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Abstract

This deliverable presents the results of the Task2.1 belonging to „WP 2: Stakeholder Requirements“ which focuses on the collection of the necessities from the involved stakeholders associated to publicly owned buildings and buildings in public use or of public interest, where the project pilots will take place. Interviews and focus groups with the building administrator and representatives of the different user types in the building have been carried out. The aim was to understand how both, administrators and building users can intervene in the energy saving process. The interviews were done according to two different questionnaires created by GreenSoul partners: *1)* for building managers (Facility manager, building owner, managing director) and *2)* for tenants, building personal, staff, visitors, and so on. The main objective of this deliverable is to present the main results of the analysis of the questionnaires and interviews, coming from the GreenSoul pilot sites, in order to examine the potential impact of the GreenSoul project on them and finally outcome a set of users' requirements. Those requirements, defined based on the needs of the stakeholders, will also affect the implementation phase applied in the other work packages. The deliverable will be also one of the inputs for the Pilots Set-up, Model Calibration and Assessment where the actual project scenarios will be implemented and tested. In addition, partners' technical experience on smart metering systems and energy saving platform has been leveraged in order to complete the list of requirements with a set of technical requirements.

Changes History

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V0.8	28/06/2016	ECOL. Summary of pilot user responses.
V0.9	29/06/2016	WSC. Final Conclusions and Stakeholder initial requirements.
V0.10	29/06/2016	UDEUSTO. Completion of tenants UDEUSTO conclusions. Completion of ECOLUTION and MPH minor changes.
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V0.12	04/07/2016	4ward. Document overall review and changing document structure regarding the chapter: introduction and methodology; add cross references for figures and tables within the text
V0.13	06/07/2016	WSC. Seville's managers conclusions added.
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V0.18	25/07/2016	Document review and formatting
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V.0.22	27/07/2016	WEIZ document review. Numbers of interviewed, typos, formatting, executive summary
V0.23	27/07/2016	UDEUSTO overall document review. TOC updated, number of pages updated. Sections changed (Pilots reallocated into Appendix). Capital letters in titles.
V0.24	28/07/2016	WEIZ review, Typos, Formatting,
V0.25	28/07/2016	WSC Review, executive summary
V0.26	28/07/2016	UDESTO add WSC comments and UDEUSTO statistical analysis.
V0.27	29/07/2016	WSC review
V0.28	29/07/2016	UDEUSTO Final review
V0.29	29/07/2016	WSC Merge and review
V0.30	29/07/2016	WSC Pre-final version for approval and last review
V0.31	01/08/2016	WEIZ change figure 1, nomination of external reviewer, formatting
V1.0	02/08/2016	WSC final aprobal and releasing of final version v1.0

Executive Summary

The overall scope of this deliverable is to outline the stakeholders' requirements for the GreenSoul Project that will be later taken into account for the definition of the functional requirements in Task 2.3. In order to clearly define the respective needs and the role of the distinct stakeholders (end-users, building managers, smart meter providers, and so on) as part of an integrated framework, a sequential methodological approach has been considered.

Through interviews, questionnaires and sessions with focus groups, the user's requirements were extracted and the potential impact of the GreenSoul project was examined in different energy efficiency research fields. By taking into account the results of the questionnaire responses, sessions and interviews, the list of GreenSoul stakeholders' requirements was defined. Furthermore, the technical requirements from the point of view of the smart energy metering platforms owners have been analysed in order to have an idea of the impact that the users requirements have over the deployment of these platforms.

Two types of Questionnaires were created and distributed among the GreenSoul stakeholders with two different aims: 1) to assess the relationship between typical GreenSoul scenarios and main GreenSoul Use Cases (both described in Deliverable 2.2); 2) to fine-tune the identified GreenSoul scenarios and define the related Use Cases respectively. In addition, the point of view of the smart meters/platforms providers has been incorporated into the analysis by including a list of technical requirements to accomplish with user's needs. Therefore, a complete, comprehensive list of stakeholders' requirements is given.

Section 2 of this report presents the GreenSoul stakeholders and the analysis methodology to obtain their requirements. This methodology is mainly based on the collection of data through interviews and questionnaires and a focus group at the pre-pilot site. The GreenSoul solution has been validated first by building owners and facility managers, and then, by everyday occupants, tenants, visitors or students.

Section 3 presents the questionnaire results statistics. Two types of questionnaires have been created and distributed to the different GreenSoul stakeholders:

- Building managers, building owners or facility managers;

- Tenants, occupants or visitors

17 managers and 114 tenants and visitors from 5 different European countries were involved in the requirements collection process.

Section 4 is devoted to the analysis of these questionnaires. Conclusions for both, per pilot site and overall pilots are presented. For instance, it has been concluded that HVAC, lighting and office workspaces cope with the majority of the buildings consumption, according to the opinion of the managers. Hence, the project focus should be on these three services. Besides, managers believe that occupancy and behavioural data can improve users' awareness among other improvements. On the other hand, lighting control should be a key point addressed by GreenSoul, since it is identified as one of the most energy consuming sources and at the same time people are keen to switch off the lights. From the point of view of the appliances in use, GreenSoul should address the usage of PCs, since it is the most used device, but should concentrate on behaviour change regarding PC usage since most of the people are reluctant to implement energy efficiency strategies.

Section 5 is aimed at presenting the results of the focus group conducted at the pre-pilot site in Bilbao. The preferred strategy to cope with energy inefficiency at workplace is Automation (Machines are energy-efficient and take automatically the sustainability oriented decisions), followed by the Behavioural strategy (People bear the full responsibility of their sustainability decisions) and the last one, Standby (After using a device, it will shift to a state in which is already prepared to work again instantly). Some participants suggested that they will feel comfortable with a savvy system that controls the temperature on people's behalf but that only can be modified if something rare happens (e.g. a faint due to high temperature). In these cases, the human intervention is a must.

Section 6 seeks to extract the technical requirements from WSC technicians and domain experts. Basically, the most relevant requirements are three-fold: a) have all the information about the infrastructure that needs to be monitored, b) assure that there is connectivity between the controlled elements and the monitoring tool, and c) take into account that some devices like lifts, HVAC, and so forth, could not be controlled due to proprietary restrictions of the manufacturer.

Section 7 summarises the GreenSoul stakeholder initial requirements from the information collected from the questionnaires and the focus group sessions. Tenants/Visitors, Managers and Technical requirements are presented to provide a list of key 27 requirements for the GreenSoul solution.

Appendix 1 is devoted to describe the pilot sites so that this information is available to understand the derived requirements. There are five pilots and a pre-pilot executed during the project in the following cities: Seville (Spain), Thessaloniki (Greece), Weiz (Austria) and two buildings in UK (Cambridge and Sussex) are the project pilots, while the pre-pilot is located in Bilbao (Spain). The participating cities are good examples of economic dynamism and social welfare in their respective countries. Their population size range from XL to L to M and to S sizes according to the OECD-EC community report [1] on European cities. Each of the participating demo sites has some distinguishing features, which make them very suitable to measure GreenSoul's impact.

Finally, Appendix 2 and 3 present the questionnaires models while Appendix 4 presents Questionnaire Answers Coding used since in order to analyse the data statistically, it was firstly mandatory to curate the raw data and to establish some codes for the answers retrieved as it will be later established in D7.2 Data Management Plan.

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1 Introduction

1.1 GreenSoul Vision and Solution

In order to illustrate the overall vision underlying the GreenSoul Project, the following example scenario can be considered:

Elisa wakes up in her apartment. After a shower, she uses her new capsule-based coffee-maker to prepare a cup of coffee. After breakfast, she turns off the lights in the kitchen, but forgets to turn the coffee-maker off! (A decision that she will regret later). Elisa leaves home and goes to work.

After arriving to her company, she goes to the WC. Despite the clarity that comes through the windows of the toilet, the lights were on. She does not think in turning the lights off when leaving.

By noon, Elisa visits the shared lounge to prepare a cup of coffee. She turns the coffee-maker on, puts a capsule of her favourite flavour and waits. When she finishes, she doubts whether to turn the coffee-maker off or let it on (standby mode), because at that time there are many colleagues who also have a coffee break.

As can be read above, there are several types of devices in this scenario:

1) Personal-use devices whose power consumption is evident (kitchen lights);
2) Personal devices whose power consumption is less evident (home coffee-maker);
3) Shared devices whose power consumption is evident (toilets lights);
4) Shared devices whose power consumption is less evident (shared coffee-maker in the office).

Very few people forget to switch off the lights at home. Likewise, it is very unlikely to leave a hair dryer on, while it is usual to forget to turn off a coffee-maker or an electric heater (although their power consumption is similar). Indeed, awareness about the energy consumption of collective appliances is negligible when compared with home or personal appliances. In these communal spaces, it would be useful to provide users with some help.

Regarding the usage of shared devices, another difficulty occurs: the diffusion of responsibility. Darley et al. (1968) [2] studied this phenomenon in relation to human behaviour in emergencies. They concluded that the process that leads people to act is not a simple decision, but occurs within a decision tree. Therefore, people have to notice, interpret, take responsibility, learn the proper way to act and finally act. Doubts in any of these steps will make difficult the final action. For this reason, we propose to introduce GreenSoul-ed things to aid Elisa to realise that there is no need to leave the toilet lights on, or recommend to her that in some parts of the day is more efficient to leave the coffee-maker in standby.

In essence, the collaboration with GreenSoul-enhanced devices might foster her to take responsibility, know the proper way to act and finally decide to act towards reducing energy consumption effortlessly.

These suggestions can be triggered either by the augmented interfaces attached to the everyday things or either by the location-based GreenSoul app, which will be produced in this project.

1.2 Objectives

The core objective of this document, which is the first deliverable on the "Requirement Analysis Work Package", is the collection of the necessities from the different stakeholders associated to publicly owned buildings and buildings in public use or of public interest, where the project pilots will take place. Different requirement collection techniques will be applied to gather the different stakeholders' needs and expectations from a solution such as GreenSoul. Interviews with the building administrator and representatives of the different user types in the building will be carried out, in order to understand how both administrators and building users can intervene in the energy saving process. Questionnaires will be also issued to the building personnel as well as focus group sessions will be conducted. In addition, WSC experience in the provision of Smart Meter technology and energy saving platforms will be leveraged. Interviews with their technical teams will also be carried out to also understand the views from technical providers towards achieving higher energy efficiency in public use buildings.

This document describes the approach used to perform the stakeholder analysis for the GreenSoul Project. In it, partners have worked on identifying the most relevant user groups, likely to benefit from the services that will be offered by GreenSoul Project.

The analysis has aimed at addressing several groups of questions such as:

1) What users, building engineers and building managers typically do on a day-to-day basis in the demo site buildings;

2) What type of information they need, and what can facilitate the uptake of energy metering systems and behaviour change approaches;
3) What these users require from a system like "GreenSoul" to enable them to carry out their activities more effectively (e.g., which functionalities) and what these users would expect from the GreenSoul platform;
4) What smart meters and energy monitoring tools have to deliver from a technical point of view to fulfil with user's requirements.

1.3 Organization of the report

The report is organized as follows. Section 2 presents the GreenSoul stakeholders and the analysis methodology to obtain their requirements. This methodology is mainly based on the collection of data through interviews and a focus group at the pre-pilot site. Section 3 presents the questionnaire results statistics whereas Section is devoted to the analysis of the answers of these questionnaires. Conclusions for both, per pilot site and overall pilots are presented. Section 5 is aimed at presenting the results of the focus group conducted at the pre-pilot site in Bilbao. Section 6 seeks to extract the technical requirements from WSC technicians and domain experts. Section 7 summarises the GreenSoul stakeholder initial requirements from the information collected from the questionnaires and the focus group sessions organized.

2 Methodology

The main objective of this Section is to present the methodology that has been followed to gain insights of the GreenSoul possible functionalities and its priorities.

2.1 Overview of Stakeholders addressed in GreenSoul

GreenSoul´s aim is to bring together different stakeholders with the ultimate goal of the optimal operation of the GreenSoul solution. Therefore, the first step to achieve was to define the project stakeholders taking into account that different groups of actors with specific roles address different services of the GreenSoul framework. The idea was to reach up to 13-15 buildings' occupants per pilot site. Hence, the distribution of the interviewed sample was performed among the roles that were present in each building. The following roles were identified along the six pilot sites:

Table 1. Roles identified across the different pilot sites.

Roles	
Full time workers	• People who work full time for the purpose of maintaining the enterprise/institute/centre. • Most of these people are researcher, IT technicians and Managing authorities.
Part time workers	• People who work part time for the purpose of maintaining the enterprise/institute/centre. • In our pilot sites these people are researchers and IT technicians, administrative staff.
Principal researcher/head of unit/boss/manager	• People who is in charge of coordinating and managing full-time and part-time workers. At our pilot sites, people in this role usually have a separate room a have a general overview of the work carried out by their workers.
Administrative staff	• Full time or part time workers who manage the administrative tasks of the enterprise/institute/centre where they work. These staffs are located all together in a separate space within the building.
Cleaning staff	• Full time or part time workers who are in charge of cleaning the buildings (pilot sites) at the end or before beginning of the work day.
Secretaries or receptionists	• Full time or part time workers who are in charge of welcoming visitors or helping Principal researchers/head of units/bosses/managers to carry out the administrative tasks on their behalf.

Caretakers/concierg es	• Full time or part time workers who are in charge of taking care of the building (Open it, closing it, switching the lights and equipment on and off, etc.).
Visitors	• People who occasionally go to the pilot for different purposes.
Tenants	• People who rent an office in a pilot building.

These actors have been recruited in each of the pilot site attaining more than 100 people as Table 2 shows:

Table 2. Number of people interviewed per pilot site.

Country	Pilot city	Num. of managers	Num. of tenants	Total interviewed
Spain	Seville	1	6	7
	Bilbao	2	31	33
UK	Cambridge	9	28	37
	Haywards heath	1	2	3
Greece	Pilea-Hortiatis	1	34	35
Austria	Weiz	3	13	16
TOTAL		**17**	**114**	**131**

As can be observed in Figure 1, the GreenSoul solution will be validated first by building owners and facility managers, and then, by everyday occupants, tenants, visitors or students.

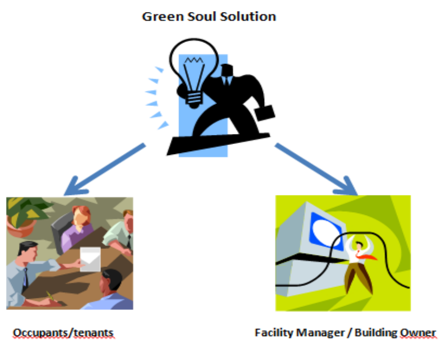


Figure 1. Hierarchy of GreenSoul delivered questionnaires.

2.2 Collecting Stakeholder's Requirements

In Figure 2 the strategy applied in this deliverable is presented. Stakeholders, tenants, building owners, managers and so forth offer their personal experiences and knowledge to refine the GreenSoul solution and to state the goals that such a platform should tackle.

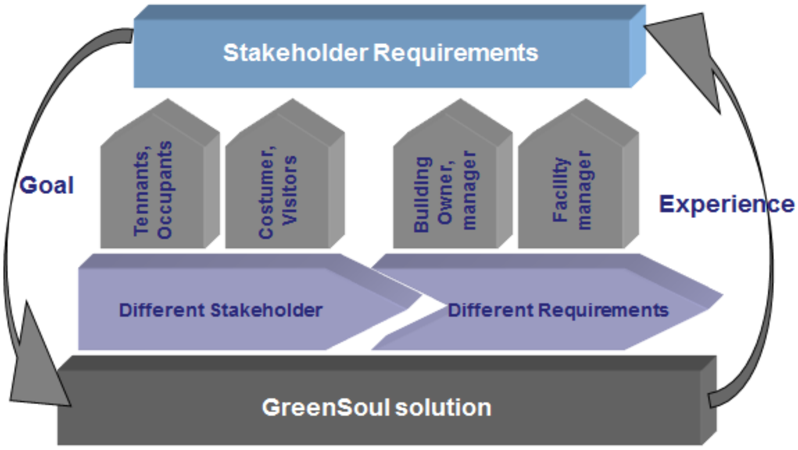


Figure 2. GreenSoul solution and strategy.

Moreover, this deliverable serves as an input to other project tasks as can be observed in Figure 3.

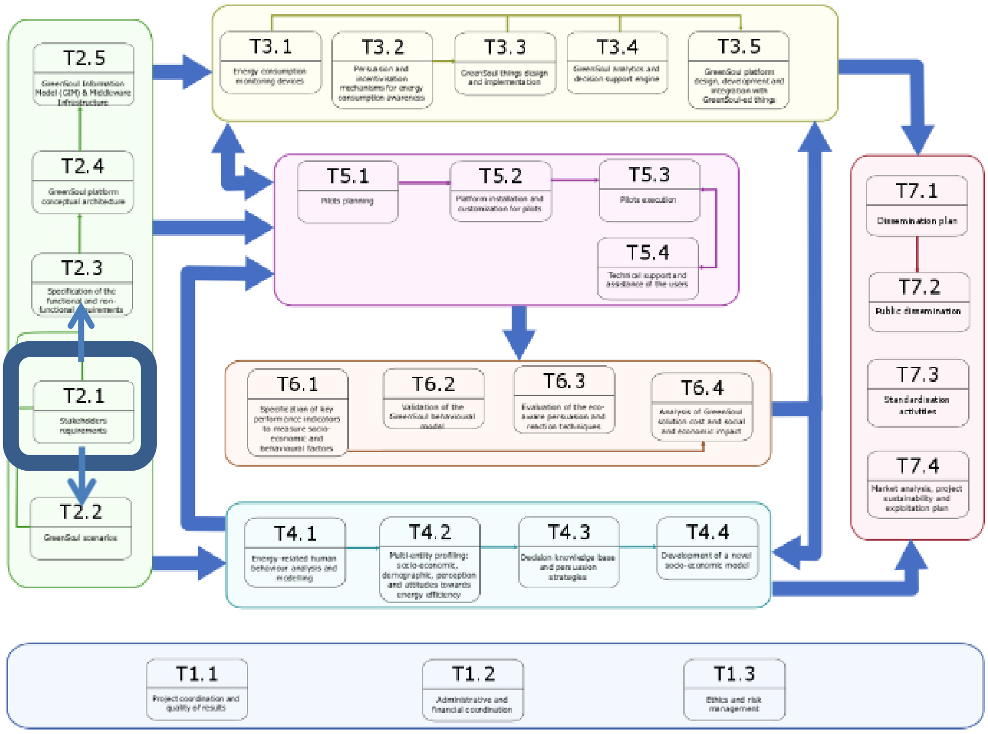


Figure 3. Interaction with other project tasks.

2.2.1 Interviews Conducted with Pilots' Users and Managers

Interviews with the building administrator and representatives of the different user types in the building were conducted, in order to understand how both administrators and building users can intervene in the energy saving process. The user/stakeholder interview is a simple and direct technique that can be used virtually in every situation. In line with the project, a lot of stakeholders are actively involved as well as being interviewed using a structured and fully fledged template. The results of this questionnaire approach are defined as a core part of the stakeholder requirements.

Two types of questionnaires have been created and distributed to the different GreenSoul stakeholders:

1) Building managers, building owners or facility managers;
2) and tenants, occupants or visitors

These questionnaires have been delivered to assess the relationship between Use Case Scenarios for each Demo Site and the GreenSoul overall solution. They have been also used to drive the definition of the User requirements.

The questionnaires were first translated into the mother tongue of each involved partner. The translation was done by different actors in each language (Greek, Spanish and German) to ensure the translation reliability. Next, the questionnaires were circulated to the involved task partners who contacted the external building stakeholders to conduct interviews at each demo-site. Questionnaires have also been distributed to the building personnel. The instruments used to perform the interviews were mainly:

- Web/e-mail/direct phone interview.
- Face to face interviews with the selected group.
- Focus groups or discussion groups.

The outcome of the interviews and focus group sessions was to give place to the "GreenSoul" requirements. The questionnaires were defined with respect to the following guidelines:

- Brevity and interest: the interviewed person is rarely keen to answer long and complex questions.
- Closed questions: only professional and expert users will be asked to answer open questions such as a request to suggest particular functionality.

2.2.2 Focus group in pre-pilot site

After finishing the pilot sites questionnaires, UDEUSTO, hosting the pre-pilot site, decided to run three sessions of focus groups in order to extract deeper insights from future users of the GreenSoul platform. In line with the questionnaires previously overviewed, we tackle questions about the time spent in different parts of the building, the electric devices they specifically use in those buildings, and other questions related to energy efficiency. However, the aim of the focus group was to reflect about the current energy efficiency measures that participants adopt in their everyday live at work. And more importantly, the aim was to discover the different energy efficient strategies, broke down by electrical device of personal or common use, that the users considered that would have to be applied to attain real efficiency in work environments.

2.2.3 Technical Inputs Extraction

The experience of Wellness Smart Cities (WSC) in the provision of Smart Meter technology and energy saving platforms has been leveraged to extract technical requirements.

Interviews with their technical teams were carried out to understand the views from technical providers towards achieving higher energy efficiency in public buildings.

WSC is in charge of deploying its energy monitoring system, called WeSave [4], in the pilot site buildings with the intention of measuring the impact of GreenSoul Project results. WeSave is an energy control and management platform for all types of building. WeSave makes it easy to monitor savings policies and the impact of users on changes in consumption.

Its open architecture makes it compatible with existing systems and aids in the integration of future applications. As it uses the communications network that is already installed, it is not necessary to make any additional investment.

The WeSave solution allows for:

- *Monitoring*. Consumption of air conditioning, lighting and equipment.
- *Reporting*. Correlation of information.
- *Alarms*. Anticipating and controlling contingencies.
- Establishment of usage policies and monitoring them.
- Increase awareness of employees using personal information.

Based on the WSC experience in deploying WeSave, the questionnaires have been analysed from a technical point of view, deriving the “GreenSoul technical requirements” regarding the installation of WeSave in the buildings. Thus, the different options included in the questionnaires derive in some cases a technical requirement regarding the energy monitoring system to be deployed in the buildings. For instance, if air conditioning is detected as one of the main consumptions in one of the buildings, then it seems reasonable to install the energy monitoring system to measure the electrical consumption in the circuits of the HVAC systems. This will be very useful for the technical architecture design and pilots planning in future work within the project.

As a result, this report includes a specific section for the analysis of the technical requirements of the different questionnaires. In addition, particular conclusions for each pilot site building from the technical point of view are included. Finally and overall conclusion, summarizing common technical requirements for WeSave among all pilot buildings are derived.

3 Overall Questionnaire Results and Analysis

After retrieving all the data from the questionnaires (check questionnaire contents in Appendix 2), careful evaluation was done on both sets of responses: Managers and Tenants. The aim was relevant in the definition of the stakeholder requirements for GreenSoul.

Hereafter we describe the overall results after performing the statistical analysis.

3.1 Tenants/Occupants/Visitors' answers

The first part of this questionnaire gathers general information about the occupants, tenants and visitors participating in the interviews. All occupants, tenants and visitors included in the GreenSoul Living Lab were contacted and a total of 114 different questionnaires were finally collected from 5 different European countries.

The second part of the questionnaire aims at defining the main aspects/functionalities of the GreenSoul Project, which reflects the role of the occupants, tenants and visitors as core part of the project.

Hereafter, the statistical comparison of the tenants' answers in every pilot is presented. The objective is to look for differences and similarities between the pilots to correctly do the planning leveraging the most suitable GreenSoul approaches in each demo site. Please note that some of the questions analysed had to be previously curated according to a Coding schema that is described in the Appendix 4.

Different statistical analyses have been done to test the hypotheses suggested after examining the images extracted from the raw data collected.

3.1.1 Gender Distribution

Figure 4 shows that the gender distribution is quite different among pilot sites. Clearly, Cambridge and Pileas-Hortiatis present a higher share of women than the remaining pilot sites. This could be due to the type of buildings. Bilbao and Weiz host two research centres with lots of engineers (a profession that typically has a strong men bias) while other pilot sites host others types of users (a municipality, a business incubator or a statistics agency) that do not have such a strong gender bias. Please note that the pilot-site with more gender skew is Bilbao where the pre-pilot will be held. To confirm our hypothesis, as "gender" is a qualitative variable, a contingency table is built and the independence between the gender distribution and the different pilot sites is assessed using a Pearson's Chi-Squared test. With p-value=0.02498, we can conclude that there is a statistically significant gender distribution between the pilot sites and extra care should be put in the Bilbao's pre-pilot to correctly take into consideration the gender aspects inside the persuasion techniques developed.

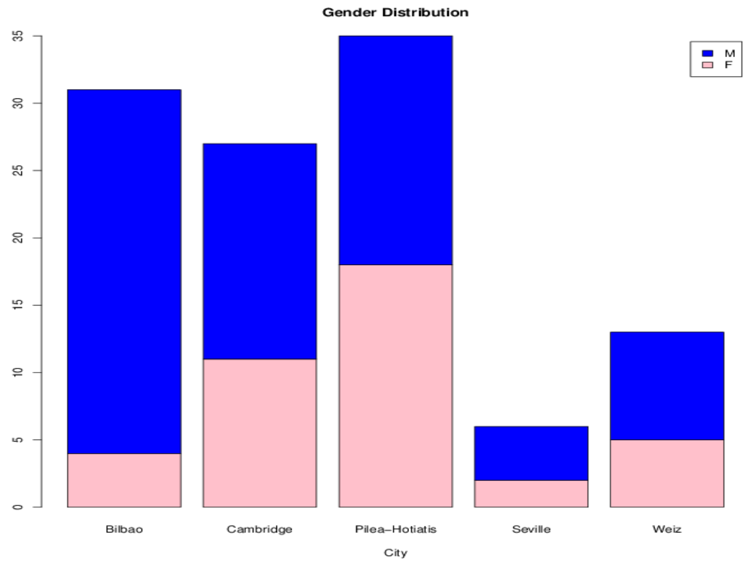


Figure 4. Gender distribution among pilot sites.

3.1.2 Age range

Figure 5 shows the mean age (errors bars represent one standard deviation over the mean value) of the different pilots' sites. As before, Bilbao presents a different pattern as the other pilots' sites. Bilbao hosts a research institute with only ten years of life so their staffs are young. On the other hand, the pilot in Seville or Pileas-Hortiatis host in both case public institutions with an older population.

As we are comparing different populations that does not follow a Gaussian distribution, a nonparametric several-samples comparison test should be used. The Kruskal-Wallis rank sum test presents an extremely low p-value (7.919e-06) so a post-hoc analysis should be used to look for the different populations. The pairwise comparisons using Tukey and Kramer (Nemenyi) test with Tukey-Distance confirms that indeed, the population of Bilbao is significantly different from the one in Pilea-Hortiatis and Seville (Bilbao and Pilea-Hortiatis have a p-value of 0.00012 and Bilbao vs Seville of present a p-value of 0.00041). The rest of age distribution seems to be equivalent. As before, these results show that extra care should be put in the Bilbao's pre-pilot to correctly take into consideration the age aspects inside the persuasion techniques developed.

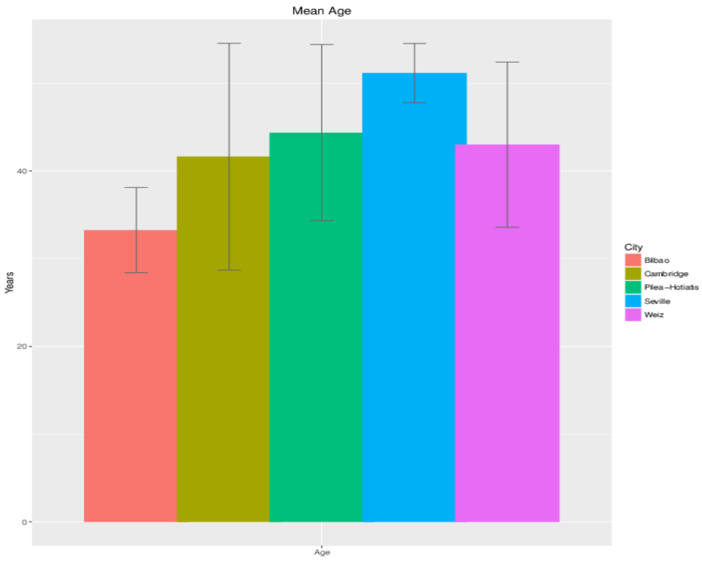


Figure 5. Age distribution among pilot-site partners

3.1.3 Technical Background

Figure 6 shows the different background knowledge related to energy efficiency presented in the different pilot sites. The main difference seems to be in the presence of 5 persons with very good knowledge in the Pilea-Hortiatis pilot and the lack of experience among the users of the Seville pilot building. Given that the five persons in Pilea-Hortiatis are technicians and the head of unit of the building (that are not a primary target of this project) and the low amount of answers in Seville (that make not very reliable the sample), it has been decided to remove these dataset as is was considered non-representative.

Again the background knowledge is a qualitative variable. Therefore, using Pearson's Chi-Squared test we obtain a very high p-value (0.5397). As we are not provided with enough information to discard the independence of the variables, therefore, we assume that the technical background distribution is the same in all pilots' sites. Please note that considering all the answers (i.e. including Seville and Pilea), the Chi-squared test has a p-value of 7.846e-05. In any case, these differences are not expected to have any consequence over the planning or the results of the actions. Moreover, the results are not consistent with regards to other similar questionnaire items. Therefore, this question could have been misunderstood by participants.

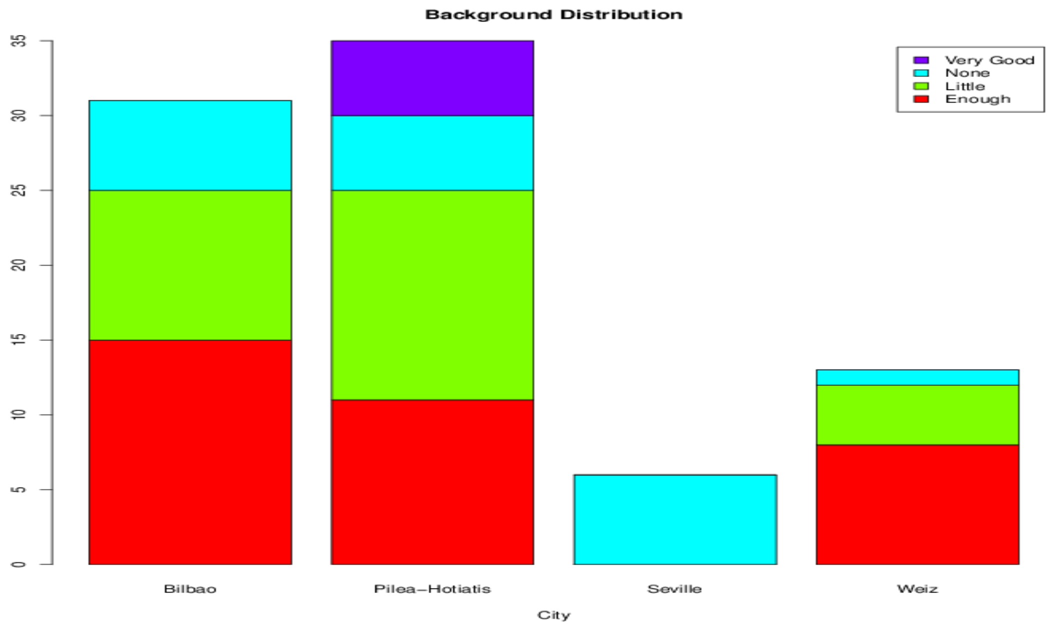


Figure 6. Technical background in each pilot site

3.1.4 Daily Patterns

The distribution of users of the building that have a similar pattern every day seems to be very uniform across pilots' sites. To confirm this hypothesis Pearson's Chi-Squared test is used to assess the independence of variables. The p-value obtained is relative high (0.1498). Therefore, we do not have enough information to discard the independence of the distribution. In this sense, we can assume that the percentage of people with patterns is the same in all pilots' sites.

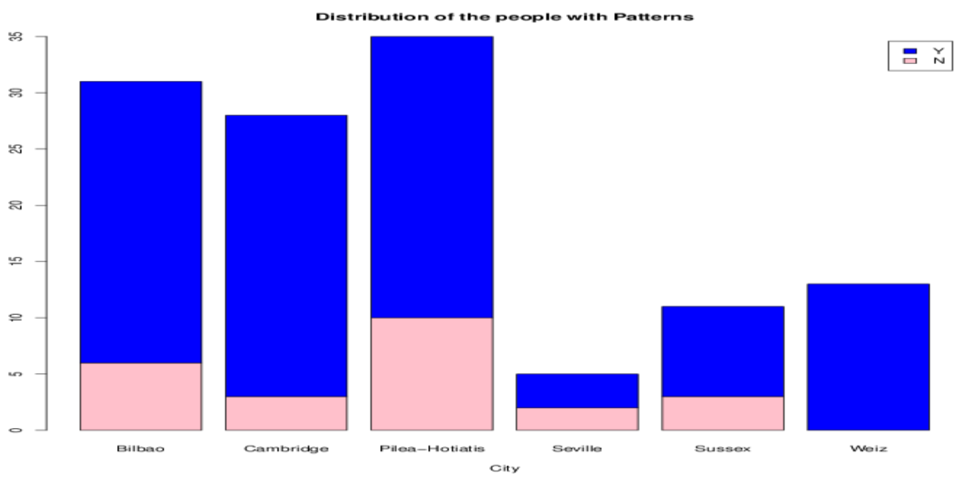


Figure 7. Distribution of the people with patterns

3.1.5 Actions Performed within the Daily Routine at Work

Figure 8 shows the actions that are made daily in every pilot sites. As the pilot sites are quite different, it is expected that huge differences are presented. Just from the image several differences can be found:

- In Cambridge and Sussex, the use of small appliances (as kettles or coffee machines) is slightly more frequent than in the rest of the pilot sites.
- In Bilbao and Pilea-Hortiatis the most frequent action is to turn off devices.

Nevertheless, as the answers do not correspond to what was expected (it was a free text question) this seem to indicate that a lot of interviewed persons did not understand what was the aim of the question. In any case, the focus groups celebrated at the pre-pilot site have provided us a lot more information about this particular topic, so we can discard this question of the survey.

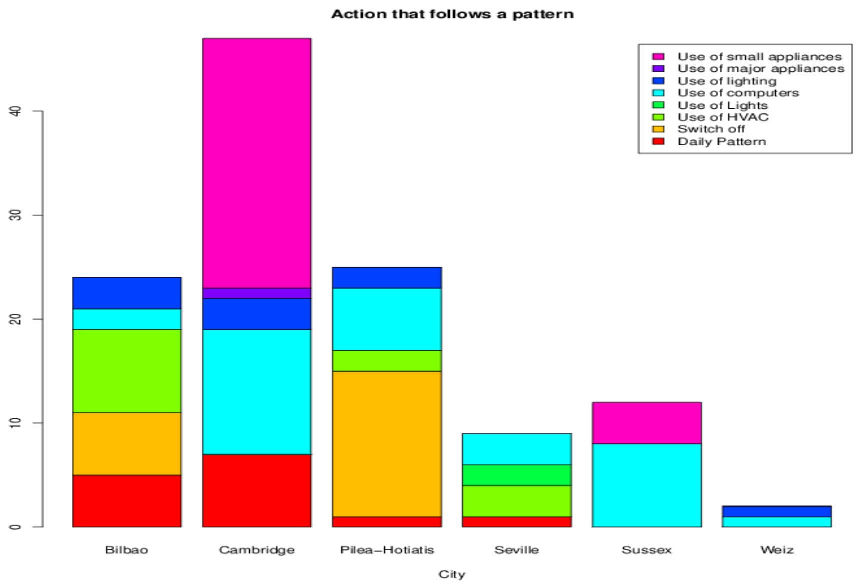


Figure 8. Actions within different patterns in each pilot-site

3.1.6 Time spent in work spaces

Figure 9 shows the mean time spent in every space for every pilot site. Given that the time spent in offices completely dominates the time spent in other spaces, the statistical overview will be focused only on this space. In particular, it seems that Bilbao is the place where the time spent in the office is the shortest one. This is compensated as it is also the place where more time is spent in others spaces (like in classrooms, rooms or in the canteen).

As we are comparing different populations that does not follow a Gaussian distribution, a nonparametric several-samples comparison test should be used. The Kruskal-Wallis rank sum test presents a low p-value (0.002031) so a post hoc analysis should be used to look for the different populations. The pairwise comparisons using Tukey and Kramer (Nemenyi) test with Tukey-Distance confirms that indeed the amount of time in offices from Bilbao and Pilea-Hortiatis 0.0027 and Bilbao and Sussex 0.0255) comes from different populations. To overcome these differences, in Bilbao Pilot will also consider the room space as a target to deploy the solution.

As an interesting note, even as Bilbao seems to be the pilot site where less time is expended in the office, Bilbao is the pilot site where the users spent more time in the building: the Kruskal-Wallis rank sum test presents a low p-value (0.0001888). As in previous occasions, Bilbao concentrates the statistically different result among the pilots sites: the pairwise comparisons using Tukey and Kramer (Nemenyi) test with Tukey-Distance confirms that there are differences between the pilot in Bilbao and the one in Pilea-Hortiatis (p-value of 0.00012) and between the pilot at Bilbao and the pilot at Cambridge (p-value of 0.04152). This results complies with others results that suggest that the Spaniards spent long hours in the office

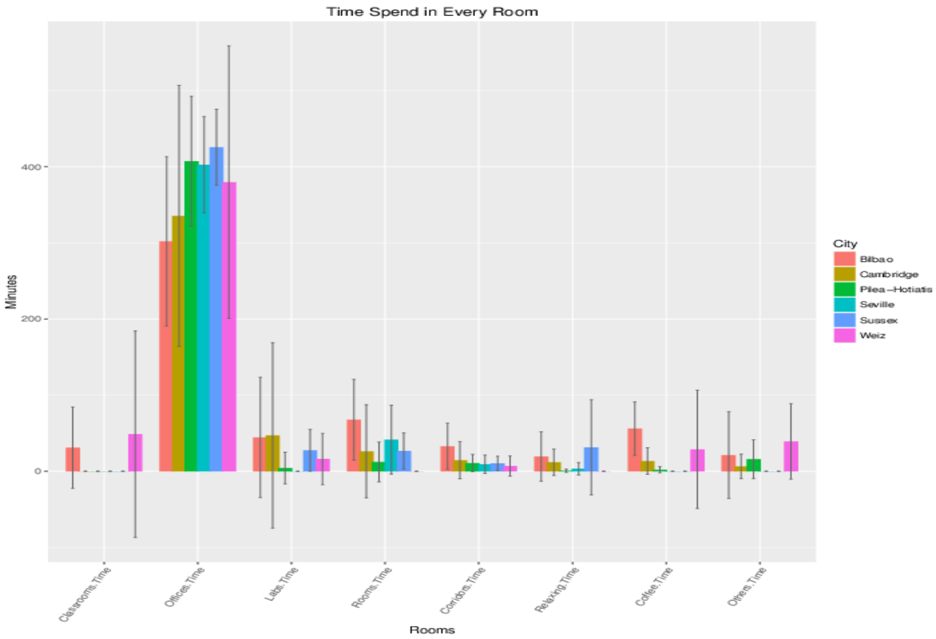


Figure 9. Time spent in different work spaces.

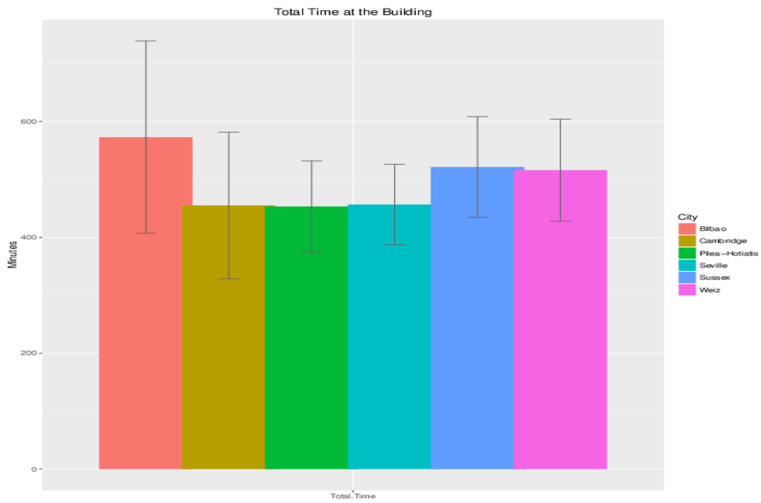


Figure 10. Time spent in buildings.

3.1.7 Devices in different spaces

From the previous results, it has been decided that the focus will be put in the office space. Figure 11 shows the amount of devices that are used in the office categorised in accordance of the coding explained in Appendix 4. .The graph clearly shows that the amount of devices in Pilea-Hortiatis is bigger than in the rest of pilots' sites. Moreover, the users seem to use almost all the equipment provided by the building uniformly. In contrast, in the rest of pilots there is a strong bias for devices that correspond to the "Computers" category. These results suggest that the distribution of equipment is not uniform among pilot sites. As this variable is qualitative, a contingency table is built and the independence between this variable and the different pilots' sites is assessed using a Pearson's Chi-Squared test. As its p-value is extremely low (4.002e-08) this hypothesis is confirmed. This result should be taken into consideration in the pilot plan.

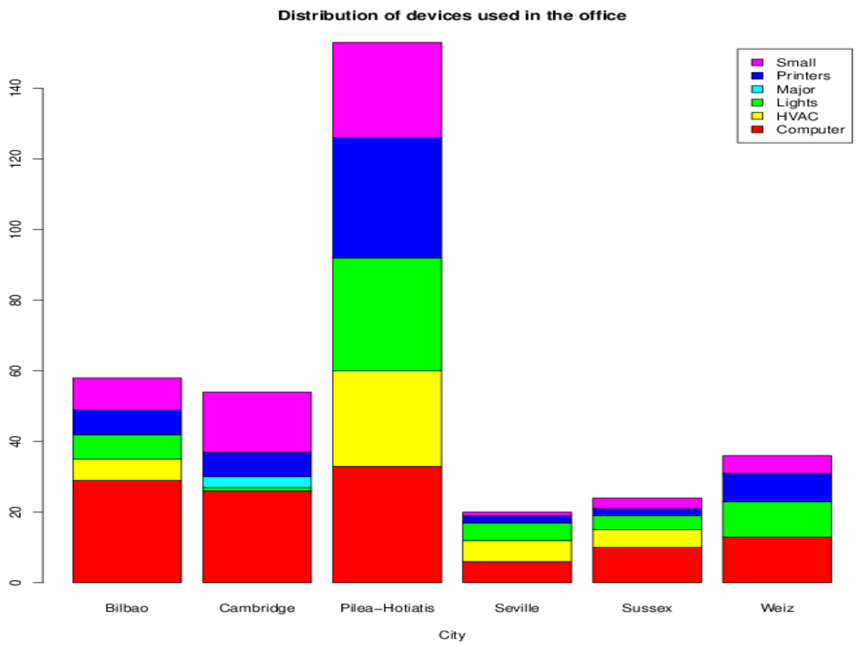


Figure 11. Devices per work environment

3.1.8 Smart Metering and Smart Plug Concepts

Figure 12 show the amount of persons that know what are a Smart Meter and, respectively, a Smart Plug. Both figures are quite similar; in general, there are around 20% of the users of the pilot sites that do not know what a Smart Meter or a Smart Plug is. As before, the biggest differences are located in the Pilea-Hortiatis pilot site (where more than two-thirds of the interviewed answer that they do not know) and in the Seville pilot site (where the complete sample have answered they do not know). These differences are explained as in both cases, the population that use the pilots' sites has a big amount of non-technical staff. To test if the differences are relevant/significant, as the variables are qualitative, contingencies tables should be built. The independence between these variables and the different pilots' sites is assessed using a Pearson's Chi-Squared test. The p-values in both cases are extremely low; 0.0001192 for the Smart Meter and 0.002542 for the Smart Plug. From this result it should be concluded that extra care should be put in both, the Seville and Pilea-Hortiatis pilot sites. In both cases special actions should be prepared to inform the users of the actions to be held.

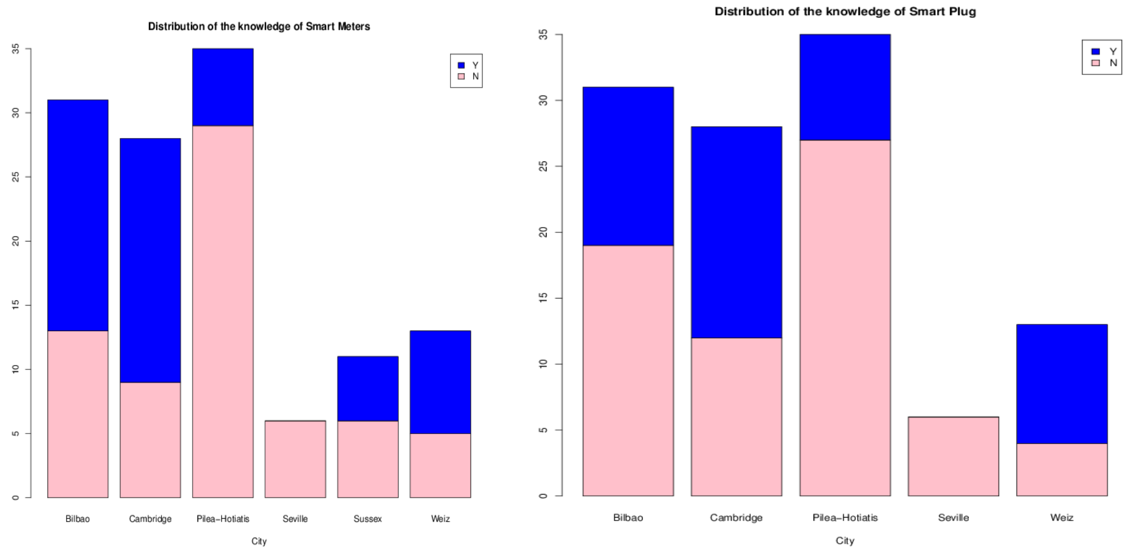


Figure 12. Knowledge of smart meters and plug

3.1.9 What a Smart plug or meter can do for you?

The figures presented in this section show the actions that the interviewed consider that a Smart Meter and, respectively, a Smart Plug should do. As before, the main differences seem to be between the pilots' sites and not between the answers of Smart Meters and Smart Plugs.

While in Pilea-Hortiatis almost all the people think that Smart Meters should provide historical data, People at Weiz seems to be more interesting in automation and information than in historical data. In Bilbao, Sussex and Cambridge there is a good amount of people that wanted to have recommendations given by the system. Moreover, they also wanted that a Smart Plugs are able to turn on or off a device.

In general, in the pilots sites that have a more technical staff it seems like are more kind of having automation or telemetry but in the others buildings are more interesting in having historical data or get educational tips. In both cases, to test if the differences are significant, as the variables are qualitative, contingencies tables should be built. The independence between these variables and the different pilots sites have been assessed using a Pearson's Chi-Squared test. The p-values in both cases are extremely low: 2.698e-07 in the case of Smart Meters and 0.002404 in the case of Smart Plugs.

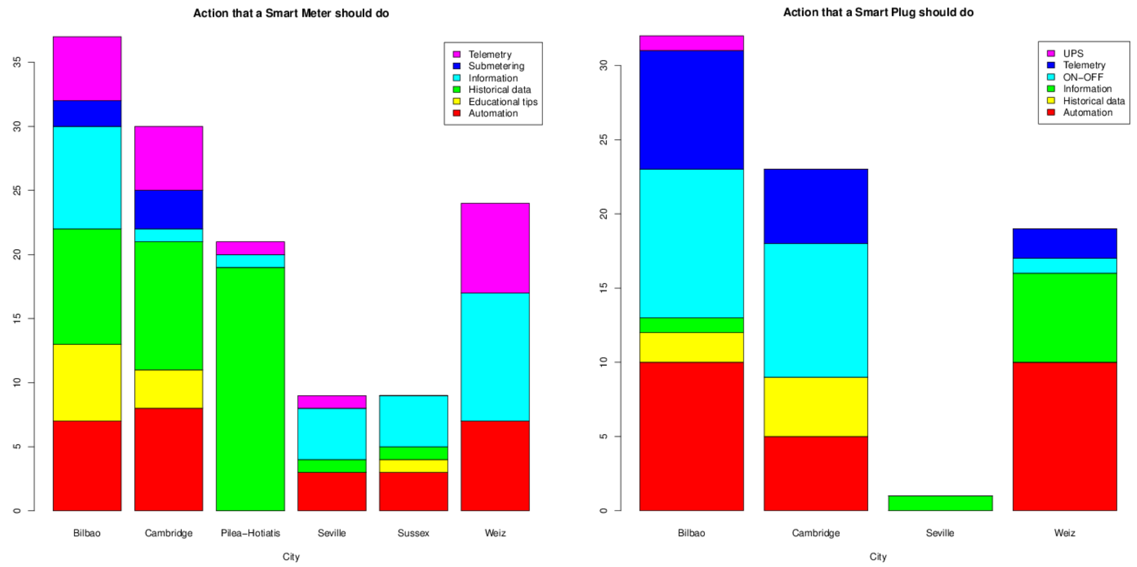


Figure 13. What a smart meter can do on your behalf.

3.1.10 Services offered by GreenSoul

In contrast to the previous figures, this section depicts the services that the users of the pilots' sites consider that a Smart Meter and, respectively, a Smart Plug should provide. In contrast to the previous cases, there seems to be consensus among pilot sites but not between Smart Meters and Smart Plugs.

In the case of Smart Meters, the most relevant services expected are aggregated and disaggregated load profile followed by optimization of the loads. Providing feedback was also much commented. On the other hand, the most common service requested for Smart Plugs was to provide information in a display or ambient lights followed by an App or a Web-based approach. E-mails and touch screens did not attract too much attention and the rest of the options were found completely marginal in comparison with previous ones.

In both cases, as theses variables are qualitative, contingencies tables should be built. The independence between these variables and the different pilots sites have been assessed using a Pearson's Chi-Squared test. Both p-values (0.8938 for the Smart Meter and 0.04407 for the Smart Plug) have been relatively high so the data is compatible with the assumption of that the distribution of services does not depend of the pilot sites.

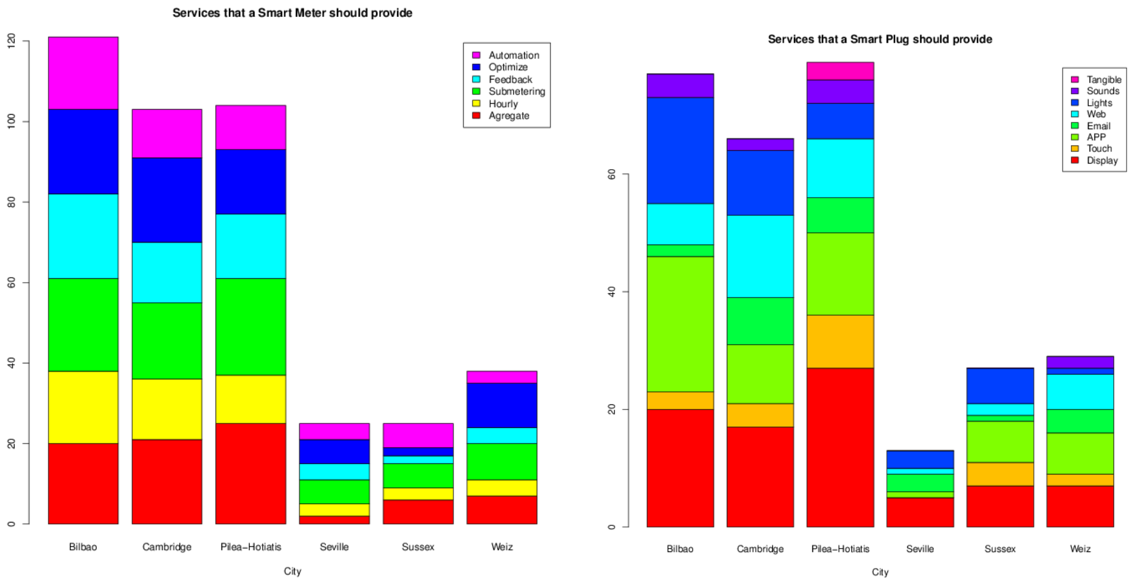


Figure 14. Services offered by a suspicious project participant

3.1.11 Energy efficiency actions

This figure shows the importance given to different actions related to energy efficiency measures. The bar denotes the mean punctuation in a Likert scale while the error bars mark one standard deviation.

The relevance given to different actions seems to be very different among pilot sites. In general, Cambridge and Weiz provided lower scores to every action. Probably a “normalization” of the punctuation should be made in order to correctly compare these data. In any case, a common pattern could be found: Bilbao and Pilea-Hortiatis give a lot more importance to illumination related measures (use of sunlight, turn off light) while Weiz and Cambridge give much more importance to devices that consume electricity or heat (Thermostat, use of energy efficiency PC, etc.). These differences should be taken into consideration when preparing the persuasive strategies.

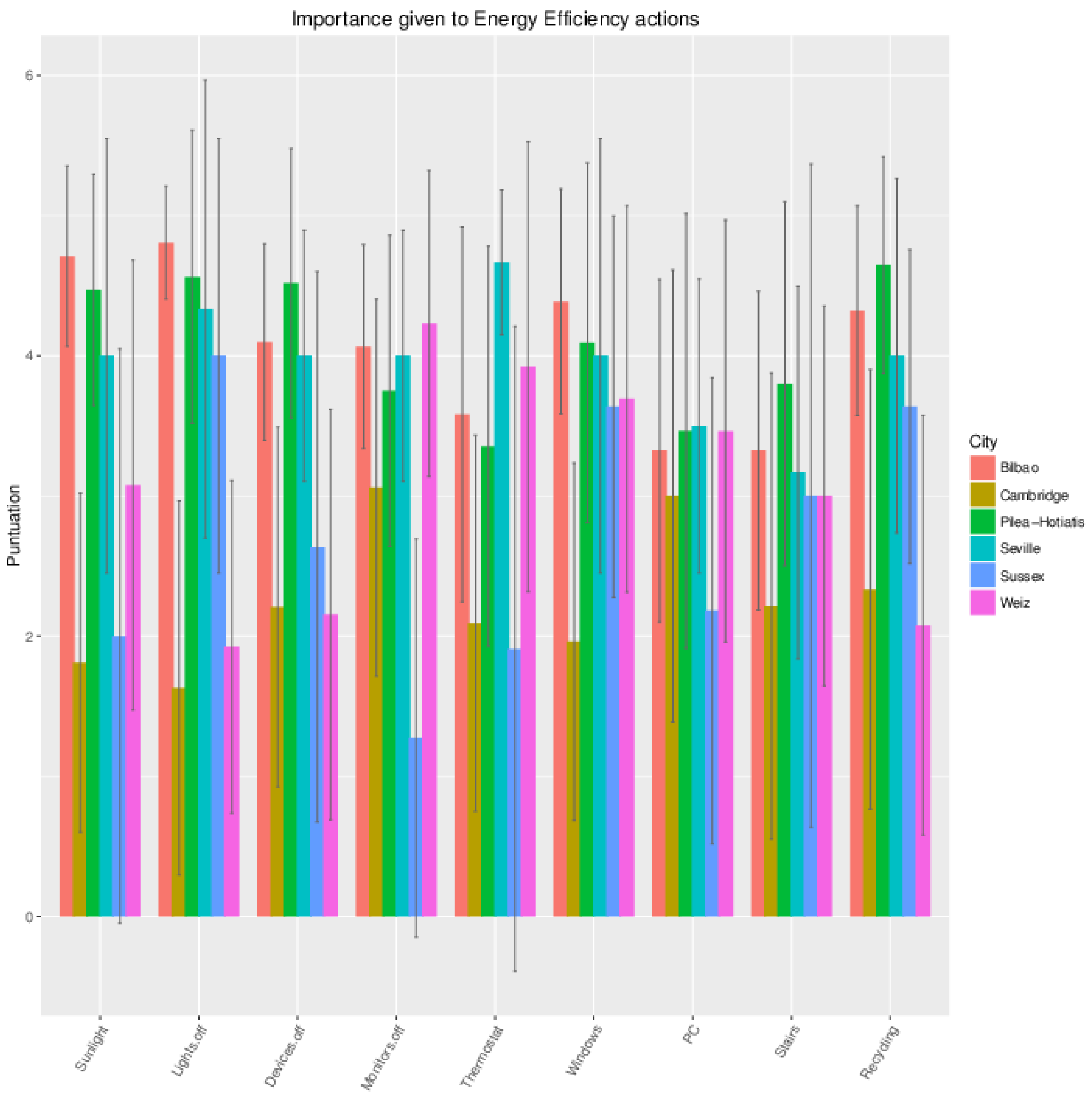


Figure 15. Relevance to energy efficient approaches

Finally, Figure 16 show the habits related to energy efficiency that are currently in place. Even as they seem quite similar, there are enough differences between the pilots to be statistically significant (0.006812). The main differences seem to be in the turn off computer equipment and the relation between windows and the HVAC systems.

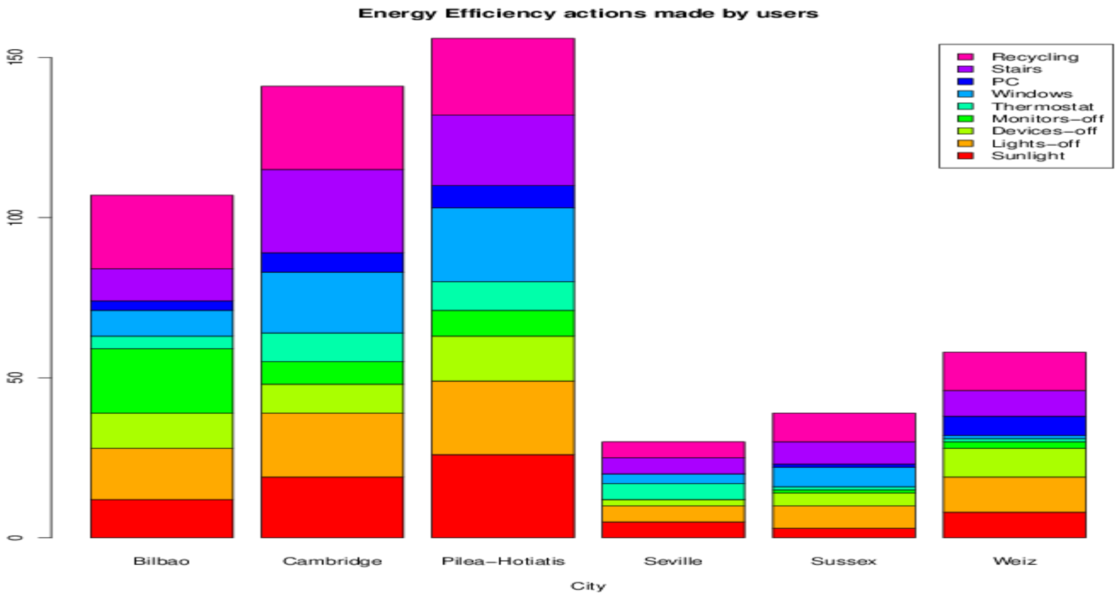


Figure 16. Energy efficient actions that can be made for human activity

3.2 Managers/Owners Answers

The following questionnaire aims at gathering information to enrich the GreenSoul use cases with further information on requirements, thereby allowing a more concrete development of the GreenSoul platform. The scope of this questionnaire is to examine the potential impact of GreenSoul Project to the managing directors/Building owner/Facility manager.

The first part of the questionnaire gathers general information about the Stakeholder/Building owner/Facility manager. All managing directors/Building owner/Facility manager included in the GreenSoul Living Lab were contacted and a total of 17 different questionnaires were finally collected from 5 demo sites.

All of the interviewed persons are full time workers and most of the interviewed persons are Managing directors then Facility managers and a few Building owner.

1. What other services does your building offer to its user/ the people working within the building?

The results about the services, which the building offers to its users/ the people reveal that HVAC, lighting, plugs and screens are the most offered services.

2. What services do you think/know have the highest energy consumption?

The Majority of the questioned Building owners, Facility Manager, Managing director believe that HVAC has the highest energy consumption. Then the lightening follows in the ranking.

3. Which are the main results about the energy performance of the whole building, (of individual devices) you would be interested in?

Various answers were provided, since this question had no predefined choices. The main answers were energy savings, reduction of GHG emissions and increase use of renewable energy sources in buildings.

4. Do you use a Building Management System (BMS Tool)?

Most of Building Owner, Facility Manager and Managing directors interviewed use a Building Management System tool. However, there are some pilots' sites like Seville's pilot site that are not implementing a BMS.

5. Is your building completely automated? Are the people able to control the energy-consuming devices) e.g.) HVAC, illumination, and so forth) in the different building spaces?

Table 3 Energy consuming device

Spaces	Devices used	User able to control?	Managers able to control?
Offices	PC/Light/printer	100 % yes	100 % yes
Labs	Laboratory equipment	75% yes	50 % yes
Meeting room	Beamer / lights	100 %	100 %
Corridor/rest Area	Light	72 % yes	80 % yes
Kitchen	coffee maker, water heater,	100 % yes	100 % yes

	stove		
Cafeteria	Dispenser, coffee maker, water heater, stove	100 %	100 %

6. Do you know what kind of energy metering system is installed in your building?

The majority of the building owner, Facility manager and managing directors do know what kind of energy metering system is installed.

7. Would you accept to install another smart metering system or a new one in case your building is not provided that?

Each Building owner, Facility Manager and Managing director would accept it.

8. In your opinion, what should a smart metering system be able to do?

Facility manager, Building owner and managing director think, that a smart metering system should mainly be able to inform of the aggregate amount of energy consumed (30%).

9. How should the information of the smart meter presented to you?

The building manager, the Managing directors and the Facility Manager view how the presentation of the results should be shown. Most of them prefer an ambient display (25%) and communication systems with smartphones, apps (23%).

10. Specify a rough estimation of time (in hours – minutes) spent by building occupants on each the below areas/spaces/zones during a typical working day?

According to Building managers´, Facility managers and Building owners´ perception, building occupants spend most of their time at the Offices or Meeting rooms and some smaller periods of time at the Corridor, kitchen, Cafeteria and the Labs.

11. What building systems can we apply to test GreenSoul devices?

The result is that few devices are candidate to test the GreenSoul solution since HVAC (26%), Lightening (26%), Kitchen Devices (25%) and PC/Printer (23%) are the most interesting ones, being in majority infrastructure devices instead of personal devices.

4 Analysis of questionnaires

4.1 Pilots Conclusions

In this section the questionnaires' conclusions in each of the pilots' buildings are reviewed. Every pilot consists of two sections, one devoted to tenants' answers and the other to the managers' answers. In the next Section, the results of the cross-pilot analysis are also provided.

4.1.1 Bilbao

4.1.1.1 Managers and owners summary

The pre-pilot manager and the technician in charge of the whole building infrastructure have replied to the proposed questionnaire. Both declare themselves as people having low knowledge about energy efficiency.

The building where the pre-pilot is going to be carried out is 25 years old and confusing at infrastructure level. Therefore, several answers related to the building features are completely opposite.

The technician has underestimated the number of equipment of shared used deployed throughout the building. This can be explained because she works in a separate building isolated from the place where students, research personal, teachers and staff develop their daily routine. There are also discrepancies between the times that people occupy each of the communal spaces. In this latter case, the manager overestimates the time that stuff stay in the different locations presented in the questionnaire.

Both agreed stating that the systems with higher energy consumption are: HVAC, lighting, laboratories' equipment and equipment distributed in working desks. Their replies were also aligned when thinking about those devices with higher rates of energy efficiency needs if they were used appropriately (in energy terms). Finally, both respondents considered to measure the energy consumption in a disaggregated manner.

The building does not feature BMS. The HVAC is pre-programmed by operators. However, tenants are able to operate them according to their preferences throughout the working day. The other electrical equipment is directly controlled by tenants.

The building does not feature tele-metering or smart metering. However, we are in consulting with WSC to install such as system.

In the interviewees' opinion, the smart meters should be capable to optimize the energy consumption of equipment of shared use. Moreover, both would like to have detailed feedback and information about these devices' performance.

None of the two participants were aware about demand-response advantages for energy efficiency.

Today it is not possible to know the building occupancy in the University of Deusto. Both managers were well aware about the advantages of having such measures to enhance the lighting system and the HVAC.

4.1.1.2 Tenants and staff summary

The interviewees were mostly men (87.1%) with the working-role of researchers (77.4%). The remaining 22.8% of working-roles was divided among technicians, internship students and administrative staff. The age of the respondents varied from 20 to 50 years having more than a third of them with ages ranging between 30 and 35 years old.

We found mixing backgrounds among interviewees on energy efficiency measures and approaches. Only 12.9% consider themselves as experts and more than 60% were found as newbies or with average background. Almost a 20% of them claim to be uninformed about this topic.

The 25 out of 31 participants assured to have a daily pattern in the building with special emphasis in HVAC and personal computers.

DeustoTech participants claimed to spend more than 5h in their personal working desk (the working day in this research centre ranged between 8h 30' - 9h 30').

- Similar as can be found in the building description on Appendix

4.1.2 Municipality of Pilea-Hortiatis

4.1.2.1 Managers summary

According to the facility managers' interview whose opinion is vital, the GreenSoul solution would preferably be deployed to the whole building and especially in the devices of A/C, Heating, and Datacentre.

The reason for choosing these devices is because the ranking of the highest consumption services -from highest to lowest- is considered to be:

1) Air conditioner

2) Heating System
3) Datacentre
4) Ventilation system

The specifics of our building are that we use HONEYWELL BMS STATION and the limitation is that the users cannot adjust the installations for heating/cooling temperature.

4.1.2.2 Tenants and staff summary

The vast majority of the interviewees (91,63%) spent at least 7 hours at their offices.

Almost 1/3 of the interviewees do not have common patterns on the usage of their devices.

From the other 2/3 of the interviewees most of them feel responsible for their personal devices (mostly PC's and personal printers) and make sure to operate them in safe mode function and to turn them off when they are leaving work. Moreover, they keep in mind to turn off the office lights if they are the last leaving the office. However, the majority don't feel responsible for the common devices in their offices (photocopy machines and printers), as well as the lights and air condition in common areas such as corridors and conference rooms.

A few of them are trying to use natural ventilation but most of them are trying to use natural light and recycle paper.

Energy consumption information was the most popular answer at the question "What should a smart metering system be able to do in your opinion?" and they prefer the results to be presented in a visible display.

4.1.3 Seville

In general, Seville's managers and tenants are interested in the Project results and are keen to participate. However, due to the public usage nature of the pilot building (devoted to regional government), it was necessary to sign several agreements to assure a proper cooperation (this was a requirement from the regional administration). This issue delayed a bit the collection of questionnaires.

In addition, there were some concerns about the role that the users of the building have to play. Their main concerns are:

- How the project would affect their daily lives within the building?. It is expected a controlled impact in current users' lives.

- Which mode of action have to be assumed, for instance, if some apps will have to be installed on user's phone to control user's location, if personal data will be handled, whether to use personal mobile devices or corporate mobiles. Then, ethics and data management plan from the project must consider this.

This was already identified as a potential risk of the Project. The Project management tackled the issue by informing the users that the retriever information will be treated in a complete anonymous way, as it was stated in the informed consent document. Then the risk was mitigated. Nevertheless, the number of questionnaires retrieved was low (1 per managers and 6 per tenants) due to the short remaining time that was available to do that prior to submit the deliverable, but enough to have an idea of Seville's users requirements.

4.1.3.1 Managers summary

The building manager has been interviewed. He is quite interested in the Project results and prospects some improvements over current energy efficiency status in the building.

On the other hand, the interview results depict a scenario where the main interest of the manager is focused on Air Conditioning /Heating, Lighting and office devices. Air conditioning is considered as the main energy consumption source. However, currently the manager has not a certain idea of the real consumption since the building does not implement any BMS. Then, the manager would be interested on the installation of such a system and also some smart metering devices. In his opinion, having the aggregate energy, per hour and per device would be interesting. Also, optimizing the energy efficiency depending on the users' requirements is of interest.

Also, in his opinion, users are 96% of the time at office, being able to control the air conditioning working temperature. Then, some impact in this aspect would be interesting.

Finally, regarding potential GreenSoul-ed things, they identified that microwaves, PC screens, printers, elevators, and meeting rooms are the most relevant ones.

4.1.3.2 Tenants and staff summary

Six tenants and staff users were interviewed for the Seville's building pilots. They are workers at the pilot site. In general, these people are beginners from an eco-aware energy efficiency attitude. This is both positive and negative. From a positive point of view, they are curious and motivated to know about how they can improve the energy consumption of the building. From the negative point of view, their learning curve regarding energy saving behaviours might be longer than that for an experimented user.

They spend most of the time at their office within the building and all they have similar habits. They can fully control their PCs at office and partially control HVAC and Lights in the building.

They have no knowledge about smart metering approaches but all of them agree on using a Smart Meter to provide detailed information of the energy consumption per device attached to it and to optimize its energy efficiency accordingly to the requirements of the users. In addition, sending feedback to the users about their usage of the monitored devices has a good acceptance.

The preferably want to receive information through a visible display and they highlight the importance of controlling lights and HVAC over other aspects to reduce the energy consumption. In addition, they are willing to participate on the controlling of lights and HVAC. Also they would like to improve the sunlight usage when possible.

4.1.4 Weiz

4.1.4.1 Managers summary

The building managers (2 people), and the facility manager of the pilot buildings, one of the building manager is also in charge of the whole building infrastructure. The manager who is also working as a “second“ facility Manager has really a lot knowledge about energy efficiency in the buildings and as well as the energy consumption and system (Heating, Ventilation, electricity consumption, etc.) in the buildings. All pilot buildings in Weiz are quite new and are very energy efficient buildings: one Passive house and two low energy buildings. The opinion of our interviewed building managers concerning, the energy consumption is, that the highest consumptions are: Heating, Cooling and Ventilation (there is no air condition in the WEIZ Campus). In the buildings there is a BMS system used (Honeywell), but the users are not able to control this.

Both managers agree on the potential of having a GreenSoul solution for HVAC or several kitchen devices, also lightening and office equipment are possible test fields for the GreenSoul solution.

4.1.4.2 Tenants and staff summary

The interviewed tenants were mainly male and researchers who work full time in the buildings. Most of the devices which they use daily are their computers and printers and the lights. Most of them did not know that a BMS System is installed, whilst a few of the interviewed persons knew that a BMS system is installed, but they are not familiar with the function of this system.

Their opinion is that the main function, which a Smart metering system should be able to, is to inform about the total energy consumption, and to optimize energy efficiency.

The presentation to the user should be via a visible display. The interviewed persons said that saving energy is a very important aspect for them, they think that the usage of sunlight and switch of the electrical devices and open the windows are very helpful for saving energy, what they do on their own for saving energy is mostly: Recycling their waste and switch of lights.

4.1.5 Cambridge

4.1.5.1 Managers summary

The two Facilities/Operations Managers for the Future Business Centre are direct employees of Allia the building owners. The Managers of Allia are also located within the centre and have a direct involvement in its operation. They all therefore have a thorough knowledge of the workings of the building and its services. Having been completed in 2013, it is a new building and was designed to be as energy efficient as possible scoring an “Excellent” rating under BREEAM.

The managers are, however, aware that some systems need adjusting and further explanation and education for the occupiers are required.

The main outcomes sought by Allia are:

- A reduction in overall energy consumption.
- An increased knowledge in the system controls available to the Facilities Managers.
- The implementation of additional systems to give enhanced energy usage figures and GreenSoul devices.
- An increase in knowledge amongst all of the Centre’s occupiers of the measures that successfully reduce energy consumption.

By real engagement of the occupiers in the GreenSoul project an addition to our community spirit within the centre.

4.1.5.2 Tenants and staff summary

GreenSoul will be implemented throughout the whole Future Business Centre from the building wide provided systems like heating and shared kitchen equipment to the individual devices used by the occupiers such as ICT, printers etc.

There are efficiencies to be gained from both, a better understanding of how the building systems function and changing them to their optimal settings as well as influencing all occupiers to think and change how they operate to reduce energy consumption.

Those interviewed identified the following needs.

- Greater and more detailed and useful information on energy bills currently provided by the BMS system.
- The identification for them of their highest usage devices and guidance on what reductions can be achieved.
- Information on the functions and advantages of smart meters and how to interpret the statistics they provide to make a difference in energy consumption.
- Comprehensive background and working instructions in use of the general energy saving systems within the centre that is already available.
- Easier to operate light switches and less delay in the PIR system for switching lights off when no-one is present.
- Assistance with informing everyone in the centre to appreciate how they can contribute to the project e.g. switching ICT equipment off at the end of the day, using dishwashers efficiently etc.
- Explanations and demonstrations on the devices introduced by GreenSoul to aid occupants in using less energy.
- Initiatives and incentives from the project that engage everyone.

What specifics arise for your building / which devices will be used?

- A thorough review of the Centre's current environmental systems to establish what improvements can be made e.g. is it economic to change all the light switches, are the boiler settings the most effective, can the time it takes for the lights to automatically switch off when no-one is present be safely reduced.
- As there is insufficient funds to provide Smart Meters for everywhere within the building the introduction of as many as possible into selected number of units to trial

their effectiveness, contribute to our overall energy saving target and provide hard evidence on what energy reductions can be achieved.

- The introduction of "GreenSoul-ed" devices on items such as coffees makers, kettles etc.
- Further information in written, visual and verbal forms to all tenants on the best use of the energy systems that are already present in the building through seminars, use of e-mails, tenant meetings etc.
- An information, education and training programme for all occupiers through as many of the GreenSoul project persuasive interactive systems that can be accommodated within the Centre.

4.1.6 Haywards Heath, Sussex

4.1.6.1 Managers summary

The building occupied by Affinity Sutton in Haywards Heath, UK, has a central heating system (fuelled by Gas), a Central Air Conditioning System and a Central Ventilation System.

There are many devices throughout the building, with lighting consisting of the vast majority of them. Otherwise, PC's, monitors and plugs are the more dominant devices used in the building. There are a few self-catered kitchens, as well as a Cafeteria and access to showers and also a Data Centre.

The most energy consuming equipment is considered to be the air conditioning system followed by the heating system and then lighting. The three least energy intensive equipment are thought to be the Cafeteria, the showers and meeting rooms.

The Facility manager expressed the lack of control over the heating system, hot water and the ventilation system. Although they did state that they had total control over the air conditioning system.

There is currently no BMS installed in the building.

Employees are unable to control energy consuming devices. The building is not automated.

The only metering system installed is traditional 'Dumb' meters, but would be willing to install a smart metering system.

The facility manager suggests the smart metering systems should be able to inform consumers of the aggregate amount of energy used, send feedback to the users on how they are using the devices monitored and for the meters to optimise energy efficiency accordingly to the requirements of the user.

They suggest that information from the smart meters should be presented to them in the same way they are presented to other employees or end users. They believe this should be through the use of ambient displays, written reports (by email etc.), web based interactive dashboards or other visual stimuli e.g. progress bars.

The Facilities manager expresses that they are unaware of the benefits demand side management and renewables can have for the building.

The building can measure real time occupancy through the entry card system installed. However, they feel this offers no advantages to contribute to real time control of equipment. They do believe that occupancy should control equipment more, but feels the entry card system is inadequate. He suggests the implementation of a PIR occupancy sensor system.

On average, the facility manager believes employees spend 6 hours in the office, 1 hour in meetings and 1 hour at lunch. During this time, they feel that, overall, lighting is by far the main equipment used, whilst in the office, computers are also prominent and, in the kitchens and cafeteria, appliances are also used.

They did not respond to the questions regarding personalised preferences and what systems GreenSoul can apply devices to.

4.1.6.2 Tenants and staff summary

- Most (72.7%) of participants said that they had a common usage pattern.
- 100% of these said that their routinely usage included a computer. Other equipment/appliances used included a microwave, printer, photocopier and telephone.
- 82% of the participants' time is spent in the office working. Only 2.2% of employees' time is spent in the kitchen. The rest of time is roughly even split (5%) between meetings, rest areas and 'Other' areas, which, for the majority, was 'on-site'.
- The devices used in the workplace consisted of a wide variety of technology, stretching across 21 different appliances/equipment. Computers was the most used (91%) followed by air conditioning (45%). Hot water was also mentioned frequently (45%), but this may have to be approached differently depending on if it is gas/electric.

- Of these, 100% of participants said they had control over computer, monitor and tablet usage, only 33% had control over the communal kettle and landlines, and 0% have control over the use of the hand dryer and hot water.

- 82% of respondents said they did not know if smart technology was installed, whilst the remaining 18% did know and stated that Affinity Sutton did not have smart technology in that building.
- When asked about smart meters, the general impression was that smart meters are thought to increase awareness of energy consumption by monitoring usage and consequently providing feedback. There were a few suggestions to say they reduce consumption and bills.
- Participants, when given a list of possible functions of smart meters, all options were selected by at least 18% of participants. Most stated they should be able to inform them of the aggregate amount used, that they should be able to automatically control devices to increase energy efficiency independently of the users and that they should be able to provide information about each device connected (55%). Least popular options were for smart meters to send feedback to the users detailing how they are using the devices and how to optimise efficiency accordingly to the person's needs.
  - In addition, participants were asked about how the information should be displayed. Smart phone notifications received 64% approval whilst visual displays and other visual stimuli were 64% and 55% approved respectively. Sound and other stimuli got 0% whilst web-based interactive features and written reports were received poorly with 18% and 9% approval.
- Out of a list of energy saving actions, the most important to participants were the ability to switch lights and air conditioning off when nobody is using them, and being able to recycle. Using natural light and the thermostat was considered the least important, but some responses implied that natural light is preferred and that there is no one central thermostat.
  - In a self-reflection about what energy saving actions employees currently are doing in the workplace, currently participants are taking the stairs 77% of the time, turning off lights they don't need 68% of the time and recycle 86% of the time. However, participants are less likely to turn off their screens during the day and be able to control PC software energy efficiencies (13.6%) and even less likely to actively use the thermostat (9%).

Some of the issues identified were:

- People did not understand what was being asked of them (1 and 8).
- People did not read the question correctly (3 and 7).
- The layout of questions confused people, resulting in some questions not being answered at all (1, 4, 5, 7 and 8).

- The type of questions was open and led to a huge variability, making the results less concise. (3)
- What options should be displays? (6)
- Only a 10% response rate.

4.2 Overall Conclusions

4.2.1 Cross-pilot managers' conclusions

The overall conclusions about the evaluated questions are:

- The majority of the interviewed have a central heating system (87%), but 11% is electrical powered. In addition, the majority of the interviewed (63%) do have an air condition
- In addition to HVAC systems, 55% of other services are Lighting and Plugs among the pilot buildings.
- HVAC, Lighting and office workspaces undertake 83% of the buildings consumption, according to the opinion of the managers. Elevators, Kitchen, Showers suppose only 5% of the consumption. Then, the focus should be done on the first three services.
- Managers are keen to support energy savings initiatives.
- The majority of the managers (63%) are familiarized with BMS and 63% of them used for energy savings. Then GreenSoul platform could fit for them, and they accept to install another BMS.
- Information about the aggregate amount of energy consumed and energy consumption per hour, and provide detailed info of the energy consumption per device fulfil 65% of the most required functionality by managers. User involvement is on 35% lower required functionality.
- 72% of the managers would like to see the results of the smart metering system in ambient displays, touch screens and smartphone apps, being this way the most preferred to show to end building users.
- People occupancy is an opportunity to exploit since most of the managers do not know what impact could have in their buildings. Their perception is that people spend most of the time in offices and meeting rooms.

- Managers believe that occupancy and behavioural data can improve users' awareness among other improvements.
- Managers believe that the most important appliances to tackle within GreenSoul are HVAC/Lighting/PC/Printer/Beamers/Microwave/Stove (86%). Then, GreenSoul-ed things and GreenSoul adaptors should address those kinds of appliances.

4.2.2 Cross-pilot Staff and Tenants Conclusions

More in depth conclusions will be provided in Deliverables D2.4 GreenSoul conceptual architecture and D3.3 Design document for persuasion and motivation. Here we will highlight the first conclusions:

- There are socio-economic aspects that have to be taken into consideration in the pre-pilot. Bilbao has significant less females than the others pilot sites and also it age distribution is different.
- The Office is the main space used but in Bilbao Rooms should also be considered to compensate the differences.
- The distribution of the devices in the different spaces is not uniform among the pilot sites. The analysis to be made in Deliverables D3.1, D3.3 and D4.3 should be made by pilot site.
- Actions should be taken to make people aware of what a smart meter and a smart plug are useful for. Special emphasis has to be taken in Seville and Pilea-Hortiatis pilot sites.
- There are not differences between the services which both smart meters and smart plug have to provide. However, in the pilots' sites that have more technical staff, it appears that they are interested on having automation or telemetry whilst in the other pilot sites they are interested in having historical data or get educational tips. This should be further investigated.
- In Bilbao and Pilea-Hortiatis are giving a lot more importance to energy efficiency actions related to illumination (use of sunlight, turn off light) while Weiz and Cambridge give much more importance to devices that consume electricity or heat (Thermostat, use of energy efficiency PC, etc.). This should be taken into consideration in Deliverables D3.1, D3.3 and D4.3

5 Focus Groups in Pre-pilot Site

As stated before, the aim of the focus group was to reflect about the current energy efficiency measures that the participants do in their everyday live at work. And more important, the aim was to discover the different energy efficient strategies, breakdown by electrical device of personal or common use, that the users considered that would have to be applied to attain real efficiency in work environments. In the following, the results for the focus groups sessions are presented.

5.1 Methodology

We recruited 18 people for running the user experience dynamic. They were separated in groups of six people per session. We asked them to select a peer to work together during the session with which they can initially discuss the ideas and them to summarise the findings with the whole group.

The groups were asked to do three main activities: *1)* reflect and discuss on the daily routine at workplace considering the energy impact of each of the actions carried out. *2)* Get insights on the best energy-efficient strategies that would be applied on electrical devices that they use in their everyday routine. *3)* Think on how they would like to obtain feedback from a hypothetical GreenSoul system.

To support these activities, the card sorting methodology was used [3]. Card sorting allows participants to construct a personalised account of their actions while having in front of them visual stimuli that eases the process. Moreover, post-its, colour pens and other stationery material were provided to increase their creativity. Images such as those of Figure 17 and the session audio were recorded and each of the sessions transcribed for further analysis.

Figure 17. Participants during the focus group sessions

5.2 Results

In this section, the results for the three sessions are presented separated by each of the three activities they conducted.

5.2.1 Storyboard

After selecting a peer, the participants were asked to reconstruct their daily routine through spaces' photographs (e.g. corridors, meeting rooms, rest rooms, etc.). They were also requested to include what devices they used in these spaces and finally to specify whether they left each of the devices switched on the whole day or they switched them off at the end of the day. The result of one of the participant group can be appreciated in Figure 18.

Figure 18. Storyboard with devices included in each space.

We count the electric devices that each of the participants included in each of the scenarios. The results of the count can be observed in Figure 19. The most used device types are lightings, followed by HVAC systems and thermostats. Those, laptops and elevators are used daily by participants. Then there is an assortment of devices that are less frequent than the previous ones but all were included in the sessions (power strips, electrical chargers, PCs, printer, coffee-makers, and so on).

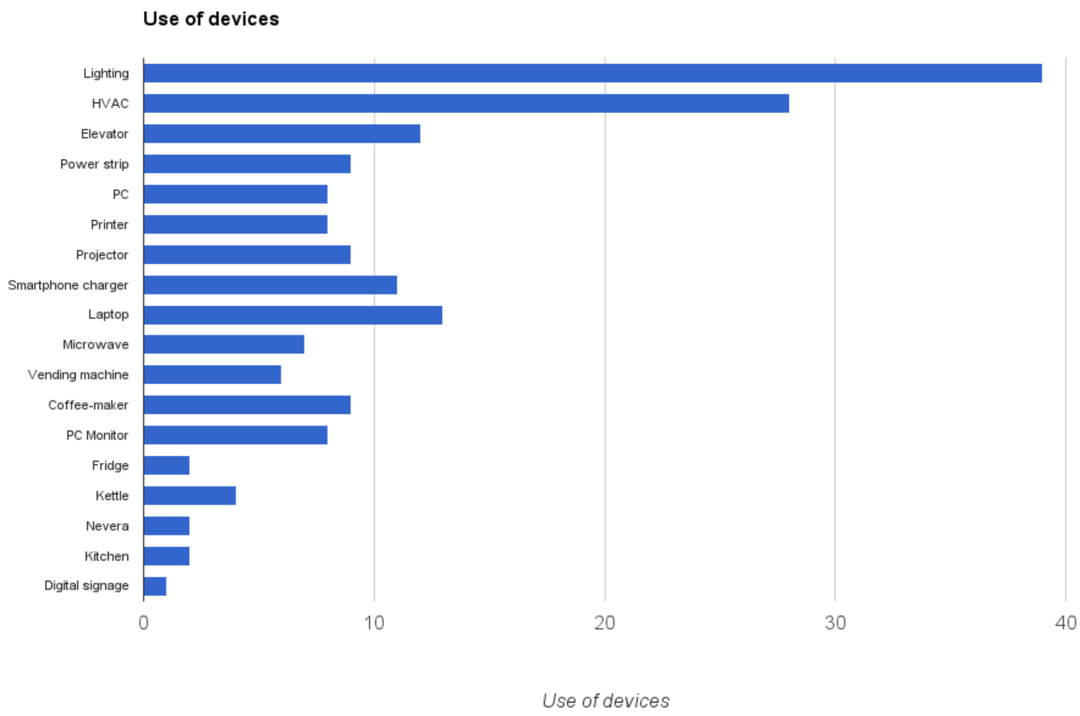


Figure 19. Devices used by participants in their everyday routine at work.

5.2.2 Energy-efficient Strategies

Figure 20. Post-its glued on top of the devices images to specify the strategy selected.

In the next activity, the participants were asked to select the best strategy to increase the energy efficiency for each of the devices that they use in their daily routine at work. To attain this objective, we offered to participants three different pre-set strategies to the participants to easily select one among them the most suitable one. They are described hereafter:

1) *Behavioural (MB).* People bear the full responsibility of their sustainability decisions either personally or in groups (e.g. switching on or off the devices).
2) *Automation (MA).* Machines are energy-efficient and take automatically the sustainability oriented decisions preventing people from controlling these devices.
3) *Stand by (MSb).* After using a device, it will shift to a state in which is already prepared to work again instantly. This strategy offers immediacy but consumes a negligible quantity of energy whilst idle.

The participants had ten minutes to stick a post-it with the strategy selected on each device. As well as in the previous section, we count the number of occurrences of each of the strategies (Figure 21), and them we broke-down the strategies by device (Figure 22).

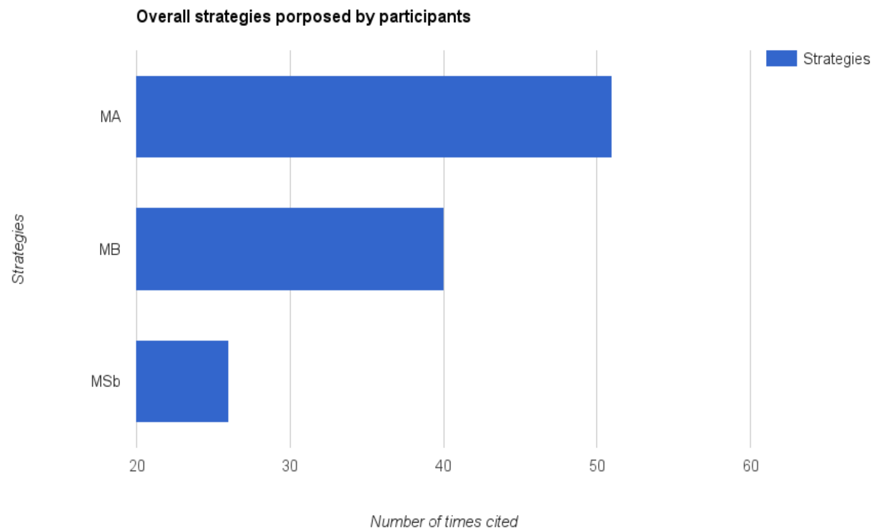


Figure 21. Number of times that participants selected one or other strategy to cope with energy-inefficiency

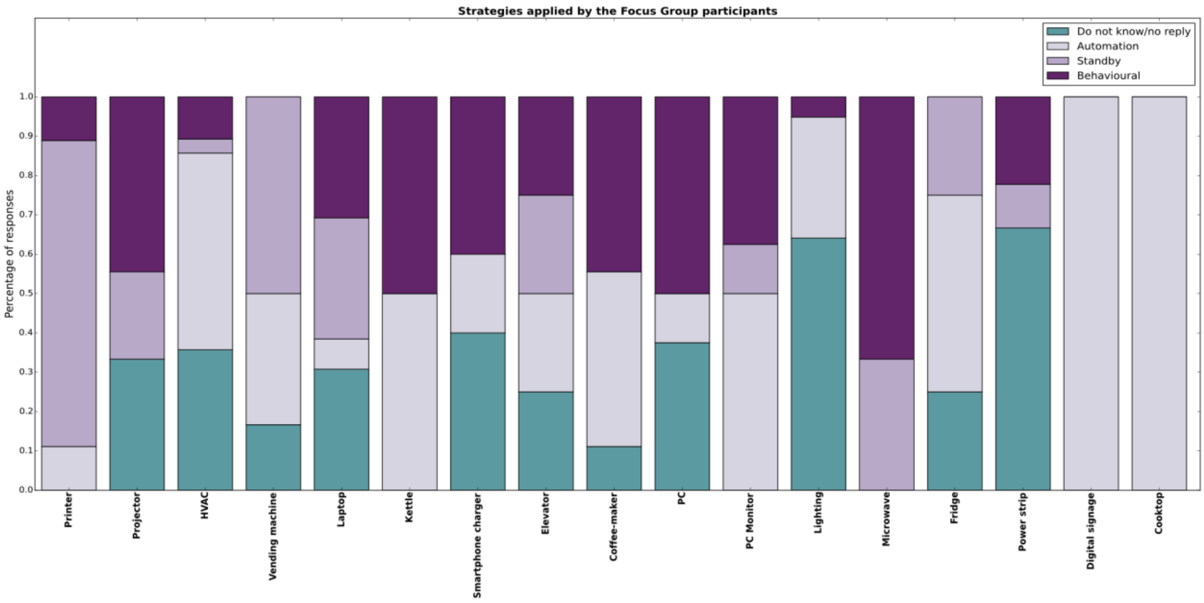


Figure 22. Energy-efficient strategy selected by device.

As can be observed in Figure 21, the preferred strategy to cope with energy inefficiency at workplace is Automation, followed by the Behavioural strategy and the last one, Standby. However, everyone agreed that Automation strategies must work appropriately without any failures. Some participants stated that a simple presence sensor attached with the system, as is installed in some bars or restaurants, is considered as a naïve approach. In the next section these ideas are treated insightfully.

To better understand in what devices people would apply one or another strategy, the breakdown of the strategies selected by each device is provided in Figure 22. Beyond the three proposed strategies, we considered important to also illustrate the percentage of opinions that were uncertain about what strategy would be applied (Do not know/Reply coloured in Green in Figure 22).

Analysing both figures, we found a common agreement that not every device or equipment is equal to each other, as well as is not equal the space where those are located. Therefore, the strategy proposed to cope with energy inefficiency won't be equal. The conclusion is that the strategies have to be tailored to each device and space by creating a taxonomy or matrix mapping that correlates strategies, spaces and devices. This task will be performed in WP3 with these inputs.

Analysing in depth the Figure 22, it can be observed that Lighting and Power strips were two of the most used devices in the work environment (Figure 19), causing great doubts among respondents. However, they all practically agree that Lighting have to be controlled automatically while the Power strip should be operated manually. Other interesting findings are: *1)* people think that the best strategy to attain energy-efficiency for printers is to keep the standby mode whilst not in use (which curiously, it is the mode featured by default); *2)* HVAC is preferred to be automatic rather than keep changing the temperature manually. Similarly as Lighting and the Power strip, these systems causes doubts among participants to figure out what might be the best energy-efficient strategy to apply; *3)* the results for laptops are mixed between standby and behavioural. Paradoxically, for PCs, that are the closest device, people mostly think that they should be switched off manually; *4)* kettles, coffee-makers and PC monitors presented mixed results between automation and behavioural strategies. Nevertheless, almost no one doubted attributing one or the other strategy (Thus, no one selected the '*Do not know/no reply' option*). We reckon that these devices are less controversial that Lighting or HVAC because are more widespread in different environments beyond the workplace (e.g. almost everyone have a coffee-maker, a kettle or PC monitor at home). Moreover, their operation is quite simple: switch on-switch off and there are no subjective measures involved (e.g. comfort); 5) finally, there was no agreement in the responses attributed to elevators. As happened with HVAC, people do not know how these devices exactly work and, therefore, the strategies proposed by different respondents are divergent.

5.2.2.1 Controversy with HVAC systems: Automation vs Behavioural

In some focus group we witnessed an interesting discussion about automation and manual controlling. Some people were disconfirmed to apply only one or other strategy.

Some participants suggested that they will feel comfortable with a savvy system that controls the temperature on the people behalf but that only can be modified if something rare happens (e.g. a faint due to high temperature). **In these cases, the human intervention is a must.**

U1S2 claimed that the thermostat may suggest a value in Celsius degrees, and then, the user will always have "the power" to change it according to its preferences.

In line with the last quote, **U2S2** suggested to let the system adjust the temperature automatically but leave to the user a fine-grained adjustment to prevent misusing of the appliance against the energy efficiency.

U3S2 proposed an automated system with some degree of uncertainty depending on user interactions and other variables such as external temperature, hour of the day, etc. In cases of certain predictions, the device will operate autonomously whilst in uncertain moments the display might be operated by humans if they want it.

U1S3 said: "*For the automation to properly work, some input from everyday users is a requirement (e.g. get some feedback from them and setup the device accordingly)"*.

U4S2 claimed: *"If the controversy about how to operate the thermostat will never disappear...the best idea for me is to automate it and end every discussion that may arise and optimise the energy efficiency as much as it can".*

5.2.3 Feedback strategies

The last part of the focus group session was to open a loud global discussion about the strategies that people considered useful to provide energy-efficiency performance indicators to workers. To this aim we presented some inspirational systems, see Figure 23, and we recorded their opinions extracting nine categories that we should take into account when designing the persuasive strategies and the informative energy feedback (Table 4): *1)* Data to compare with; *2)* Peer assistance; *3)* Pecuniary incentives; *4)* Data analogies; *5)* Ambient feedback; *6)* Visualizations; *7)* Direct feedback and 8) positive vs aversive feedback.

Figure 23. Different eco-feedback strategies from the literature review.

Table 4. Categories extracted from the last focus group's activity.

Comparative data	Peer assistance	Pecuniary strategies	Data transformation	Ambient cues	Visualising data	Personal vs General data	Direct feedback	Positive impact vs aversive
Absolute data will never work! A number in kWh, money (€ $) or CO2 only is comprehensible if it is compared with other measures (e.g. a similar day or to a similar place)	*People volunteered to teach about actions at workplace: P1S1 "I will give to you a course about energy efficiency policies for laptops".*	*People deal everyday with money. Hence, if people learn how much money they are losing (or they would have saved) if some actions were performed...that would increase their awareness.*	*People think that money and kWh or CO2 data are not comprehensible if it is not translated into understandable metaphors/analogies (e.g. One electric bus would have driven during 4Km if....)*	*If subtle data is provided people will think: Why is that happening? Why these sounds are being played or are lights bighting?*	*Historical data about the energy performance at hotspots (e.g. work entrance). Using panels, monitors, displays or digital signage*	*U1S2: If the device is being used by many people. I want it to let me know my own consumption saving.*	*Will impact the user mind more insightfully than if this data is provided with some delay (e.g. bills or reports).*	*Some information about the resources saved (e.g. CO2)*
Performance about how much energy one is saving throughout the time.		*One enterprise gave holidays to workers due to energy saved.*	*Colours are easily understandable by everyone and graphs or diagrams only by a restrict set of people*	*Different interactions work better than typical bar charts/plots.*	*daily graphs, but also trend analysis or historical close to electric device*	*Interesting for devices of personal use like PCs*	*Never by e-mail!, an app or a web-based app*	*People in general are more keen to positive feedback and appraisal*
Even applying gamification principles among workers		*If you had switched me off you, you would have earned XXX € (direct feedback*	*No the absolute measure of the energy data. Only the data which deal with*	*Charts are difficult to interpret (depends of background)*		*But also a general performance given in communal places (e.g. elevators or work*	*Close to the device that consumes energy*	*Positive feedback in private spaces and aversive in public (e.g. you have killed three*

		from the device to the user ==> personalized feedback)	*inefficiency*			*entrances)*		*trees)*
Relative data to other variables. For instance, occupancy and energy consumed or temperature and energy consumption.		*Is much better to offer money savings than punish people with an economical fine or something similar*	*To make the data understandable, use simple metaphors (e.g. traffic lights). And for those more eager to get more data, use a tag to let them learn more*			*U3S3 "I prefer to have personalised feedback to know my own contribution to the whole building"*	*A coach embedded in an smartwatch remembering you what to do or what impact your action may pose to the environment*	*Be careful with negative reinforcement it may numb some behaviours in the work context and personal context*
		Share among workers the yearly money savings attained within the enterprise	*Gradient-wise. From green to red throughout the working day.*			*A system that counts the energy that I'm consuming every day. As a calorie counter.*	*better in real-time in the moment of performing the unsustainable action*	*Better appraisal that negative reinforcement*

5.3 Conclusions

The following conclusions can be extracted from this study:

- The devices that focus group participants claimed to use more frequently, ordered from most use to least use, are: *1)* Lighting; *2)* HVAC; *3)* Laptops and PCs; *4)* Chargers and Power Strips; *5)* Elevators; *6)* Small appliances (e.g. coffee-makers, Kettles, etc.); and 7*)* Printers and Projectors.
- People preferred strategy to cope with energy efficiency is Automation. It was followed by Behavioural strategies and Stand by modes.
- Mapping favourite strategies to most-used devices, we obtain the following results:

Table 5. Mapping of most-used devices and energy-efficient strategies

Devices	Strategies (MA, MB, MSb or Don't know)
Lighting	Don't know + Automation
HVAC	Don't know + Automation
Laptops and PCs	Don't know + Behavioural + Standby (*Only in Laptops*)
Chargers and Power Strips	Don't know + Behavioural
Elevators	Mixed (25% to each strategy)
Small appliances	Automation + Behavioural
Printers and Projectors	Don't know + Behavioural + Standby (*Only in Printers*)

- Some people were reluctant to select only one or another strategy in HVAC systems and Lighting. Some ideas aroused to combine these two energy-efficient strategies. The problem we found if both approaches were merged is that the energy optimisation might be jeopardized because temperature and light comfort are subjective measures.
    - Questions to explore in future deliverables are: Who will be able to change the temperature or dim lights? Everyone? Only Managers? Can the GreenSoul solution give a reply to this answer?
- Nine categories of persuasive strategies or informative energy feedback were found of interest among focus group participants: *1)* Data to compare with; *2)* Peer assistance; *3)* Pecuniary incentives; *4)* Data analogies; *5)* Ambient feedback; *6)* Visualizations; *7)* Direct feedback and 8) Positive vs. Aversive feedback.

6 Technical Requirements Derived from Technician Insights

In the following, the link between the technical deployment requirements for the WeSave energy monitoring system and each one of the questionnaires is presented:

6.1 Facility Manager

Question	Technical requirement
1) Please give us some information about the installed energy systems within the building	From a **monitoring** point of view: [TR1] WeSave is specialized on measuring electrical consumption. Then the specific electrical circuits for those systems/areas must be isolated and independently monitored during the WeSave installation on the building. [TR2] The following data have to be gathered for a proper deployment dimensioning: o Number of circuits o Type of circuit (single-phase, 3-phase) o Nominal Intensity per circuit (for intensity transformers dimensioning) o One-wire electrical diagram o Physical space on the electrical panel o Data Communication coverage (mobile GPRS connectivity) [TR3] The WeSave web based application must be able to differentiate the energy consumption of each service. From a **control** point of view: [TR4] To evaluate the control possibilities and the physical interconnection between Heating/Ventilation/Air-Conditioning (HVAC) Systems and WeSave, the HVAC

		manufacturer and third-party integration possibilities must be provided.
2)	**What other services does your building offer to its users/ the people working within the building?**	No specific technical requirements are identified in general.
3)	**What services do you think/know have the highest energy consumption? Please, order the list from highest to lowest consumption.**	From a **monitoring** point of view, [TR1], [TR2] and [TR3] apply for each service. [TR5] To monitor individual things (i.e., Screens, PCs, coffee makers, and so on) in WeSave, a specific monitoring device for each individual thing must be deployed (e.g., GreenSoul-ed Things or GreenSoul Smart Adaptors). Each monitoring device must report the energy consumption to WeSave or a place that is accessible from WeSave. From a **control** point of view, [TR4] and the following specific technical requirements apply: [TR6] To control the lightings, and additional ON/OFF output module (relays) must be installed. The ON/OFF schedule must be provided. [TR7] For security reasons, Elevators and Datacentres WILL NOT be controlled. [TR8] To control individual things, GreenSoul-ed Things or GreenSoul Smart Adaptors must accept the control commands from WeSave.
4)	**Which are the main results about the energy performance (of the whole**	No specific technical requirements are identified in general.

	building, of individual devices) you would be interested in?		
5)	**Do you use Building Management System (BMS) tools?**	[TR9]	To integrate the most interesting functionalities of current BMS with WeSave, BMS manufacturer must provide open, industry-standard, license-free interfaces, protocols and software.
6)	**What are the limitations of the current tools from (BMS Tools) user perspective?**	No specific technical requirements are identified in general.	
7)	**Is your building completely automated? Are the people able to control the energy-consuming devices (e.g. HVAC, illumination, etc.) in the different building spaces?**	[TR10]	The different WeSave users profiles and privileges must be provided
8)	**Do you know what kind of energy metering system is installed in your building?**	[TR11]	To integrate energy meters with WeSave, energy manufacturer must provide open, industry-standard, license-free interfaces, protocols and software.
9)	**Would you accept to install another smart metering system or a new one in case your building is not provided of that?**	No specific technical requirements are identified in general.	
10)	**In your opinion, what should a smart metering system be able to do?**	All the mentioned functionalities can be implemented in WeSave from a technical point of view.	
11)	**How should the information of the smart meter be presented to you?**	No specific technical requirements are identified in general.	
12)	**How should the information of the smart meter be presented to end users? Ambient sounds, etc.).**	No specific technical requirements are identified in general.	
13)	**Are you aware about the benefits of the Demand Side Management and the integration of Renewable Energy Sources into your building?**	No specific technical requirements are identified in general.	

14)	**What is your knowledge on the occupancy data of the building?**	[TR12] People counter must reset daily when the building area is supposed to be empty. People counter must differentiate IN/OUT ways.
15)	**Specify a rough estimation of time (in hours – minutes) spent by building occupants on each of the below areas/spaces/zones during a typical working day?**	[TR13] People counter **should** count the time spent by people in a specific building area.
16)	**In your opinion, which are the main devices used during tenant's presence on the building on those spaces?**	No specific technical requirements are identified in general.
17)	**What are the main aspects on personalized preferences that could potentially affect the optimal control of the infrastructure (e.g. thermal comfort)?**	[TR14] Ambient sensors (temperature/humidity) must be installed to consider all possible ambient in the monitored area (i.e., north-oriented rooms, south-oriented rooms, upper-floors…).
18)	**What building systems can we apply to test GreenSoul devices?**	No specific technical requirements are identified in general.

6.2 Visitor/Tenant

Question		Technical requirement
1)	**Do you have common patterns on the usage of devices during your presence on the building infrastructure?**	No specific technical requirements are identified in general.
2)	**Specify a rough estimation of time (in hours - minutes) spent on each of the below areas/spaces/zones, during a typical working day?**	[TR13] applies.
3)	**List the devices that you typically use during your presence on the building? Can you control them (e.g. switch them off; leave them on**	[TR1] to [TR8] apply

	standby, etc.)?	
4)	**Are you familiar with the function and aim of smart metering systems? Do you know if there is a smart metering system installed within the building? What should a smart metering system be able to in your opinion?**	No specific technical requirements are identified in general.
5)	**Do you know what a smart plug is? What should a smart metering system be able to do on your behalf?**	All the mentioned functionalities can be implemented in WeSave from a technical point of view.
6)	**How should the information of the smart plug be presented to end users?**	No specific technical requirements are identified in general.
7)	**In the building, what energy efficiency actions do you consider as the most important for you? And the most annoying to perform?**	[TR1] to [TR8] apply. [TR15] Open window sensors must be connected to WeSave.
8)	**In your building, do you struggle about energy inefficiency? List the actions that you or your office mates do in relation to energy efficiency.**	[TR1] to [TR8] apply.

7 Summary of GreenSoul Stakeholder Initial Requirements

7.1 Tenants/Visitors

From the analysis of the questionnaires, the following tenants/visitors requirements are derived:

[VR1] GreenSoul should focus on office areas since most of the time tenants/visitors are in those areas

[VR2] From the point of view of the appliances in use, GreenSoul should address the usage of PCs, since it is the most used device, but should pay effort on changing the behaviour since most of the people are reluctant to implement energy efficiency strategies.

[VR3] Lighting control should be a key point addressed by GreenSoul, since it is identified as one of the most energy consuming sources and at the same time people are keen to switch off the lights.

[VR4] HVAC systems / Open Windows control should be also a key point addressed by GreenSoul, since people behaviour might be changed to respond to certain energy saving demands in this area.

[VR5] Most of the people feel that they will better engaged by visible displays, mobile apps and visual stimuli, so GreenSoul should consider these presentation channels.

[VR6] GreenSoul should monitor the aggregated energy consumption, being HVAC, Lighting and Office appliances the most used devices by people.

7.2 Managers

From the analysis of the questionnaires, the following managers' requirements are derived:

[MR1] GreenSoul should focus on the monitoring of aggregate consumption for HVAC, Lighting and Plugs in the areas of interest within the buildings

[MR2] GreenSoul should focus on the office areas within the buildings since they are the most used.

[MR3] GreenSoul should address energy savings as a key performance indicator since it is the most important reason for a manager to use a BMS.

[MR4] GreenSoul should present the results through visual screens and mobile apps.

[MR5] GreenSoul should exploit occupational and behavioural data for enforce energy saving policies on end building users

[MR6] GreenSoul should focus con lighting control followed by IT devices.

7.3 Technical requirements

In addition to stakeholder requirements, the relationship between stakeholders' needs and the associated technical requirements to fulfil those needs has been derived. Then, after analysing the information of the different questionnaires, the following technical requirements, regarding WeSave deployment in pilot site buildings are obtained:

[TR1] WeSave is specialized on measuring electrical consumption. Then the specific electrical circuits for those systems/areas should be isolated and independently monitored during the WeSave installation on the building.

[TR2] The following data have to be gathered for a proper deployment dimensioning:

- Number of circuits
- Type of circuit (single-phase, 3-phase)
- Nominal Intensity per circuit (for intensity transformers dimensioning)
- One-wire electrical diagram
- Physical space on the electrical panel
- Data Communication coverage (mobile GPRS connectivity)

[TR3] The WeSave web based application should be able to differentiate the energy consumption of each service.

[TR4] To evaluate the control possibilities and the physical interconnection between Heating/Ventilation/Air-Conditioning (HVAC) Systems and WeSave, the HVAC manufacturer and third-party integration possibilities should be provided.

[TR5] To monitor individual things (i.e., Screens, PCs, coffee makers, etc.…) in WeSave, a specific monitoring device for each individual thing should be deployed (e.g., GreenSoul-ed Things or GreenSoul Smart Adaptors). Each monitoring device should report the energy consumption to WeSave or a place that is accessible from WeSave.

[TR6] To control the lightings, and additional ON/OFF output module (relays) should be installed. The ON/OFF schedule should be provided.

[TR7] For security reasons, Lifts and Datacentre WILL NOT be controlled.

[TR8] To control individual things, GreenSoul-ed Things or GreenSoul Smart Adaptors should accept the control commands from WeSave.

[TR9] To integrate the most interesting functionalities of current BMS with WeSave, BMS manufacturer should provide open, industry-standard, license-free interfaces, protocols and software.

[TR10] The different WeSave users profiles and privileges should be provided

[TR11] To integrate energy meters with WeSave, energy manufacturer should provide open, industry-standard, license-free interfaces, protocols and software.

[TR12] People counter should reset daily when the building area is supposed to be empty. People counter should differentiate IN/OUT ways.

[TR13] People counter **should** count the time spent by people in a specific building area.

[TR14] Ambient sensors (temperature/humidity) should be installed to consider all possible ambient in the monitored area (i.e., north-oriented rooms, south-oriented rooms, upper-floors…).

[TR15] Open window sensors should be connected to WeSave.

Appendix 1. Pilot Sites

Since task 2.1 focusses on the collection of the necessities from the different stakeholders associated to publicly owned buildings and buildings in public use or of public interest, a special focus is given to Projects' pilots. Therefore, a short description of each pilot site is included in this deliverable. The pilot sites have also been visited and different requirements collection techniques have been applied to gather the different stakeholders' needs and expectations from a solution such as GreenSoul.

General information

There are five pilots and a pre-pilot executed during the project in the following cities: Seville (Spain), Thessaloniki (Greece), Weiz (Austria) and two buildings in UK (Cambridge and Sussex) are the project pilots, while the pre-pilot is located in Bilbao (Spain). The participating cities are good examples of economic dynamism and social welfare in their respective countries. Their population size range from XL to L to M and to S sizes according to the OECD-EC community report on European cities. Each of the participating demo sites has some distinguishing features, which make them very suitable to measure GreenSoul's impact: **Questionnaires and interviews were conducted with various stakeholders in the following pilot sites:**

- **Seville** (XL size) is a very large metropolitan area in the South of Spain. The pilot will be held at the Institute of Statistics and Cartography of Andalusia, which was built in 1992 for the World Exposition that was hosted in Seville. The building was the New Zealand Pavilion that was built as a touristic building. After the end of the World Exposition, the pavilion was acquired by the public regional government and they built offices inside to host the whole Institute of Statistics and Cartography of Andalusia. The building consists of basement, three floors and roof. The pilot has an area of 3.529 m². One of the main challenges was to rebuild the building into offices and the major project was related to the adaptation of the air conditioning to current usage conditions and energy requirements. Due to the fact that the existing facility was designed for an unlimited period of time and characteristics of use, it was necessary to design a completely new air conditioning system.
- **Thessaloniki** (Large size) is the second largest city in Greece. The pilot will be held at the Pilea-Hortiatis municipality hall buildings. The Municipality of Pilea-Hortiatis is based in a quite new building operating from 2010 on. A variety of retrofitting actions have been performed, updating the buildings to energy category

B according to KENAK (Greek Regulation for the Energy Efficiency of Building), reducing their operational energy consumption. Furthermore, the roof of the Municipality Hall buildings is partially covered with photovoltaic (PVs) panels and the energy produced is sold to the National Electricity Provider Company (Public Power Corporation S.A). The Municipal Hall is open to the general public 5 days a week while a number of events are organized during the afternoons as well as in the weekends. The offices are used by the administrative personal and members of the Municipal Council.

- **Bilbao** (Large size) is a large metropolitan city in northern Spain. The pilot will be performed at ESIDE-COMERCIAL, which was built in 1921 and houses the famous Faculty of Economics and Business Administration. Its neoclassical façade is 107 metres in length, and it consists of a basement, ground floor and two floors. In 1996, the modern ESIDE building was attached to its back. ESIDE hosts the Faculty of Engineering, DeustoTech (a research centre which belongs to Deusto Foundation) and DeustoKabi (a start-up incubator). Moreover, the new adjacent facilities for the Sports Degree have been opened in 2014. All these buildings share the electricity, water and heating systems.
- **Sussex** (Medium size) Affinity Sutton is one of the largest providers of affordable housing in England managing over 58,000 homes and properties in over 120 local authorities. They are a non-profit organisation for social purpose with commitments to reduce carbon emissions and increase energy efficiency across its own buildings and housing stock including tackling fuel poverty of residents. Ecolution have a very strong working relationship with Affinity Sutton having worked with them to install renewable technologies and energy efficient measures across their buildings and housing stock. Ecolution are now working with Affinity Sutton under a long-term contract to monitor and maintain all of Affinity Sutton's CleanTech systems across the UK.
- Furthermore, another pilot is going to be performed in Allia Ltd premises. **Cambridge – Pilot at ALLIA Future Business Centre. The Future Business Centre is owned and operated by Allia Ltd.** It opened in November 2013.The Future Business Centre is a business innovation centre with a difference – to grow businesses that do good for society and the environment. More than just a set of workspaces for rent, it is a place where people can grow their ideas to make a difference in the world. It offers affordable, high quality workspace on flexible terms with specialist business support and an ethos of collaboration and innovation. It is also home to Cambridge CleanTech who will be further supporting CleanTech start-ups in the City**.**

● **Weiz** (Small size) is a capital of the eastern part of the Austrian state of Styria. The pilot will be deployed at the Energy and Innovation Centre of Weiz (W.E.I.Z.), which is an innovative and trendsetting business centre. Here, 34 entrepreneurs and organizations in the field of F&E, Economy and Education find attractive office and storage rooms, which are conceived after the latest cognitions and get professional support from the management of W.E.I.Z. The W.E.I.Z. is located in the centre of Weiz. The optimal infrastructure is supplemented by flexible room sizes and a sophisticated use and energy concept. The building campus is the largest Styrian impulse centre outside the capital city Graz.

Description of pilot buildings

The following sections contain a detailed description of each pilot site also including some KPIs and figures about the energy systems installed and the on-site energy consuming devices.

Pilot in Seville (Spain)

The Institute of Statistics and Cartography of Andalusia was built in 1992 for the World Exposition that was hosted in Seville. The building was the New Zealand Pavilion that was built as a touristic building. After the end of the World Exposition, the pavilion was acquired by the public regional government and they built offices inside to host the whole Institute of Statistics and Cartography of Andalusia.

Figure 3: View of the Institute of Statistics and Cartography of Andalusia in Seville

Potential Energy saving actions

Energy Saving	**18,5%**
Key Figures	
Potential Energy Saving Actions	Bill savings of 15% and more comfort
Annual Energy Saving (kWh/yr.):	28.219
Annual Carbon Dioxide Reduction (kg CO2/yr.):	27.909
Annual Financial Saving (EUR/yr):	2.822
Average Annual Energy Consumption Before Intervention (kWh/yr):	152.478
Average Annual Energy Consumption After Intervention (kWh/yr):	124.259
Average Annual Energy Consumption per Demand Unit for the project before intervention (kWh/yr):	322
Average Annual Energy Consumption per Demand Unit of a dwelling in the same country (kWh/yr):	20.539

Pilot in Thessaloniki (Greece)

The Municipality of Pilea-Hortiatis is based in a quite new building operating from 2010 on. The Municipal Hall (buildings A and B) is open to the general public 5 days a week from 7:00 am to 16:00 pm, while Building B is open in the afternoons till 21:00 am as it hosts the music school and the concert and conference halls. In Building B a number of events are organized during the week as well as in the weekends. The offices are used by the public administrative and members of the Municipal Council. Due to the Town Hall location – which is close to the centre of the city of Panorama – and its parking space, it is easily accessible by citizens who are passing regularly to receive by person the municipal services.

Figure 4: A view of the Municipality Halls' buildings

Potential Energy Saving Actions

Energy Saving	**36,6%**
Key Figures	
Potential energy saving actions	Employees' information about the energy consumption. Citizen information about the energy consumption. Incentives to citizens depending on their energy saving behaviour.
Annual Energy Saving (kWh/yr):	44.216

Annual Carbon Dioxide Reduction (kg CO2/yr):	43.730
Annual Financial Saving (EUR/yr):	4.422
Average Annual Energy Consumption Before Intervention (kWh/yr):	120.928
Average Annual Energy Consumption After Intervention (kWh/yr):	76.712
Average Annual Energy Consumption per Demand Unit for the project before intervention (kWh/yr):	342
Average Annual Energy Consumption per Demand Unit of a dwelling in the same country (kWh/yr):	20.539

Pilot in Bilbao (Spain)

ESIDE-COMERCIAL was finished in 1921 and houses the famous Faculty of Economics and Business Administration. Its neoclassical façade is 107 metres in length, and it consists of a basement, ground floor and two floors. In 1996, the modern ESIDE building was attached to its back. ESIDE hosts the Faculty of Engineering, DeustoTech (a research centre which belongs to Deusto Foundation) and DeustoKabi (a start-up incubator). Moreover, the new adjacent facilities for the Sports Degree have been opened in 2014. All these buildings share the electricity, water and heating systems.

Figure 5: Picture of the ESIDE-COMERCIAL in Bilbao

Potential Energy Saving Actions

Energy Saving	**30.00%**
Key Figures	
Potential energy saving actions	Improve the control of the HVAC (free cooling, open window detection, etc.). Improvement on the lighting system (LEDs). Improvement on the use of computers.
Annual Energy Saving (kWh/yr):	438,000
Annual Carbon Dioxide Reduction (kg CO2/yr):	433,182
Annual Financial Saving (EUR/yr):	43,800
Average Annual Energy Consumption Before Intervention (kWh/yr):	1,460,000
Average Annual Energy Consumption After Intervention (kWh/yr):	1,022,000
Average Annual Energy Consumption per Demand Unit for the project before intervention (kWh/yr):	2,920
Average Annual Energy Consumption per Demand Unit of a dwelling in the same country (kWh/yr):	12,258

Pilot in Haywards Heath, Sussex (UK)

Affinity Sutton is one of the largest providers of affordable housing in England managing over 58,000 homes and properties in over 120 local authorities. They are a non-profit organisation for social purpose with commitments to reduce carbon emissions and increase energy efficiency across its own buildings and housing stock including tackling fuel poverty of residents. Ecolution have a very strong working relationship with Affinity Sutton having worked with them to install renewable technologies and energy efficient measures across their buildings and housing stock. Ecolution are now working with Affinity Sutton under a long-term contract to monitor and maintain all of Affinity Sutton's CleanTech systems across the UK.

Figure 6: View of the Pilot Haywards Heath, Sussex

Potential Energy Saving Actions

Energy Saving	**22.00%**
Key Figures	
Potential Energy Saving Actions	Personal devices, communal devices, lighting and AC
Potential energy saving actions	
Annual Energy Saving (kWh/yr):	30.140 kWh electricity
Annual Carbon Dioxide Reduction (kg CO2/yr):	13563,00
Annual Financial Saving (EUR/yr):	3616,80
Average Annual Energy Consumption Before Intervention (kWh/yr):	137000 kWh Electricity 71.000 kWh Gas
Average Annual Energy Consumption After Intervention (kWh/yr):	106,860kWh Electricity 71.000 kWh Gas
Average Annual Energy Consumption per Demand Unit for the	174 kWh/m² a

project before intervention (kWh/yr):	
Average Annual Energy Consumption per Demand Unit of a dwelling in the same country (kWh/yr):	

Pilot in Cambridge (UK)

The Future Business Centre is owned and operated by Allia Ltd. It opened in November 2013.The Future Business Centre is a business innovation centre with a difference – to grow businesses that do good for society and the environment. More than just a set of workspaces for rent, it is a place where people can grow their ideas to make a difference in the world.

It offers affordable, high quality workspace on flexible terms with specialist business support and an ethos of collaboration and innovation. It is also home to Cambridge CleanTech who will be further supporting CleanTech start-ups in the City.

Key metrics:

- Total approximately 34,993ft^2 (3,251m^2)
- Lettable Office Area 17,104 ft^2 (1,589 m^2)
- Lettable Workshop Area 3170 ft^2 (294.5 m^2)
- Common 14,719 ft^2 (1,367.5 m^2) this includes conference, meeting rooms, atrium café, Allia offices, plant room etc.

Allia is a charity that supports organisations dedicated to making a positive social impact.

Social ventures are organisations that exist for the primary purpose of tackling particular social issues or creating specific social benefits. They may be charities or social enterprises and can take a variety of forms.

Allia exists to support these social ventures so they can make maximum impact. We get alongside people with an idea and help them flesh it out and start up new enterprises. From our base in Cambridge we offer incubation and hot-desking space for small, growing ventures, and affordable office space on flexible terms for ventures to come and co-locate with other like-minded people. We also develop finance solutions to connect individual and corporate investors to social ventures in need of funding. “Future Business Centre” is an Allia Innovation.

Figure 7: Picture of the ALLIA Future Business Centre

Table 5 Main characteristics of the ALLIA Future Business Centre

Energy Saving	**15.00%**
Key Figures	
Potential energy saving actions	Interrogation of Building Management System and tuning the system to give increased efficiency; Energy saving tenant engagement; marketing and promotions; consideration of additional monitoring and/or efficiency technology. Employees' information about the energy consumption and ways to change to more efficient behaviours. Scrutinising and refining the building management system to better suit occupants overall needs and savings. Bill savings of a further 15%
Annual Energy Saving (kWh/yr):	49,701.9
Annual Carbon Dioxide Reduction (kg CO2/yr):	tbc

Annual Financial Saving (EUR/yr):	tbc
Average Annual Energy Consumption Before Intervention (kWh/yr):	331,346
Average Annual Energy Consumption After Intervention (kWh/yr):	281,644.1
Average Annual Energy Consumption per Demand Unit for the project before intervention (kWh/yr):	tbc
Average Annual Energy Consumption per Demand Unit of a dwelling in the same country (kWh/yr):	17,294

Table 6 Building performance of the ALLIA Future Business Centre

Pilot in Weiz (Austria)

		
A.) W.E.I.Z. I Research and Founder Centre **Construction period:** 15.01.1999 - 26.10.1999 **Type of construction:** Passive energy office house (largest wooden skeleton construction of Central Europe) **Costs in €:** 2,3 Millions **Total Area:** 2.070 m² (without external area) **Rentable Area:** 1.350 m²	**B.) W.E.I.Z. II Research and Founder Centre** **Construction period:** 21.4.2006 - 11.05.2007 **Type of construction:** Cool-Box (heating and cooling with terrestrial heat) **Costs in €:** 3,3 Millions **Total Area**: 2.842 m² (without external area)	**C.) W.E.I.Z. III Founder and Training Centre** **Construction period:** 02.10.2009 - 01.06.2010 **Type of construction:** Life Cycle Cost Building (energy & cost-efficient heating and cooling) **Costs in €:** 3,9 Millions **Total Area:** 2.596 m² (without external area)

	Rentable Area: 2.167 m^2	**Rentable Area:** 2.313 m^2

The Energy and Innovation Centre of Weiz is an innovative and trendsetting business centre. Here, 34 entrepreneurs and organizations in the field of F&E, Economy and Education find attractive office and storage rooms, which are conceived after the latest cognitions and get professional support from the management of W.E.I.Z.

The W.E.I.Z. is located in the centre of Weiz. The optimal infrastructure is supplemented by flexible room sizes and a sophisticated use and energy concept.

The building campus is the largest Styrian impulse centre outside the capital city of Graz.

Potential Energy Saving Actions

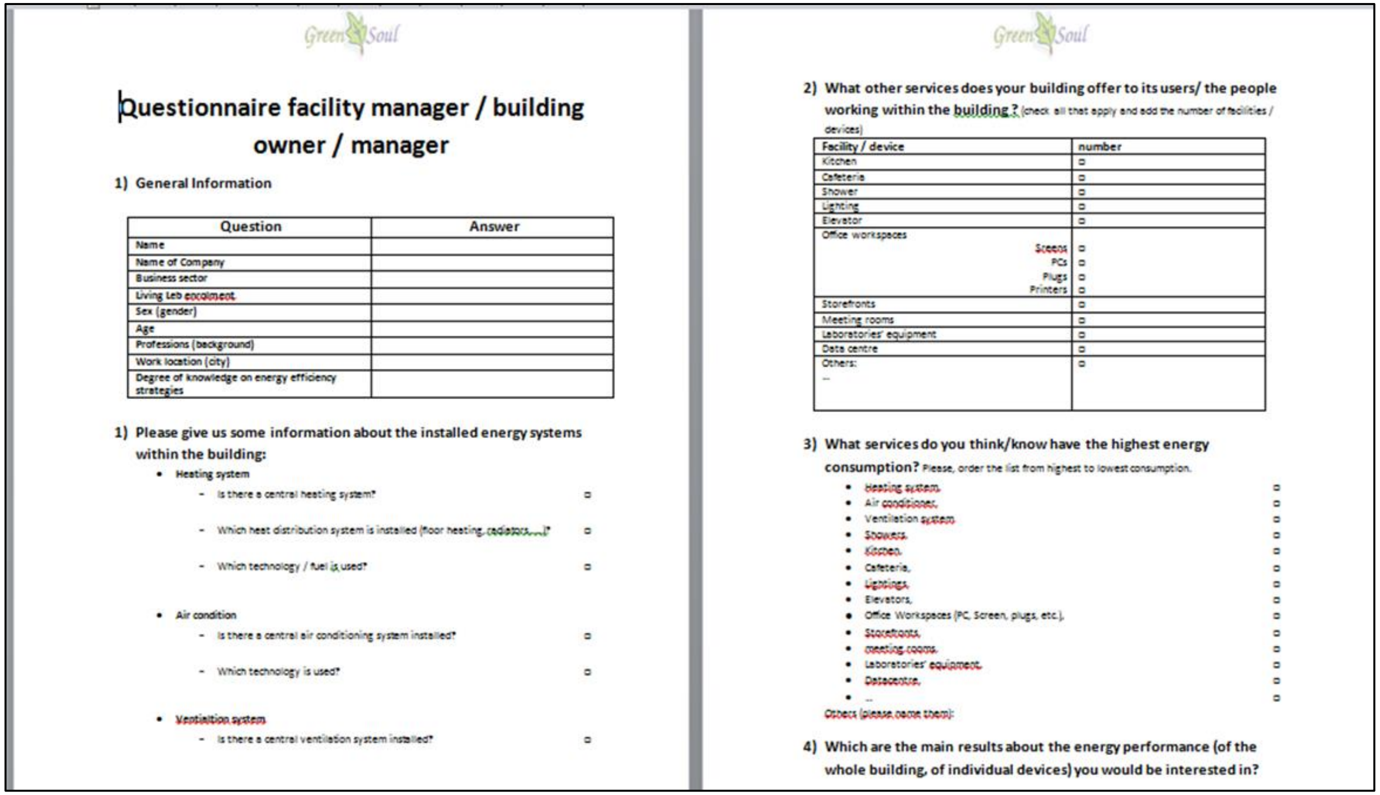
Energy Saving	**24,6%**
Key Figures	
Potential energy saving actions	Employee's information about the energy consumption. Trainings for their energy saving behaviour.
Annual Energy Saving (kWh/yr):	78.620
Annual Carbon Dioxide Reduction (kg CO2/yr):	17
Annual Financial Saving (EUR/yr):	7.862
Average Annual Energy Consumption Before Intervention (kWh/yr):	267.620
Average Annual Energy Consumption After Intervention (kWh/yr):	189.000

Average Annual Energy Consumption per Demand Unit for the project before intervention (kWh/yr):	35,6
Average Annual Energy Consumption per Demand Unit of a dwelling in the same country (kWh/yr):	95

Appendix 2. Scanned Questionnaires

Two types of questionnaires were created and distributed to the different GreenSoul stakeholders.

Building managers/ Building owners/Facility managers Questionnaire



Questionnaire facility manager / building owner / manager

1) General Information

Question	Answer
Name	
Name of Company	
Business sector	
Living Lab enrolment	
Sex (gender)	
Age	
Professions (background)	
Work location (city)	
Degree of knowledge on energy efficiency strategies	

1) Please give us some information about the installed energy systems within the building:

- Heating system
  - Is there a central heating system? ☐
  - Which heat distribution system is installed (floor heating, radiators,…)? ☐
  - Which technology / fuel is used? ☐
- Air condition
  - Is there a central air conditioning system installed? ☐
  - Which technology is used? ☐
- Ventialtion system
  - Is there a central ventilation system installed? ☐

2) What other services does your building offer to its users/ the people working within the building ? (check all that apply and add the number of facilities / devices)

Facility / device	number
Kitchen	☐
Cafeteria	☐
Shower	☐
Lighting	☐
Elevator	☐
Office workspaces	
Sceens	☐
PCs	☐
Plugs	☐
Printers	☐
Storefronts	☐
Meeting rooms	☐
Laboratories' equipment	☐
Data centre	☐
Others: …	☐

3) What services do you think/know have the highest energy consumption? Please, order the list from highest to lowest consumption.

- Heating system, ☐
- Air conditioner, ☐
- Ventilation system ☐
- Showers, ☐
- Kitchen, ☐
- Cafeteria, ☐
- Lightings, ☐
- Elevators, ☐
- Office Workspaces (PC, Screen, plugs, etc.), ☐
- Storefronts, ☐
- meeting rooms, ☐
- Laboratories' equipment, ☐
- Datacentre, ☐
- … ☐

Others (please name them):

4) Which are the main results about the energy performance (of the whole building, of individual devices) you would be interested in?

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5) Do you use Building Management System (BMS) tools? If yes:

□ yes □ no

- What kind of BMS do you use? □
- Do you know the BMS technical specifications? □
- For what reason do you use BMS? □
- Can you tell us the things which are automated or remotely controlled in your building by BMS (e.g. HVAC, illumination, etc.)? □
- Who is responsible for the operation / maintenance of the BMS tool? □

6) What are the limitations of the current tools from (BMS Tools) user perspective?

7) Is your building completely automated?

□ yes □ no

Are the people able to control the energy-consuming devices (e.g. HVAC, illumination, etc.) in the different building spaces?

Spaces	Devices used	Users able to Control?	Managers able to Control?
Offices		□ yes □ no	
Labs		□ yes □ no	
Meeting room		□ yes □ no	
Corridor/rest area		□ yes □ no	
Kitchen		□ yes □ no	
Cafeteria		□ yes □ no	
others		□ yes □ no	

8) Do you know what kind of energy metering system is installed in your building?

□ yes □ no

9) Would you accept to install another smart metering system or a new one in case your building is not provided of that?

□ yes □ no

10) In your opinion, what should a smart metering system be able to do?

- Inform of the aggregate amount of energy consumed. □
- Give information about the aggregated energy consumption per hour. □
- Provide detailed information of the energy consumption per device attached to it. □
- Send feedback to the users of how their are using the devices monitored. □
- Optimize its energy efficiency accordingly to the requirements of the users. □
- Automatically control the devices monitored to increase its energy efficiency despite

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11) How should the information of the smart meter be presented to you?

Through : (check those which are more important for you)

- Ambient displays. □
- Touch screens. □
- Communication system with smartphones (apps). □
- Written reports (by email or in paper). □
- Web-based interactive dashboards. □
- Other visual stimuli (light of different colours, progress bar filled, etc.). □
- Other sound stimuli (adverts, horn sound, ambient sounds, etc.). □
- Other sensory stimuli (e.g. tangible). □
- ... □
- Other. □

12) How should the information of the smart meter be presented to end users? Through a: (check those which are more important for you)

- Ambient displays. □
- Touch screens. □
- Communication system with smartphones (apps). □
- Written reports (by email or in paper). □
- Web-based interactive dashboards. □
- Other visual stimuli (light of different colours, progress bar filled, etc.). □
- Other sound stimuli (adverts, horn sound, ambient sounds, etc.). □
- Other sensory stimuli (e.g. tangible). □
- ... □
- Other. □

13) Are you aware about the benefits of the Demand Side Management and the integration of Renewable Energy Sources into your building?

□ yes □ no

14) What is your knowledge on the occupancy data of the building?

- Can you measure the occupancy in realtime anyhow? □ yes □ no
- In your opinion, what would be the advantages of having occupancy information during real time control of coffee makers, lights, PC, printer, eg.?

15) Specify a rough estimation of time (in hours – minutes) spent by building occupants on each of the below areas/spaces/zones during a typical working day?

Spaces	Time
Offices	
Labs	
Meeting room	
Corridor/rest area	
Kitchen	
Cafeteria	
Other	

16) In your opinion, which are the main devices used during tenant's presence on the building on those spaces?

Place	Devices used	Control?
Offices		□ yes □ no
Labs		□ yes □ no
Meeting room		□ yes □ no
Corridor/rest area		□ yes □ no
Kitchen		□ yes □ no
Cafeteria		□ yes □ no
other		□ yes □ no

17) What are the main aspects on personalized preferences that could potentially affect the optimal control of the infrastructure (e.g. thermal comfort)?

18) What building systems can we apply to test greensoul devices?

Tenants, Occupants, User Questionnaire

Questionnaire occupants/tenants

General Information

Question	Answer
Name	
Name of Company	
Business sector	
Living Lab enrolment	
Sex (gender)	
Age	
Professions (background)	
Work location (city)	
Degree of knowledge on energy efficiency strategies	

1) Do you have common patterns on the usage of devices during your presence on the building infrastructure?

a. □ yes □ no
b. Explain (storyboard) □

2) Specify a rough estimation of time (in hours - minutes) spent on each of the below areas/spaces/zones, during a typical working day?

Place	Time spent
Offices	□
Labs	□
Meeting room	□
Corridor/rest area	□
Kitchen	□
Cafeteria	□
other	□

3) List the devices that you typically use during your presence on the building? Can you control them (e.g. switch them off, leave them on standby, etc.)?

Place	Devices used	Control?
Offices		□ yes □ no
Labs		□ yes □ no
Meeting room		□ yes □ no
Corridor/rest area		□ yes □ no
Kitchen		□ yes □ no
Cafeteria		□ yes □ no
other		□ yes □ no

4) Are you familiar with the function and aim of smart metering systems?
□ yes □ no
Do you know, if there is a smart metering system installed within the building?
□ yes □ no
What should a smart metering system be able to in your opinion?

5) Do you know what a smart plug is?
□ yes □ no
What should a smart metering system be able to do on your behalf?
(check those which are more important for you)

a. Inform of the aggregate amount of energy consumed. □
b. Give information about the aggregated energy consumption per hour. □
c. Provide detailed information of the energy consumption per device attached to it. □
d. Send feedback to the users of how their are using the devices monitored. □
e. Optimize its energy efficiency accordingly to the requirements of the users. □
f. Automatically control the devices monitored to increase its energy efficiency despite of the users. □
g. Other. □

6) How should the information of the smart plug be presented to end users? Through a: (check those which are more important for you)

- a visible display. □
- touch screen. □
- communication system with smartphones (app). □
- written report (by email or in paper). □

- other visual stimuli (light of different colours, progress bar filled, etc.). ☐
- other sound stimuli (adverts, horn sound, ambient sounds, etc.). ☐
- other sensory stimuli (e.g. tangible). ☐
- other. ☐

7) In the building, what energy efficiency actions do you consider as the most important for you? And the most annoying to perform? (Likert scale 1 to 5)

a. Use sunlight as much as possible. ☐
b. Switch off lights when nobody is in the room. ☐
c. Switch off shared devices when nobody use them. ☐
d. Switch off the screen when going to the toilet or having a meeting. ☐
e. Set the thermostat at more than 26 ºC in summer and less than 21 ºC in winter. ☐
f. Do not use the climatization when the windows are open. ☐
g. Set energy efficiency policies in your computer. ☐
h. Use stairs instead of the elevator. ☐
i. Recycle paper, plastic and other packaging. ☐
j. ... ☐
k. Others ☐

8) In your building, do you struggle about energy inefficiency?

☐ yes ☐ no

List the actions that you or your office mates do in relation to energy efficiency.

a. Use sunlight as much as possible. ☐
b. Switch off lights when nobody is in the room. ☐
c. Switch off shared devices when nobody use them. ☐
d. Switch off the screen when going to the toilet or having a meeting. ☐
e. Set the thermostat at more than 26 ºC in summer and less than 21 ºC in winter. ☐
f. Do not use the climatization when the windows are open. ☐
g. Set energy efficiency policies in your computer. ☐
h. Use stairs instead of the elevator. ☐
i. Recycle paper, plastic and other packaging. ☐
j. ... ☐
k. Others ☐

Appendix 3. Scanned informed consents

Before starting the interviews, every participant signed an informed consent which was first created in English and then translated into German, Spanish and Greek. For the sake of saving document space, we only present the English version hereafter[1].

[1] Please note that the LOGO that appears in the attached document is the old version that was later changed by the green tree that can be observed in the deliverable header.

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Title of Study:	Interviews with tenants and building's stakeholders
Principal researcher:	
Co-researcher:	
Contact (phone, mail...):	

We invite you to participate in a research study under the direction and supervision of **XXXX**, and **YYYY** in the context of the EU funded H2020 GreenSoul project. We ask that you read this document and ask any questions you may have before agreeing to be in the study.

Purpose: We are interested in *1)* understand your knowledge about energy resources and the actions to cope with energy inefficiency in the workplace; *2)* to figure out what are the devices and appliances that you use the most or what are those that you think tenants use more frequently in your building; *3)* we are also interested about your knowledge on smart metering systems and eco-feedback technologies (Eco-feedback technology provides feedback on individual or group behaviours with a goal of reducing environmental impact through different channels: mobile phones, social networks or augmented everyday objects); *4)* (only for stakeholders) to know if there are monitoring and management systems installed in your building.

Duration: Your participation will take about 30 minutes.

Procedures: The entire interview will be conducted in the place where you work everyday. If you agree, you can go across the building facility with the interviewer in order to identify together potential places where you stay and devices you use in your daily routine at the pilot building.

Risk and Benefits: We do not anticipate any major risks and/or discomforts for you; however, some risks may be unforeseeable. All participants will receive a debriefing form at the end of the study explaining our specific research questions. In addition, you may choose to sign up to receive a report of our findings at the conclusion of our study.

Confidentiality: We will take several steps to protect your confidentiality. First, you will be alone with the interviewer. Second,we will not be keeping a master list connecting participant names and answers for this interview. Although we plan to publicly describe the research for research purposes, it will be impossible to identify you or any other respondent in those presentations.

GreenSoul: Eco-aware Persuasive Networked Data Devices for User Engagement in Energy Efficiency

http://www.greensoul-h2020.eu/

Voluntary participation: Participation in this study is completely voluntary. Your decision whether or not to participate will not affect your current or future relations with this **XXXX (institution, university, enterprise...)** or any of its representatives. If you decide to participate in this study, you are free to withdraw from the study at any time without affecting those relationships.

Questions & Contacts: The researchers conducting this study are **XXXX**, **YYYY**, and **ZZZZ**. You may ask any questions you have right now. If you have questions later, you may contact the researchers at XXXXX. If you have questions or concerns regarding this study and would like to speak with someone other than the researchers, you may contact the Chair of **XXXXXXX**.

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Appendix 4. Questionnaire Answers Coding

In order to analyse the data statistically, it was firstly mandatory to curate the raw data and to establish some codes for the answers retrieved[2]. The questionnaire handed out to pilot's tenants contained four questions that need some standardisation:

1) *Do you have common patterns on the usage of devices during your presence on the building infrastructure?*

In this initial question, the objective was to know if the users of the buildings have a common pattern of actions in order to select the best place to make interventions. Two issues arose with this question: *1)* many people answered what actions related to energy efficiency they made; and *2)* those that answered correctly, only stated that they had a common pattern but they did not explain them thoroughly. In the former case, we have coded the different actions following the code:

- **Switch off:** patterns related to switch off devices when not in use or (mostly) when living a room.
- **Use of HVAC:** patterns related with the control (mostly when it is turned on) of the HVAC system.
- **Use of lighting:** patterns related with the control (mostly when it is turned off) of lights.
- **Use of computers:** patterns related to the use of computers, laptops, mobile phones, printers and the rest of ICT related devices that are in an office.
- **Use of small appliances:** patterns related to the use of kettle, coffee machine, microwaves and other small appliances mostly used to prepare food.
- **Use of major appliances:** patterns related to the use of big appliances like fridges or lab equipment.

2) *List the devices that you typically use during your presence on the building?*

In this question the objective was to know what devices are been used in every space of a building to know what are the most attractive device/spaces combination to instrument. As the amount of devices is huge and very diverse, the following code has been fixed:

- **Computer:** comprises all devices that have a relation with ICT except printers. A non-exhaustive list is: laptops, screens, servers and desktop PC.
- **Printers:** comprises all devices that are print or copy document in paper. A non-exhaustive list is: printers, copiers, multi devices, faxes, and projectors.
- **Small:** comprises the small appliances that are used to make food and the rest of devices that are typically plug in an office desk. A non-exhaustive list is: kettles,

[2] Please note that this information is also written in the deliverable D7.2 for the Data Management Plan.

coffee-maker, smartphones, desk phones, tablet, network devices (only when considered in the office), radios, and microwaves.
- **Major:** comprises big appliances mostly used to keep food. A non-exhaustive list that includes fridges, elevators, dishwashers and vending machines.
- **Instrumentation:** comprises small devices used in a lab environment. Examples are: network devices, power supplies, welding machines, analysers, etc.
- **Lights:** comprises all devices that produce light.
- **HVAC:** comprises all the machines that produce heat, cool or ventilation.

3) *What should a smart metering system be able to in your opinion?*

The objective of this question is to explore the expectation of the users over a smart meter. To such end, the answers were diverse but could be arranged following the next code:

- **Telemetry:** In this category all answers that mention the possibility of obtaining the measurements remotely by the user (or the DSO) are grouped.
- **Submetering:** In this category differs with the previous one in this case the smart meter will also provide the consumption of every device attached to it individually.
- **Information:** This category group the answers related to feedback loops given by the smart meter.
- **Historical data:** This category differs over telemetry as in this case the smart meter give information about the past consumption in order to be analysed by a human.
- **Educational tips:** This category groups all the answers that ask for tips to reduce the energy waste or increase the energy efficiency.
- **Automation:** This category groups all the answers that ask for a smart meter that can control the devices attached to it in order to optimise the consumption.

4) *What should a smart plug be able to do on your behalf?*

As in the previous one, in this question we wanted to know the expectation of the users but in this case over a smart plug instead of a smart meter. In this case, the code has been:

- **UPS:** this category group all answers relate to provided battery backup power to the devices attached to the plug.
- **Telemetry:** In this category all answers that mention the possibility of obtain the measurements remotely by the user are grouped.
- **Historical data:** This category differs over telemetry as in this case the smart plug give information about the past consumption in order to be analysed by a human.
- **Information:** This category group the answers related to feedback loops given by the smart meter.
- **ON-OFF:** This category groups all the answers that mention the capability of switch on (or off) the device attached remotely.

- **Automation:** This category differs from the previous one as in this case groups the answers that mention the self-capability to be autonomously switched on (or off) the devices attached trying to optimizing their energy consumption.

Comments from External Reviewers

External Reviewer #1

July 29th, 2016

Issue	Yes	No	Score (1=low to 5=high)	Comments
Is the architecture of the document correct?	x		4	
Does the architecture of the document meet the objectives of the work done?	x		4	
Does the index of the document collect precisely the tasks and issues that need to be reported?	x		5	
Is the content of the document clear and well described?	x		4	Yes, but more cross-references and contextualization with appendixes included could have been added
Does the content of each section describe the advance done during the task development?	x		3	
Does the content have sufficient technical description to make clear the research and development performed?	x		4	Sufficient, some further references could have been added to the document
Are all the figures and tables numerated and described?	x		5	
Are the indexes correct?	x		4	
Is the written English correct?	x		4	
Main technical terms are correctly referenced?	x		5	
Glossary present in the document?	x		4	More terms could be added

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External Reviewer #2

August 1st , 2016

Issue	Yes	No	Score (1=low to 5=high)	Comments
Is the architecture of the document correct?	x		4	
Does the architecture of the document meet the objectives of the work done?	x		5	
Does the index of the document collect precisely the tasks and issues that need to be reported?	x		4	
Is the content of the document clear and well described?	x		4	
Does the content of each section describe the advance done during the task development?	x		4	
Does the content have sufficient technical description to make clear the research and development performed?	x		4	
Are all the figures and tables numerated and described?	x		5	
Are the indexes correct?	x		5	
Is the written English correct?	x		4	
Main technical terms are correctly referenced?	x		4	
Glossary present in the document?	x		4	

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[1] Dijkstra, Lewis and Poelman, Hugo (2012) Cities in Europe, the new OECD-EC Definition, http://ec.europa.eu/regional_policy/sources/docgener/focus/2012_01_city.pdf

[2] Darley, J. M., & Latane, B. (1968). Bystander intervention in emergencies: diffusion of responsibility. Journal of personality and social psychology, 8(4p1), 377.

[3] Nielsen, Jakob (May 1995). "Card Sorting to Discover the Users' Model of the Information Space".

[4] http://www.wtelecom.es/productos-y-servicios/smart-cities-solutions/wesave/?lang=en

List of Acronyms

Acronyms	
HVAC	Heating, Ventilation, Air Conditioning
WSC	Wellness Smart Cities
UDEUSTO	University of Deusto
MPH	Municipality of Pilea-Hortiatis
WEIZ	WEIZER ENERGIE-INNOVATIONS-ZENTRUM GMBH
ECOL	Ecolution
BMS	Building Management System
PIR	Passive Infrared sensoR
OECD	Organisation_for_Economic_Co-operation_and_Development

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