10 sec           | 1,32 sec                          |



| Technical Indicator   | Acceptable Value | Achieved Value (after evaluation) |
|---|------------------|-----------------------------------|
| TI-13: Success rate (%) in the "add product" section.                                   | 95%              | 100,00%                           |
| TI-14: Time needed of TI13 add product.   | 15 sec           | 9,80 sec                          |
| TI-15: Search success rate (%) in the "Search Products" section, by using key-words     | 95%              | 100,00%                           |
| TI-16: Time needed for the display of TI4 search results                                | 5 sec            | 0,1 sec                           |
| TI-17: Search success rate (%) in the "Search Key elements" section, by using key-words | 95%              | 100,00%                           |
| TI-18: Time needed for the display of TI7 search results                                | 5 sec            | 0.23 sec                          |
| TI-19: Search success rate (%) in the "Search Tenders" section, by using key-words      | 95%              | 100,00%                           |
| TI-20: Time needed for the display of TI9 search results                                | 5 sec            | 0,96 sec                          |

### 2.2.1 Conclusions of the technical evaluation of GRASPINNO Databases

The acceptable values of the time limits, derived from the users' tolerance when developing a task on a tool and the acceptable success rates of the individual tasks are quite high, in order to ensure the proper functionality of GRASPINNO Databases. The implementation of the technical evaluation procedure of GRASPINNO Databases after the application of the improvements is summarized as follows:

- GRASPINNO Databases proven fully effective and productive, even after the improvements.

- The improvements didn't have a significant effect on the technical indicators of the Databases.
- All the individual functions work successfully, according to the technical indicators.
- In technical terms, the Databases are also quite fast, since not even one function was over the time limits (acceptable values).
- The time needed for registering in GRASPINNO Unified Platform is quite low comparing to the acceptable value, thus the improvements contributed significantly on minimising the registration time.

### 3. GRASPINNO eGPP TOOL IMPROVEMENTS

#### 3.1 Brief description

Evaluation results, derived from the technical evaluation procedure of the eGPP tool (the GRASPINNO electronic green procurement tool), were based on the outcome of laboratory testing and of both technical testing and the certification of the proper functioning of the system's software.

The technical evaluation of the system relied on the testing of two parameters: a) the reliability of the system's operations, and b) the time response of the system for certain user requests. The technical evaluation was realised with the use of "Technical Indicators", as well as with the use of "Simple Confirm Indicators".

Based on the findings of the technical evaluation, ATLANTIS technical team reviewed the functionalities of the eGPP tool and applied both the improvements proposed by the indicative users during the pilots and the improvements the team thought that will offer added value to the user during the use of the eGPP tool.

In the following subsections, these improvements are presented along with an additional technical report with the new results of the set indicators, after applying the improvements.

#### 3.2 Improvements applied to eGPP tool

The analysis of the technical evaluation (with the use of Technical Indicators) results led to the following conclusions:

- The development and implementation of the eGPP software was based on a continuous check of the integrity and reliability of the basic operations of the system. With the completion of laboratory trials, the sum of omissions, failures, and errors that were identified, were completely rectified. Hence, the lack of execution errors of the implemented system operations was certified.

- The technical examination of the eGPP tool during laboratory trial, certified the correctness and reliability of the services offered by the system, from the perspective of the needs and expectations of the user.

These conclusions, led the technical team to the decision of applying only verification tests in relation to reinforced improvements on the performance of the eGPP tool, taking into account that all the results of the trials were within the accepted thresholds.

Regarding, the technical evaluation results (with the use of Simple Confirm Indicators) the technical team decided to add further functionalities in the eGPP tool, so as to improve user experience and UI. More specifically the improvements applied were the following:

#### 3.2.1 User hints for publishing a tender

When a user is trying to publish a tender, he is required to fill in some fields containing information about the specific tender. In order the tender to properly be publish, the user, while filling in the field "Categories", should not type any category he wants, but he should select from a drop-down list created by the tool. For this reason, a specific hint was added in order to help the user to select the right category:

interreg Mediterranean e-GPP Support Tool


Home Library Tender Tender Description My TIPS LCC Support Help About Admin Logout


### Publish a tender

Use this form to publish a tender of your organization. The tender details will be available to all registered users of the platform. The tender will be visible during the time period between the two dates that will be specified.


\* Title:

\* Categories:   
 ⓘ Please select category from list

\* Opens at:  


\* Closes at:  

\* Type:   
 Please specify the tender type(for example national)

\* Tender text:  

URL:

\* Contact Details:




The information contained in this website is for general information purposes only. We make no representations or

Figure 8. "Publish a tender" section - Hint for selecting tender categories

### 3.2.2 "Delete a tender" functionality

During the technical evaluation of the eGPP tool, with the use of Simple Confirm Indicators (D3.10.1), there was no functionality for the user to delete already published tenders. In the updated version of the eGPP tool, such functionality was added:


 e-GPP Support Tool

[Home](#)
[Library](#)
[Tender](#)
[Tender Description](#)
[My TIPS](#)
[LCC](#)
[Support](#)
[Help](#)
[About](#)
[Admin](#)
[Logout](#)

## Search for a tender

In this page you may search for published tenders.

☒ Search in closed tenders, too

### Results (38)

Filters

Category: 
 Closing Date After: 
 Closing Date Before: 
 Status: 
 Results Per Page:

| Title                       | Categories       | Type     | Closes at  | Organization                                 | Status | Download | Delete                 |
|-----------------------------|------------------|----------|------------|--|--------|----------|------------------------|
| Procurement for 2 servers   |                  | National | 24/12/2014 | GRASPINNO TEAM                               | Closed |          | <a href="#">Delete</a> |
| Procurement for solar panel | Renewable Energy | National | 21/04/2015 | Chamber of Commerce and Industry of Terrassa | Closed |          | <a href="#">Delete</a> |
| Solar panel                 | Solar Energy     | National | 22/04/2015 | Chamber of Commerce and Industry of Terrassa | Closed |          | <a href="#">Delete</a> |

Figure 9. "Delete a tender" functionality

## 4. ADDITIONAL BRIEF eGPP TECHNICAL EVALUATION

This section, presents the results of the technical evaluation of the eGPP tool, after the application of the identified improvements.

### 4.1 Technical evaluation with the use of Technical Indicators

As presented in **D3.10.1 "Technical Evaluation Report"** the following table presents the list of the Technical Indicators with the respective acceptable thresholds, used for the measurement and technical evaluation of the eGPP tool and also the achieved results:

*Table 3: eGPP tool Evaluation Results of Technical Indicators*

| Technical Indicator  | Acceptable Value | Achieved Value (after evaluation) | Remarks |
|--|------------------|-----------------------------------|---------|
| TI-1: Success rate (%) for user identification (Login)                                 | 95%              | 100,00%                           |         |
| TI-2: Search success rate (%) in the "Library" section, by using key-words             | 95%              | 100,00%                           |         |
| TI-3: Search success rate (%) in the "Search for a Tender" section, by using key-words | 95%              | 100,00%                           |         |
| TI-4: Time needed for the display of TI2 search results                                | 5 sec            | 0,48                              |         |
| TI-5: Time needed for the display of TI3 search results                                | 5 sec            | 0,37                              |         |
| TI-6: Time needed to publish a tender  | 15 sec           | 12,58                             |         |
| TI-7: Time needed for the display of tender descriptions                               | 5 sec            | 2,08                              |         |
| TI-8: Success rate (%) for extracting a tender description                             | 95%              | 1,00                              |         |
| TI-9: Time needed for the display of a tender's general information.                   | 10 sec           | 1,67                              |         |
| TI-10: Success rate (%) for extracting a TIP   | 95%              | 100,00%                           |         |

| Technical Indicator  | Acceptable Value | Achieved Value (after evaluation) | Remarks   |
|--|------------------|-----------------------------------|---|
| TI-11: Time needed for the display of a TIP's extraction             | 10 sec           | 1,12                              |   |
| TI-12: Success rate (%) for creating a new TIP                       | 95%              | 100,00%                           |   |
| TI-13: Success rate (%) for publishing a tender                      | 95%              | 100,00%                           |   |
| TI-14: Success rate (%) for the display of products' main categories | 95%              | 100,00%                           |   |
| TI-15: Success rate (%) for the display of products' subcategories   | 95%              | 100,00%                           |   |
| TI-16: TIP_Precision   | 80%              | 100,00%                           | n. of correct fields (fields filled in by the user while creating a TIP) in exported TIP / total n. of fields in exported TIP |
| TI-17: TIP_Recall  | 80%              | 100,00%                           | n. of fields in exported TIP / total n. of fields in stored TIP   |
| TI-18: F-Measure of TIP extraction (TIP_FM)                          | 85%              | 100,00%                           | $\frac{2 * \text{TIP\_PREC} * \text{TIP\_REC}}{\text{TIP\_PREC} + \text{TIP\_REC}}$   |
| TI-19: TenderDescription_Precision                                   | 80%              | 100,00%                           | n. of correct fields (fields filled in by the user while creating a TD) in exported TD / total n. of fields in exported TD    |
| TI-20: TenderDescription_Recall                                      | 80%              | 100,00%                           | n. of fields in exported TD / total n. of fields in stored TD   |
| TI-21: F-Measure of Tender Description extraction (TD_FM)            | 85%              | 100,00%                           | $\frac{2 * \text{TD\_PREC} * \text{TD\_REC}}{\text{TD\_PREC} + \text{TD\_REC}}$   |

## 4.2 Technical Evaluation with the use of Simple Confirm Indicators

In the case of simple confirm trials, a limited number of trials was conducted in order to certify the reliability of the relevant system operation. The following table presents the results of the evaluation procedure with the use of identified Simple Confirm Indicators, after the application of the identified improvements:

*Table 4: eGPP tool Evaluation Results of Simple Confirm Indicators*



| Code   | Simple Confirm Indicator  | Successful<br>(Functionality<br>existent)<br>/<br>YES | Unsuccessful<br>(Functionality<br>non-existent)<br>/<br>NO | Remarks |
|--------|---|---|--|---------|
| SCI-1  | User Registration functionality   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-2  | Functionality for User Authentication   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-3  | User Management functionality (i.e. User roles, DB authentication)  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-4  | e-GPP tool General Information (i.e. tool description, User Guide, FAQs section)  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-5  | Option of choosing more than one language   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-6  | "Library" functionality   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-7  | Search Functionality for documents related to "green" specs   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-8  | Functionality to upload documents related to "green" specs, products, services, procurement, and other "green" characteristics) | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-9  | Search Functionality for published tenders  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-10 | Functionality for publishing tenders  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-11 | Deletion of a published tender  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-12 | Multilingual "Create new tender" functionality  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-13 | Deletion of a tender description  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-14 | Creation of new TIP   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |

| Code   | Simple Confirm Indicator   | Successful<br>(Functionality<br>existent)<br>/<br>YES | Unsuccessful<br>(Functionality<br>non-existent)<br>/<br>NO | Remarks |
|--------|--|---|--|---------|
| SCI-15 | Functionality for adding "green" specs in a TIP  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-16 | Functionality for adding "green" products/services (found after performing a search in the available products in the tool's DB) in a TIP | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-17 | Ability to define "green" criteria to be satisfied in a tender   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-18 | Addition/Deletion of "green" criteria from products/services.  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-19 | Editing the values of "green" criteria   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-20 | Search functionality for products/services suppliers   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-21 | Extraction of a TIP in a readable/editable format  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-22 | Deletion of a TIP  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-23 | When the system is down, all stored information is not deleted   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-24 | The system offers added-value to the work of the user  | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |
| SCI-25 | Implementation of the e-GPP tool, in a Windows environment   | <input checked="" type="checkbox"/>                   | <input type="checkbox"/>                                   |         |

## 5. GRASPINNO LCC TOOL IMPROVEMENTS AND ADDITIONAL TECHNICAL EVALUATION

### 5.1 Introduction

The improvements to the old (or ex post) LCC tool are needed because of its application after the publication of the tender. The ex post LCC tool gives a correct evaluation of the tender in economic and environmental terms but the assessment arrives when the tender is already published and eventual corrections to it are not possible anymore. With an ex-post evaluation only the experience can help to formulate the tender with a correct setting and the verification is useful only in perspective. With the new (ex ante) Terre di Siena Lab has exploited the testing phase to introduce an ex-ante application to be used after the audit or like a pre-audit system. According to the Italian Public Procurement procedures, described in the following figure, it would be possible. This usage allows the Public Administration to avoid, in absence of a prompt audit, to prepare a tender where the winning company has to prepare a refurbishment together with a planning. This kind of tender is a correct GPP procedure but it is generally considered unclear and dangerous by the small municipalities because the real costs and benefits are defined by the company that will refurbish the building. Small Public Bodies often are not able to control the real cost of this kind of operation not having at own disposal the right instruments and available human resources. A third part approach with an ex-ante application of LCC could help to guarantee an equal distribution of cost saving between company and Public Administration. TSL presented this new tool and its local application in the GRASPINNO partners' meeting in Sorrento.

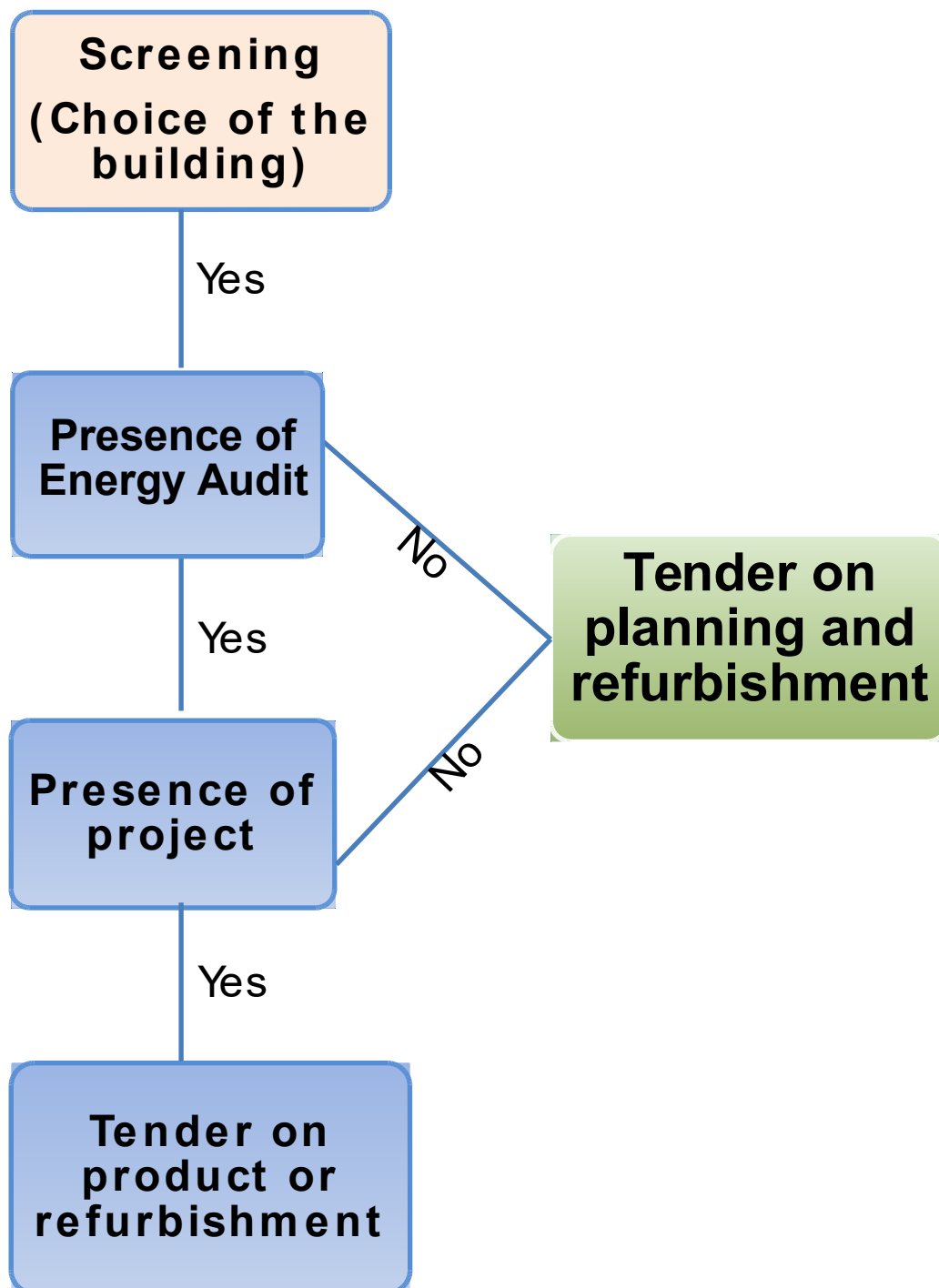


Figure 10. Ex-Ante Application

## 5.2 IMPROVEMENTS

As showed in the previous figure (ex ante application) the new tool is very suitable for situations in which small municipalities or other public bodies with a scarce availability of financial resources want to refurbish their buildings. The local experience originated by local pilots showed contexts in which the local body had no financial opportunities to prepare a specific audit or project. In these cases, the tool seems somewhat effective in implementing the tender correctly and allowing the execution of the compulsory preliminary steps (energy audit and project) through a Public and Private Partnership (PPP) where the choices are carried out by selecting the intervention through a payback ranking in which products or services are chosen starting from those with the shortest payback. For other traditional (public) solutions the ex ante tool leaves the opportunity to use the Life Cycle Cost of the interventions as a ranking criterion instead of the payback, by starting from those with the lowest cost. The payback ranking has been built on a "Politecnico di Milano" study showed in the following image.

| I TEMPI DI RITORNO CON GLI INCENTIVI – LO STUDIO POLIMI |               |                |                  |          |                        |                  |                  |         |               |                    |                           |                   |
|---|---------------|----------------|------------------|----------|------------------------|------------------|------------------|---------|---------------|--------------------|---------------------------|-------------------|
| TECNOLOGIA/<br>AMBITO DI<br>APPLICAZIONE                | Illuminazione | Refrigerazione | Motori Elettrici | Inverter | Building<br>Automation | Chiusure vetrate | Superfici opache | UPS     | Cogenerazione | Pompe<br>di Calore | Caldia a<br>condensazione | Solare<br>Termico |
| RESIDENZIALE  | 0,1 -0,4      |                |                  |          | 2,2-3,8                | 4 - 6            | 8,5 - 11         |         |               | 4,5 - 7            | 2,5-4,5                   | 5 - 7             |
| GDO   | 0,5 - 1,2     | 0,7-1,2        | 2 - 3,1          | 1,6-2,6  | 1-1,6                  | 12 - 14,5        | 19 - 21          | 0,9-1,3 | 4,5 - 6,2     | 2,5 - 4,5          | 6,5 - 8,5                 | 1,5 - 3           |
| HOTEL   | 0,5 - 1,3     |                | 2,5-3            |          | 2-3,2                  | 3,5 - 6          | 8 - 10,5         | 0,9-1,3 | 1,5 - 3,5     | 1,8 - 3,5          | 5 - 7,5                   | 3,5 - 6           |
| BANCA   | 1 - 2         |                |                  |          | 4,8-10                 | 6 - 7,5          | 9 - 11           | 2,1-3,1 |               | 1,5 - 3,2          | 6,5 - 8                   |                   |
| SCUOLA  | 1,8 - 3       |                |                  |          | 1,3-2,1                | 13 - 16          | 12 - 15          |         |               | 6 - 8              | 6,5 - 8,5                 | 4 - 6             |
| OSPEDALE  | 0,1 - 0,5     | 3-4,6          | 2,5-3            | 2,1-3,2  | 0,2-0,4                | 12 - 14          | 13 - 16          | 0,2-0,4 | 0,9 - 3       | 2 - 4              | 5,5 - 8                   | 4,5 - 6,5         |
| EDIFICIO<br>INDUSTRIALE                                 | 0,2-0,6       |                |                  |          | 6 - 9                  | 6,5-8            | 14-17            |         |               | 3-4,5              | 5-7                       | 3-6               |

**Incentivo**

Titoli Efficienza Energetica

Detrazioni Fiscali

Conto Termico

Soglia accettabilità nel residenziale: 4 - 6 anni

Soglia di accettabilità nel terziario: 2- 3,5 anni

Fonte: prof. Vittorio Chiesa, Politecnico di Milano

Figure 11. Payback Ranking Criterion

Another interesting characteristic of the new tool is the use of real preliminary data to calculate the energy class of the building. EE tools often use theoretical estimations of the energy consumptions but this can give a relevant bias in the overall assessment. The ex ante tool avoids this problem by uploading real data obtained in the GRASPINNO analysis through the collection of electricity and natural gas bills for a relevant number of buildings.

The following figure shows this issue with a study carried out by CasaClima / KlimaHaus agency, located in Alto Adige / Südtirol. The image represents the possible bias in calculating the energy class before (prebound) and after (rebound) the intervention. Not always facing this problem is possible but, by uploading real data on energy consumption, the “prebound” bias can be eliminated.

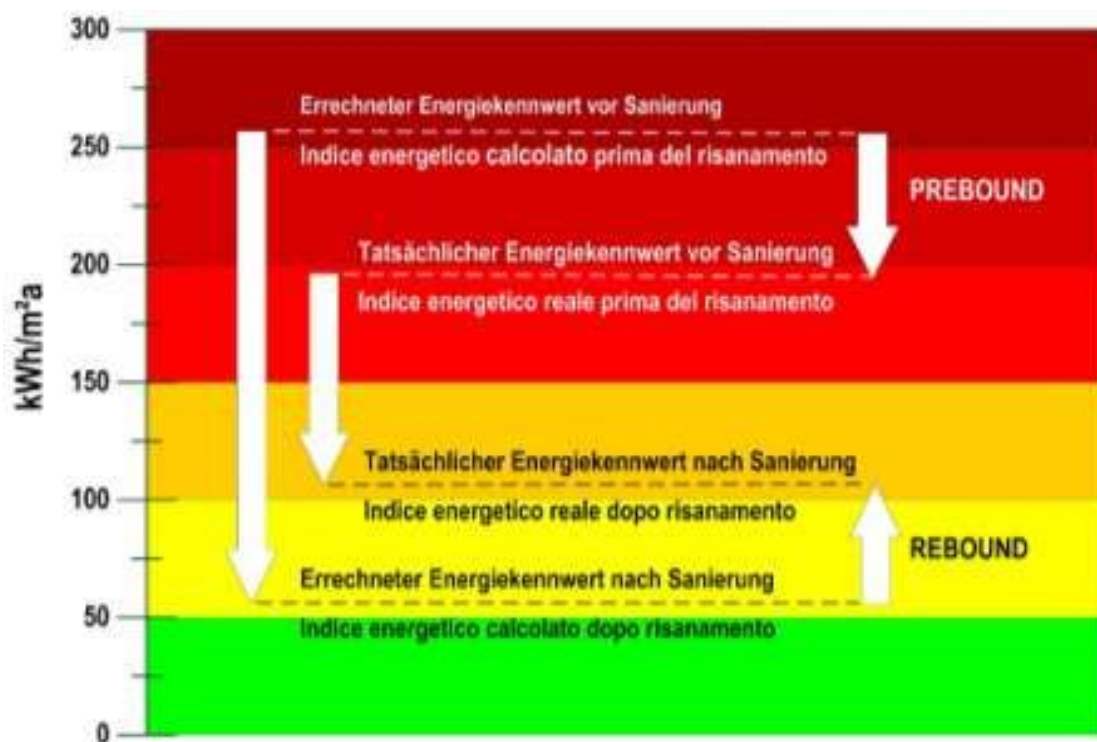


Figure 12. Potential bias on calculating the energy class before and after the intervention

A series of possible interventions considers the main solutions used in the energy refurbishment of the buildings (building automation, lighting, solar heating, voltage transformer, boiler, insulation of roof and walls, insulation of windows and doors) but the greatest difference, in comparison with the ex post LCC tool, is the modality of use. In fact, the new instrument can be utilized before the tender in order to implement it correctly through some indications of cost that highlight the limit parameters to obtain a lower LCC. In other words, the tool works as a simulation of the refurbishment by giving indication on prices, quantities and typologies of products that allow to face a series of issues and guarantee good results in economic and environmental terms in a real tender.

A first step in using the tool is to set the amount of energy savings by indicating the target percentage. Automatically, as shown in the following image, the instrument is able to identify the thermal and electrical class. After this step, the user can choose the type of intervention to achieve the goal, with full awareness of following a specific strategy that can be a shortest payback or a lower LCC. The strategy is chosen by the Public Administration on the framework illustrated in figure n. 1: a traditional path that arrives at a tender on products or refurbishment or, alternatively, a PPP solution in which the subject of the tender can be the planning and restructuring phase. The different path is important for defining the selection criteria. For a traditional path, the prevalence is the public interest and the strategy identified is LCC, while for the PPP the priority is the private financier and the chosen strategy is the shortest payback. Hybrid strategies that simultaneously take into account public and private interests are possible.



| ENERGY CLASS  |  | Inizial Index |             |
|---|--|---------------|-------------|
| Index thermal (kWh/year/sm)   |  | 109,8         |             |
| Index thermal (kWh/year/cm)   |  | 36,6          |             |
| Electrical index (kWh/year/sm)  |  | 81,4          |             |
| Electrical index (kWh/year/cm)  |  | 27,1          |             |
| Target in terms of reduction of consumption through intervention of energy efficiency |  | Reduction     | Final Index |
| Thermal   |  | 65%           | 38,4        |
| Electrical  |  | 51%           | 39,9        |
| Energy Class  |  | Ex ANTE       | Ex POST     |
| Thermal   |  | C             | A           |
| Electrical  |  | C             | A           |

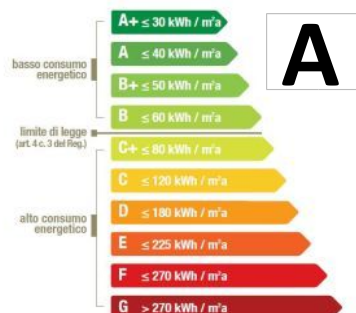


Figure 13. (sheet named "class")

A key representation of the payback approach and its possible results is contained in the sheet named «target» and showed in the following figure 5. In the table is reported the current consumption and the expected typology of saving chosen in the previous «class» sheet and already showed in the figure 4. In addition, the thermal and electrical saving of a series of possible interventions are showed together with their sum, while in the column "Differences compared to the expected savings" there is the difference between the energy saving target and the value obtained by the sum of the chosen interventions.

Contribution of every intervention to the target achievement of reduction

|   | Current Consumption | Expected savings | 1. Building Automation | 2. Lighting | 3. Solar heating | 4. Transformer | 5. Condensing boiler | 6. Insulation (roof and external walls) | 7. Windows and doors | Sum of the interventions | Differences compared to the expected savings |
|---|---------------------|------------------|------------------------|-------------|------------------|----------------|----------------------|---|----------------------|--------------------------|--|
| * tons TOE (thermal)  | 12.95               | 8.42             | 3.50                   | 0.00        | 1.00             | 0.00           | 2.79                 | 0.00                                    | 1.03                 | 8.31                     | -1.3%  |
| * tons TOE (electric)   | 6.23                | 3.18             | 1.12                   | 0.43        | 0.00             | 0.58           | 0.00                 | 0.00                                    | 0.00                 | 2.14                     | -32.6%                                       |
| * tons TOE  | 19.18               | 11.60            | 4.62                   | 0.43        | 1.00             | 0.58           | 2.79                 | 0.00                                    | 1.03                 | 10.45                    | -9.9%  |
| * CO2 (000)   | 41.17               | 25.07            | 10.03                  | 1.03        | 3.08             | 1.51           | 9.58                 | 0.00                                    | 5.27                 | 30.50                    |  |
| * Euro  | € 20.027            | € 12.040         | € 4.779                | € 594       | € 1.381          | € 872          | € 4.298              | € 0                                     | € 2.365              | € 14.290                 |  |
| * TEE while certificates (Italy)  | € 3.705             | € 2.256          | € 903                  | € 93        | € 277            | € 136          | € 862                | € 0                                     | € 475                | € 2.745                  |  |
| * % of the total consumption  | 100.0%              | 60.5%            | 24.1%                  | 2.3%        | 5.2%             | 3.0%           | 14.5%                | 0.0%                                    | 5.4%                 | 54.5%                    |  |
| Difference in yearly maintenance costs  |                     |                  | 40                     | -250        | 0                | -20            | 0                    | 0                                       | 0                    | -230                     |  |
| Payback (PB) - number of year   |                     |                  | 1.05                   | 3.44        | 4.16             | 6.07           | 1.86                 | #DIV/0!                                 | 3.52                 | 3.27                     |  |
| Environment-friendly Product  |                     |                  |                        |             |                  |                |                      |   |                      |                          |  |
| Price (€) *   | 0                   |                  | 6.000                  | 1.500       | 6.900            | 6.000          | 9.619                | 15.000                                  | 10.000               | 55.019                   |  |
| Maintenance (€)   | 36.450              |                  | 1.200                  | 750         | 800              | 300            | 1.800                | 0                                       | 0                    | 4.850                    |  |
| Energy costs (€)  | 600.801             |                  | 457.429                | 2.286       | 12.642           | 68.725         | 155.476              | 155.476                                 | 145.165              | 997.201                  |  |
| Emissions -Economic value of avoided CO2 (€)                                  | 0                   |                  | -1.546                 | -22         | 873              | -877           | -765                 | -12.527                                 | -12.497              | -27.360                  |  |
| Life Cycle Cost (€)   | 637.251             |                  | 463.083                | 4.514       | 21.215           | 74.149         | 166.131              | 157.949                                 | 142.668              | 1.029.709                |  |
| LCC - risparmio sul Ciclo di Vita del Prodotto                                |                     |                  | 24.1%                  | 8.5%        | 10.6%            | 12.5%          | 32.9%                | 0.0%                                    | 18.1%                |                          |  |
| Lifetime (year)   | 30                  |                  | 30                     | 6           | 20               | 15             | 20                   | 30                                      | 30                   |                          |  |
| LCC difference (absolute value)   |                     |                  | -137.718               | -4.351      | -10.391          | -30.544        | -56.146              | 2.473                                   | -12.808              | -249.484                 |  |
| LCC difference (percentage)   |                     |                  | -22.9%                 | -49.1%      | -32.9%           | -29.2%         | -25.3%               | 1.6%                                    | -8.2%                | -19.5%                   |  |
| LCC savings (period determined by the intervention with the longest lifetime) |                     |                  | -137.718               | -21.753     | -15.586          | -61.088        | -84.219              | 2.473                                   | -12.808              |                          |  |
| Lowest Price Product or Ax ante condition                                     |                     |                  |                        |             |                  |                |                      |   |                      |                          |  |
| Price (€)   |                     |                  | 0                      | 300         | 0                | 0              | 0                    | 0                                       | 0                    | 300                      |  |
| Replacement (€)   |                     |                  | 0                      | 600         | 0                | 0              | 0                    | 0                                       | 0                    | 600                      |  |
| Maintenance (€)   |                     |                  | 0                      | 2.250       | 0                | 0              | 0                    | 0                                       | 0                    | 2.250                    |  |
| Energy costs (€)  |                     |                  | 600.801                | 5.715       | 31.605           | 104.693        | 222.277              | 155.476                                 | 155.476              | 1.276.043                |  |
| Life Cycle Cost (€)   |                     |                  | 600.801                | 8.865       | 31.605           | 104.693        | 222.277              | 155.476                                 | 155.476              | 1.279.193                |  |



Figure 14. (sheet named «target»)

Practically, the values reported in the last column, -1,3%, for the thermal component, and -32,6%, for the electrical component, indicate that the energy saving targets haven't been reached. Two typologies of corrections are possible to reach the targets; in case of a little difference between the saving target and that obtained by the sum of the single interventions, like the thermal component, a solution can consist in strengthening the chosen interventions starting from that with the shortest payback, while, in case of relevant difference, like the electrical component, could be more appropriated to reduce the energy saving target fixed in the «class» sheet Fig 4.

A similar representation for the LCC approach is reported in the figure 6. The framework of the table is a little different because the payback ranking doesn't matter. In this case, the ranking is defined through the standardized LCC in which the analysis of the costs is carried out considering the maximum lifetime of the foreseen interventions. The order obtained with the standardized LCC will be used in place of the payback to define the interventions with which the building will be refurbished. The further step will be to fill in the sheet with the specific data for every chosen product.

Contribution of every intervention to the target achievement of reduction

|   | Current Consumption | 1. Building Automation | 2. Lighting | 3. Solar heating | 4. Transformer | 5. Condensing boiler | 6. Insulation (roof and external walls) | 7. Windows and doors |
|---|---------------------|------------------------|-------------|------------------|----------------|----------------------|---|----------------------|
| * tons TOE (thermal)                          | 12,95               | 3,50                   | 0,00        | 1,00             | 0,00           | 4,05                 | 0,54                                    | 1,03                 |
| * tons TOE (elettrici)                        | 6,23                | 1,12                   | 0,53        | 0,00             | 0,78           | 0,00                 | 0,00                                    | 0,00                 |
| * tons TOE                                    | 19,18               | 4,62                   | 0,53        | 1,00             | 0,78           | 4,05                 | 0,54                                    | 1,03                 |
| * CO2 (.000)                                  | 41,17               | 10,03                  | 1,03        | 2,25             | 1,51           | 9,10                 | 1,21                                    | 2,31                 |
| * Euro  | € 20.027            | € 4.779                | € 594       | € 1.008          | € 872          | € 4.081              | € 541                                   | € 1.035              |
| * TEE white certificates (Italy)              | € 3.705             | € 903                  | € 93        | € 202            | € 136          | € 819                | € 109                                   | € 208                |
| * % of the total consumption                  | 100,0%              | 24,1%                  | 2,8%        | 5,2%             | 4,1%           | 21,1%                | 2,8%                                    | 5,4%                 |
| Difference in yearly maintenance costs        |                     | 40                     | -250        | 800              | -21            | 0                    | 0                                       | 0                    |
| Payback (PB) - number of year                 |                     | 1,05                   | 3,44        | 3,43             | 6,38           | 1,96                 | 23,08                                   | 8,04                 |
| <b>Environment-friendly Product</b>           |                     |                        |             |                  |                |                      |   |                      |
| Price (€) *                                   | 0                   | 6.000                  | 1.500       | 6.900            | 6.300          | 9.619                | 15.000                                  | 10.000               |
| Maintenance (€)                               | 36.450              | 37.650                 | 1.290       | 25.100           | 24.720         | 24.300               | 36.450                                  | 36.450               |
| Energy costs (€)                              | 600.801             | 457.429                | 116.731     | 381.571          | 383.085        | 319.973              | 595.411                                 | 590.490              |
| Emissions - Economic value of avoided CO2 (€) | 0                   | -1.546                 | -130        | -1.309           | -155           | -1.112               | -81                                     | -155                 |
| Life Cycle Cost (€)                           | 637.251             | 499.533                | 119.391     | 412.262          | 413.950        | 352.780              | 646.780                                 | 636.785              |
| Lifetime (year)                               | 30                  | 30                     | 6           | 20               | 20             | 20                   | 30                                      | 30                   |
| Standardized LCC at the longest lifetime      | 637.251             | 499.533                | 596.957     | 618.393          | 620.925        | 529.170              | 646.780                                 | 636.785              |
| LCC difference (percentage)                   |                     | -21,6%                 | -6,3%       | -3,0%            | -2,6%          | -17,0%               | 1,5%                                    | -0,1%                |

Figure 15. Presentation of the LCC approach

### 5.3 Additional Technical Evaluation Report

With the introduction of the ex ante LCC tool, a new technical evaluation was needed to measure the capability of the new and old tools to improve their effectiveness in reducing the LCC in the building refurbishment.

According to the European and national legislations, a tender is regular when it contains all the requested GPP criteria, but it still can present some negative environmental and economic impacts. The LCC tools (ex ante and ex post) try to verify these aspects. In other words, the tool gives the opportunity to avoid this bias through some Technical Performance Indicators (TPIs).

For the individuation of Technical Performance Indicators (TPIs) an evaluation table (see below) has been introduced with three levels of efficiency. Every tender can be assessed with this method.

A first level of efficiency is given by the timing of the use; in particular, an ex ante use of the LCC tool has a higher value of efficiency because it can avoid the generation a bad result after the implementation of the tender (a bad implementation means a generation of a higher value of LCC or CO<sub>2</sub>). In theory, this level would be enough for assessing the tender and the further levels wouldn't be needed because the ex ante application is able to avoid a bad result by modifying some specifications of the same tender before the publication. It means that if the LCC or GHG emissions value is higher than the previous situation, a Public Administration should change products for the energy refurbishment (increasing the performance) or reduce their price.

A second level of efficiency is given by a LCC value that can be obtained by comparing the results of the LCC as found through the the tool; if the value of the new product/service is higher than the old one, then the tender has had a bad result. This level is considered to be higher than the third one, because it can offset a higher emission value, the sole element measured by the third order level. In fact, LCC value

contains also the emissions value, if the cost is lower than a previous situation it means that is able to offset the value of the emissions.

A third level of efficiency is given by the emission value obtained through the tool; if the value is higher, then the tender has had a bad result.

A clear representation of the scheme of the Technical Performance Indicators (TPIs) is available in the following table:

*Table 6: Measurement of the efficiency of the LCC tools*

| Level                                     | Order | Presence (score) | Absence (score) |
|---|-------|------------------|-----------------|
| Ex ante LCC application                   | I     | Yes (3)          | No (0)          |
| New product with lower LCC value          | II    | Yes (2)          | No (0)          |
| New product with lower CO2 emission value | III   | Yes (1)          | No (0)          |

With this system of Technical Performance Indicators, the partnership is able to classify the results of any tender on the basis of the table described in the table 1. The first level indicator would be already enough to establish that the tender procedure is correct.

Even if the presence of human errors cannot be excluded, in theory a technician has a powerful instrument (ex ante LCC tool) to avoid a bad result in the tender procedure. Terre di Siena Lab stresses that unexpected results that could occur with the previous version of the tool (ex post LCC tool), can be corrected only changing the specifications of the future tenders that have the same characteristics; moreover, with the old tool the presence of errors doesn't mean that the tender is not valid; even if the procedure seems formally correct, the tender could be not set up well.

In the event of an ex post application, the second and the third levels should be verified. The second-level indicator has a higher importance than the third because it can offset a higher CO2 emission value. However, the greenhouse gas negative effects cannot be excluded only by analyzing the second level.

The presence of the positive condition for each level (cells with "Yes" in green color) classifies the tender as best performer. If the positive condition is not present for each level, the first order is the most important and, on the contrary, the third one is the worst. The qualitative system of evaluation can be transformed in a quantitative assessment by using a different numerical value for every specific characteristic reported in the table ((3) for ex ante application, (2) for lower LCC value and (1) for lower emissions value). The absence of each of the above mentioned characteristics gives always a value equals to 0. This measurement, also reported in the table with the numbers in the brackets, allows to consider a minimum level of efficiency and productivity of the tool. A value of 3 (50% of the maximum amount obtainable by this evaluation) can be considered sufficient.

## 5.4 Conclusions

The ex ante LCC tool has been created as a dynamic and incremental system. In other existing tool/software the data entered are often fixed and referable to a past period of time. The GRASPINNO tool is much more suitable if the aim is setting the tender in a cost-effective way. In simpler words: if the aim is setting an energy performance of the intervention, the new tool gives the opportunity to choose new technologies or new materials with very high performance, also giving, as an additional characteristic, the opportunity to than update product price. This is a relevant advantage in comparison with other existing tool in which the values remain steady because the technology remains old and or not updatable in a simple way. A full integration with a vast product database would make the ex ante LCC tool very powerful.

The new ex ante LCC tool, by anticipating its use before the publication of the tender, should be able to contribute to a correct tender setting, maximizing the economic and environmental positive effects. The systematic use of the tool before the publication of tenders should strongly contribute to make sustainable the local economy.

## 6. ANNEX I

In this part of the document there is a description and an explanation of how use the file and choose the interventions

### 6.1 BUILDING AUTOMATION AND CONTROL SYSTEMS

The building automation and control systems are defined in compliance with the UNI EN 15232 standard.

Outline of the regulatory context:

EN 15232 defines four different BACS classes, from D to A, of energy efficiency to classify building automation systems, both in residential and non-residential:

**D = NON ENERGY EFFICIENT:** includes traditional technical systems without automation and control, which are not energy efficient

**C = STANDARD:** includes systems equipped with building automation and control systems, however at minimum performance levels compared to their real potential.

**B = ADVANCED:** includes systems equipped with an advanced automation and control system (BACS) and also equipped with some functions for managing specific building technical (TBM) systems for centralized and coordinated management of individual plants.

**A = HIGH ENERGY PERFORMANCE:** corresponds to BAC and TBM systems with high energy performances, ie with levels of precision and completeness of the automatic control that guarantee high energy performance of the system.

According to this regulation, wherever possible, all buildings must commit themselves to reaching at least the level B.

For BACS there are two main tables (sheets):

from the first one, is possible to choose, thanks to a drop-down menu, the class to reach. For example, to reach class B from class C, It will appear automatically the percentage of the consumption reduction, the cost of the intervention and maintenance costs. In the office case, in the thermal section there will be a 20% savings; in the electrical section there will be a 7% savings.

The second one, is a summary table in which it is possible to see the savings in reference to the building to be improved (schools, hospitals, hotels, restaurants, shops, domestic building). It is important to remember that according to the UNI EN 15232, only possible cases are:

- D→A
- D→B
- C→A
- C→B

## 6.2 LIGHTING

The structure is similar to the ex post tool where the LCC is defined with the following elements:

- Price
- Duration
- Maintenance
- Energy costs
- Emissions
- Total life cycle cost

with the difference that it is possible to choose between different products at the same time. For this reason, the LCC framework/structure is repeated for 15 times, giving the opportunities to describes at least 15 different products that can be compared with the old ones.

For lighting interventions there are two main tables (sheets):

The first one, is a summary table, in which there is the percentage of the consumption reduction, the cost of the intervention and the maintenance costs. It is only a result summary.

The second one, is the operational table in which all the intervention hypothesis are defined and the changes are possible. It is possible to choose between 15 different products depending on the characteristics of the lamps. After the total calculation, the savings results will be shown automatically also in the summary table.



## 6.3 SOLAR HEATING

The structure is similar to the classical LCC tool framework where the LCC is defined with the following elements:

- Price
- Duration
- Maintenance
- Energy costs
- Emissions
- Total life cycle cost

For solar heating interventions there are two main tables (sheets):

The first one, is a summary table, in which there is the percentage of the consumption reduction, the cost of the intervention and the maintenance costs. It is only a result summary.

The second one, is the operational table in which all the intervention hypothesis are defined and the changes are possible. The brown spaces must be filled with the appropriate data. The comparison between a new product and one already used is carried out through the last two columns in the table (D and F), while the comparison between two new products, look at the first two columns. (B and D).

At the bottom there is another table in which, after choosing the product, the required data have to be entered; in particular: water specific heat, Standard value for a good placement of the plant "Ns" and a value provided by the company "Nc" indicating monthly average performance of the solar panel. Differently, In the dark blue box, the data has to be obtained from the internet at the link: [www.solaritaly.enea.it/CalcComune/Calcola.php](http://www.solaritaly.enea.it/CalcComune/Calcola.php)

## 6.4 TRANSFORMER

The voltage transformer reduces and stabilizes the potential difference in the electrical network allowing a reduction of the energy consumption around 14% (from 12 to 16).

In this case, the sheet is only one and provides 3 brown spaces that must be filled with the appropriate data:

- foreseen saving by applying the transformer
- indicative lifetime of the product;
- indicative maintenance costs.

The purchase cost is given by this table but it is calculated automatically.

**Legend: Intervention Cost per kW<sub>p</sub>**

|                            |       |
|----------------------------|-------|
| 1. up to 20 kW (€/kW)      | 400,0 |
| 2. from 21 to 40 kW (€/kW) | 300,0 |
| 3. from 41 to 60 kW (€/kW) | 200,0 |
| 4. over 60 kW (€/kW)       | 125,0 |

## 6.5 CONDENSING BOILER

For the boiler there are two main tables (sheets):

- The first one, is a summary table, in which there is the percentage of the consumption reduction, the cost of the intervention and the maintenance costs. It is only a result summary and it is filled in automatically.
- The second one, has three columns in which it is possible to compare the older boiler (column B), the new boiler (column D) and another new boiler with a higher efficiency (column F). The brown spaces must be filled with the appropriate data:
  - Price per product
  - Number of purchases
  - Lifetime
  - Number of Maintenance Units per year
  - Maintenance Cost per unit
  - Price of energy (€/kwh)
  - Energy consumption (kwh)

The economic value of CO<sub>2</sub> can be found on the internet at the link:  
[www.sendeco2.com](http://www.sendeco2.com)

“The average yearly time usage” cannot exceed the value calculated by the product of the “Days with heating turned on” multiplied by the “Hours with heating turned on”. The real usage value depends on the real days and hours of presence in the building during the winter and it has to be normally estimated dividing the annual consumption in kwh by the boiler power. If the energy efficiency of the old boiler is less than 100% and it has to be substituted, the found value has to be entered in the “parameters” sheet of the boiler (real work) and, automatically, the number of the real work hours of the new boiler is calculated referring to the energy efficiency.

## 6.6 INSULATION (ROOF AND EXTERNAL WALLS)

For the insulation there are four main sheets:

- The first one, is a **summary table** but there are some brown spaces to fill in:
  - Cost of the intervention
  - Yearly maintenance costs (it accounts the maintenance costs before and after the intervention)
  - Lifetime (estimated duration of the roofing and/or external walls before and after the intervention)
- The second one represents the calculation of the transmittance of the vertical walls and roofing before the intervention (transmittance ex ante). It is broken down into four columns:
  - Building materials
  - Conductivity
  - Thickness of the material
  - Thermal Resistance

The brown space has to be filled in; automatically it is calculated the resistance and transmittance and there is also a drop-down menu where it is possible to choose the thermal surface resistances.
- The third one is similar to the second one but it explains the transmittance after the intervention (transmittance ex post)
- The forth one is the transmittance difference between the ex-ante and ex post situation. As regards the transmittance, if there are already data calculated by a technician, enter them directly. If not, in this sheet, the following brown spaces have to be filled in:
  - $F$  = correction factor that takes into account the value of the average internal temperature (lower than  $20^{\circ}\text{C}$ , since the heating in the rooms does not happen continuously during the day but only at pre-established times). It is recommended for residential buildings  $f = 0.9$ , and for all other cases from 0.4 to 0.8.
  - Global seasonal average performance of the system building/plant
  - Caloric power of the fuel

- Price € per Nmc

## 6.7 WINDOWS AND DOORS

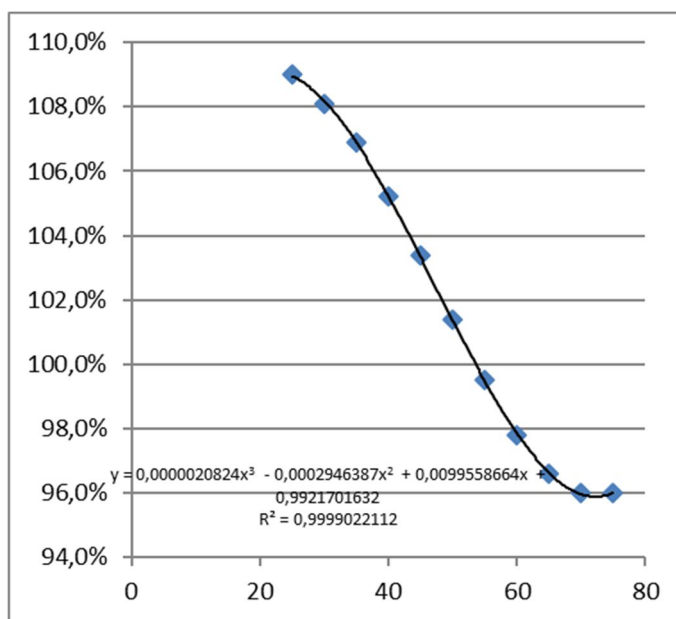
For the windows and doors there are four main sheets:

- The first one, is a summary table but there are some brown spaces to fill in:
  - Cost of the intervention
  - Yearly maintenance costs (it accounts the maintenance costs before and after the intervention)
  - Lifetime (estimated duration of the windows and doors before and after the intervention)
- The second one, is the transmittance ex ante sheet, where, to calculate the thermal transmittance of the window before the intervention, is possible to choose between the options offered by the drop-down menu:
  - Type of windows frame material
  - Type of glass
  - Percentage of the frame area relative to the area of the entire window
  -
- The third one, is the transmittance ex post sheet; it is similar to the second one but it explains the transmittance after the intervention, by choosing the characteristics of the new windows and/or doors through a drop-down menu.
- The forth one is the transmittance difference between the ex-ante and ex post situation. As regards the transmittance, if there are already data calculated by a technician, enter them directly. If not, in this sheet, the following brown spaces have to be filled in:
  - Transmittance of existing windows (doors)
  - Transmittance of new windows (doors).

If the intervention concerns only windows and doors and not roofing and external walls, the 4 four brown spaces in the sheet named "6. LCC Insul.roof-walls DIFFER." must be filled with the appropriate values.

## 6.8 PARAMETERS

In the "Parameters" sheet, it is important to notice the graphic that refers to the condensing boiler.



Through this graphic it is possible to see the efficiency of the condensing boiler based on the return temperature. Beyond theoretical efficiency value of the boiler, is important to know the return temperature of the heating system. The lower the temperature, the more the actual efficiency corresponds to the theoretical one, otherwise even a very efficient boiler with a very high return temperature has a yield of less than 100%.

The other tables (sheets) contain conversion parameters and may be useful for filling the previous sheets.