D.4.5

Requirements of the building owners and recommendations on the dashboard

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1	October 2016	First analysis of User Tests results	Savills
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3, 4, 5	31 March 2017	Quality review by Savills, Open Domo, SinCeo2 (V3 & V4) & review by PFP (V5)	Savills
6	2nd May 2017	Final version with the added reviews of ATER and Lands	Savills

Executive summary

For building owners, data and information about buildings is key for taking an appropriate investment decision regarding the energy renovation programmes at the scale of multiple buildings. However, nowadays institutional building owners of social, affordable and public housing have limited possibilities to access information about the energy performance of the building stock, its financial evaluation as well as its future energy needs. Consequently, building owners lose opportunities to take informed decisions about the energy optimization strategies that could approach Near Zero standards and they do not achieve maximum benefits from the renovation programmes performed. In Sweden specifically, the problem is also that building owners need to adopt a more holistic approach, thus energy renovation is only one parameter and taking the "right" or more sustainable decision is complex.

In this context, a group of partners in the DREEAM project lead by Open Domo, Savills & SinCeo2 will develop a specific digital platform dedicated to building owners and potentially also to the tenants involved in the renovations. The key added value of this platform should be the possibility to finely visualize the impact of the DREEAM renovations on the energy efficiency performance of the buildings, and to propose optimal solutions to building owners in the context of the DREEAM renovation scenarios;

Shortly, the DREEAM platform should ideally be able to:

- Inform the building owners about the energy usage in the common areas and on the building level to evaluate a potential for different scenarios of energy reduction strategies;
- Recommend very specific actions for energy optimisation, which will range from identifying the quick wins (low hanging fruit) in the demand shifting to comprehensive renovation strategies;
- Incorporate the renewable energy monitoring and the overall energy supply management.

The task related to the deliverable 4.5 (WP4) is precisely to prepare the development of the DREEAM platform in 2016 and 2017, and to determine which options and services are relevant to develop in the context of the multi-building approach of the DREEAM project, and the needs of building owners. In 2017, the final options will be determined with the DREEAM partners and the building owners before starting the implementation of these options in the DREEAM platform (end 2017). The current deliverable 4.5 describes the work performed from 01.10.2015 to 31.03.2017 for the development of the DREEAM Platform by the group of DREEAM partners involved at this stage of the development (Open Domo, Savills, SinCeO2, PFP, ATER, Lands, Chalmers).

This deliverable is divided in 2 parts:

1. **Open Domo platform (basis):** a description of the existing Open Domo platform that will serve as the basis to develop the particular DREEAM platform;
2. **User Tests and methodology:** a description of the User Tests performed in 2016 with the 3 building owners of the Open Domo platform in order to gather the specific required information to develop the DREEAM platform.

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1 Deliverable structure

In the first part of the deliverable 4.5 we present in detail the existing Open Domo platform that will be used as a basis to develop the future DREEAM platform. We indeed believe that it is important to have a detailed vision of the existing options offered by the Open Domo platform (Part 1) before describing the users test that we performed in 2016 on this platform with staff of the building owners – who are the future users of the DREEAM platform (Part 2).

Part 1 of the deliverable: Description of the existing Open Domo Platform (basis of the future DREEAM platform)

The Open Domo company, that is a partner of the consortium in the DREEAM project has developed prior to the DREEAM project, a platform of visualization and management of energy consumption in buildings (commercial and industrial buildings but never residential buildings), that many professional customers are already using. In the context of the DREEAM project, this pre-existing Open Domo platform will be improved based on the requirements expressed by the 3 residential building owners involved in the DREEAM project: ATER, Landskronahem and PFP. The platform developed out of the basis of the Open Domo platform by integrating the residential building owners' needs will be called: the DREEAM platform. Shortly, the objective of the future DREEAM platform is to support the visualization of the impact of the DREEAM approach on the pilot buildings' energy efficiency.

Part 2 of the deliverable: evaluation by residential building owners of the existing Open Domo platform and the synthesis to their requirements to develop the future DREEAM platform

We have carried out in 2016, 3 tests with the 3 building owners of the existing Open Domo platform. We have then synthetized the evaluations and requirements expressed by residential building owners' employees during these 3 user tests in part 2 of this deliverable.

Shortly Part 2 presents chronologically the steps of our user tests performed in 2016:
⇒ From the (original) Open Domo platform presentation to building owners' employees ⇒ to the detailed evaluations executed with testers ⇒ to the answers/requirements expressed by testers ⇒ to the options and questions remaining for the 2nd User Tests in 2017.

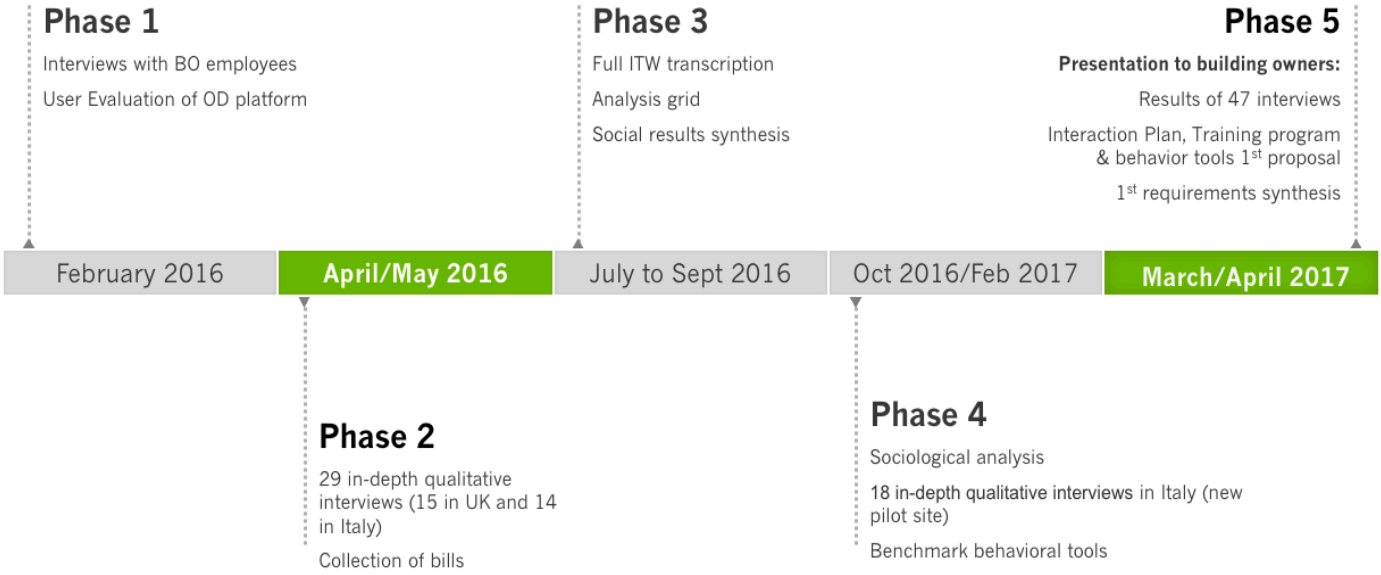
Part 2 describes by key theme the process of evaluation that we have followed and the key results obtained during the tests.
In each theme, we follow a similar presentation of the results:

- ⇒ **Title 1:** description of the presentation made by Elisabet Cuenca (CEO of Open Domo) of the platform to the building owners' employees and presentation of the screens/pages displayed live to the testers during this presentation;
- ⇒ **Title 2**: we list the questions that we have prepared before the user tests and that we have asked directly to building owner's employees. This list allows us later to check if all questions have been addressed or to identify for each cycle of test what questions remain;

⇒ **Title 3:** we present a table synthesis of the answers obtained with each group of building owners' employees. We present the result per building owner in the same order for each theme (PFP, Landskronahem, ATER)

The presentation of the entire process of the 1st. evaluation and its results is the simplest way to describe our work to an external reviewer, and to illustrate both our strong involvement to understand the needs of the future users of the platform and the relevance of our methodology based on a "User Centered" approach and UX design principles (User Experience).

Reminder: the timeline of sociological & User Experience evaluation during the Period 1



2 Context of deliverable 4.5 in the Work Package 4

Deliverable 4.5 is part of task 4.4 in the work package 4 related to the development of the DREEAM platform. This platform will be dedicated to display the energy consumption of buildings post-renovation and to help building owners to visualize the impact of the DREEAM approach on the energy efficiency of the pilot buildings.

You will find below the synthesis of the reports delivered within period 1 in each task of the WP4:

TASK 4.1: ENERGY PERFORMANCE MONITORING **Objective of the task:** evaluating the energy performance of the buildings before and after the DREEAM approach.
 Deliverable 4.1 (31.03.2017)
Task 4.2: Strategy and planning for the social and behavioral evaluation **Objective of the task:** monitoring the social acceptance of the DREEAM approach by tenants through behavioral and sociological evaluations.
 Deliverable 4.2: Strategy and planning for the social and behavioral evaluation (2nd May 2017) Deliverable 4.4: Preliminary analysis of the qualitative interviews with housing companies and tenants (2nd May 2017)
Task 4.3: Benchmarking and financial analysis **Objective of the task:** monitoring and assessing the renovation process developed in the DREEAM approach in the 3 pilot sites and from the building owners point of view (socioeconomic and financial factors).
 Deliverable 4.3: Benchmarking and financial analysis of the DREEAM pilot sites to be delivered in 2019 (M43)
Task 4.5: DREEAM monitoring platform **Objective of the task:** developing the DREEAM digital platform.
 Deliverable 4.5: Requirements of the building owners and recommendations on the dashboard (2nd May 2017)

3 How do we work with building owners to identify their requirements?

In WP4, the energy management platform developed from the Open Domo platform will have a crucial role to play in:

- **The understanding (by building owners) of the impact of renovations on buildings efficiency;**
- **The satisfaction evaluation of the DREEAM approach by building owners.**

The interviews with building owners showed us that 2 key objectives of the DREEAM platform development are crucial:

1. **This platform should be a comprehensive monitoring platform** for building owners to monitor the energy performance of their buildings after the renovations and ideally before/after renovations. By comprehensive, we mean a platform that is adapted to the work process of building owners and their existing habits to assess regularly their building stocks´ efficiency. An important aspect of the innovation of this platform is to understand their future users, to question them on their real-life use of such a tool and to adapt the DREEAM platform accordingly (User Centered approach). Our goal is not to develop a tool that will be used rarely and only by very specialized experts or employees, but to deliver a tool that serves the assessment & the visualization of the DREEAM approach' impact, and that supports the capacity of building owners to trust our assessment protocol and to use easily our different tools with a "User Friendly" navigation and adequate displays, and modules.

2. **This platform should also help to understand the overall effects of energy efficiency renovations in respect of portfolios of buildings based on the final DREEAM approach adopted in each pilot site.** For this specific objective, we need to question building owners on their business strategy, the national context of energy efficiency and their particular investment perspectives that could be impacted positively by multi-building approaches like in the DREEAM project. The employment of qualitative interviews with building owners (Deliverable 4.4) is crucial in this respect and will help to set the definition of the DREEAM platform and its options, based on the understanding of the global strategy of building owners and the "know-how" of the existing practices to calculate Return On Investment (ROI), and the numerous other factors that are part of the decision making process in regard to renovations and its funding.

This is why our strategy has been focused on a deep understanding of the building owners´ objectives in regard of:

- Qualitative interviews with Building Owners staff (4.2)
- The first tests of the Open Domo platform with Building Owners (4.5) in order to understand what options can better fit their existing work process.

The phases of qualitative interviews and User Experience evaluations with building owners are linked, and the results obtained in the tasks 4.2 and 4.4 must be considered as complementary as well as the results of deliverables that will be presented. These 2 tasks have in this context followed a similar timeline as we wanted to present all the results of tenants and building owners interviews, and the platform evaluations at the same time (originally forecasted for January 2017, the results will finally be presented in March/April 2017).

In this context, the present deliverable 4.5 must be read ideally after or directly together with deliverable 4.4 "Preliminary analysis of the qualitative interviews with housing companies and tenants".

In deliverable 4.4 we present synthetically the results of the qualitative interviews performed with several employees of each of the 3 building owners on general matters related to the DREEAM project, the social context of their pilot sites and their ambitions related to energy reduction. In deliverable 4.4, we also present the results of the interviews with a corpus of selected tenants in UK and Italian pilot sites. The results of the interviews with building owners' staff should be in this context directly integrated to the exchanges between the DREEAM partners during the development phase of the DREEAM monitoring platform in the next months, as they offer an additional understanding on the objectives, strategies and work organization of each building owner that might affect their potential interest for the platform.

In the DREEAM Project, the tasks 4.2 and 4.4 are additional/linked:

Task 4.2 Social and behavioral evaluation of tenants and BOs

(M1 – M40)
Task leader: Savills.
Partners involved: PFP, ATER, Landskronahem, SP, SinCeo2

Deliverables

4.2 Strategy and planning for the social and behavioral evaluation

4.4 Preliminary analysis of the qualitative interviews with BOs and tenants (March 2017)

4.7 Final analysis on housing companies´ attitude towards the energy efficiency renovations (M40)

4.8 Final analysis on the tenants´ engagement and communication strategies (M40)

Task 4.4 DREEAM monitoring platform

(M10 – M46)

Task leader: SinCeo2.

Partners involved: Open Domo, B&W, PFP, ATER, Landskronahem, Savills

Deliverables

4.5 Requirements of the building owners and recommendations on the dashboard (March 2017)

4.6 Integration of the requirements; first version of the platform developed (M20)

4.10 Validation of the platform with the building owners (M46)

4 Who is involved in developing the DREEAM platform?

The design development in the WP4 is a complex task that requires to mix the expertise of various specialists: statisticians, engineers, developers, designers, sociologists and UX experts to test the platform.

The various DREEAM experts will be led by Savills and the energy consultancy SinCeO2 to adapt the current available technology of Open Domo and to create the DREEAM monitoring tool.

- The technical adaptation of the platform will be performed by Open Domo and its internal team of experts. SinCeO2 supports Open Domo in the collection of data needed for the platform from the building owners and to coordinate task 4.4 with Savills.
- Savills will in particular contribute to the definition of design requirements. Qualitative interviews and collaborative design meetings will be organized by Savills between building owners, sociologists and the developers of the dashboard to establish the best options for the dashboard structure, the data content and ergonomic aspects.
- The expertise of business strategists and building managers of building owners is also required to establish the best services and options aligned to the building owners' expectations and to the specific topic of the « multi-building » approach in the project. In this context, B&W will work alongside with the building owners to identify specific platform requirements and associated indicators (energetic, social and financial).

5 The partners involved in the production of deliverable 4.5

Period: 01.10.2015 to 30.03.2017

Key contributors:

- Open Domo and Savills (authors and coordinators of the development methodology, preparation of User Tests, heuristic evaluation and redaction of deliverable 4.5)
- SinCeO2 (task leader and data collection coordinator)

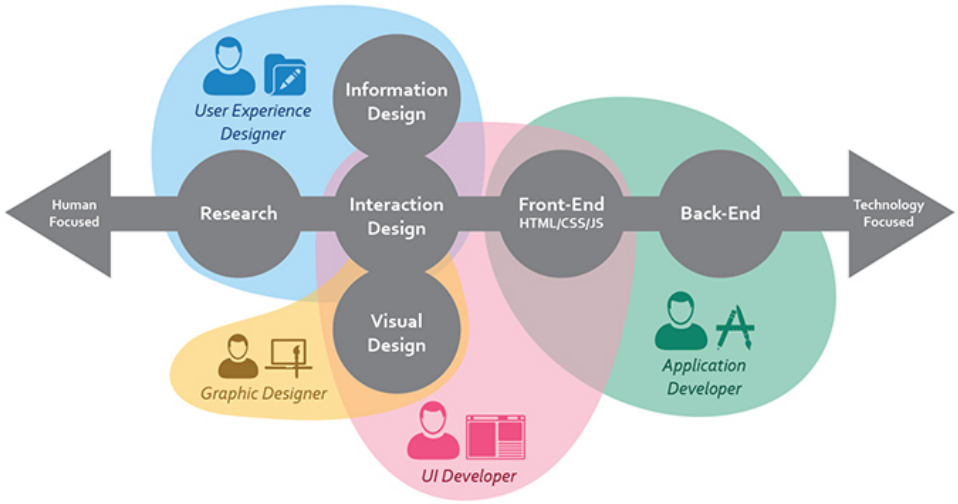
Other contributors:

- PFP, Treviso, Landskronahem (participation of each building owners´ team to User Tests at their office, collaboration to the data collection, quality review of the deliverable)
- Chalmers (participation to each User Test, checking of work delivery within task 4.4 and the final quality review of the deliverable)

6 Methodology

6.1 A coordinated team with User Interface developers and User experience specialists

In the WP4, the work for the development of the DREEAM platform is divided between 2 key missions related to the development of the UI (User Interface) and the development of the UX (User Experience of users/ user experience of building owners). The 2 tasks, UI and UX, are linked as illustrated below with coordination between the Open Domo team (User Interface mission with UI developer + Graphic Designer + Application Developer) and Savills team (Sociological + User Experience mission).



The difference & links between UX and UI[1]

Indeed, for the development of the User Interface (UI):
Open Domo oversees the development of the DREEAM platform interface. They are managing the tasks related to the graphic design & the interface development of the DREEAM platform.

And for the development of the User Experience (UX):
Savills oversees the development of the User Experience of the DREEAM platform from the beginning to the end of the project.
The Savills team works on:

- establishing the global concept of the DREEAM platform based on the requirements of their future users (Building owners);
- establishing the key services and options needed;
- testing the user satisfaction of the different platform prototypes until the final version of the platform.

The role of the 3 building owners is particularly important in the phase of testing and determining the key elements of the User Experience. Indeed, regular test meetings and feedbacks on the experiment from building owners on the development of the DREEAM platform will be organized until the last year of the project, when the final prototype of the DREEAM platform will be presented and validated by the consortium.

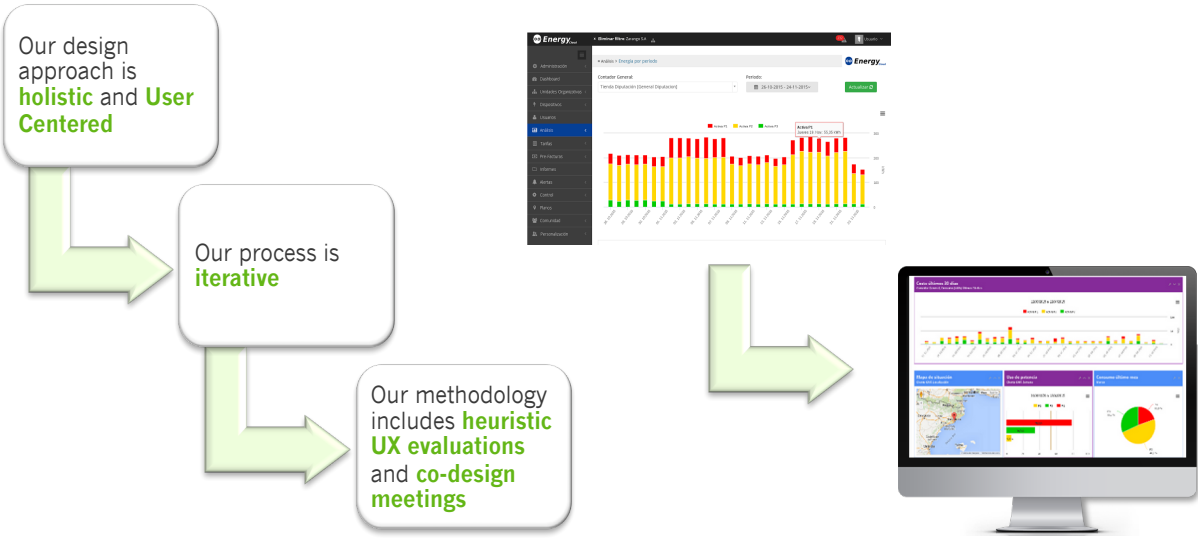
[1] (Copyright graphic design Ahamed Meeran)

The expertise of Bax & Company will be valuable during the 2nd phase of development of the platform in 2017, with in-depth discussions related to the potential business application of the DREEAM platform for building owners and the use of the platform to simulate replication of DREEAM renovation scenarios at a bigger scale and in other pilots (such as municipalities already involved in the replication strategy).

6.2 The User Interface development (UI) and the User Experience (UX) have a common User Centered development approach (UCD)

In the development process of the DREEAM platform, the work methodology of both Open Domo and Savills mixes 3 successful paradigms from sociology and design theories proposed by Savills' sociologist:

1. A holistic approach of the users' needs not only limited to the User Test context;
2. An iterative process of development: several tests and platform versions until satisfaction;
3. A focus on the future users involved as co-designers during the development phase and hence not only at the end of the platform development for final testing.



6.2.1 Paradigm n.1: Thinking about the experience of future users in a socio-technical & holistic approach.

We try to understand the existing users' environment of work and the future context of interactions with the DREEAM platform from the point of view of its future users (in our case the building owners' staff). Our first effort in 2016 was to determine during the 1st. User Test meeting in what context the energy platform would be used after renovations, and also to understand who would be the future users of the platform and their specific needs.

Method n.1 from the field of sociology of consumption and habits: qualitative semi-directive face to face interviews with several building owners' staff members involved at different levels of the decision making process in the DREEAM project, and with mixed experience on energy efficiency renovations. The interviews carried out with building owners are mostly audio recorded following agreement of the different persons

interviewed. Then interviews are rigorously transcribed either entirely or synthetically per theme. Finally, the interviews verbatim (quotations) and synthetic results are submitted to a review/validation by the building owner's manager and the employees interviewed for validation or justified amendment before the release of any reports /deliverables.

Method n.2 from the sociology of organization: the **observation of participants,** meaning **observing and questioning** the work process of BO staff on the long term during the duration of the project and analysing their **real-life experience** with the different steps and tools developed in the project. The feedback from these **transparent observations/interactions/questions** will give significant insights to develop the training program for other building owners and SME´s in the context of the replication plan (for example for the development of efficient communication tools based on real experiments of DREEAM renovations such as a User guide of the platform, best practice guidelines during renovation both for technological work and for interaction with tenants).

6.2.2 Paradigm n.2: Iterative process and agile approach

The methodology proposed will be an iterative process involving a User Centered approach (UCD) and the tools from the User Experience evaluation approach.

The iterative process means that the development of the DREEAM final platform will follow 2 to 3 complete cycles of **"conception-testing by users ⇒ users' experience evaluation ⇒ and improvement of the prototype"**.

This iterative approach is based on the evaluation of users' experience and is according to us the more prone to support the development of an efficient tool that meets the professional needs of building owners. The User Experience approach requires a development process that offers a margin of flexibility from developers to integrate the future User expectations expressed during interviews and tests of the solutions. We will develop the final prototype of the DREEAM platform only after 2 or 3 cycles of **"development/ testing by users and improvement, re-evaluation of users experience and re-improvement of the prototype"**.

The goal of this so called « agile and iterative approach » is to test the improvements done in the platform by the developers from the point of view of their future users (several times if needed) to reach a high level of adequacy in the final prototype between the BOs' requirements and the final services and design developed in the DREEAM platform.

6.2.3 Paradigm n.3: 2 methods from the User Experience Evaluation (UX) with co-design & heuristic evaluation

A various number of methods exists in the User Experience (UX) approach and in design theories. We have selected 2 methods that have proven their success: **the co-design method and the heuristic evaluation**. These 2 methods focus on studying the various ranges of factors that influence the positive or negative interactions between a user and a tool (in our case between the building owners' staff and the Open Domo Platform).

Method n.3: Co-design with future users

During the 1st. development meeting with building owners (future users), we evaluated the interaction between them and the platform by following a rigorous heuristic evaluation that is one of the tools proposed in the UX approach. The building owners are directly integrated in the development team of the DREEAM platform thanks to the iterative co-designing process: building owners, developers and sociologists will work all along together with the WP1 and WP2 partners to adapt the existing Open Domo solution into a relevant software solution that can really support the monitoring of the DREEAM approach impact.

During the several User tests meetings, building owners can directly express their expectations of improvements and development, with the partners in charge of the design integration of these requirements, and not only at the end of the development phase. Building owners are involved at all steps of the DREEAM platform development. The 1st. User Tests were organized in 2016 with a live presentation of the platform to the 3 building owners by Open Domo's CEO. During the meeting the possibility has been given to building owners' staff to request navigation between the different options and pages and to directly ask questions to Open Domo. Open Domo and Savills then directly asked for their feedback and the positive/negative perception of the elements of the Open Domo platform following a rigorous heuristic evaluation guideline that will be presented in detail in the following paragraph.

6.2.4 Heuristic evaluation

This method is particularly efficient when the target users are professionals, as these users often have very precise expectations about the type of functionalities and commands they expect from a digital solution. In this context, using a rigorous and very detailed test guideline is relevant and particularly efficient to improve micro-elements both linked to the content and the design of the platform.

The heuristic evaluation is a very detailed and rigorous list of actions/interactions that are tested with the users. This list is prepared in advance of the User Tests and allows then to list very precisely the different improvements or additional services requested by the users before/after the different testing phases. The heuristic evaluation method has been proven to be one of the more efficient methodologies to improve the usability of an interface (Nielsen and Molich,1990; Nielsen, 1994b)[2].

We have integrated in our heuristic evaluation one of the key references in Design development (Nielsen and Molich,1990): the list of 10 usability heuristics developed by the 2 authors to guarantee efficient User Interface Design.

[2] Nielsen, J, and Molich, R. (1990). Heuristic evaluation of user interfaces, *Proc. ACM CHI'90 Conf.* (Seattle, WA, 1-5 April).
Nielsen, J. (1994b). Heuristic evaluation. In Nielsen, J., and Mack, R.L. (Eds.), *Usability Inspection Methods*, John Wiley & Sons, New York, NY.

10 Usability Heuristics (Nielsen and Molich, 1990)

- ***"Visibility of system status***

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

- ***Match between system and the real world***

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

- ***User control and freedom***

Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

- ***Consistency and standards***

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

- ***Error prevention***

Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

- ***Recognition rather than recall***

Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

- ***Flexibility and efficiency of use***

Accelerators - unseen by the novice user - may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

- ***Aesthetic and minimalist design***

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

- ***Help users recognize, diagnose, and recover from errors***

Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

- ***Help and documentation***

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large".

Based on these 10 best practices in design development: we have prepared a detailed list of questions for each of the services and tools proposed today in the platform, and we question in live the building owners' staff about the relevance of each service/option, and then if the design option to display and have access to these options is easy to use/understand or should be improved.

The illustration below shows an extract of the heuristic evaluation prepared for the test of the platform with the building owners.

In the illustration, the green arrows point at examples used during the tests on specific options that are displayed in live to the building owners and to which they react. During the tests, indeed, the CEO of Open Domo navigates inside the different modules of the platform either actively, either on demand of the BO employees and describes in live how to use the services, the different commands and some examples of improvements that Open Domo could propose in the future DREEAM Platform.

Example of our heuristic evaluation process used during the co-design meetings:

Identify the mandatory /Important/ Optional options for each item:

- Energy types per scale of data collection
- Organisational Units (data groups)
- Time patterns used for reporting and checkings
- What are the options particularly relevant to assess the impact of a multi-building approach ?
- What additional comparison could we try to develop ?
  - Comparisons between similar buildings in the region ?
  - Comparison before/after visually
  - Estimation of consumption if solution replicated in a selected stock ?

Design:

- Is the type of display understandable ? Intuitive ?
- Does the navigation / access path intuitive ?
- The name of the commands and titles relevant ?

From the evaluation to the final prototype:

- During the development stage, the synthesis of heuristic evaluation results is used at the beginning of each design integration phase;
- The changes/improvements between the heuristic evaluation results, the improvements requested by building owners and the final design of the DREEAM platform will be tracked in a document and reported in the deliverables due for the task 4.4 until 2019;
- This document will allow to follow and test the perceptions of the users on the evolution/improvement of each item/function during the different iterative cycles until the final prototype version.

Our methodology to develop the DREEAM platform follows the ISO guideline related to the Ergonomic requirements for office work with visual display terminals (VDTs)

ISO 9241-11:1998

Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability'

"Introduction

The objective of designing and evaluating visual display terminals for usability is to enable users to achieve goals and meet needs in a particular context of use.

ISO 9241-11 explains the benefits of measuring usability in terms of user performance and satisfaction. These are measured by the extent to which the intended goals of use are achieved, the resources that have to be expended to achieve the intended goals, and the extent to which the user finds the use of the product acceptable.

ISO 9241-11 emphasizes that visual display terminal usability is dependent on the context of use and that the level of usability achieved will depend on the specific circumstances in which a product is used. The context of use consists of the users, tasks, equipment (hardware, software and materials), and the physical and social environments which may all influence the usability of a product in a work system. Measures of user performance and satisfaction assess the overall work system, and, when a product is the focus of concern, these measures provide information about the usability of that product in the particular context of use provided by the rest of the work system.

The effects of changes in other components of the work system, such as the amount of user training, or the improvement of the lighting, can also be measured by user performance and satisfaction.

The term usability is sometimes used to refer more narrowly to the attributes of a product which make it easier to use (see Annex D). Requirements and recommendations relating to the attributes of the hardware, software and environment which contribute to visual display terminal usability, and the ergonomic principles underlying them, are provided in other parts of ISO 9241".

Ref: Official ISO website (https://www.iso.org/obp/ui/#iso:std:iso:9241:-11:ed-1:v1:en)

7 The translation of our design approach into 11 stages of development

7.1 STEP1: our work started with listing all the services of the existing OPENDOMO platform

Open Domo has developed an energy monitoring platform that is already used by many clients. We will adapt this platform to the very specific objectives of the DREEAM approach that is to support a residential multi-building approach/synergy and not only a single building approach for which many existing platforms already exist in the market.

- To clearly understand the services and options already available in the Open Domo platform. We have prepared a detailed description in the 1st. part of this deliverable;
- During the meeting with building owners, the key elements of this description have been presented;
- Building owners also have received a personal access code to test the platform since February 2016 and after the final validation of deliverable 4.4 in March 2017, the detailed description of the Open Domo platform will be transmitted to building owners to prepare the 2nd User Evaluation meetings in the middle of 2017.

7.2 STEP 2: The 1st. interview and co-design meeting with the evaluation by BO

7.2.1 Complete interview guideline with building owners´ staff (Part 1)

The 5 themes addressed:

We have first prepared a detailed heuristic evaluation guideline of the Open Domo platform in order to gather information needed on 5 themes during the User Tests:

1. **Understanding the previous experiences of BO´s with similar platforms like BMS (Building Management System) and EMS (Energy Management System).**

   Their existing experience as users is important to understand in order to target the positive and negative options and feedback they already had, and to integrate these experiences in the improvement of the platform.

2. **Establish the context of use of the future platform and their future users in the organizations**

   We have to understand the environment in which the platform will be used by BO´s in order to propose a relevant service, and to target which department/employees are really expected to use such a platform (technical operation managers, management of the company, communication service) and for what purposes exactly (reporting, optimization, etc.) Finally, this information is useful in case that there is a need for training building owners' staff when the skills to use such a platform is low. This aspect is important to integrate later on in the training program (WP6).

3. **Clarifying the objectives of the stakeholders in their use of the DREEAM platform:**

   We have addressed the following key questions to building owners:

- What is the building owners´ priority? Monitoring data consumption, evaluating the efficiency of the DREEAM approach or to be able to visualize things with the platform? Or maybe to control equipment from a distance in a multi-building strategy?
- Is the objective to control the energy consumption, to display the energy efficiency results internally/externally?
- The platform should help BO´s to anticipate the potential impact of the DREEAM approach on other buildings.

4. Identify the interest/need of BO linked to social indicators and their tenants

We have asked building owners' staff if they are interested in the development of a dedicated access in the platform for tenants to inform them, send advises, alerts or any options that BO´s find relevant in the project. We also asked if they want to add social indicators in the platform such as the satisfaction of tenants with the DREEAM project.

5. Usability and design

During tests of the platform, we have started to identify with buildings owners the best options existing in the Open Domo platform and the crucial improvements needed both regarding the content (information/data) and the usability (easiness to use the platform based on the graphic display options, the navigation, the command names, etc.).

The complete interview guideline is presented below:

Beginning of the workshop: (30 mins)
Introduction of the day:
- Description of the User Experience Evaluation steps
- Reminder about the development of the platform and the co-design meetings
- Presentation of the steps following this workshop during M8 to M13
- Description of the Open Domo Platform key functionalities: 10 mins

Then answers/questions with BOs:

1. Previous experiences of similar Energy Platforms
   - Did your company or yourself already used this type of platform?
   - In which context? What is your objective to use this platform in your company?
   - What are the pros and cons of the similar/previous energy performance/platform you have used before?
   - Why? Do you have material/reports on your experience/existing platform that is available?

2. Targeting the relevant users of the DREEAM platform
   - Who exactly in your company has a professional interest to use the platform?
   - Do you have employees who are specialized in energy monitoring platform or are you captive of the platform technology/service? What are your needs in term of problem solving? Customer relations when problems occur?
   - For which part/mission in your work this type of platform is interesting?
   - Do you use the results displayed in this type of platform for internal communication? Or external communication? (tenants' association, municipality, reports?) or would you like to be able to use the platform for such purposes?

3. Targeting the key objectives of BOs with the platform
   - What services do you value the more or the least with this type of platform? Why?
   - Energy consumption display
   - Energy consumption comparison (time scale /space scale, other?)
   - Statistics on energy efficiency/energy performance (methodology integrated in the platform)
   - Control of electrical equipment in the collective areas
   - Control of heating system
   - Others? For each of the previous items that are the most important for the building owners' employees, ask in addition the 3 following questions:
     - What make you trust or disbelieve in a service to display or control this specific item (electrical appliances, heating system, energy consumption, etc.)?
     - Do you have examples to explain why?
     - How do you use the data in each of these categories in your work/with your colleagues/externally? Do you have communication material where you have already use the data/results displayed in an energy performance platform before? Any example to show?

4. Open Domo Platform
   - Did you tested the Platform Open Domo?
   - During your first use, what were your first impression in terms of usability? That is to say: does the platform is easy to understand? To navigate through?
   - What are the first options you have tried to find? Why? Can you show us?
   - Are there options/service that you were expecting and that you haven't found? Can you show us?

5. DREEAM platform and the DREEAM approach: which links needed for BOs
   - What are you expected in the DREEAM project with the dedicated energy platform that will be proposed to you? What would be the ideal service according to you?
   - Which options do the DREEAM platform should propose to prove the interest of the DREEAM approach for your company?
   - What are more specifically the type of display/data visualization in the platform that would allow you to check the relevance/efficiency of a multi-building approach?
   - What pages presented by Open Domo embody/integrate the more this specific need?

6. Optional indicators to integrate in the platform
   - Do you want that the collective energy consumption can be accessible for tenants on the platform? (specific access for example) Have you already done that before? (display for tenants?)
   - Do you accept to integrate this possibility to display collective energy consumption and energy performance of the project in the communication strategy with tenants?
   - Do you think that some specific stakeholders might support or be opposed to this public display? Who and why?
   - In the case of a public access to energy consumption, do you see any additional service that should be necessary to display for tenants to help them understand the tool?
   - Would you like to use the public access of tenants to get feedbacks from them on the energy uses in the buildings? And for your local employee? Would you like an additional service to collect feedbacks from their work on the ground during the DREEAM implementation and after during regular uses? Integrate quantitative social indicators in platform? Such as level of satisfaction during DREEAM visits/ installations, communication from housing companies?

7.2.2 The 3 interviews and User Tests organized in 2016

Then, following the finalization of the heuristic evaluation 3 separate meetings have been organized with each of the building owners.

Description of the 3 User test Meetings organized in 2016
PFP **Where: PFP Office – Preston (UK)** DREEAM partners present during the meeting: Savills (coordinator of the meeting, heuristic evaluation & transcription of exchanges); Open Domo (lead of the live navigation and exchanges with BO employees); SinCeo2 (exchanges with BO employees on the data collection for the platform); Chalmers (the project manager was present to follow the quality of the exchanges and gather information on BO perspectives and strategies about the project and the future DREEAM platform). Date of the meeting: 27 January 2016 The qualitative interviews lasted 2 hours The User Tests lasted 2 hours
Landskronahem **Where: Landskronahem office – Landskrona (Sweden)** Date of the meeting: 17 February 2016 DREEAM partners present during the meeting: Savills (coordinator of the meeting, heuristic evaluation & transcription of exchanges); Open Domo (lead of the live navigation and exchanges with BO employees); SinCeo2 (exchanges with BO employees on the data collection for the platform); Chalmers (the project manager was present to follow the quality of the exchanges and gather information on BO perspectives and strategies about the project and the future DREEAM platform). The qualitative interviews lasted 2 hours The User Tests lasted 2 hours

Ater

Where: ATER office – Treviso (Italy)

DREEAM partners present during the meeting:

Savills (coordinator of the meeting, heuristic evaluation & transcription of exchanges);

Open Domo (lead of the live navigation and exchanges with BO employees);

SinCeo2 (exchanges with BO employees on the data collection for the platform);

Chalmers (the project manager was present to follow the quality of the exchanges and gather information on BO perspectives and strategies about the project and the future DREEAM platform).

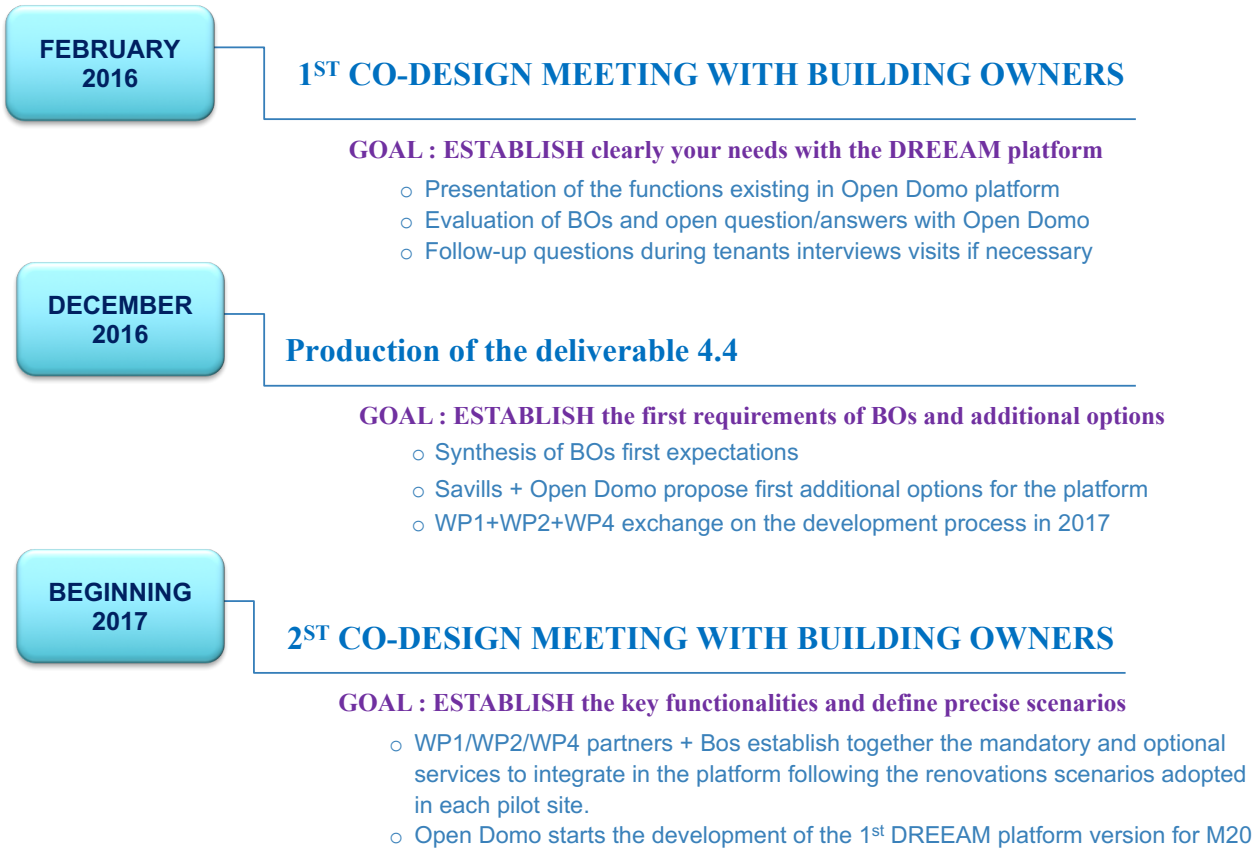
Date of the meeting: 4 February 2016

The qualitative interviews lasted 2 hours

The User Tests lasted 2 hours

7.3 STEP 3: Deliverable report n.1 D 4.5

From the tests performed with building owners' staff, we have produced the current report that will be used as a basis for the development process of the platform in 2017 as shortly synthesized below (with a correction that the 2nd co-design meetings will finally be organized by mid-2017 and not at the beginning of 2017 as announced in the illustration below):



7.4 STEP 4: Workshop with WP1/WP2 once that the renovation scenarios are defined for each pilot site

GOAL: BUILD design scenarios based on Building owners and WP1/WP2 requirements for the platform.

WP1+WP2+WP4 partners will exchange during a workshop the best options to integrate in the platform based on building owners' requirements and the DREEAM scenarios/approaches proposed for each pilot site by the WP1+WP2 partners.

The exchanges will be organized to identify the services in the platform that are particularly relevant for the "multi-building approach" of the DREEAM project.

7.5 STEP 5: Preparing the 2nd co-design meeting (mid-2017)

In the middle of 2017, once that the renovation scenarios have been defined for each of the 3 pilot sites, Open Domo and Savills will organize 3 additional User Evaluation meetings with each of the 3 building owners. The process to organize these additional meetings is described below.

1. **Preparation of the meeting: feasibility analysis**

   In preparation of the 2nd Evaluation meeting, Savills and Open Domo will produce a detailed feasibility analysis from the Design requirements report in order to list the capacity of Open Domo to integrate the improvements expressed by building owners, and also to evaluate the possibility to implement new options depending of the level of cost/time/importance for BO´s and Open Domo.

2. **Use of the platform with access code by building owners before the User Test meeting**

   An invitation will be sent to building owners´ staff in order to test the platform and use it more often before the 2nd evaluation meeting, and that they register their perception/feedback on the platform that now displays real data collected from the 3 pilot sites (different to the previous testing period). In addition, 2 documents will be sent to building owners in order to prepare the 2nd Evaluation meeting: 1 document will shortly remind the building owners the key functions of the existing platform, and 1 Excel table will be presented in order to show the alignment of the existing Open Domo platform with the building owners requirements as collected during the 1st. Evaluation meeting, and the list of the missing options that could be developed + their feasibility.

7.6 STEP 6: 2nd co-design meeting (mid-2017)

The goal of this 2nd evaluation is to detail very specifically the different services and design options that the building owners are expecting.

This meeting will be divided in 2 parts:

Part 1: collective meeting with Building Owners' staff, Open Domo, Savills, Chalmers

- Perform a collective live test to collect feedback from future users on the Open Domo platform with the data displayed from their pilot sites in the existing platform
- Establish the satisfaction level of BO´s on the data displayed in the platform of their pilot buildings (indicator of satisfaction and relevance)
- Present to building owners the additional options that could be interesting according to Open Domo, Savills and other DREEAM partners.
- Determine the potential options for tenants according to building owners´ perspective. This meeting should allow to present interesting options to building owners for their tenants using the data that is collected on the pilot sites. Based on the social options proposed, the data collected and the objectives of the building owners, we will establish a limited number of scenarios for the tenants platform.

Part 2: individual test between 1 building Owners' staff member and Open Domo + Savills

- **After the 1st collective meeting,** we will organize individual User Tests lasting 1h to establish the usability of the platform / the easiness to use it (user friendly). We will do this individual test with 1 to 3 employees of building owners with a **prepared use scenario** based on what the employees say they normally try to do with such a platform. The user is left alone with the different scenarios, the evaluator notes the navigation, questions of the users, his/her findings or difficulties in order to identify improvements both for the design, the navigation and the commands **(we use here the "Think Aloud technic" in usability testing).** In case of specific problems impeding the pursuit of the test, the evaluator answers to usability issues. The strengths, issues are listed in a document in order then to improve the platform options/design as much as possible.

7.7 STEP 7: 2nd heuristic evaluation

In addition to User Tests with building owners, we make a 2nd deep heuristic evaluation to list all the potential problems of the platform by ideally 3-4 evaluators from Savills, Chalmers (Project Manager) and the designers of Open Domo.

- Each service and command already existing in the platform will be tested and reviewed by the building owners. The goal is to test both the information structure, the data displayed and the ergonomic quality of each option.
- For each existing option, a quantitative indicator will be used in order to monitor the satisfaction of the existing versions in the Open Domo platform and its level of importance according to building owners for the DREEAM platform
- For the options that need to be entirely developed, the building owners will be asked to propose the best design option / user friendly way to display/ get access to it. Open Domo should exchange in live with building owners to propose alternatives.

7.8 STEP 8: Design requirements Report n.2

After this 2nd Evaluation meeting, Open Domo with the support of Savills and SinCeO2 will produce a detailed report of the design requirements following the 2 evaluation meetings organized in 2016 and 2017. In this report the different services and design options to integrate in the 1st. version of the DREEAM platform prototype will be listed. Also, an Excel table listing each BO´s requirement expressed during co-design meetings (each specific function and its related command) will be produced. This Excel table will list the additional options expected by building owners and the detailed answers given also during the qualitative interviews in order to be reviewed and approved by the consortium of partners before the start of the implementation.

7.9 STEP 9: start of the implementation– prototype n.1 of the DREEAM platform

By end of 2017 we will start to adapt the existing Open Domo platform to the requirements of building owners as expressed during the 1st. and the coming 2nd User Evaluation meeting (middle of 2017)

1. After validation of the development options with different partners involved, Open Domo will start the design integration and the preparation of deliverable 4.6: "Integration of the requirements: first version of the platform developed";
2. An invitation will be sent to building owners staff to test the 1st prototype during several weeks before the evaluation n.2;
3. Individual workshops will be organized from a distance with each building owner in order to list the additional improvements expected, the difficulties encountered in the use of the 1st platform prototype, the need to improve the usability of the platform, the need to build a user guide or another training tool to use the platform (such as a webinar)

7.10 STEP 10: 3rd co-design meeting: workshop with WP4 partners, Chalmers, SP, BO (2018)

The process of development will be focused on determining and responding to the users' needs (the building owners' needs) with this tool. The platform will be validated by the BO´s in the last 2 years of the project.

- Presentation of 2nd prototype version of the DREEAM platform based on the renovation scenarios adopted in 2017 and the improvements requested after the workshop with building owners on prototype 1
- An Excel table will list in detail the alignment of the 2nd prototype on the building owners' requirements expressed during the 1st and 2nd co-design meeting organized in February 2016 and 2017 in the 3 countries
- If limitations/impossibilities have occurred to implement some desired options, Open Domo will explain what the limitations are
- Tests of this 2nd DREEAM platform prototype will be made directly with the future users: the building owners will be able to again give their direct and complete feed-back on each function to SAVILLS and Open Domo
- The follow-up feedback from future users will be directly integrated in the original Excel File (heuristic evaluation list) to check the progress of the design development and to track the quality of the functions presented
- A detailed exchange will be organized to check that the "multi-building approach" of the DREEAM project is addressed in the information and commands proposed by the platform
- **If possible we would like to organize a test with future users outside the project consortium**: with a municipality and 1 or 2 other building owners with whom we want to replicate the DREEAM approach and the DREEAM platform. These meetings could allow to improve a training program to use the platform for replication, and to increase the potential of dissemination of the platform. This option must be discussed in 2018, depending on the network of external partners available for an interview and a live test of the platform.

7.11 STEP 11: Last step: Validation of the final platform prototype & dissemination (2019)

- Preparation of deliverable 4.10 “Validation of the platform with the building owners” due for month M46 (end of the project)
- Analysis of the frequency of use of the platform by the building owners, and statistics about the most and least used pages/options
- Discussion on the communication material proposed and the improvements needed on the content and information given to future users
- A consensus on the final quality of the platform (strengths and weaknesses) will be established between the DREEAM partners
- Final selection of potential targets to propose the DREEAM approach and the DREEAM platform: (municipalities, building owners, etc.)
- Meetings/conferences/network to present the tool (Open Domo, Chalmers, Savills, etc.).

8 Description of the existing Open Domo platform

In the following part n.1, we will describe the existing functionalities of the Open Domo platform. This part n.1 is a needed pre-requisite to the part n.2 where we describe the 3 tests of this existing Open Domo platform executed with building owners, and their feedback.

8.1 Open Domo Software Cloud

Open Domo Software (ODS) offers an open technology that promotes the integration of third parties, both on software and hardware level.

The software level is the ODS Cloud (shown in Figure 1), which is an energy management tool that counts various modules: Dashboard Module, Organizational Units Module, Devices Module, User Module, Analysis and Measurement & Verification Module), Billing & Set Rates Module, Reports Module, Alerts Module, Control Module and Flat Module. The functionalities of each module are explained in the following paragraphs.

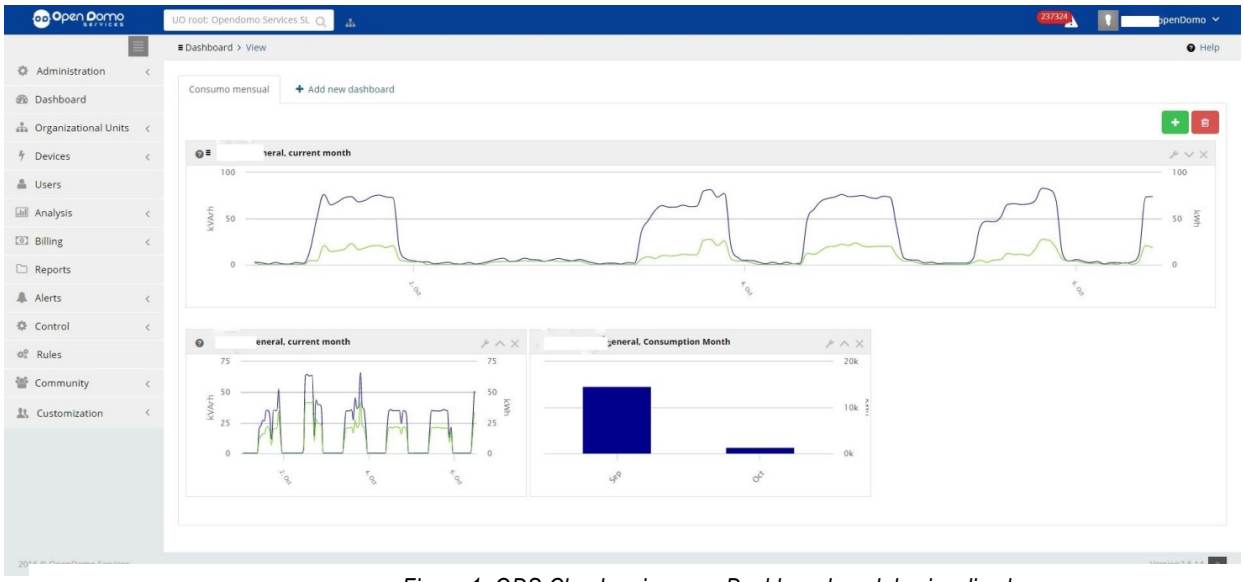


Figure 1: ODS Cloud main page. Dashboard module visualized.

Dashboard Module: It is the first screen that appears after logging in and is fully customizable by the user. This module is thought to give easy and quick access to the most relevant content for every single user and it's therefore individually customized. Several widgets are set by default, but the user can create customized widgets, as well as edit or eliminate those that already exist (Figure 1)

User Module: It is the module used to create a user account within the platform. It is possible to create as many users as needed. Users are created according to the profiles defined by the customer and they are immediately ready to be used. There are two different types of users: TECHNICAL and NORMAL. Technical users can create new users and can decide to which Organizational Units (explained below), modules and devices they have access. This allows the OD Cloud manager to choose which elements can or cannot be shown to the users, so that elements to which they do not have access disappear from their environment. In this way access to information is adapted and/or limited to different profiles and privacy is assured to everyone.

This kind of structure guarantees a secure and private selective access to the data stored in the cloud. Here we give an example of a possible implementation of this feature for 3 different buildings belonging to the same owner:

- Full access to all the data: OD Cloud manager and buildings' owner
- Access to all the information of one building: administrator
- Access to the consumption of one flat: households.

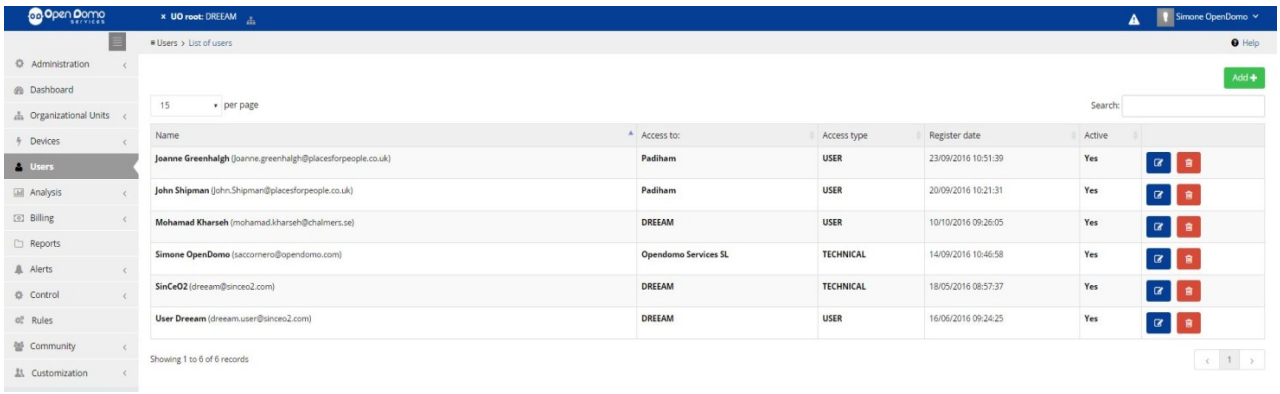


Figure 2: User Module

UO Module: UO are organizational units such as installation type, geographic area, company, etc. that are used to group more devices into units and thus create an organizational tree structure. The consultant can create the different UO´s and the hierarchical structure in the most optimal way to facilitate his tasks, grouping installations by type according to different defined parameters as the ones mentioned above. The entire structure is always set and validated by the customer.

Additionally, it is possible to create groups of UO, obtaining a total value for different variables of the contained elements. That is for example the case, if a group of UO´s is created containing 3 schools, the group will give as a result the value of the chosen variable of the 3 schools combined. This tool is very useful and can be adapted to the user's needs. In this example, it could be helpful to separate the consumption in order to compare educational buildings with administrative buildings, or in the case of the DREEAM Project, the consultant could create a group of houses where only couples live and a group containing only families` houses, and thus compare the consumption and the KPI´s.

For the DREEAM Project, as it is shown in the figure below, the UO´s are the different geographical areas and the different buildings.

Figure 3: Organizational Unit Module. Tree structure- TOP company name, BOTTOM metering device.

Device Module: In this module, the devices that send information to the cloud are created and registered. Such devices can be manufactured either by ODS or by 3rd. parties, or can be virtual devices configured to include external data into the cloud.

The main features of this module are the following:

- Online configuration of on-site installed devices (smart meters, control devices, sensors etc.). By specifying the MAC address of the device, it is possible to start the communication with the cloud and send all the data. While configuring, it is possible to select the physical quantity that is being measured (lighting or HVAC or total consumption, room temperature, communal lighting etc.)
- Configuration of virtual meters that allow the consultant to upload data coming in csv format (Excel), both consumption and other variables. The data could be either coming from historical bills or from devices installed by third parties.
- Data gathering from weather stations such as outdoor temperatures, humidity, solar irradiation, wind etc. without installing sensors. This feature to perform studies that show how different key parameters influence consumption.
- Creation of virtual meters that are the result of mathematical operations between variables in the cloud (for example, general consumption – climate consumption = lighting consumption or aircon1+aircon2+aircon3=total HVAC) or between constants and variables. These meters behave like the real ones and allow the user to graph data, create alarms, write a report about it, etc.
- Through virtual meters, it is also possible to create KPI's (consumption per square meter, consumption per occupant, consumption by thermal variation, etc.), or by multiplying the previous year's consumption with a constant, to calculate the forecasted energy consumption for the next year.

It is important to keep in mind that when discharged, an OD Energy (ODS electric meter) 3-phase device can allow you to decide whether you prefer to view the results like 3-monophase signals or like a 3-phase signal, as well as whether you are measuring generation or consumption. The latter is because the OD Energy equipment can be measured in both directions and allows plotting in the cloud in positive or negative (depending on whether generation or consumption) to create a virtual device difference and control the consumption network.

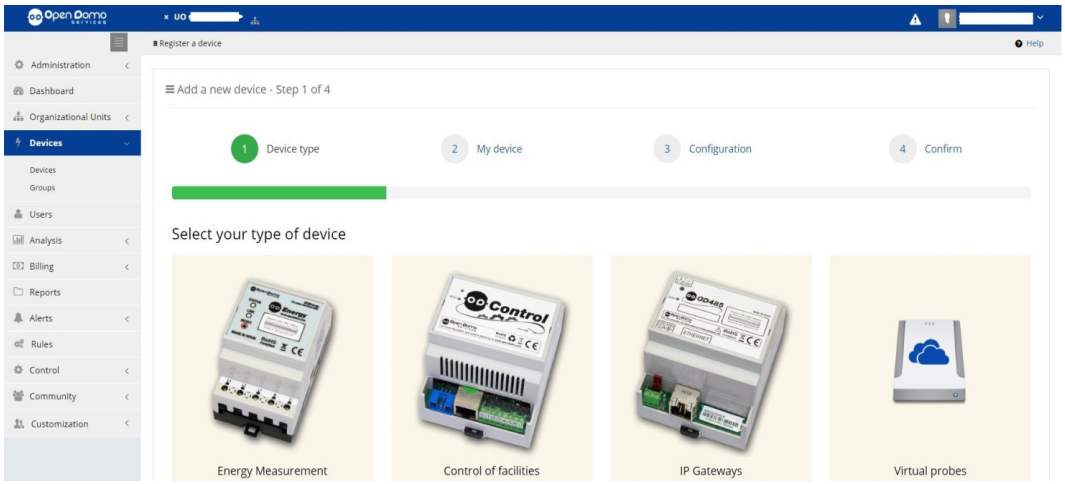


Figure 4: Configuration procedure of the different metering devices and virtual probes.

Set Rates Module: This module will introduce customer contracts with indicated expiration. In addition, the user can choose to display the following: advanced notice of expiration, rate type, energy collection type (fixed rate, indexed pass-pool or indexed pass-through), penalties, collection equipment, etc. (all of which will have the information consumption in monetary units).
The module allows for pricing simulations to analyse if it is more convenient to change companies or rates. Also, the water and gas contracts can be introduced. It is necessary to introduce contracts for the automatic generation of invoices simulated (or pre-bills) at the end of month. Rates will be created from 2005 to the present value to keep track of them all.

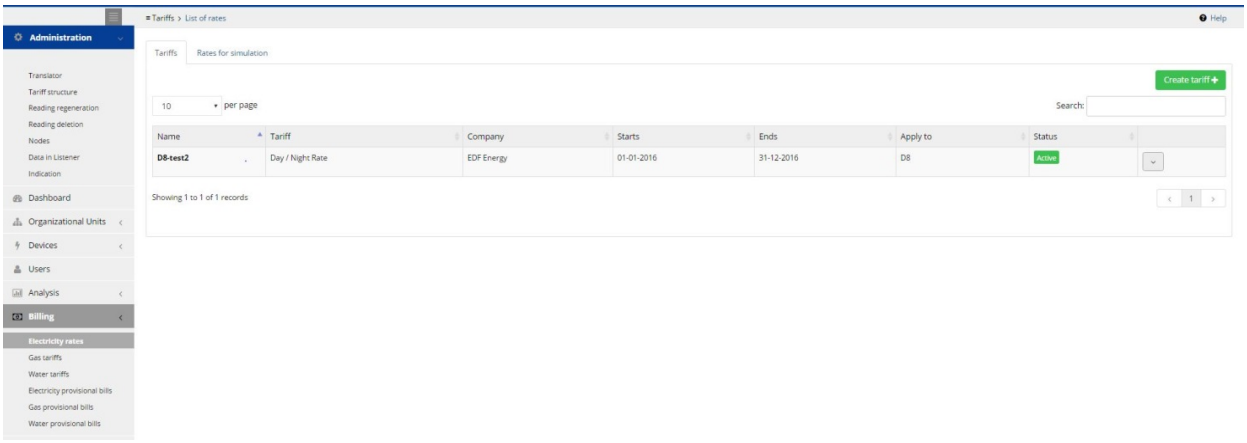
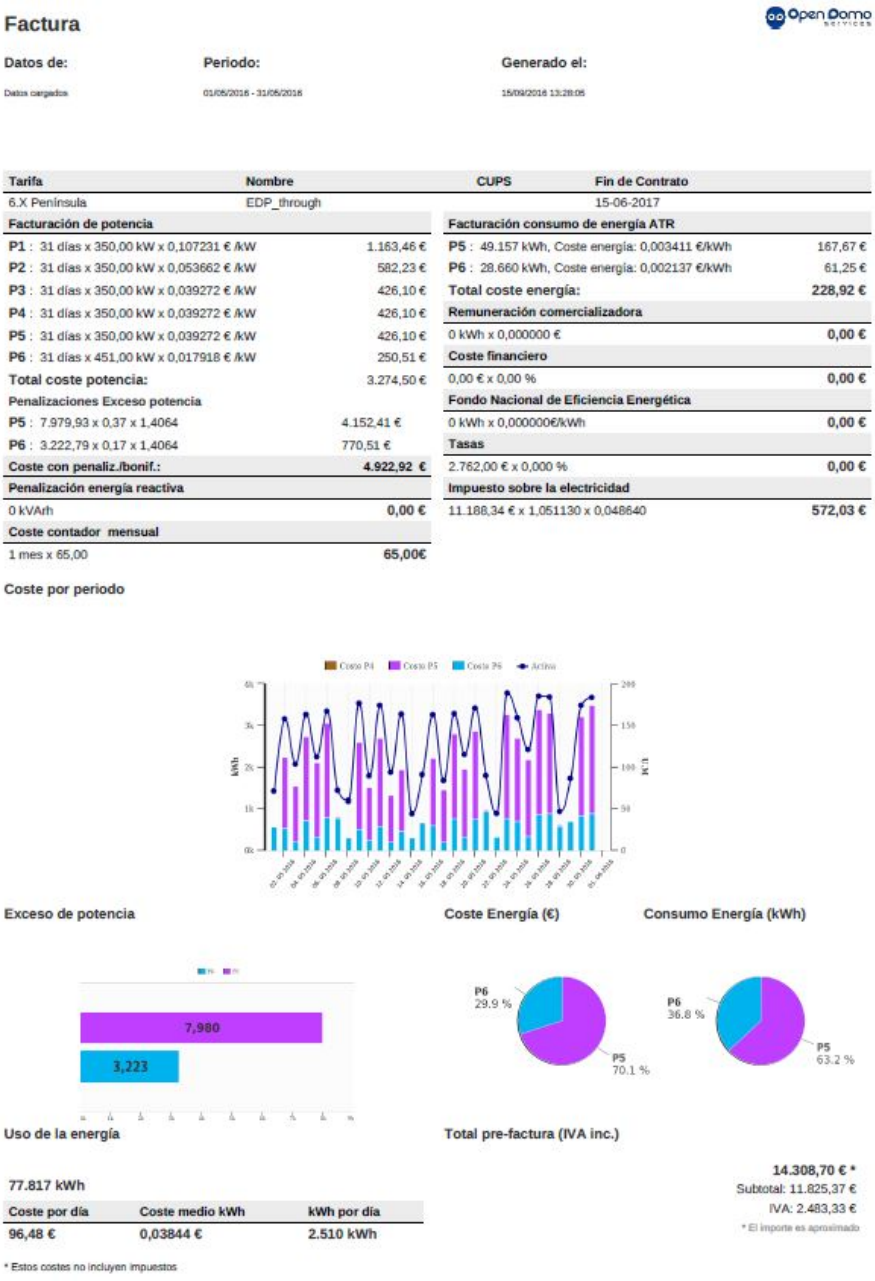


Figure 5: Screenshot of the Billing Module displaying the user's tariff

Billing Module: Each end of the month, invoices of general consumption are automatically generated on the platform (water, gas and electricity). However, pre-invoices can be generated manually by putting in different dates.

An example of a pre-invoice generated by the OD Cloud is shown in the figure below.



Factura

Datos de: Periodo: Generado el:

Datos cargados 01/05/2016 - 31/05/2016 15/09/2016 13:28:05

Tarifa	Nombre	CUPS	Fin de Contrato
6.X Península	EDP_through		15-06-2017

Facturación de potencia		Facturación consumo de energía ATR	
P1 : 31 días x 350,00 kW x 0,107231 € /kW	1.163,46 €	P5 : 49.157 kWh, Coste energía: 0,003411 €/kWh	167,67 €
P2 : 31 días x 350,00 kW x 0,053662 € /kW	582,23 €	P6 : 28.660 kWh, Coste energía: 0,002137 €/kWh	61,25 €
P3 : 31 días x 350,00 kW x 0,039272 € /kW	426,10 €	Total coste energía:	228,92 €
P4 : 31 días x 350,00 kW x 0,039272 € /kW	426,10 €	Remuneración comercializadora	
P5 : 31 días x 350,00 kW x 0,039272 € /kW	426,10 €	0 kWh x 0,000000 €	0,00 €
P6 : 31 días x 451,00 kW x 0,017918 € /kW	250,51 €	Coste financiero	
Total coste potencia:	3.274,50 €	0,00 € x 0,00 %	0,00 €
Penalizaciones Exceso potencia		Fondo Nacional de Eficiencia Energética	
P5 : 7.979,93 x 0,37 x 1,4064	4.152,41 €	0 kWh x 0,000000€/kWh	0,00 €
P6 : 3.222,79 x 0,17 x 1,4064	770,51 €	Tasas	
Coste con penaliz./bonif.:	4.922,92 €	2.762,00 € x 0,000 %	0,00 €
Penalización energía reactiva		Impuesto sobre la electricidad	
0 kVArh	0,00 €	11.188,34 € x 1,051130 x 0,048640	572,03 €
Coste contador mensual			
1 mes x 65,00	65,00€		

Coste por periodo

Exceso de potencia

Coste Energía (€)

Consumo Energía (kWh)

Uso de la energía

77.817 kWh

Coste por día	Coste medio kWh	kWh por día
96,48 €	0,03844 €	2.510 kWh

* Estos costes no incluyen impuestos

Total pre-factura (IVA inc.)

14.308,70 € *
Subtotal: 11.825,37 €
IVA: 2.483,33 €
* El importe es aproximado

Figure 6: pre-invoice.

Analysis Module: It allows the graphic or textual visualizations of any variable stored in the cloud, either received or uploaded. This module features many different visualization opportunities:

- Graphic visualization through lines or bars of every variable available in the cloud for a selected period. They can be displayed all at once, or it is possible to highlight different types of variables in order to see the relationship between them or to overlap different periods to compare past and present consumption.
- Tools to highlight contracted power, peak demand periods, line of maximum and minimum (for an easy and quick reading of the data), and consumption trend lines of the selected period.
- Data can be shown in quarter-hourly, hourly, daily, weekly and monthly frequency. It allows zooming in and out in order to carry out a more accurate analysis. It allows for the comparison of periods, as well as monthly comparisons by matching the days of the week instead of the numerical days of the month.
- It can display the data of separate power phases, provided the connected equipment permits it.
- After selecting the variables to be displayed, the period and the frequency, the graphics are downloadable in different formats and the data can be downloaded in csv format (Excel). Labels and comments can be added to the graphs to mark anomalies or incidents and make them easier to read and be understood by an unexperienced user. These labels can be viewed by everyone or only by the person that generated them and can indicate whether or not you want them to appear in reports.

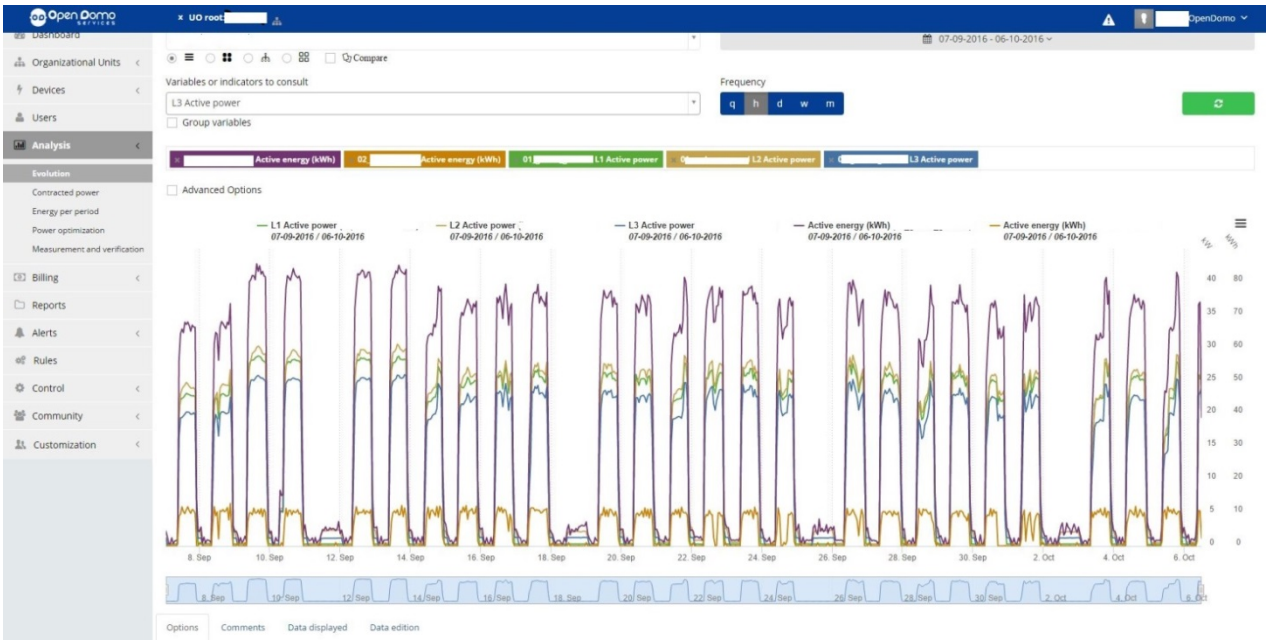


Figure 7: example of an analysis performed on an installation. The graphs for Active Energy (climate, lighting and general) and Current Intensity for each of the 3 phases, are shown in the plot

Measurement and Verification Module: Module that allows the creation of a baseline on dynamic and static variables for the proper monitoring of consumption variables. An energy baseline is a reference tool. It allows comparing energy performance before and after a change is made to the site or system independently from exterior key energy affecting factors (e.g. outdoor indoor set-point temperature, occupancy, surface etc.).

The baseline establishes the "before" by capturing a site or system's effective total energy use prior to making improvements and it compares it with the current consumption. It allows to zero in on what's contributing to good or bad energy performance by providing a like for like comparison of energy use between two different periods.

An example of this tool is presented in the figure below.

Figure 8: example of an installation's savings analysis through the calculation of the baseline as function of surface, occupancy and temperature performed by the software.

Alarm Module: Allows for the rapid detection of any abnormality in each one of the facilities. The customer can create, edit and delete their own alarms for any type of variable (electricity, water, gas, cost, temperature, pH, humidity, contact, opening, power on/off, etc.) and decide to receive a notification when the condition occurs, as well as set them for some days of the week at specific times. These alarms, in addition to being registered in the cloud in the notification section, are sent by mail to the specified people. It will create a first alarm to be sent to define who is responsible for this effect, which will be defined by the customer.

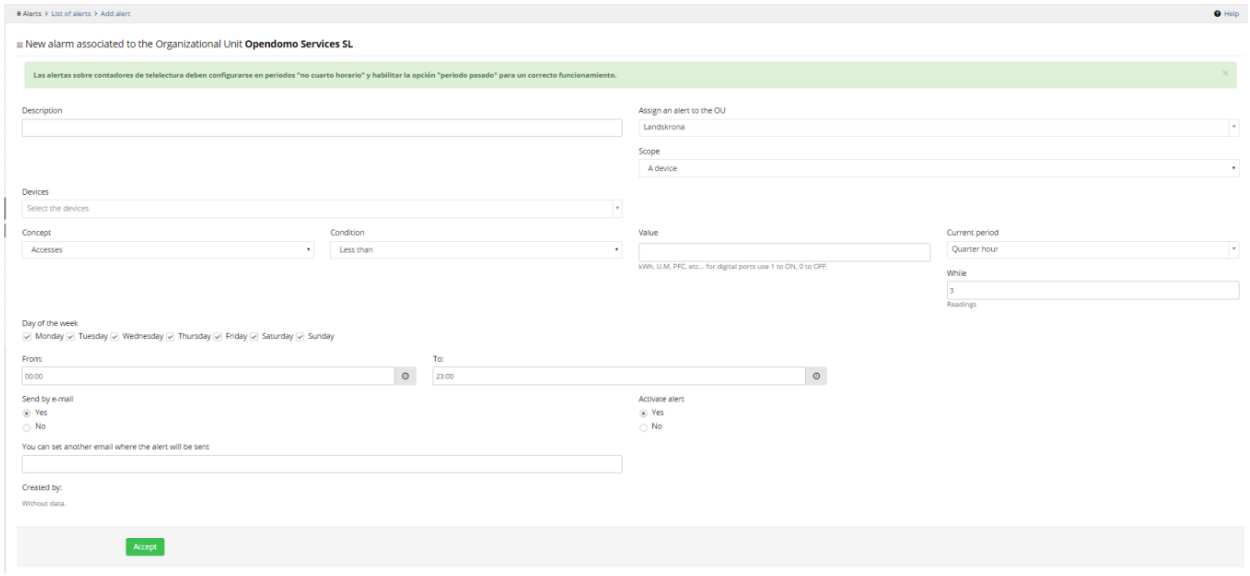


Figure 9: guided configuration process to create alarms.

Report module: There are different types of predefined reports and different graphic that the customer or the consultant can use to create their own report template. Reports can be generated in real time or be scheduled for weekly or monthly delivery. The reports generated are editable, in order to allow the customer to add appropriate comments on each graph or table incorporated in the report before sending them to the responsible center.

The module includes the creation of two costumed reports (technical or financial one). The available widgets are used to homogenize the information to be sent to the responsible party.

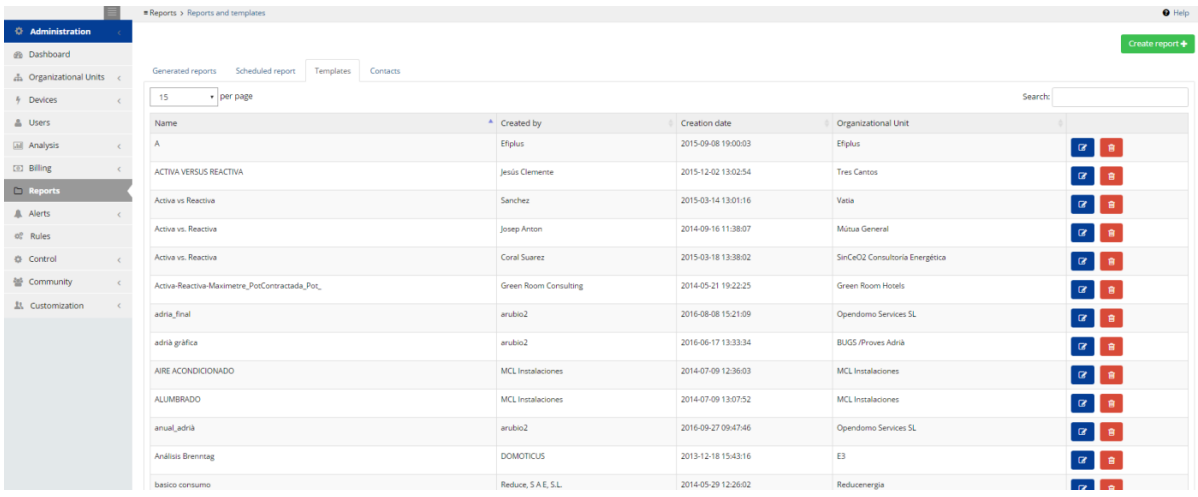


Figure 10: Templates of the Report Module suggested by the Cloud.

Control Module: ODS offers automation equipment and remote control of facilities. Installing an OD Control, it allows the user to automate and optimize the ON/OFF of different applications, such as heating, cooling, lighting or domestic appliances The programming is built-in to the equipment, so that if communications are lost, it does not harm the installation, since the programming could continue to run its course. Communication with the equipment is only necessary when performing a remote change to the configuration (change in the program schedule, for example), to actuate the device remotely or in order to have information about the state of the ports (on, open…).

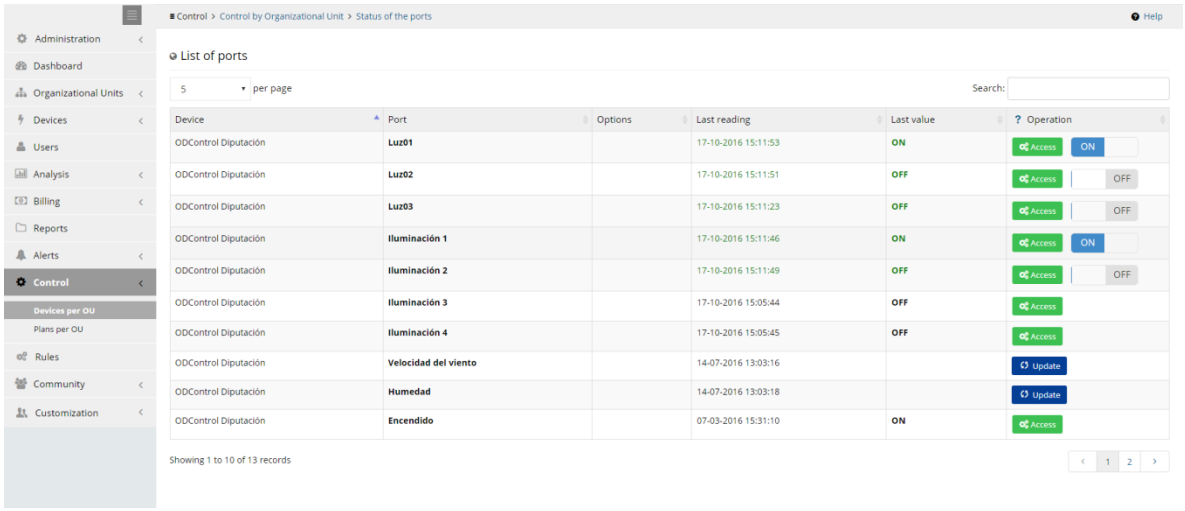


Figure 11: Control module

Floorplan module: Since the control module is unattractive to the user, to be button type, ODS has a module where you can import an outline / diagram / overview / photography / flat 2D or 3D installation monitored at no additional cost. Where the customers can themselves can add the actual existing elements of measurement and control in the facility. Once the equipment is connected, it will represent its value (temperature, power consumption, humidity, etc.), updated with the latest reading, and allow power on / off control by control equipment (turn off or turn on lights / weather / elements will be represented etc. remotely). If the desired configuration is set by the supplier, the customer must deliver images/plans and the estimation will be calculated separately.

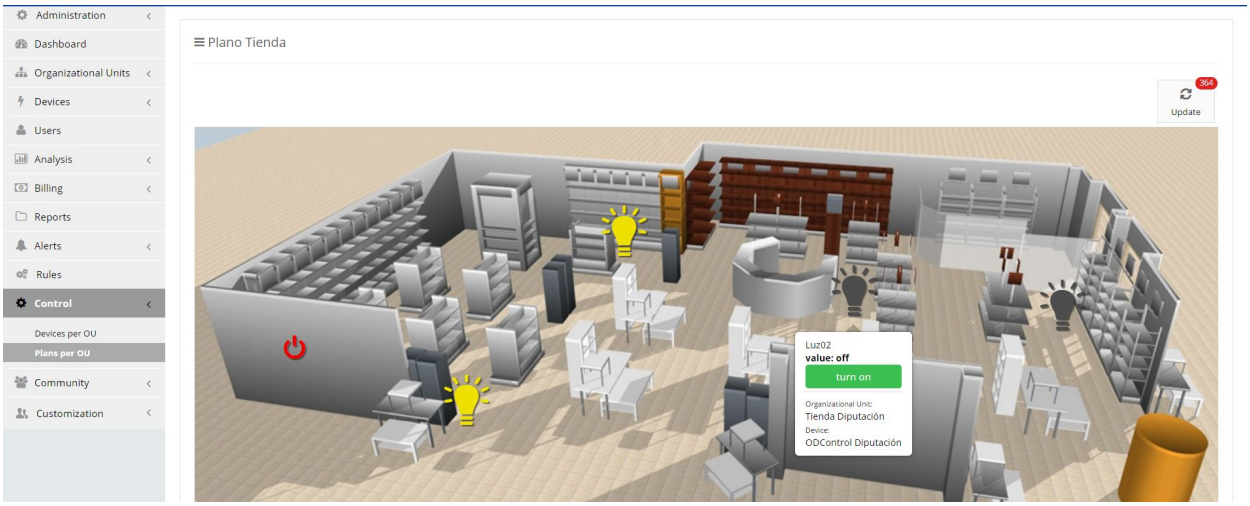


Figure 12: remote control of lighting using the floorplan module to visualize the installation.

8.2 System architecture and data integration

The on-site metering and data integration into the platform is executed through devices either manufactured by ODS or by 3rd. parties.
Before explaining in detail the characteristics of each ODS device, we proceed showing the architecture of the OD Cloud and how the devices interact with the platform.

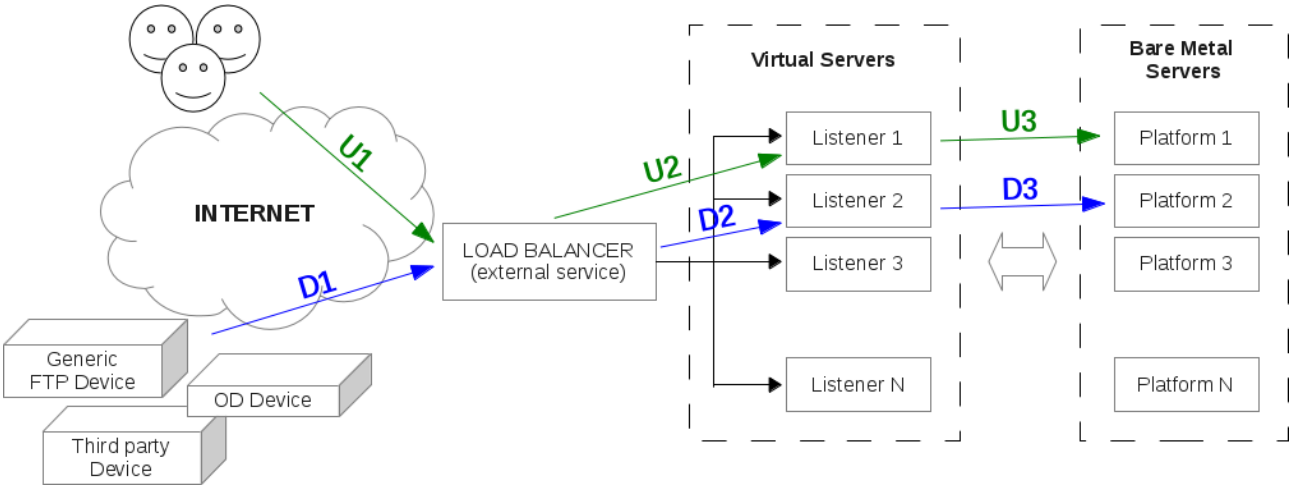


Figure 13: OD Cloud system architecture

The complete solution architecture is structured in three layers: The user or device layer, the device recognizer or LISTENER layer and the application or PLATFORM layer. This architecture allows an almost linear growth and provides the ability to easily distribute servers geographically.

User or device layer:

The devices send data from the installation through Internet. There are devices, such as those manufactured by ODS, that send data directly to the Internet and devices that require an intermediate gateway. Most of the metering devices use standard protocols such as Modbus / RTU and therefore they require gateway devices to translate into TCP / IP protocol. However, there are some teams that send Internet data in .csv format via FTP.
In any case, the data is sent to a managed domain through a load balancer. Then, the load balancer provides the address of a LISTENER node randomly, which will be responsible for collecting data. In the same way, the users are sent to a LISTENER node randomly via the load balancer:

LISTENER layer:

The LISTENER nodes are responsible for the collection of data and of the redirection of the users to the PLATFORM node. They are all equal and scale linearly (adding new LISTENER nodes) to meet the demands of a growing number of users and devices. The function of the LISTENER node in the device case it is to store the data sent. These data are prepared to serve the PLATFORM nodes when they demand it (D3). In the user case, the function of the LISTENER node is the redirection of a user to a random PLATFORM node where the user can login (U3).

PLATFORM layer:

In the device case, the PLATFORM nodes are responsible for serving the energy management application. For this it needs data from devices, which are found in the LISTENER nodes. Thus, when a PLATFORM node requires it, it requests measurement data from the LISTENER servers: only the data of the associated devices are passed to the PLATFORM servers.

In the user case, the PLATFORM nodes are responsible for the Login to the assigned PLATFORM node. That is to say, a user can be redirected to any PLATFORM node, but when performing login, said PLATFORM node will send the user to their assigned node: the one which has their devices and their user configuration.

8.3 Metering devices

The ODS devices mentioned in the architecture are:

- Energy: OD Energy mono or tree phase Wi-Fi or Ethernet.
- Control: ODControl2
- Gateways: OD485C

OD Energy

OD Energy is an energy meter in real-time IP connection via Ethernet or via Wi-Fi. Given the flexibility and simplicity provided by this type of connection, access to the product is possible from any Internet connected device and, therefore, the monitored energy consumption of your electrical installation can be visualized with Open Domo Cloud.

This device uses a proprietary but open protocol so that it can be integrated into any other server. Thus, changing the IP address that appears on the device's web server, it will start sending directly to the indicated server. Although, by default, OD Energy is configured to use the Cloud Open Domo, the OD Energy product has an open protocol in order to integrate any other cloud service with it. There are different ways in which OD Energy can work: OD Energy as customer & OD Energy as server.

8.3.1 OD Energy as customer

This is OD Energy's default setting. When OD Energy is in client mode, it sends data to a server (the server indicated in the initial setup screen) to TCP port 1730. This server must always be listening to this port, so that OD Energy works properly. OD Energy can send different frame types to the server. They all use a common header. The following explains in detail the format of the frames and the execution flow.

Header

All the frames sent by OD Energy to the server have the following format:

```
ODEVV:XXXXXXXXXXXX TT:LLLLL PPPPP...PP
```

Where VV indicates the protocol version, XXXXXXXXXXXX indicates the unique ID of the device, TT is the frame type, LLLLL is the total length of the frame in decimal and P is the variable length, indicating the contents of the package. Let's look at a real example of plot:

```
ODE02:000555812F61 PW:00092 T1389706857 V:2385,2394,2402 I:51,27,3,0 P:99,69,7 Q:-84,-23,-7
```

Here we can see that it is using protocol version 02, the OD Energy ID is 000555812F61, the package is PW type and the total length is 92 ASCII characters.

Consumption frame

The consumption frame is a PW type and the content of the package carries different strings separated by spaces. Each one of the string has a timestamp (unix epoch) and includes the indicated instantaneous consumption. The data are shown in this order: volts x10, amps x100, active power, reactive power. For each of these variables, three values are shown, respecting the 3 phases L3, L2 and L1, respectively. Continuing the above example:

```
ODE02:000555812F61 PW:00092 T1389706857 V:2385,2394,2402 I:51,27,3,0 P:99,69,7 Q:-84,-23,-7
```

We would see that the package indicates:

```
- 238,5V in L3, 239,4V in L2 y 140,2V in L1.
- 510mA in L3, 270mA in L2, 30mA in L1 y 0mA in el neutro.
- 99watts in L3, 69watts in L2 y 7watts in L1.
- -84varsa in  L3, -23vars in L2 y -7vars in  L1.
```

State frame

The state frame is a ST type and the content of the package carries different strings separated by spaces. Each one of the string has a timestamp (unix epoch) and includes the following data: data are shown in this order: active energy, reactive power, firmware version and IP. For the nergy and power variables, three values are shown, respecting the 3 phases L3, L2 and L1, respectively.Here is an example:

```
ODE02:000555812C67 ST:00123 T1389706847 AE:+164.627,+66.356,+17.361 RE:+7.664,-6.222,-3.855 FW:1.0.0_ET IP:192.168.1.174
```

Therefore, the package tells us: - 164.627 kwh in L3, 17,361kwh in L2 and 66,356kwh in L1. - 7,664kvarh in L3, -3.855kvarh in L2 -6.222kvarh in L1. - Firmware version 1.0.0_ET – device's IP 192.168.1.17.

TIME command

OD Energy can send a simple frame as follows:

```
TIME
```

OD Energy will add special characters ASCII \ n \ r, i.e., the plot will become "TIME \ n \ r".

This frame is used to synchronize time with the server, so that the server will respond with a timestamp of the "unix epoch" type. For example:

```
1358370479
```

Adding at the end the value ASCII "\ n" . That is, the response would be "1358370479 \ n"

Every time that OD Energy E sends a frame to the server, it waits until this will answer with a string "ODEOK \ n" (except for the case of the TIME frame). If OD Energy E does not receive this string, it considers that the

package has not reached its destination successfully and tries again. The number of retries can vary between versions of OD Energy E, but is typically greater than 10.
Note: OD Energy E adds a "\ r" at the end of the frame.

Execution flow

After setting up an OD Energy, the execution flow is as follows:

1. Access to the network and obtaining basic data: IP, GW, DNS, etc.
2. Connection to the server and sending the TIME command. The process will not continue until it receives a valid date from the server.
3. Entering normal operation, the PW and ST frames are sent when necessary

8.3.2 OD Energy as server

From the main page "Overview", it is possible to get access to the consumption data in XML (XML Data). This data can be used so that an external program can read the data from the OD Energy and process it. Here an XML example is presented:

```
<device uid="0004A3000000" version="1.0.0_ET">
 <accumulated>
  <boottime>1387290508</boottime>
  <timestamp>1387291451</timestamp>
  <active_L3>12820</active_L3>
  <active_L2>12482</active_L2>
  <active_L1>12778</active_L1>
  <reactive_L3>30462</reactive_L3>
  <reactive_L2>30164</reactive_L2>
  <reactive_L1>30059</reactive_L1>
 </accumulated>
 <instant>
  <voltage_L3>232</voltage_L3>
  <voltage_L2>233</voltage_L2>
  <voltage_L1>232</voltage_L1>
  <current_L3>6790</current_L3>
  <current_L2>6790</current_L2>
  <current_L1>6790</current_L1>
  <current_N>0</current_N>
  <active_L3>1523</active_L3>
  <active_L2>1523</active_L2>
  <active_L1>1523</active_L1>
  <reactive_L3>400</reactive_L3>
  <reactive_L2>400</reactive_L2>
  <reactive_L1>400</reactive_L1>
 </instant>
 </device>
```

The labels showing "voltage_ *" represent the voltage measured in volts. The "current *" labels represent the current in mA (miliAmperes). The labels "active *" in "instant" represent active power in W. The labels "reactive*" in "instant" represent the reactive power in VAR. The labels "active *" in "accumulated" represent active energy in Wh. The labels "reactive*" in "accumulated" represent reactive energy in VARh. The label "boottime" indicates the time in *"unix time"* format of the last time the device was restarted. The "timestamp" label shows the time in *"unix time"* format at which the readings shown in the XML were taken.

NOTE: 'When you want to collect data using XML it may be necessary that the device does not send data to the server. In order to do this, it is necessary to set the device itself as server. This is done by selecting the "Server Mode" option under "Configuration".

b)

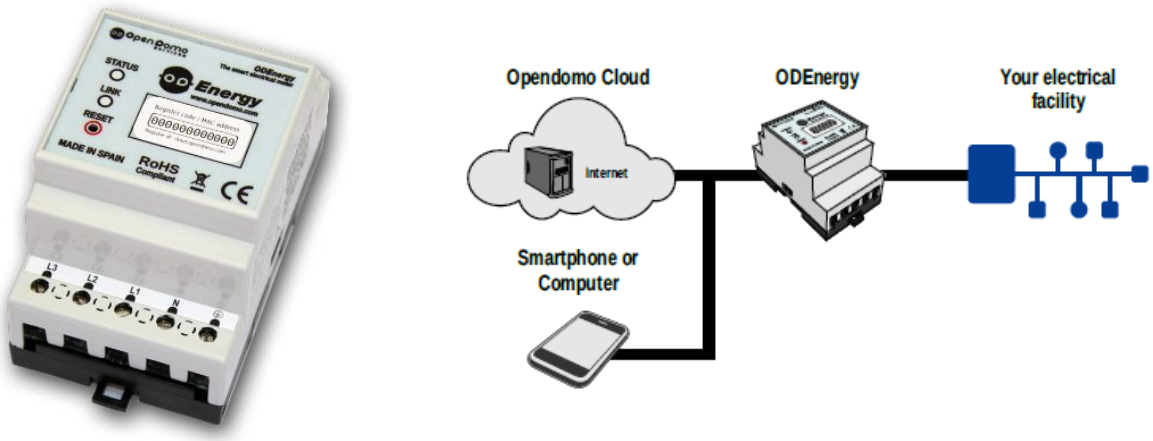


Figure 14a,b: ODEnergy and simplified working scheme

Model	System	Connectivity
ODEnergy ME	Single-phase	Ethernet
ODEnergy MEW	Single-phase	Ethernet + WIFI
ODEnergy TE	Single-phase/three-phase	Ethernet
ODEnergy TEW	Single-phase/three-phase	Ethernet + WIFI

Table 1

The main characteristics of the equipment are listed below:

- Values measured: Active Power (KW), Reactive power (Kvar), Apparent power (KVA), cos phi, Volts, Amperes.
- Supply voltage: From 85 to 265V AC Grid frequency 47-80 Hz. A supply voltage of 230 V ± 15% and 50-60 Hz is recommended to maintain high accuracy.
- Equipment consumption: 5 VA
- Relative error: 1%
- Maximum power measured: 2,147 GW
- Maximum energy measured: 2147 Gwh
- Ethernet Connectivity: 10Base-T with Rj45 connector
- WIFI Connectivity: Compatible with 802.11b / g / n networks, Output Power: 10dBm, receiver sensitivity: -91dBm, supports WEP, WPA-PSK, WPA-2-PSK.
- Box sizes: 86x53x58 mm. DIN rail format: 3 units to be installed on any standard electrical box.
- Memory size: 48 hours[3]

3 ODEnergy has an internal memory allowing you to store data (for sending frequency every 15 minutes) in case internet access is lost.

ODControl2

The ODControl2 is an electrical IP controller with the ability to interact with digital sensors and actuators both digital and analogue. The device has a web server for control and configuration, and in addition it can be configured and controlled remotely through OpenDomo Cloud. The ODControl is easily programmed using an integrated configurator that can be accessed via a web interface.

Figure 16: ODControl

Figure 15: Digital input voltage levels

Additionally, you can use templates and these can be stored safely in the cloud of OpenDomo.

Digital Inputs

The ODControl includes 8 digital inputs that can be used for push buttons, switches or any device such as an alarm sensor, dry contact or any source of voltage compatible with the values shown in the table of product characteristics. All inputs have an internal pull-down configuration that causes that all unconnected inputs will have a value of zero.

Examples of supported devices:

- Switches, push-buttons and limit switches.
- Sensors, level-switches and contacts in general.

Digital Outputs

The ODControl includes 8 open collector digital outputs, that can be connected to any load current, respecting: the polarity and maximum power of 2W for each output. Each output has an internal diode mounted in anti-parallel to simplify assembly of relays.

Example of supported devices:

- Relays and solid state relays.
- Pilot lights, sirens and other signalling devices.

Analogue Inputs

ODControl features 2 analogue inputs with two modes of operation: voltage and current. In voltage mode, the inputs can be configured for a standard range to 0-10 V or 1-10 V. The analogue inputs in voltage mode can be used as a voltmeter to measure any voltage within the range of 0-10 V. In the current operation mode, the inputs can be configured for a standard input of 0-20 mA or 4-20 mA. ODControl supports current loops with 2, 3 and 4 wires.

Examples of supported devices:

- Environmental sensors (temperature, humidity, light intensity, etc.).
- Electrical sensors (voltage, current, power, etc.).
- Distance sensors, volume, weight, pressure, etc.

And Analogue Outputs

ODControl provides 2 analogue outputs with two modes of operation: voltage and current. In voltage mode, the outputs can be configured for a standard mode of 0-10 V or 1-10 V In the current operation mode, the outputs can be configured for a standard mode of 0-20 mA and 4-20 mA.
Examples of supported devices:

- LED, fluorescent and incandescent dimming.
- Control valves.
- Control product dispensers.
- Linear actuators or servos.

Parameter	Minimum	Typical	Maximum
DC supply voltage	8 V	12 or 24 V	28 V
Current supply (12 V)		120 mA	
Current supply (24 V)		65 mA	
Allowable voltage in digital input ports	0 V C.C.		28 V C.C
Allowable voltage in digital output ports	0 V		The supply voltage
Logic “high” value in digital input ports	5 V		28 V
Logic “low” value in digital output ports	0 V		2 V
Current digital output ports			100 mA
Allowable voltage in AI0 and AI1 analog ports in voltage mode	0 V	0-10 V	30 V(1)
Input impedance of the AI1 and AI2 analog ports in voltage mode		39,2 KΩ	
Allowable current in AI1 and AI2 analog ports in current mode	0 mA	0-20 mA o 4-20 mA	25 mA(2)
Internal resistance of AI1 and AI2 analog ports in current mode		82 Ω	
Output voltage of AO1 and AO2 analog ports in voltage mode	0 V		10 V
Output current of AO1 and AO2 analog ports in voltage mode			10 mA
Output current of AO1 and AO2 analog ports in current mode	0 mA		20 mA
RS485 port transmission speed	1200 Bd		115200 Bd
RS485 bus length			1200 m(3)
Number of devices attached to the bus RS485			32
Ethernet port transmission speed			10 Mbps
Ethernet cable length			100 m(4)
Autonomy of real time clock without power		60 hours(5)	
Operating temperature	-10 ºC		60 ºC
Storage temperature	-10 ºC		70 ºC
Power supply input terminal block torque			0,5 Nm
Remaining terminal block torque			0,3 Nm
Power supply input terminal block cable size	0,5 mm^2 (AWG20)		2,5 mm^2 fine (AWG14) o 4 mm^2 solid (AWG12)
Remaining terminal block cable size			0,75 mm^2 (AWG19)

(1) From 10 V the input is saturated and the device will not indicate a higher voltage.
(2) From 20 mA the input is saturated and the device will not indicate a higher current.
(3) Assuming a theoretical value AWG24 cable section and a maximum speed of 100 kbps, the cable resistance approaches the resistance value at the end of reducing the signal bus about 6 dB.
(4) Using UTP cable, the specified value in IEEE 802.3-2008 standard.
(5) With the supercapacitor fully charged.

OD485C

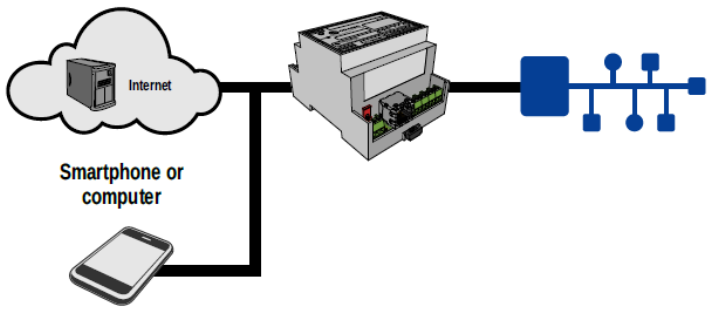
The OD485C is a Modbus/RTU to Ethernet gateway which can capture the data from any compatible device using the standard Modbus/RTU and send it to the OpenDomo Cloud or any other server automatically. The OD485C can read data from electricity, calories or water meters, environmental sensors such as temperature or humidity, and any other type Modbus/RTU compatible device.

OD485C includes 8 pulse inputs that allow the user to connect pulse counters with reed type emitters, transistor output, electromechanical and similar.

The device has an embedded web server for control and configuration and it can be configured and remotely controlled through the OpenDomo Cloud.

The device has an external MicroSD memory allowing storage of quarterly hour data for a period up to 6 months.

a)



b)

Figure 17a & 18b

The main characteristics of the device are listed in the table below:

Parameter	Minimum	Typical	Maximum
DC Supply Voltage	8V C.C.	12 o 24 V C.C.	28 V C.C.
Current Supply (12V)		120 mA	
Current Supply (24V)		65 mA	
RS485 port transmission speed	1200 Bd		115200Bd
RS485 bus length			1200 m
Number of devices attaced to the bus RS485			32
Ethernet port transmission priod			10 Mbps
Ethernet cable length			100m
High logic level of the pulses inputs	5 V		28V
Low logic level of the pulses inputs	0 V		2 V
Frequency of the pulses inputs			500 Hz
Width of the pulse (positive and negative)	1 ms		
Operating temperature	-10 °C		60°C
Storage temperature	-10 °C		70°C
Power supply input terminal block torque			0.5 Nm
RS485 terminal block torque			0.3 Nm
Power supply input terminal block cable size	0.5 mm2 (AWG20)		2.5 mm2 until (AWG14) or 4 mm2 solid (AWG12)
RS485 terminal block cable size			0.75 mm2 (AWG19(

9 Integration and display of the data collected in the Swedish Pilot site

9.1 Information available and collected

LANDSKRONAHEM PILOT INITIAL INFORMATION REQUESTED.	Initial Availability	AGENT INVOLVED	SCOPE	TIPOLOGY	FREQUENCY	2012	2013	2014	2015
ENERGY CONSUMPTIONS.									
DISTRICT HEATING. (HEATING&DHW) B11,13,15,17,19	NO	LANDSKRONA ENERGY	Sum 5 Buildings	MEASURED	HOURLY		available	available	available
DISTRICT HEATING. (HEATING&DHW) B11,13,15,17,19	NO	LANDSKRONAHEM (BMS)	Sum 5 Buildings	NORMALIZED	MONTHLY	available	available	available	available
ELECTRIC CONSUMPTION (COMMUNAL INSTALLATIONS)	NO	LANDSKRONA ENERGY	Each Building.	MEASURED	MONTHLY		available	available	available
ELECTRIC CONSUMPTION (COMMUNAL INSTALLATIONS)	NO	LANDSKRONA ENERGY	Each Building.	MEASURED	HOURLY				available
ELECTRIC CONSUMPTION TENANTS AGGREGATE.	NO	LANDSKRONA ENERGY	Each Building.	MEASURED	HOURLY				available
M3 DHW	NO	LANDSKRONA ENERGY	Sum 5 Buildings	MEASURED		available	available	available	available
INDOOR TEMPERATURE	NO	LANDSKRONAHEM (ECOGUARD)	Each Flat,	MEASURED	HOURLY				available from dic2015
	NO		5 Buildings.						
VENTILATION	NO				NONE AVAILABLE DATA				
EXAUSTED AIR HEAT PUMP.	NO	LANDSKRONAHEM	Building 1	ESTIMATION: Through DH Production and Electric Consumption.					
BUILDING DESCRIPTION. (drawings technical description)									
Arquitectonical	YES	LANDSKRONAHEM	Basic description provided						
Electric installation	NO	LANDSKRONAHEM	Basic description provided						
HAVC installation.	NO	LANDSKRONAHEM	Basic description provided						
SOCIOLOGICAL CHARACTERISITC									
Number of tenants per dwelling	NO	LANDSKRONAHEM	Not Provided yet						
Family status.	NO	LANDSKRONAHEM	It is been imposible to perform tenants interviews before renovations.						

The energy consumption data corresponding to 2015 have been integrated by SinCeO2 into the Opendomo Platform. This procedure has been possible thanks to the collaboration of Landskrona energy. For each parameter, it has created a CSV file with all the data for 2015 and next this file has been imported to the Opendomo platform using the Virtual Meter option, as described below.

9.2 Detailed description of the technical process of integration

The process of data integration from the installed devices follow the same structure as explained in the previous description of the architecture of the ODCloud.

In the case of Landskronahem (Swedish Pilot Site), instead of installing the metering devices on site, virtual meters were created on the ODS platform. These meters allow uploading chosen variables (e.g. active energy in kWh) and making the consumption and temperature data (obtained by bills provided by the energy company) available in the cloud in order to perform some analysis.

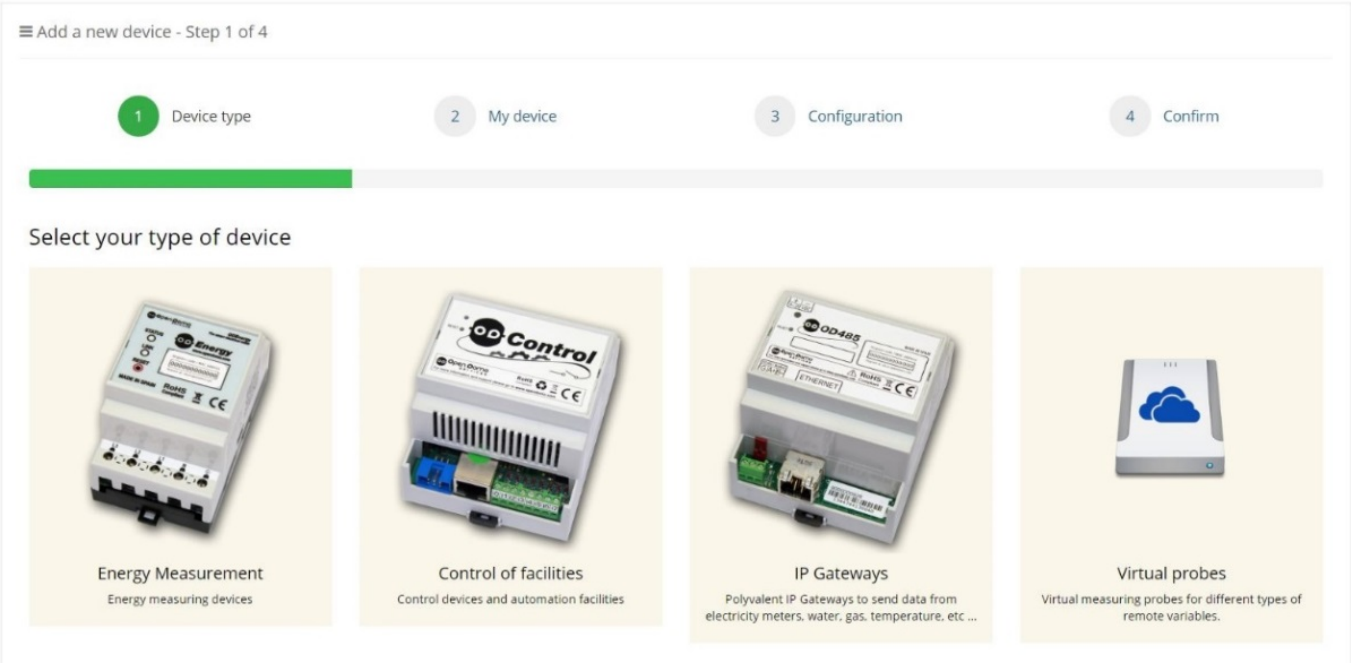


Figure 18: creation process of the virtual metering devices (virtual probes)

The creation of a virtual meter allows different ways of personalization during the configuration process:

- Operation between electric devices
- Operations between variables
- Upload the variables.
- Virtual temperature

By selecting: "Operations between variables", virtual meters can be created that are the result of mathematical operations on variables in the cloud (for example, general consumption – climate consumption = lighting consumption or aircon1+aircon2+aircon3=total HVAC). These meters behave like real ones and allow the user to graph data, create alarms, write a report, etc. Right now, there are no virtual meters of this kind installed yet.
"Virtual Temperatures" allow data gathering from weather stations such as outdoor temperatures, humidity, solar irradiation, wind, etc. without installing sensors. The data from weather station Landskrona is currently being used.

Through the option: “Upload the variables” it is possible to upload a csv file (Excel file in the format DD/MM/YYYY HH:MM:SS, VALUE. Lower than 2MB) and make the data related to selected variables available in the cloud.

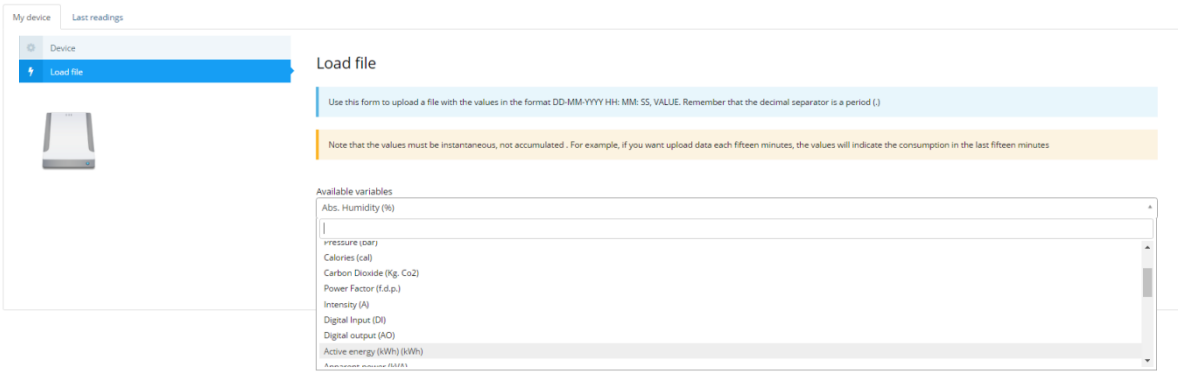


Figure 19: selection of the “update the variables” option.

The variables that can be uploaded are the ones that can be measured and handled by the cloud. The main ones regarding consumption are listed in the table below:

Variable	Unit
L1 active power in watts / hour	Wh
L2 active power in watts / hour	Wh
L3 active power in watts / hour	Wh
L1 reactive power in volt-amperes reactives / hour	varh
L2 reactive power in volt-amperes reactives / hour	varh
L3 reactive power in volt-amperes reactives / hour	varh
L1 active power in watts	W
L2 active power in watts	W
L3 Active power in watts	W
L1 reactive power in volt-amperes reactives	var
L2 reactive power in volt-amperes reactives	var
L3 reactive power in volt-amperes reactives	var
L1 phase voltage in volts	V
L2 phase voltage in volts	V
L3 phase voltage in volts	V
L1 current in milliamps	mA
L2 current in milliamperes	mA
L3 current in milliamps	mA

In the following picture, you can see an example of how data are visualized in the cloud. You can aggregate them monthly, weekly, daily, hourly or every quarter of an hour and choose to display only a certain range of dates.

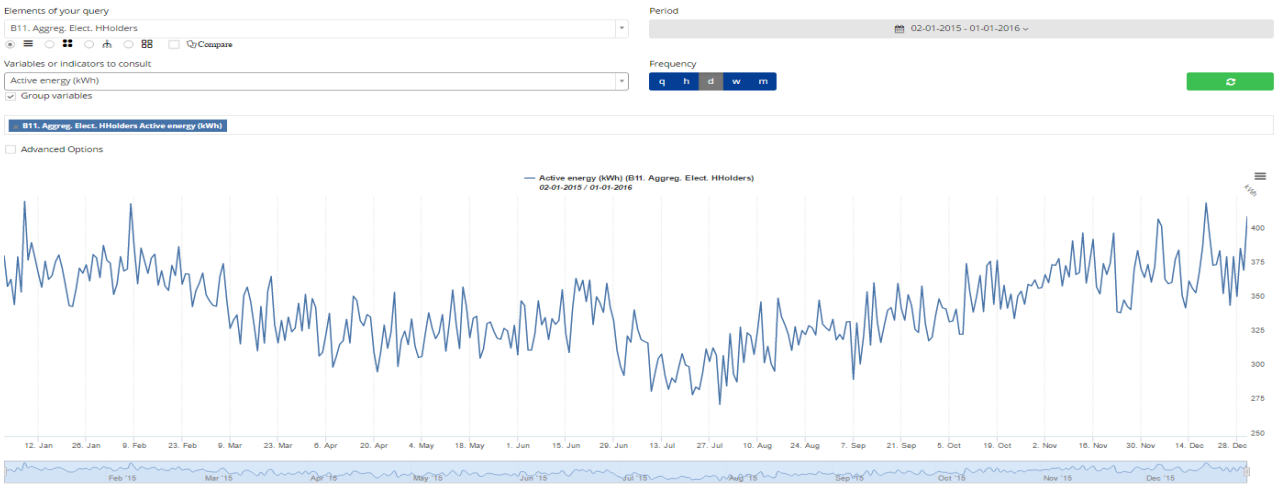


Figure 21: visualization of uploaded data.

In addition, it is possible to upload data about absolute humidity, occupancy, pressure, Kg CO2, Voltage etc. Once the data is stored in the cloud, it is available to be used for any kind of analysis and to perform the baseline computation analysis.

9.3 Data protection practices - data collected on buildings and tenants' consumption

Data is stored in distributed fault-tolerant virtual servers. Thus, the fall of a server involves no loss of data. Then the data is used and processed by the application servers, storing encrypted backups daily.

Privacy Policy

In accordance with:

- The Spanish law 15/1999, of December 13, Protection of Personal Data, and Law 34/2002 of July 11, Services Society Information and Electronic Commerce;
- And the European laws on privacy (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation);
- We have informed building owners and also tenants before the start of the data collection that personal data provided, both by the monitoring equipment and throughout the relationship during the project, will be included in a file managed by Open Domo Services, with the sole purpose of meeting the requests about the products or services developed in the DREEAM project. The building owners and the tenants are informed that they can exercise their rights of access, cancellation, rectification or opposition by sending a message to the system managers via email: support@opendomo.com

"Consent should be given by a clear affirmative act establishing a freely given, specific, informed and unambiguous indication of the data subject's agreement to the processing of personal data relating to him or her, such as by a written statement, including by electronic means, or an oral statement. This could include ticking a box when visiting an internet website, choosing technical settings for information society services or another statement or conduct which clearly indicates in this context the data subject's acceptance of the proposed processing of his or her personal data. Silence, pre-ticked boxes or inactivity should not therefore constitute consent. Consent should cover all processing activities carried out for the same purpose or purposes. When the processing has multiple purposes, consent should be given for all of them. If the data subject's consent is to be given following a request by electronic means, the request must be clear, concise and not unnecessarily disruptive to the use of the service for which it is provided".
Reference: Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

Disclaimers

Data transfer

The user agrees that his/her data may be transferred to servers and storage media located in territories within the European Union, exclusively for the stated purposes. Therefore, it agrees to extend the expressed authorization to other entities that provide professional hosting services and data management that are located within the European economic area.
User's acceptance, so that their data can be processed or transferred in the modality stated in this paragraph, is always revocable, without retroactive effect.

In the event that the user is a legal entity, the consent given by the managers for the purposes of Article 21 of Law 34/2002, is intended as given by both their own behalf and on behalf of the legal entity they represent and may at any time oppose the sending of advertising communications via mail, email or through other means of electronic communication. In any case, the data belong to the customer and Opendomo cannot use them for marketing purposes. Once a client withdraws from the service / project, the total reset of its data can be requested. If this is not requested, OpenDomo deletes the data a few months after the expiration of the license has not been renewed. In the communication protocol of the equipment itself, there is a UID (User Identifier) necessarily associated with the device. This device must be assigned to one UO (Organizational Unit User). Each user has access only to the UO which he was given access to. It is not possible to display other UO´s or its associated data. In fact, a user cannot modify the UO to which he has access. Only administrators can modify the UO associated with a user.

Password

The password is not saved, only a hash cryptographic is saved. Therefore, you cannot recover passwords from anyone. If a person loses his password, a new one must be requested. An email is sent to the user's personal account with a link to change the password.
When the user changes the password, it cannot be equal to any of the previous 3. It is mandatory to change the password every 3 months to increase security. The password must have a minimum of 8 characters and must contain a capital letter and at least one number.

9.4 List of the options and display currently available for building owners

It's already possible to access to the modules previously explained, even though it is not possible to design a common dashboard for the Building Owner, since only historic data is available and the widgets of the dashboard are thought to visualize and give easy access to the real time data.
Thanks to the "Analysis" tools, the Building Owner can visualize and track the electric and heating consumption of the buildings, compare the trends and analysis with the previous weeks' consumption data in order to better understand the consumption footprint, to quickly intervene in case of possible failures of the system and plan future interventions (e.g. peak shaving, automatization and control etc.). Currently, the data available for the Building Owner on the platform is from 2015. Nevertheless, with this historical data it is already possible to carry out some important first considerations on how to proceed further and how to plan the future interventions.

The buildings for which the data is available are the buildings: B11, B13, B15, B17 and B19. The virtual meters available for the analysis are the following:

Aggregated electric consumption of all the households living in the building.
These data refer to the aggregated consumption of all the apartments that are currently occupied by tenants, which is the total electric consumption of the households.

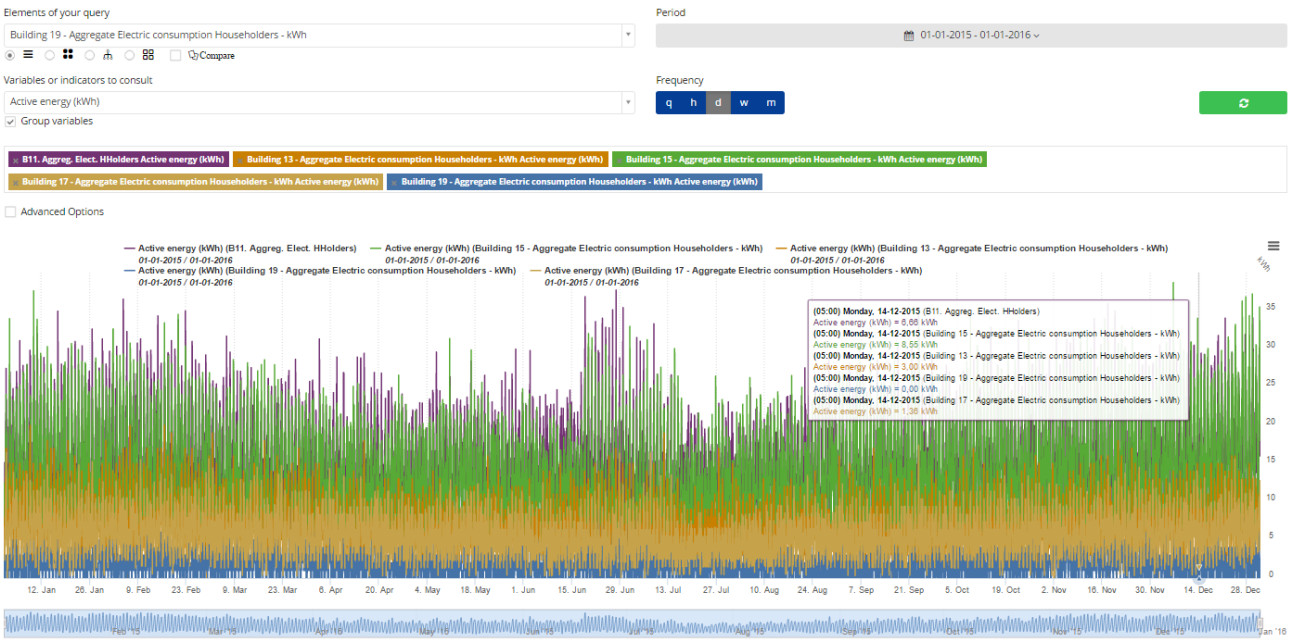


Figure 20: list of the virtual metering devices "installed" in each building.

It's interesting to notice that, even though the largest consumption corresponds to winter months, as we can see in the following graphs, in summer (between the 15th of June to the 15th of July) we can observe consumption peaks always at 9pm which proves that there was a change in the consumption pattern.

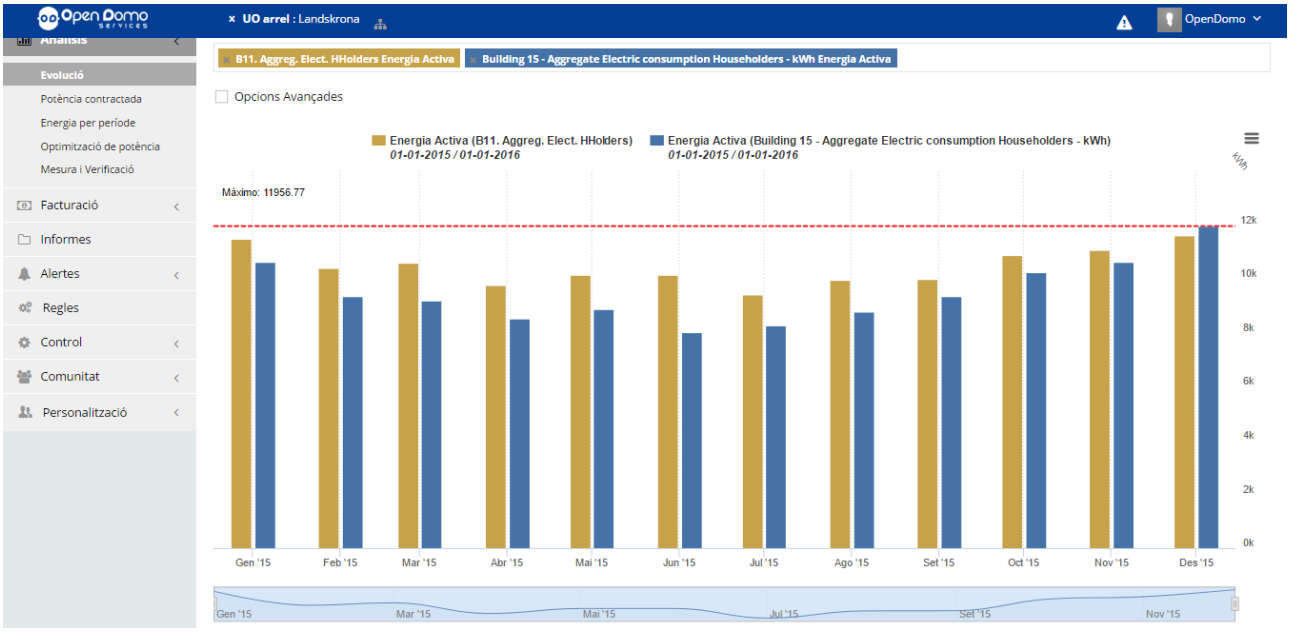


Figure 21: Aggregated electric consumption per month

The graph shown in Figure 22 clearly shows that building 19 consumes considerably less electricity than the others and that buildings 11 and 15 are the biggest consumers. This information is in absolute terms and therefore, it has to be assessed where more energy is being used per capita. To do so, the aggregated consumption is divided by the number of tenants per building, possibly also taking into account that different kind of tenants (singles, young couples, elderly couples, families, etc.) will have different consumption patterns.

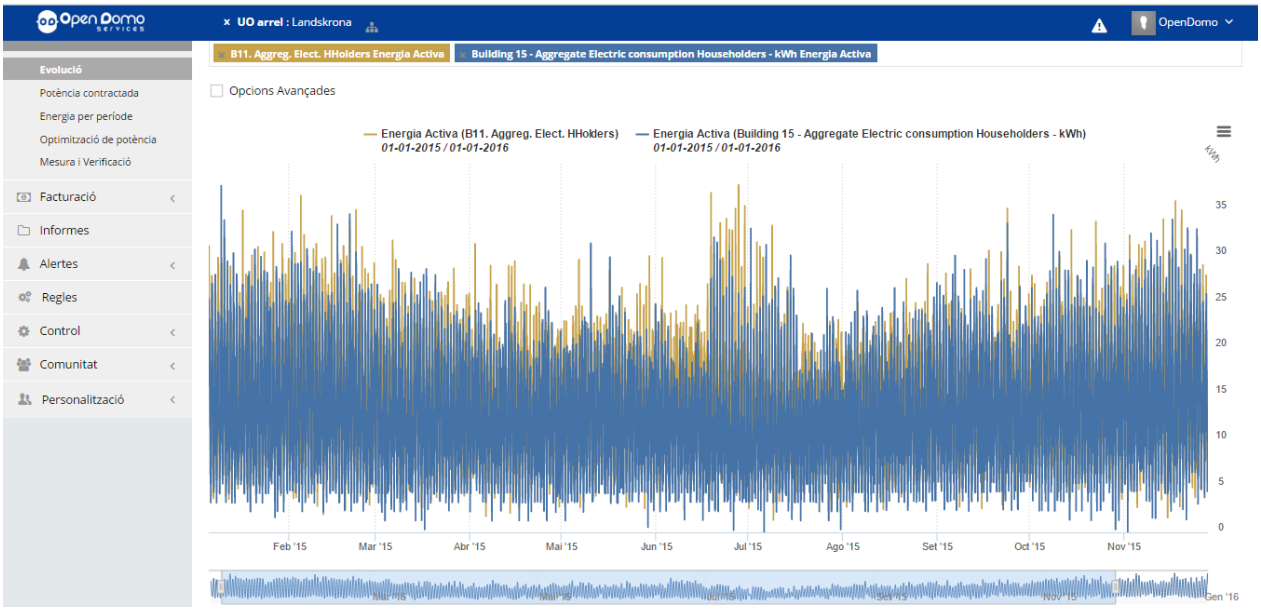


Figure 22: Hourly aggregated electricity consumption

Electricity consumption of communal services.

Similarly, regarding consumption in communal areas, building 13 and 17 consume less than the others, as can be understood from the following picture. This consumption is due to the heat recovery pump that was installed in 2015 and it has been tested during the year 2016.

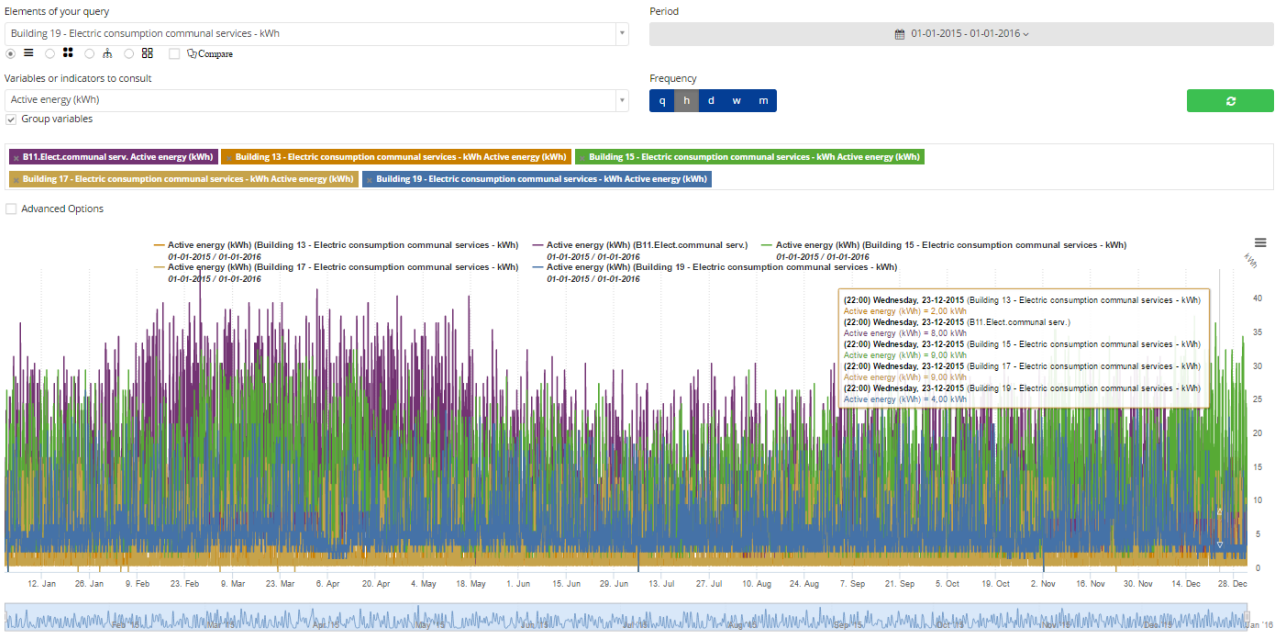
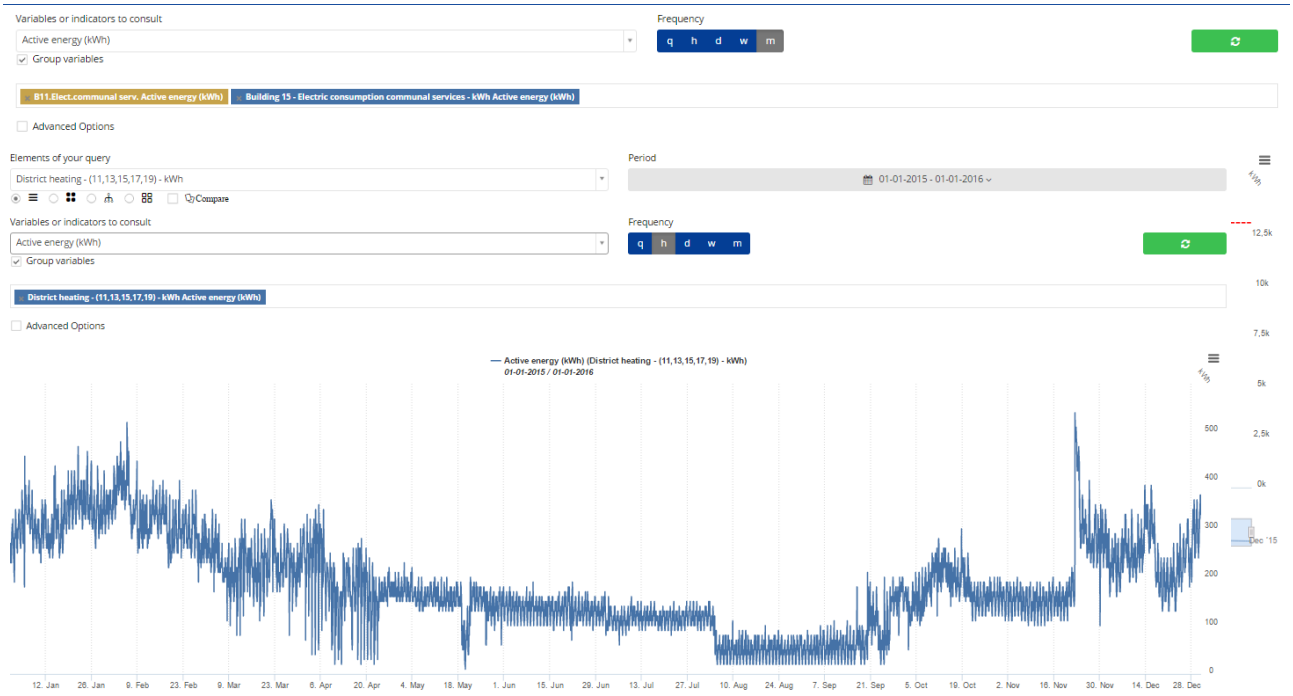


Figure 23: Hourly energy consumption of communal services for buildings 11, 13, 15, 17.

Cumulative district heating for all 5 buildings.

District heating data cannot be interpreted. The individual usage needs to be known. What we can see in the following graph, is a higher consumption in winter time and a decrease of consumption according with the evolution of outdoor temperatures during the summer time.



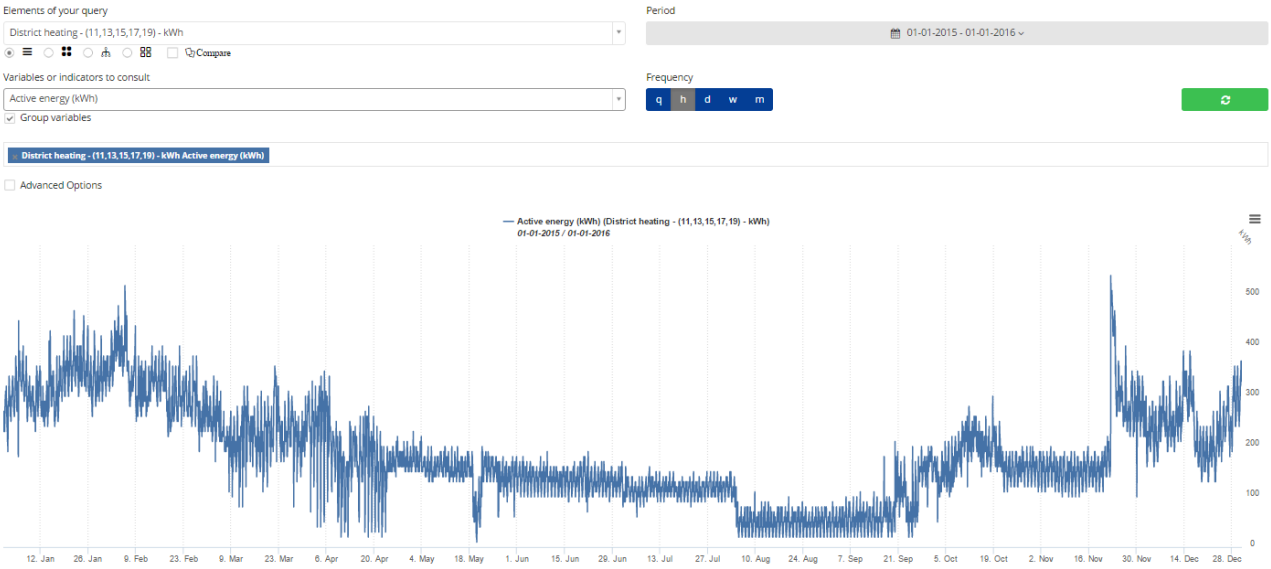


Figure 25: Energy consumption per month of communal services

Figure 26: District heating consumption per month

Figure 27: External temperature

Temperature probe for each apartment on each floor of each building (110 sensors in total).

The next picture shows an example of the internal temperature of a room (it corresponds to one of the 110 sensors)

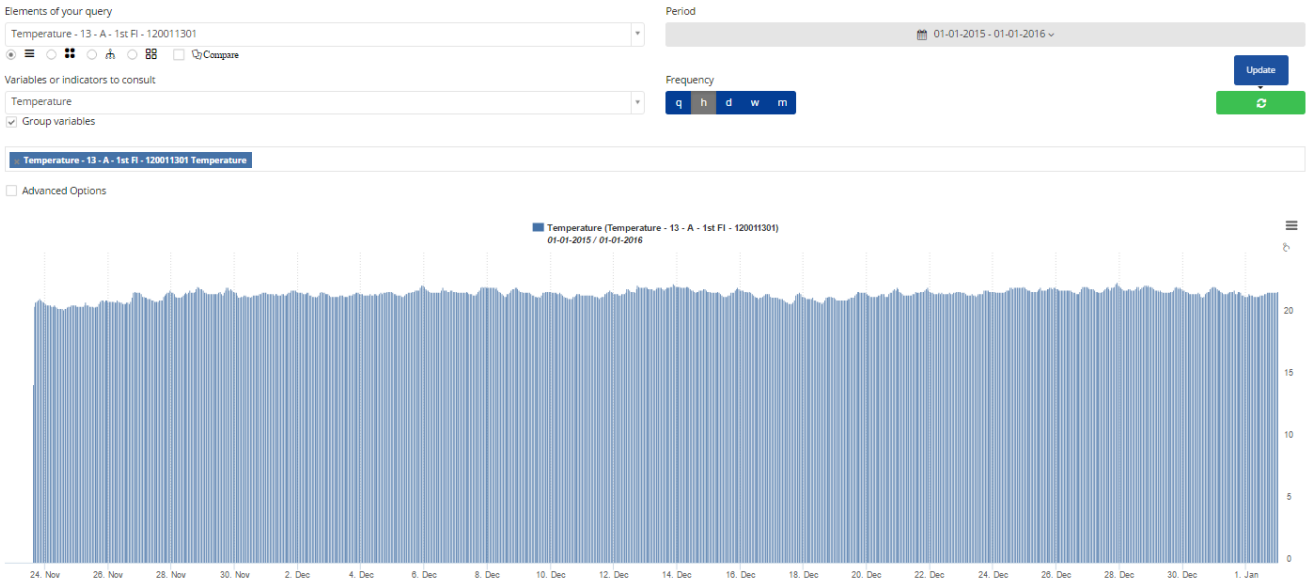


Figure 28: interior temperature evolution

In addition, the Building Owner can use the 2015 consumption data through the “Measurement and Verification” module which computes the baseline from 2015 consumption. This is a fundamental tool that allows the Building Owner to see the effective energy consumption independently of the number of households, the outdoor temperature and other factors.

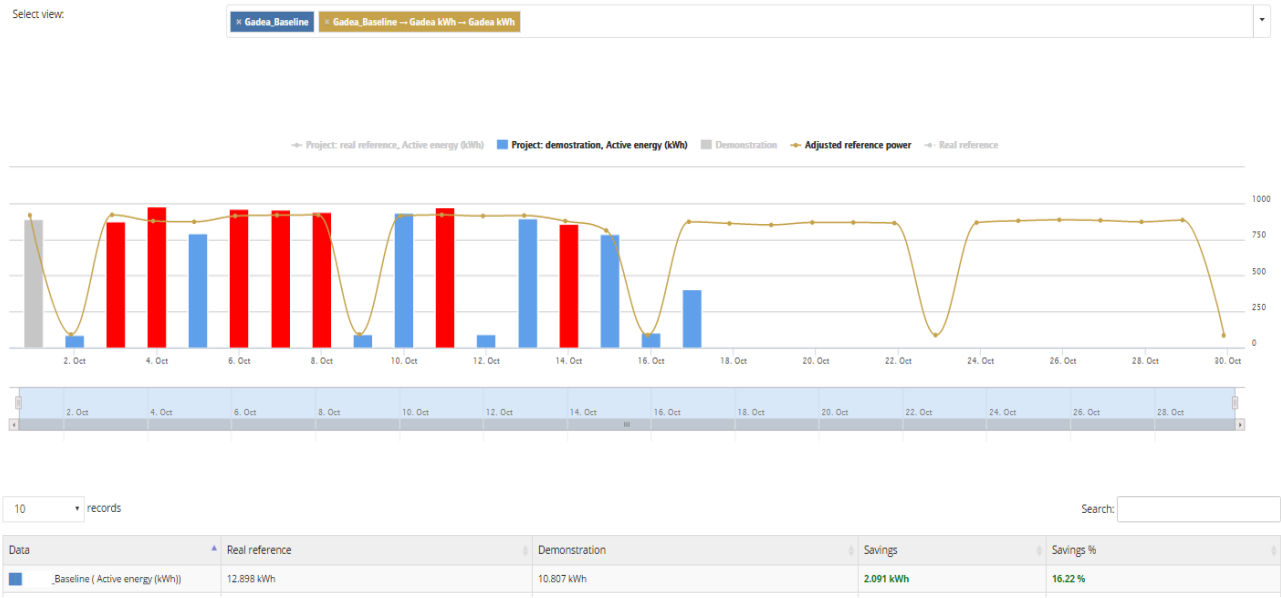


Figure 29: example of baseline

Thus, it enables the Building Owner and the consultant to evaluate in the most correct way the intervention performed in the building, the increase in energy efficiency and the consumption savings, comparing data from before the retrofitting and after it.

The picture above shows an example of baseline (for a building for which we had it available). The line represents what the consumption at a certain moment should be, according to a function that correlates it to certain variables, while the bars correspond to the actual consumption. In red you can see the days where the baseline was exceeded, in blue the ones where savings where achieved.
This allows computing the savings and their percentage on the total as shown in the bottom of the picture.

10 Integration and display of the data collected in the UK Pilot site

10.1 Data collection description

PFP PADIHAM PILOT INITIAL INFORMATION REQUESTED.				
Information	**Initial Availability**	**Agent involved**	**Other Agent requested**	**information Provided**
ENERGY CONSUMPTIONS				
Electric consumptions tenants	NO	PFP	Aggregate consumptions requested to GRID OPERATOR Without no results.	4 Tenants /some months
GAS Consumption tenants	NO	PFP		1 Tenant/1 year
BUILDING DESCRIPTION. (drawings technical description)				
Arquitectonical	YES	PFP		Basic description of tipologies.
Electric installation	NO	PFP/SinCeO2		Information collected in field visit.
Heating system	NO	PFP/SinCeO2		Information collected in field visit.
SOCIOLOGICAL CHARACTERISITC				
Number of tenants per dwelling	NO	PFP		
Family status.	NO	PFP/Savills		during interviews with tenants.

As the table shows, the available information in the PFP pilot site is limited despite the great collaboration and effort done by PFP to collect energy data.
In this context, the monitoring Plan (D4.1a) has been designed in order to collect the energy consumption from the main systems: Heating and Domestic hot water as well as the whole consumption.

Monitoring equipment was installed in September 2016. This equipment will provide the energy consumption in 9 archetypes dwellings, collecting the energy consumption from different installations and the air comfort parameters: temperature and humidity.

10.2 Detailed description of the technical process of integration in OD platform

In the UK Pilot Site, the devices were physically installed in the buildings. The devices deployed for this installation are:

- ODEnergy Three phase: Two different devices are installed, with phases respectively of 120A and 80A. Each phase of the meter measures a different circuit: main switch, house sockets, cooker, boiler, kitchen sockets and shower.
- IP Gateway OD485: used as a Connection Bridge between the sensors in the building and the platform. It collects data about humidity and temperature (living room and bedroom).
  The communication between the devices and the ODCloud takes place according to the architecture already explained in the previous section. The details of the installed devices for each apartment are displayed in the following tables.

		CODE	Csensor	CIRCUIT	Power (kW)	Temp./Hum.	Test
ODENERGY 1		D1.1.L1	120 A	Main Switch	5,4		Shower
		D1.1.L2	120 A	Shower	5,3		Low Power
		D1.1.L3	120 A	House Sockets	0,08		
ODENERGY2		D1.2.L1	80 A	Cooker	1,9		
		D1.2.L2	80 A	Boiler	0		
		D1.2.L3	80 A	Kitchen Sockets	1,3		Microwave
OD485C	SONDA1	D1.TEMP.LIV				18	
		D1.HUM.LIV				70	
	SONDA2	D1.TEMP.BED				18	
		D1.HUM.BED				79	

Apartment D1

		CODE	Csensor	CIRCUIT	Power (kW)	Temp./Hum.	Test
ODENERGY 1		D2.1.L1	120 A	Off Peak (e.s.heaters)	0		
		D2.1.L2	120 A	Main Switch	0,322		House Sockets.
		D2.1.L3	120 A	Shower	2,1		low
ODENERGY2		D2.2.L1	80 A	Downfloor Sockets	0,33		
		D2.2.L2	80 A	Immersion (DHW)	3,2		
		D2.2.L3	80 A	Bathroom Heater	2,1		
OD485C	SONDA1	D2.TEMP.LIV				20,9	
		D2.HUM.LIV				65	
	SONDA2	D2.TEMP.BED				21,5	
		D2.HUM.BED				63	

Apartment D2

		CODE	Csensor	CIRCUIT	Power (kW)	Temp./Hum.	Test
ODENERGY 1		D3.1.L1	120 A	Off Peak (e.s.heaters)	0		
		D3.1.L2	120 A	Main Switch	6,8		Shower+BH
		D3.1.L3	120 A	Shower	4,5		medium
ODENERGY2		D3.2.L1	80 A	Sockets Downstair	0,11		
		D3.2.L2	80 A	Immersion (DHW)	-		
		D3.2.L3	80 A	Bathroom Heater	2,3		
OD485C	SONDA1	D3.TEMP.LIV				20,7	
		D3.HUM.LIV				67	
	SONDA2	D3.TEMP.BED				21,5	
		D3.HUM.BED				64	

Apartment D3

		CODE	Csensor	CIRCUIT	Power (kW)	Temp./Hum.	Test
ODENERGY 1		D4.1.L1	120 A	Main Switch			
		D4.1.L2	120 A	Shower	9		High
		D4.1.L3	120 A	Off Peak (e.s.heaters)			
ODENERGY2		D4.2.L1	80 A	Immersion (DHW)	3,17		
		D4.2.L2	80 A	Sockets	2,121		aux.heater
		D4.2.L3	80 A	Bathroom Heater	2,14		
OD485C	SONDA1	D4.TEMP.LIV				25	
		D4.HUM.LIV				48	
	SONDA2	D4.TEMP.BED				23,3	
		D4.HUM.BED				53	
	SONDA3	D4.TEMP.EXT				18,4	
		D4.HUM.EXT				67,7	

Apartment D4

		CODE	Csensor	CIRCUIT	Voltage (V)	Power (kW)	Current (A)	Power Factor	TEST
ODENERGY 1		D5.1.L1	120 A	Main Switch	247	10,7	43	0,99	Microwave+Shower
		D5.1.L2	120 A	Shower	244	5,4	21	0,99	medium
		D5.1.L3	120 A	House Sockets	246	0,22	0,95	0,98	TV
ODENERGY2		D5.2.L1	80 A	Cooker					No use
		D5.2.L2	80 A	Boiler					
		D5.2.L3	80 A	Kitchen Sockets	245	1,3	5,45	0,98	Kettle
OD485C	SONDA1	D5.TEMP.LIV							17,6
		D5.HUM.LIV							64%
	SONDA2	D5.TEMP.BED							18,1
		D5.HUM.BED							70%

Apartment D5

		CODE	Csensor	CIRCUIT	Voltage (V)	Power (kW)	Current (A)	Power Factor	TEST
ODENERGY 1		D6.1.L1	120 A	Off Peak (e.s.heaters)					
		D6.1.L2	120 A	Main Switch	242	12,1	48,5	0,99	Shower + kettle
		D6.1.L3	120 A	Shower	243	9,18	36	0,99	High
ODENERGY2		D6.2.L1	80 A	House Sockets	246	2,3	9	0,99	Aux Heater
		D6.2.L2	80 A	Immersion (DHW)					
		D6.2.L3	80 A	Kitchen Sockets	246	1,39	5,15	0,99	Kettle + Microwave
OD485C	SONDA1	D6.TEMP.LIV							18,5
		D6.HUM.LIV							69,50%
	SONDA2	D6.TEMP.BED							18,3
		D6.HUM.BED							67,50%

Apartment D6

		CODE	Csensor	CIRCUIT	Voltage (V)	Power (kW)	Current (A)	Power Factor	TEST
ODENERGY 1		D7.1.L1	120 A	Off Peak (e.s.heaters)					
		D7.1.L2	120 A	Main Switch	246	2,6	10,31	0,99	Washing
		D7.1.L3	120 A	Shower	245	8,33	33,12	0,99	High
ODENERGY2		D7.2.L1	80 A	Kitchen Sockets	246	3,18	12,6	0,99	Washing+Kettle
		D7.2.L2	80 A	Immersion (DHW)	246	3,18	12,46	0,99	Boost
		D7.2.L3	80 A	Bathroom Heater	245	2,16	8,58	0,99	
OD485C	SONDA1	D7.TEMP.LIV							21
		D7.HUM.LIV							41,67%
	SONDA2	D7.TEMP.BED							22,6
		D7.HUM.BED							47%

Apartment D7

		CODE	Csensor	CIRCUIT	Voltage (V)	Power (kW)	Current (A)	Power Factor	TEST
ODENERGY 1		D8.1.L1	120 A	Off Peak (e.s.heaters)					
		D8.1.L2	120 A	Main Switch	245	12,13	48,3	0,99	Shower+Heater Bath
		D8.1.L3	120 A	Shower	245	9,7	38	0,99	High
ODENERGY2		D8.2.L1	80 A	Downfloor Sockets	246	2,32	9,2	0,99	Aux heater
		D8.2.L2	80 A	Immersion (DHW)	245	3,3	1,3	0,99	Boost
		D8.2.L3	80 A	Heater Bathroom	243	2,11	8,42	0,99	
OD485C	SONDA1	D8.TEMP.LIV							19,9
		D8.HUM.LIV							52%
	SONDA2	D8.TEMP.BED							19,4
		D8.HUM.BED							60%

Apartment D8

		CODE	Csensor	CIRCUIT	Voltage (V)	Power (kW)	Current (A)	Power Factor	Notes
ODENERGY 1		D9.1.L1	120 A	Off Peak (e.s.heaters)					
		D9.1.L2	120 A	Main Switch	245	12,2	48,3	0,99	Heater+Shower
		D9.1.L3	120 A	Shower	245	9,55	37,87	0,98	High
ODENERGY2		D9.2.L1	80 A	Downfloor Sockets	245	3	11,8	0,99	
		D9.2.L2	80 A	Immersion (DHW)	246	3,3	13,1	0,99	boost
		D9.2.L3	80 A	Heater Bathroom	244	2,1	8,4	0,99	Heater
OD485C	SONDA1	D9.TEMP.LIV							18,6
		D9.HUM.LIV							67%
	SONDA2	D9.TEMP.BED							18
		D9.HUM.BED							72%

Apartment D9

10.3 List of the options and display currently available for building owners

As already displayed in the tables above, the devices are installed in 9 different flats (D1, D2, D3, D4, D5, D6, D7, D8, D9) with different surface and occupancy characteristics.
Now we will take the building D7 as example to show what tools are available for the Building Owner. The specifications of this flat are shown in the following figure.

Normal Heating pattern of use:
Period; October – April
Electric Storage heater normally On during winter: Living room+ 2 bedroom, (main bedroom without heater)
Auxiliary heater by gas on ground floor.
Auxiliary electric heater (2000 w) in kitchen.

Appliances (Electric Consumption):
Fridge, Microwave, Cooker, Oven, Washing machine, Drier machine, Kettle, toaster

Figure 30: characteristics of the apartment D7.

In the PFP pilot there is no historic data available, the data can be visualized starting from the day of installation, which for flat D9 is September, 22nd. 2016.

The daily and hourly consumption measured by each meter is illustrated in the following graphs.

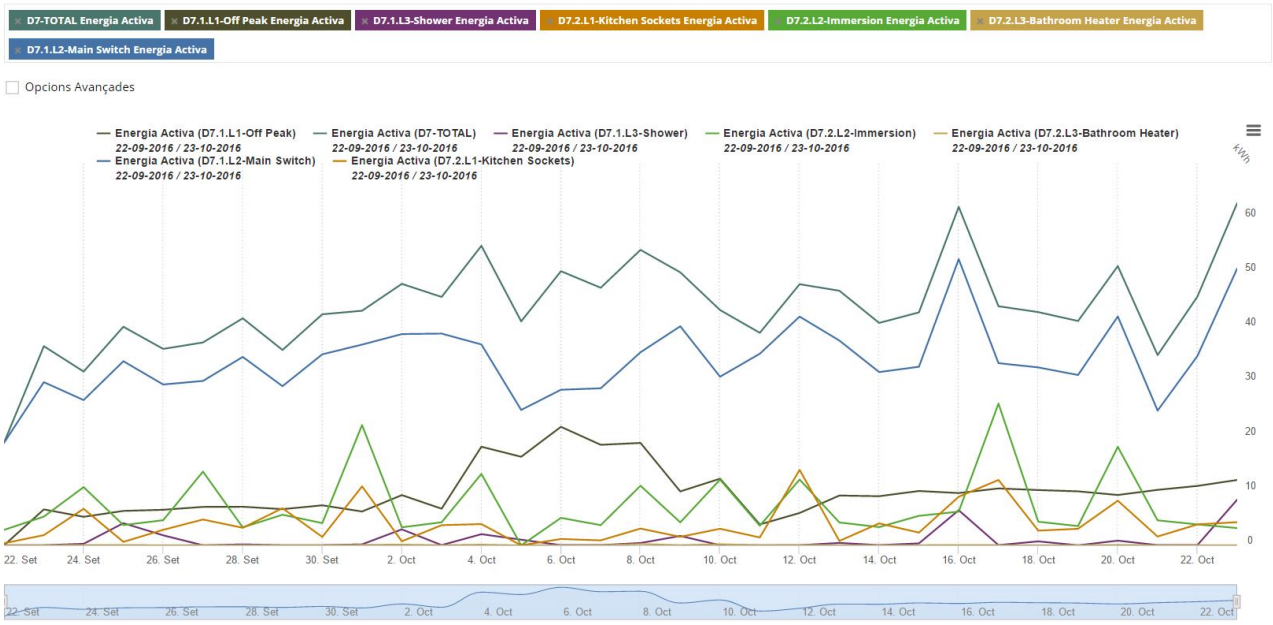


Figure 31: daily consumption lines measured by each single meter from 22/09 until the current day.

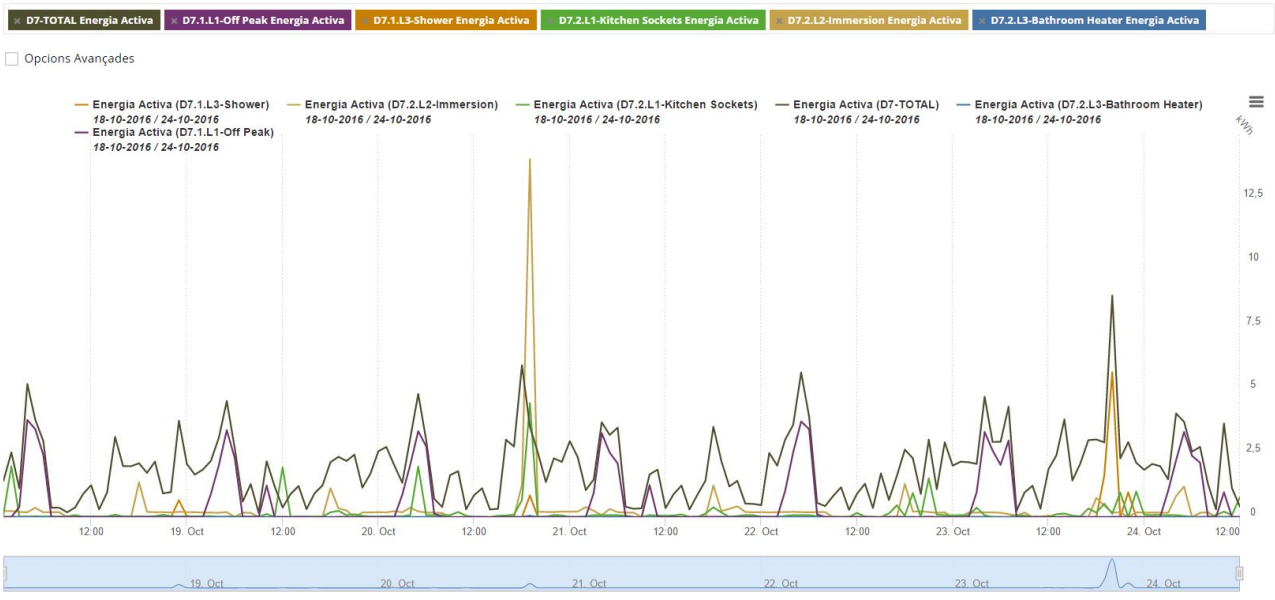


Figure 32: Hourly consumption lines representing the measured values by each meter during the last days.

Below, we explain what the results of each meter represent:

Main switch + off-peak meter

The following illustration shows the total consumption as the sum of “main switch + off-peak”.

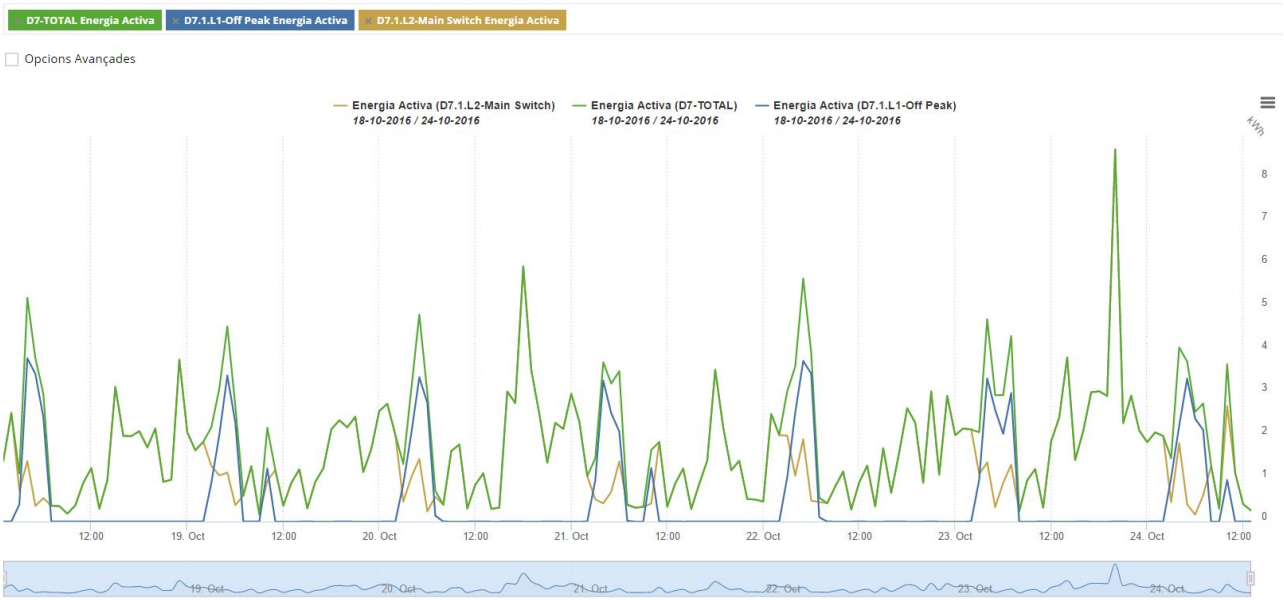


Figure 33: Total energy consumption=main switch + off-peak (nocturnal) consumption.

Night consumption

The following illustration displays the measures of the consumption during the night. This is done because the tenants have a two-part tariff, meaning a different electricity price during day time (more expensive) and night time (cheaper). The electric storage heaters store energy overnight and make it available in the morning.

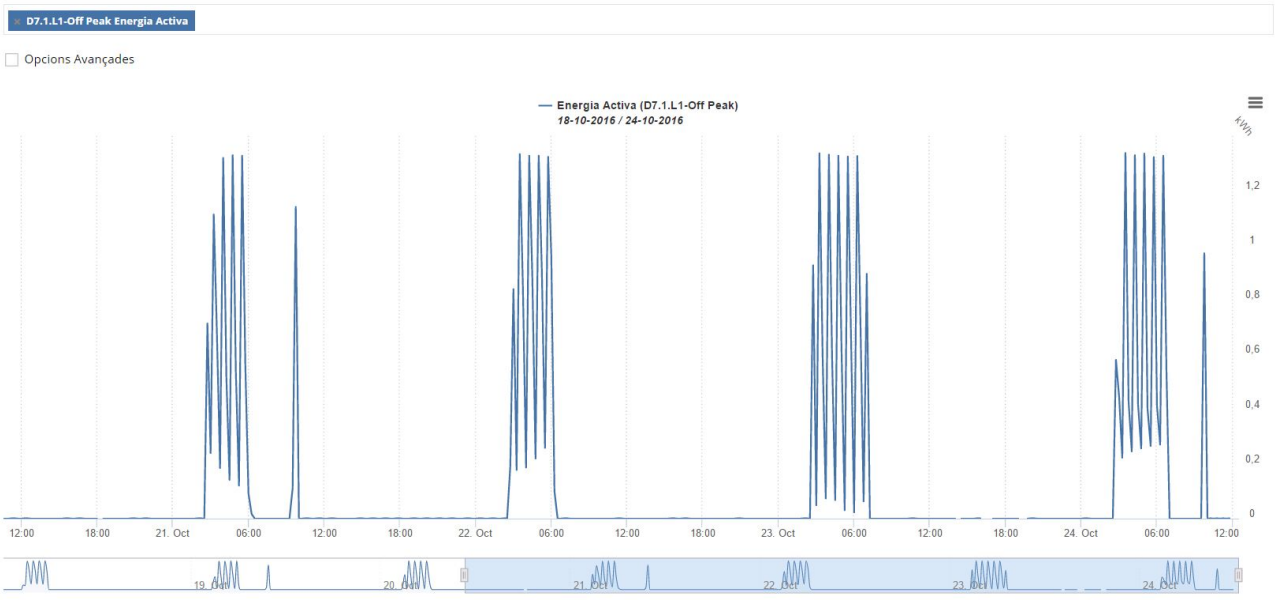


Figure 34: nocturnal electricity consumption.

Main-switch meter

This meter is connected to the main switch and therefore it is the measurement of the sum of all electric consumption of the house including:

- Shower.
- Appliances (cooker, oven, fridge, etc.).
- Immersion. It is a resistive heating element for DHW.
- Bathroom heater (ambient heating).
- Lighting System

Temperature and humidity sensors: the temperature and the humidity are detected in the living room and in one of the two bedrooms. The results are shown in the graphs below.

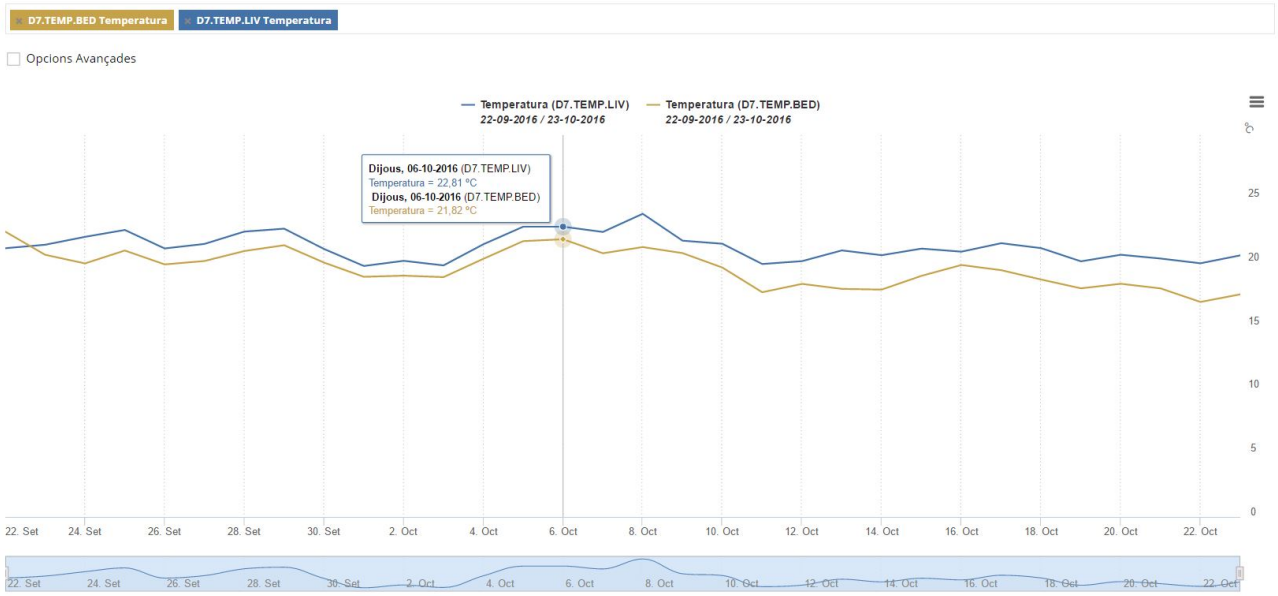


Figure 35: evolution of indoor temperatures

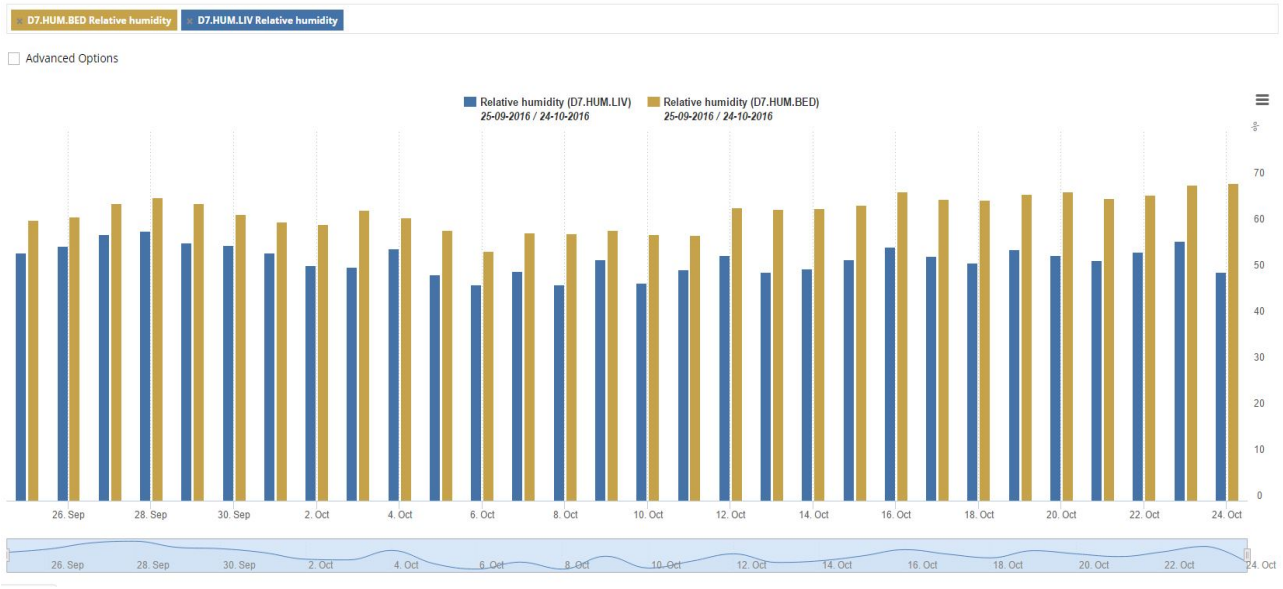


Figure 36: relative humidity

Finally, even though the data available are very limited, it is possible to make some observations. For example, it is interesting to analyse the heating consumption (off-peak meter) related to the outdoor temperature. This is done in the graph displayed below. As we can notice in the figure, there is a peak in the consumption of the electric storage heater which is not due to an abrupt decrease of the outdoor temperature or increase of the indoor temperature. The reasons behind this very high peak consumption have to be found and the apartment consumption trends have to be monitored in order to understand if this is an isolated event or if it happens regularly.

The same meters are installed in all apartments and therefore the same explanation is not repeated for each one of the dwellings. The same failures that happen in apartment D7 are present in all the other ones, and hence further research is required. The meters of the apartments D2 and D6 stopped working on October, 5th at 10am and 1pm respectively. The reasons of these failures are being inspected.

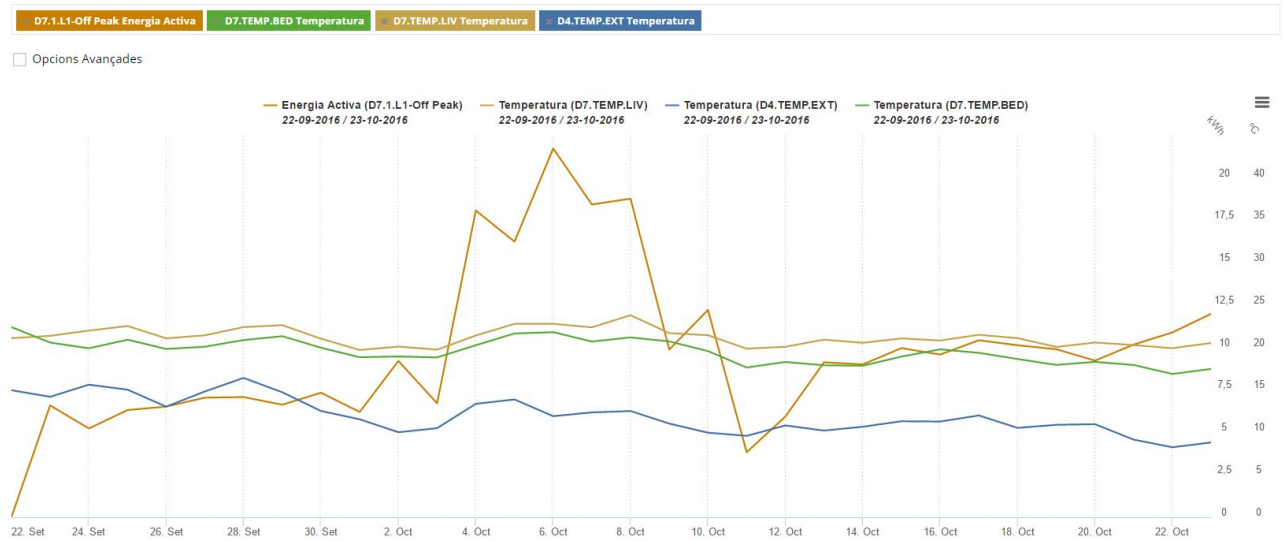


Figure 37: electricity consumption for heating in correlation with the indoor and outdoor temperature.

10.4 Data protection practices - data collected on buildings and tenants' consumption

Data is stored in distributed fault-tolerant virtual servers. Thus, the fall of a server involves no loss of data. Then the data is used and processed by the application servers, storing encrypted backups daily.

Privacy Policy

In accordance with:

- The Spanish law 15/1999, of December 13, Protection of Personal Data, and Law 34/2002 of July 11, Services Society Information and Electronic Commerce;
- And the European laws on privacy (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation);
- We have informed building owners and also tenants before the start of the data collection that personal data provided, both by the monitoring equipment and throughout the relationship during the project, will be included in a file managed by Open Domo Services, with the sole purpose of meeting the requests about the products or services developed in the DREEAM project. The building owners and the tenants are informed that they can exercise their rights of access, cancellation, rectification or opposition by sending a message to the system managers via email: support@opendomo.com

Disclaimers

Data transfer

The user agrees that his/her data may be transferred to servers and storage media located in territories within the European Union, exclusively for the stated purposes. Therefore, it agrees to extend the expressed authorization to other entities that provide professional hosting services and data management that are located within the European economic area.

User's acceptance, so that their data can be processed or transferred in the modality stated in this paragraph, is always revocable, without retroactive effect.

In the event that the user is a legal entity, the consent given by the managers for the purposes of Article 21 of Law 34/2002, is intended as given by both their own behalf and on behalf of the legal entity they represent and may at any time oppose the sending of advertising communications via mail, email or through other means of electronic communication. In any case, the data belong to the customer and Opendomo cannot use them for marketing purposes. Once a client withdraws from the service / project, the total reset of its data can be requested. If this is not requested, OpenDomo deletes the data a few months after the expiration of the license has not been renewed. In the communication protocol of the equipment itself, there is a UID necessarily associated with the device. This device must be assigned to one UO. Each user has access only to the UO which he was given access to. It is not possible to display other UO´s or its associated data. In fact, a user cannot modify the UO to which he has access. Only administrators can modify the UO associated with a user.

Password

The password is not saved, only a hash cryptographic is saved. Therefore, you cannot recover passwords from

anyone. If a person loses his password, a new one must be requested. An email is sent to the user's personal account with a link to change the password.
When the user changes the password, it cannot be equal to any of the previous 3. It is mandatory to change the password every 3 months to increase security. The password must have a minimum of 8 characters and must contain a capital letter and at least one number.

11 Integration and display of the data collected in the Italy Pilot site

11.1 Information collected and available in the 1st ATER Pilot site

ATER TREVISO !st PILOT INITIAL INFORMATION REQUESTED.				
Information	**Initial Availability**	**Agent involved**	**Other Agent requested**	**information Provided**
ENERGY CONSUMPTIONS				
Electric consumptions comunal Areas	NO	Ater/building manager	Eon (utility) Without no results	1 year
Electric consumptions tenants	NO	Ater/	Aggregate consumptions requested to Eon (utility) Without no results.	8 Tenants 1 year
Gas consumptions Central Heating.	NO	Ater/ Syram (Esco)		3 Years
Gas consumptions Central Heating.	NO	Ater/ Syram (Esco)		3 Years
Tenants heating bills (from electronic allocators)	NO	Ater/Syram/tenants		1 Year (7 tenants)
BUILDING DESCRIPTION. (drawings technical description)				
Arquitectonical	YES			Basic description.
Electric installation	NO			Information collected in field visit.
HAVC installation.	YES			Basic description
SOCIOLOGICAL CHARACTERISITC				
Number of tenants per dwelling	NO	Ater/Savills		Ater/
Family status.	NO	Ater/Savills		Savills Interviews

The information provided corresponds to monthly energy consumption. This data has been integrated into the Opendomo Platform, however with a monthly interval the energy consumption pattern is not as complete as an hourly or daily analysis. The monitoring plan was designed to include all energy consumption from the central heating and the electrical consumption of tenants. This plan meant that the Opendomo hardware needed to register all the parameters every 15 minutes in the OD Platform.

The integration of available data into the OD platform has been performed through the option of virtual meters as explained before in the Landskronahem Pilot site description.

11.2 Information collected and available in the 2nd ATER Pilot site

ATER TREVISO 2nd PILOT INITIAL INFORMATION REQUESTED.				
Information	Initial Availability	Agent involved	Other Agent requested	information Provided
ENERGY CONSUMPTIONS				
Electric consumptions comunal Areas	NO	Ater/building manager	NA	1 year
Electric consumptions tenants	NO	Ater	NA	11 Tenants 1 year
Gas consumptions tenants	NO	Ater	NA	10 Tenants 1 year
BUILDING DESCRIPTION. (drawings technical description)				
Arquitectonical	YES			Basic description.
Electric installation	NO			Information collected in field visit.
HAVC installation.	YES			Basic description
SOCIOLOGICAL CHARACTERISITC				
Number of tenants per dwelling	NO	Ater/Savills		Ater/
Family status.	NO	Ater/Savills		Savills Interviews

The monitoring plan for this pilot site is currently in process and it is initially designed to collect the following information:

- Electric consumption in communal areas (lighting, elevator, others);
- Total electric consumption for each tenant;
- Gas consumption of each tenant, (despite of being designed this way there has not been collaboration from the gas supply company and the data from gas consumption will be registered manually);

The monitoring plan (D.4.1) prescribes all the devices and installations needed to perform the integration in Open Domo Platform. The integration process into Open Domo platform is similar to the UK Pilot Site through OD energy meters and OD485 gateway.

11.3 List of the options and displays currently available for building owners

The data available in the Cloud represent the aggregated consumption of the 100 apartments that compose the building, thus there is no meaningful data available to make considerations about the households' consumption pattern.

11.4 Data protection practices - data collected on buildings and tenants' consumption

Data is stored in distributed fault-tolerant virtual servers. Thus, the fall of a server involves no loss of data. Then the data is used and processed by the application servers, storing encrypted backups daily.

Privacy Policy

In accordance with:

- The Spanish law 15/1999, of December 13, Protection of Personal Data, and Law 34/2002 of July 11, Services Society Information and Electronic Commerce;
- And the European laws on privacy (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)**;**
- We have informed building owners and also tenants before the start of the data collection that personal data provided, both by the monitoring equipment and throughout the relationship during the project, will be included in a file managed by Open Domo Services, with the sole purpose of meeting the requests about the products or services developed in the DREEAM project. The building owners and the tenants are informed that they can exercise their rights of access, cancellation, rectification or opposition by sending a message to the system managers via email: support@opendomo.com

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Password

The password is not saved, only a hash cryptographic is saved. Therefore, you cannot recover passwords from anyone. If a person loses his password, a new one must be requested. An email is sent to the user's personal account with a link to change the password.

When the user changes the password, it cannot be equal to any of the previous 3. It is mandatory to change the password every 3 months to increase security. The password must have a minimum of 8 characters and must contain a capital letter and at least one number.

12 1st Users Evaluation meetings

12.1 How the 1st Users evaluation has been prepared and performed?

Before the Users Tests:

1. 1st heuristic evaluation: SAVILLS has first evaluated and synthetized the key elements of the existing Open Domo platform that are relevant to research and use in the specific context of the DREEAM project. The strengths and weaknesses of the platform have been listed based both in terms of utility and usability. Then a division of the elements to test has been done between the 1st and the 2nd Users tests as we don't have time in one meeting of 2 to 4 hours to cover all the different content and design of the platform. This is why 3 Users tests have been programmed in 2016 (before the renovation options) and 3 new Users Tests in 2017 (after the final definition of the renovation options in the 3 pilot sites) with each of the 3 building owners;

2. For each of the key services that the Open Domo platform already proposes, Savills and Open Domo have prepared a PPT presentation explaining the content, design and the navigability options that building owners can have access to in the platform. This PPT presentation has been used during the User Tests;

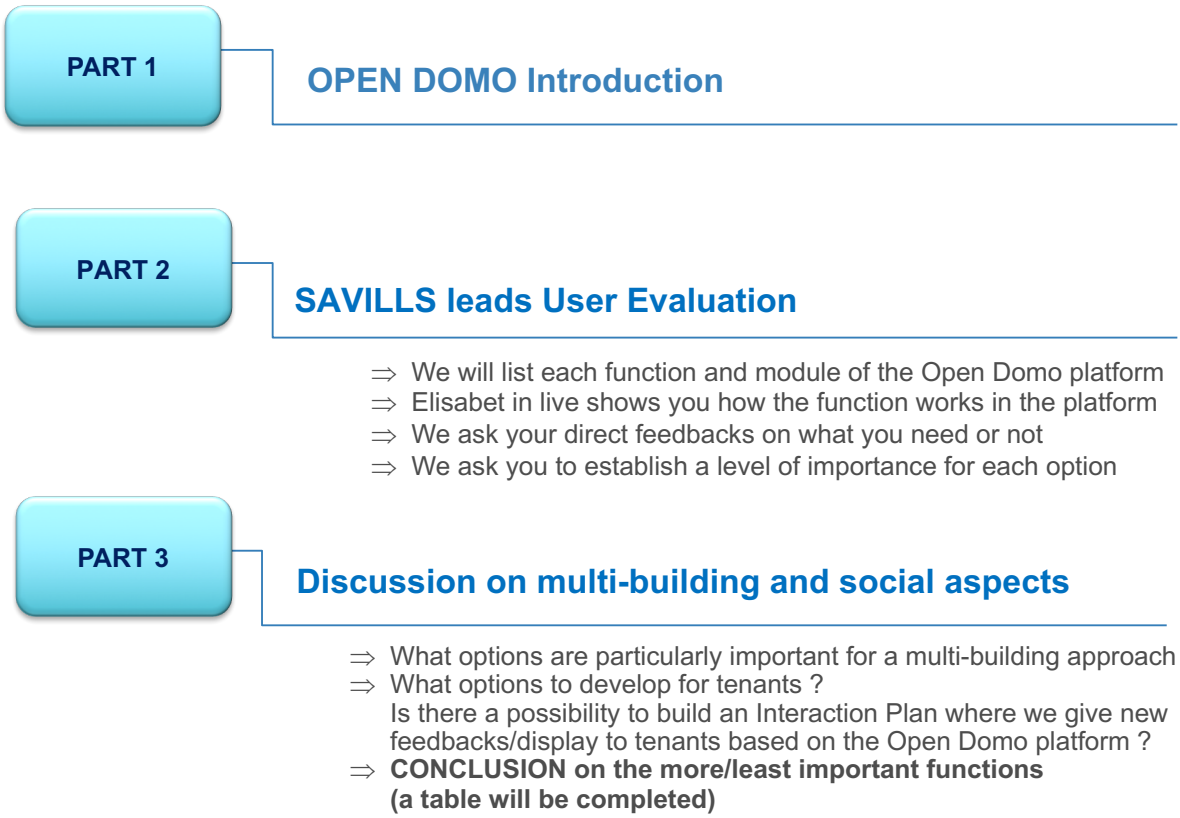
During the Users tests:

3. In live, Open Domo displayed on the presentation screen the services and navigation to the building owners in order to show to the users how they can get access to the function in the platform and how it is working. The key objective of this step is not yet to study the detailed question of the usability and the easiness of use, but to concentrate our work on the interest of the different services/options and their relevance for the building owners. Our work will indeed be divided in 3 steps in the platform development: definition of services, design of the information (content structure), usability (interactions users/interface: navigation, graphical options);

4. After the short live presentation of Open Domo, and the navigation inside the service, Savills and Open Domo asked directly to the building owners' employees a list of prepared questions (heuristic evaluation guideline) to evaluate the platform;

5. Then for each service and option proposed, we have asked the building owners to establish a level of importance for them in the context of the DREEAM project and in a multi-building approach, in order to identify what will be mandatory, normal and ideal options in the platform for each building owner. Based on this list together with the budget for the development of Open Domo and the exchanges with the other Work Packages, we will be able to establish the scope of options that Open Domo should improve or develop in 2017 from the existing Open Domo platform into the DREEAM platform.

12.2 Presentation of the Users Evaluation schedule organized with the 3 building owners:



12.3 The heuristic evaluation guideline/ list of questions used during 1st Users evaluation

The sociologist of SAVILLS has built the detailed guideline in collaboration with Open Domo after having listed:

- The improvements that Open Domo could develop according to their human resources and budget;
- And the key options that could be relevant to build in the specific objective of assessing the impact of a multi-building approach on energy demand and energy consumption.

The detailed heuristic evaluation guideline has been presented in its complete version in the part 7.2 (p. 22).

13 Users evaluation: synthetic results from the 1st Users Tests

Following the 3 meetings with the 3 building owners, Open Domo and Savills have produced a deliverable report with a synthesis of the Open Domo characteristics/functions and a synthesis of the improvements & additional options that the building owners have requested during the 1st evaluation tests in 2016.

In the following part, we present the results of the 3 User Tests in the following manner:

Part 1: introduction about each service/option. We describe what Open Domo has presented to the building owners live on screen and the explanations given to them whilst on the Open Domo platform;

Part 2: we detail the list of questions asked to building owners' employees;

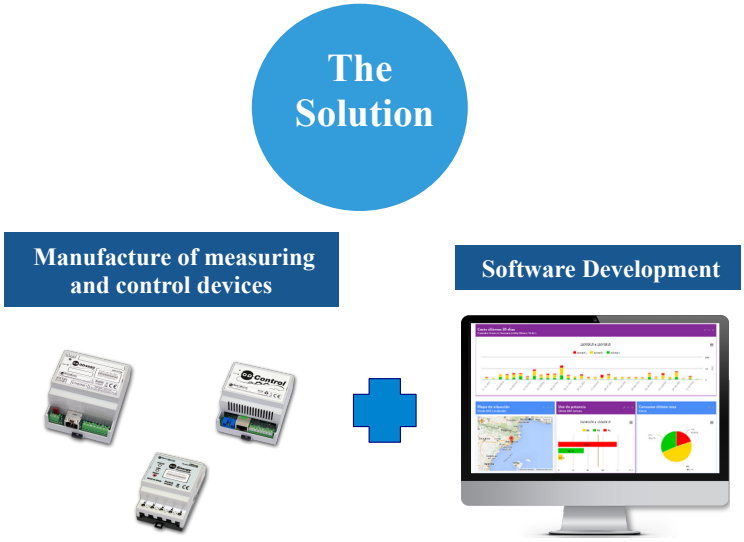
Part 3: we synthetize the answers given by the building owners' employees.

We present the results from the Users Tests in this manner (chronologically and thematically) in order to:

- Simplify the reading of the reviewer;
- Illustrate our co-design approach with a concrete description of what we asked the building owners´ staff and what the answers of BO were.

13.1 Budget allocated to develop the platform and the future costs for BO´s

Open Domo first presented the basic facts about the platform functions and the costs linked to this service for building owners as described below.

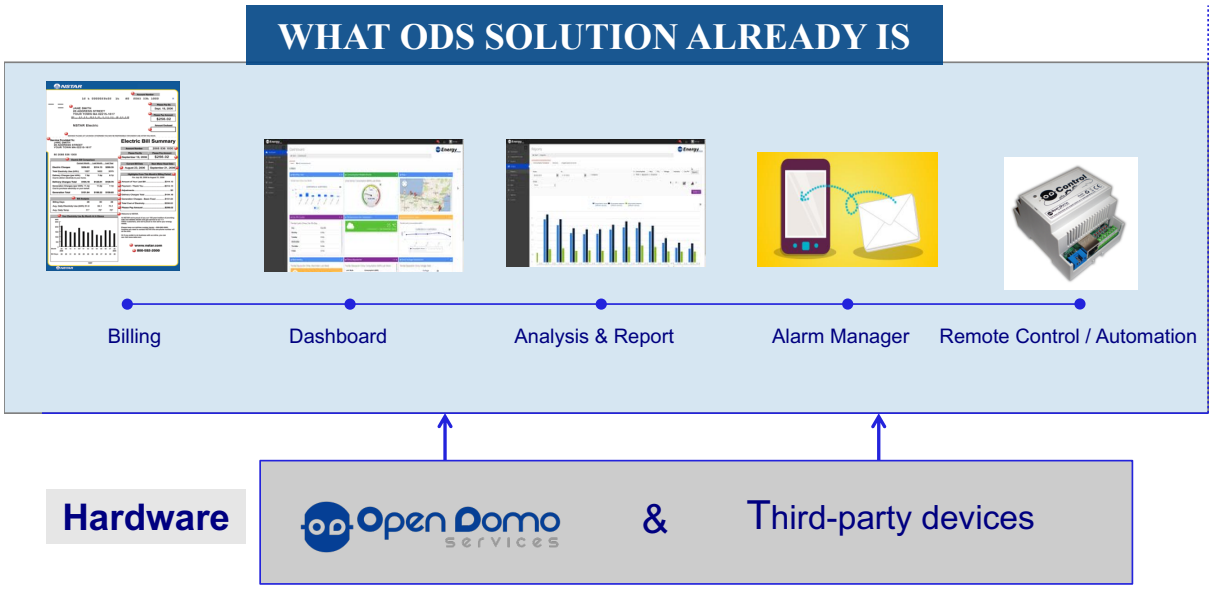


WHAT ODS BRING TO DREEAM?

⇒Platform for free during 4 years
- After that owners can pay licensing or use other software (hardware compatible)

⇒New software developments
such as new options and modules specific to multi-building approach

⇒ODS has a maximum budget for devices, enough to cover the need for measurement and verification of results
- 55.000€ in product
- Define the necessary devices for measuring facilities



Important information about our solution:

- Adapted to your needs as much as the allocated budget allows it (User centered design as possible)
- Electricity rates of the 3 countries will be introduced, with review of them by the owners
- Extra costs for specific options will only be proposed and adopted if BOs want them
- The platform will be translated in Italian
- **QUESTIONS ?**

What has been explained to the building owners in detail by Open Domo was the following:

- All the metering equipment installed in the context of the DREEAM platform will belong to the building owners after the end of the project;
- The metering equipment installed is using open protocol so that building owners can collect the data from the DREEAM monitoring equipment with their own energy platform or any other ICT´s they use;
- The platform will be free to use for building owners during the duration of the project;
- The data collected will be sent directly to the platform and can be remotely controlled. The option to control equipment at distance is an interesting option for building owners (see part « remote control »).
- The software is stored in the Cloud and the method to treat the data from tenants and buildings will be to anonymize these data at the earliest stage possible.

13.2 Building owners' feedbacks

At the start of the exchanges with building owners' employees, one of their key interests was related to the future costs for them to install equipment linked to the DREEAM platform and the usage of it. In the 3 pilot sites, the building owners' representatives were particularly interested to question Open Domo and the other partners on 2 topics:

1. **Which partner would pay to get the metering equipment and to install them?**

   Open Domo explained during the meetings to building owners that:

   - In priority SinCeO2 and Open Domo will work with the currently installed monitoring system if there was any available in the pilot sites (like smart meters, existing collective meters, temperature sensors, etc.);
   - The monitoring equipment that needs to be installed will be free for the building owners and will be left installed on the pilot site after the end of the project (included and limited to the DREEAM budget allocated to Open Domo to cover the expenses related to the installation of additional meters).

   This information has been received positively by the building owners, as they don't want to be locked in any equipment or protocol. Open Domo insisted that the equipment installed in the context of the DREEAM project uses an open protocol so building owners will be able to use it with their own software if they want after the end of the project.

2. **Will building owners have to pay to use the platform DURING the duration of the DREEAM project and AFTER the end of the DREEAM project?**

   Open Domo explained that the use of the platform will be entirely free for building owners for the duration of the DREEAM Project. After the 1st. Users Tests, all the 3 building owners' employees have understood that they will have access to the platform for free.

   It is unclear how the future DREEAM platform will be sold to other building owners after the end of the DREEAM project and by which company, and if Open Domo will develop their own commercial platform based on the results of the DREEAM project in parallel to an "Open" DREEAM platform free of charge for the partners of the DREEAM project. This specific matter must be clearly discussed in the beginning of 2017 between all the DREEAM partners as well as the licensing perspective of the other digital platform developed in the project called "DREEAM tool" managed by Chalmers.

   For future use, we should clearly determine the different business and users targets of the DREEAM platform service:

   - **Option 1/The DREEAM platform is contextual to the project only**: in this option, we consider that services that are interesting for building owners are free during the specific duration of the project;
   - **Option 2/The platform services to keep the interest of the building owners involved after the end of the project**: in this option, we consider that building owners would be willing to pay to continue the use of the platform after the end of the project.

- **Option 3/The DREEAM platform for replication with other building owners outside the consortium:** in this option, we consider services that are interesting to other building owners outside the consortium of the DREEAM project and that support the attractiveness of the DREEAM approach and the visibility of the DREEAM multi-building approach & renovations scenarios.

It is unclear for the moment, what are the options of the DREEAM platform that would be interesting enough for building owners to buy and access after the end of the project. So, the question of licensing will be solved during the period of the 2nd Users Tests in 2017 to identify quickly if the DREEAM platform should serve the purpose of the DREEAM project only, or if the platform should become a commercial service with standards options/services developed within the DREEAM project and co-owned and licensed by the consortium of DREEAM partners or the WP4 partners who developed it only.

3. Language used in the platform

The building owners' employees asked in which language the platform would be available. At the time of the 1st Users Test the platform was only available in Spanish, Catalan and Portuguese. Open Domo explained that the platform will be translated into English, and can also be translated into Italian and Swedish. The translation is mandatory in English and Italian for 2 pilot sites, but it is not mandatory in Swedish for the team of Landskronahem considering their high English skills – though it would be ideal for them to have it in Swedish. Open Domo explained to building owners that they would welcome any comments on improvements of the language in the platform if any name/term needs to be changed. In 2017, we will make a test dedicated to the appropriate and accurate use of words (**terminology and use of familiar concepts in the professional world of building owners**). The appropriate translation and choice of terms is very important to participate to a high usability of the platform so we will dedicate a session to check the relevance of the translation in the 3 different languages.

13.3 Previous experiences with energy platforms

13.3.1 List of questions addressed to BO´s

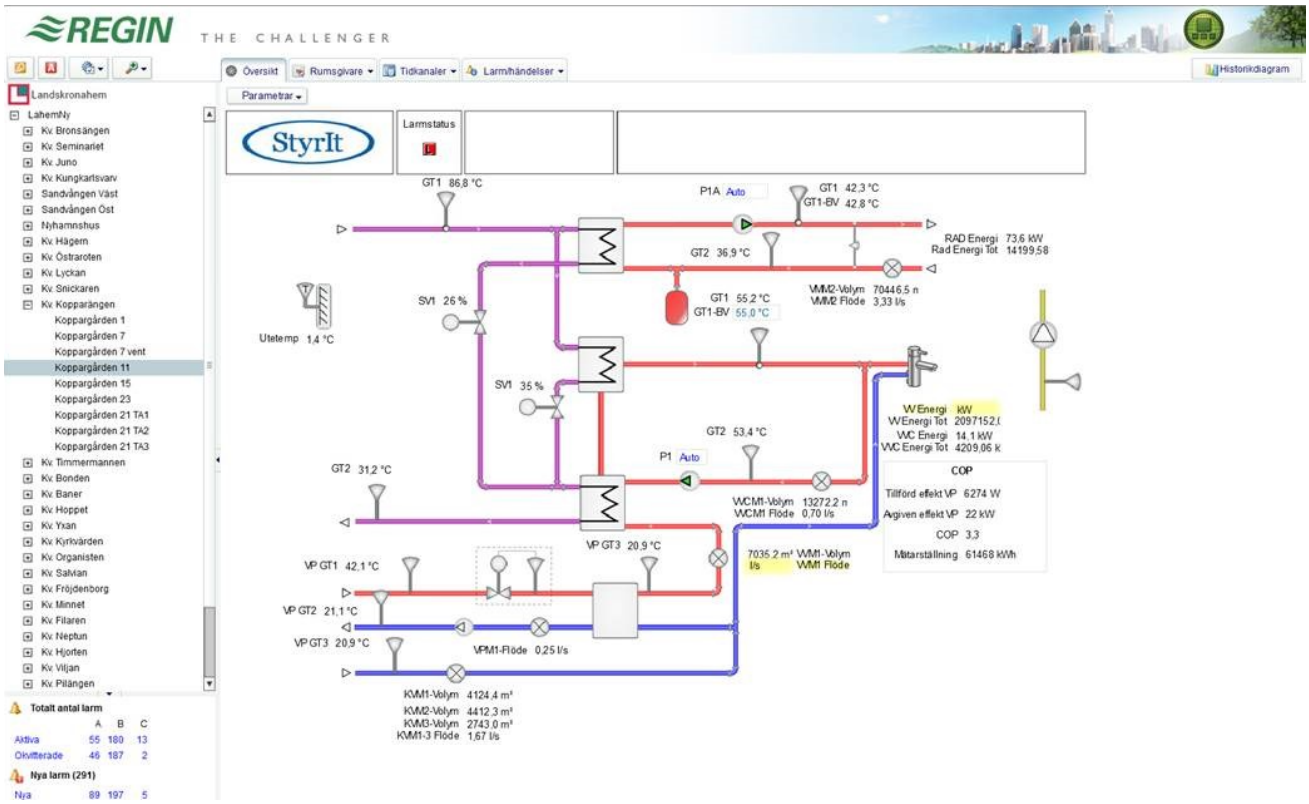
- Did your company or yourself already use this type of platforms?
- What were the functions of the platforms that you used particularly? Display/compare/alarm/control?
- What were the functions that were not important?
- Does the platform you already used include buildings of the DREEAM project or similar buildings in the same district/area?
- Can we have access to data or displays of the platform you already used for the project?
- Do you have material/reports on your experience/existing platform that is available?
- Do you already have a multi-building project/platform or experience?

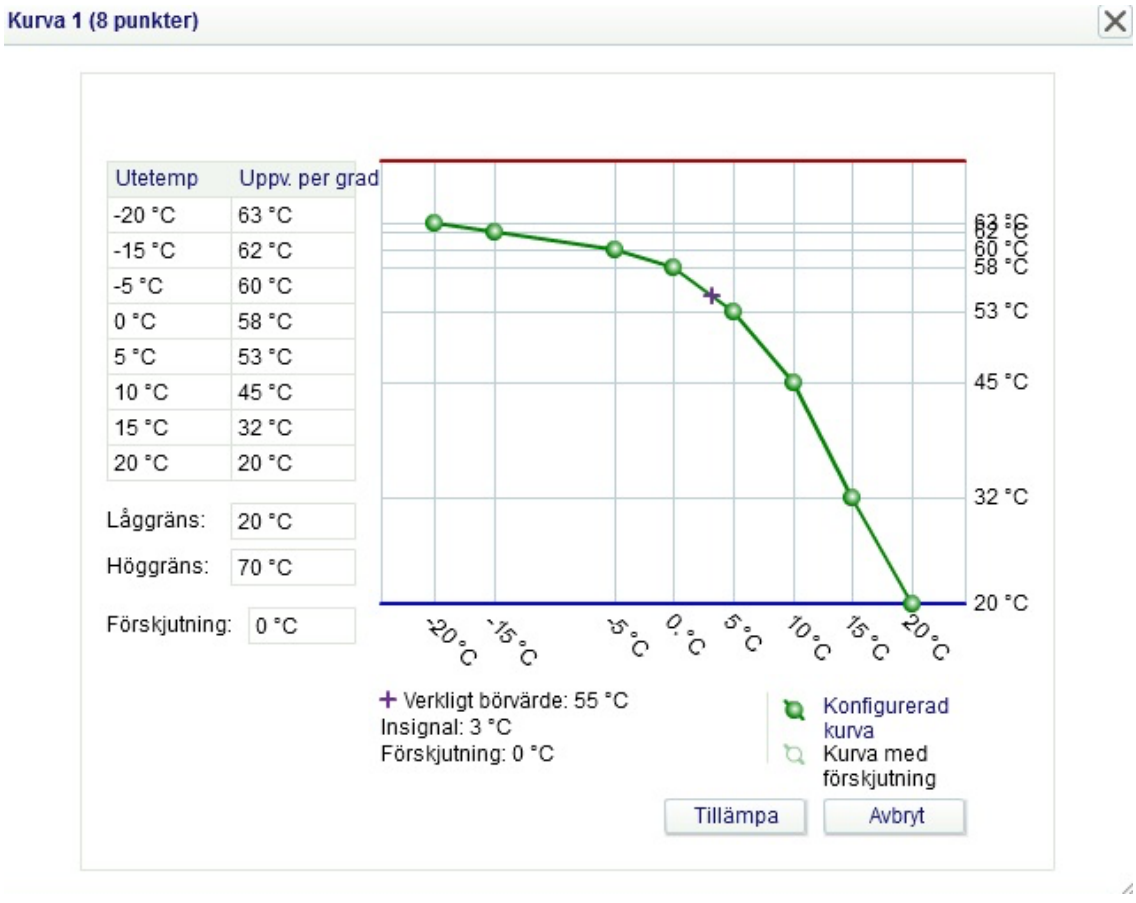
13.3.2 Synthesis of BO answers: previous experiences with energy platforms

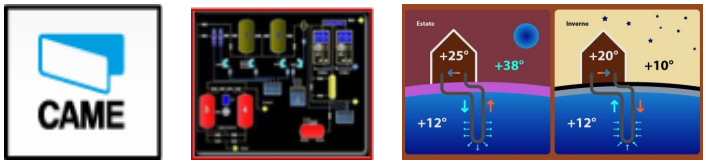
UK /PFP	Previous experience in commercial properties e.g. Leisure Centers. No experience for residential real estate. <u>Information available about this platform with:</u> • Sustainability Manager PFP • Digital Services manager PFP • For the information related to the use of the OD platform, the WP4 members can exchange directly with the Sustainability Manager of PFP

SWEDEN/ LANDSKRONAHEM	Experience of Building Management System/ BMS for heating control. The origin of their access to this existing platform is that Landskrona energy proposed them a portal access with a display of electricity consumption. They have 2 systems: Ecoguard and Regin 1. **ECOGUARD system**. It is a platform that monitored the indoor temperature in each flat. 2. **REGIN – THE CHALLENGER IN BUILDING AUTOMATION** Regin has developed products and systems for control/regulation of indoor climate since 1947. They have a long tradition in flow control, and also develop and produce valves and actuators for different OEM applications. **Services** *- Product design, construction - Prototype production* *- PCB production* *- Injection moulding of casings - Assembly* *- Testing, e.g. climate tests* *- Customising different applications - Programming* *- Customised packaging* *- Manuals, instructions* **Examples of OEM (Operation Energy Management) areas of expertise:** *- Zone control* *- Ventilation* *- Heating/cooling* *- Managing humidness - Heat pumps* *- District heating/cooling* *- Circuit boards* They also have a Regin academy to train professionals and clients to use their products. Official description of Regin products: http://www.regin.nl/drupal/sites/default/files/downloads/brochures/BR-COMPANY-EN.pdf

Below are 2 illustrations of the REGIN system currently used by Landskronahem:





ITALY / ATER	ATER is currently testing a platform proposed by the company CAME HOME AUTOMATION in the context of a renovation project in Mogliano (Near zero energy timber building: 20 dwellings have been built near Treviso. The dwellings are made available for socio-economic vulnerable households). This platform is a building automation energy management system with: - an optimization of the synergy between various renewable energies to avoid giving energy to the public grid; - an action on behaviors with consumption display and alerts for tenants; - a calibration of supplies according to the actual situation via remote monitoring. **CAME Platform used by ATER** NEAR ZERO ENERGY RETROFITTING: « Energy consumption monitoring and ITC control experience ».  Between ATER TREVISO and the company CAME HOME AUTOMATION was set up a partnership, aimed to create a NZE «tailor made» building model. ATER TREVISO wants to gain experience in energy consumption monitoring and ICT control to better understand actual project investment ROI, and EPC conditions. Finally, there is a high desire to reduce energy consumption of the building portfolio. 1° ACTION: To optimize the synergy between the various renewable energy (geothermal, solar and photovoltaic) to avoid giving energy to the public grid. The home automation system manages accumulations (e.g. of solar energy in tanks) and peak demand. 2°ACTION: Minimize waste heat by acting on behaviours. Through a classic and well known Intrusion and Probes device in every room, it is signalled to the tenant by an alarm the maximum time in which the window opening does not involve use of additional energy for heating. The sensors record the temperature in each room. The house is divided into areas of temperature that can be set for that purpose. 3° ACTION: Calibrate supplies according to the actual situation via remote monitoring. The dwelling is designed according to data that are derived from abstract models. To avoid discomfort and thermal waste due to the inevitable discrepancies between the model and reality, in this building a system of remote monitoring allows you to record on a computer, the data on the behaviour and external and internal temperatures. This registration also allows you to compare the different performances of the two buildings and to perform a cost benefit analysis of the technical choices.

13.3.3 BO´s feedbacks: most useful services from previous experiences with energy platforms

UK /PFP	Historical comparison Yearly reporting	**Historical comparison is used in reporting.** The energy system in commercial properties is used to produce year on year comparisons that are reported as part of ISO 50001.
SWEDEN/ LANDS	Heating control Optimization	**Building Management System to control and optimize their heating uses in buildings.** They have a BMS for heating control but Landskronahem wants a solution even more efficient. The parameters defining the representation of an "efficient" BMS for Landskronahem employees is related to the capacity of the system to: • Detect inefficiencies of equipment & tariffs choices • Propose tariffs optimization and equipment calibration; • Propose additional solutions to optimize, control and reduce the use of the heating (such as limiting the inertias).
ITALY / ATER	Historical comparison Sociological /behavioural options	**Historical comparison function for the reporting:** the platform allows to establish the whole consumption during 1 year from date to date. **Sociological options:** an alarm is displayed in the tablet installed inside the 20 dwellings of the Near zero energy timber frame project. If tenants open their windows more than 10 minutes when the radiators are on an alarm will ring and the user must close the window to stop the alarm. This option can't be implemented in the DREEAM project as it is not part of the budget and the final renovation design.

13.4 Data display

Open Domo presented first to building owners' employees the different key options to display the data collected in the buildings:

Ergonomic options

Graphical type: in Open Domo the key displayed data are shown in lines and bars but this presentation could be changed if necessary

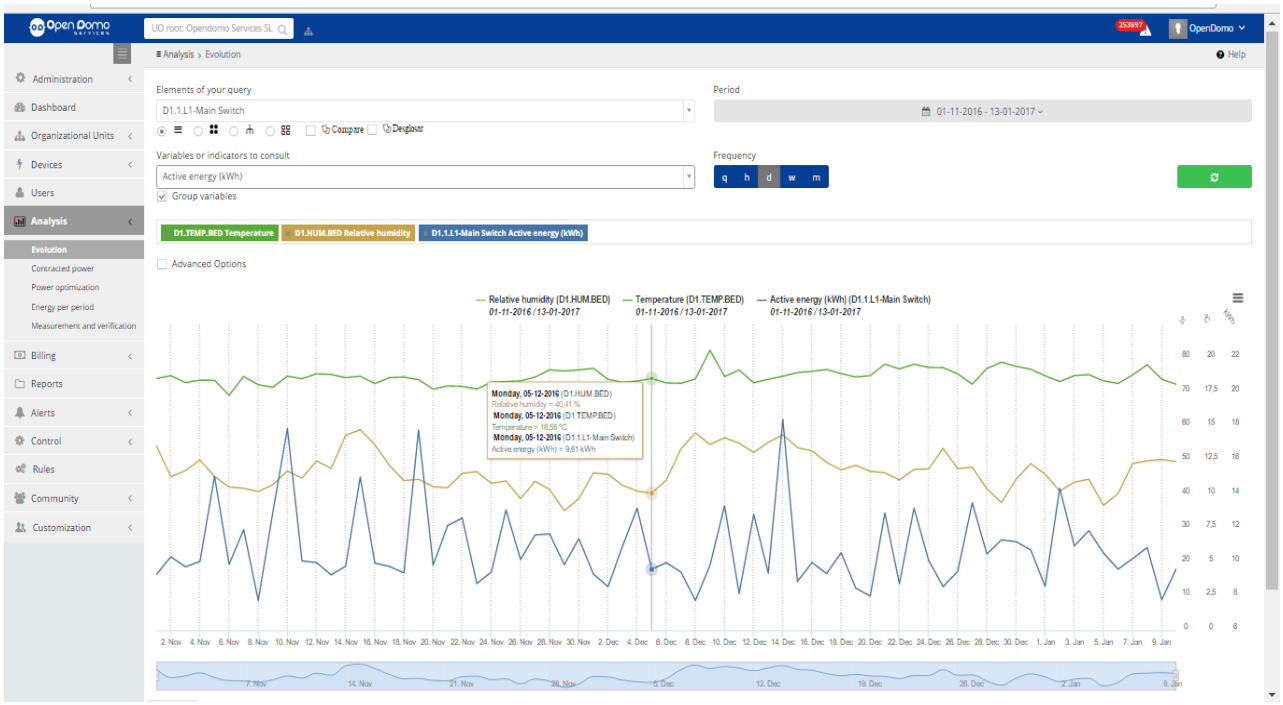


Figure 38: Graphical display

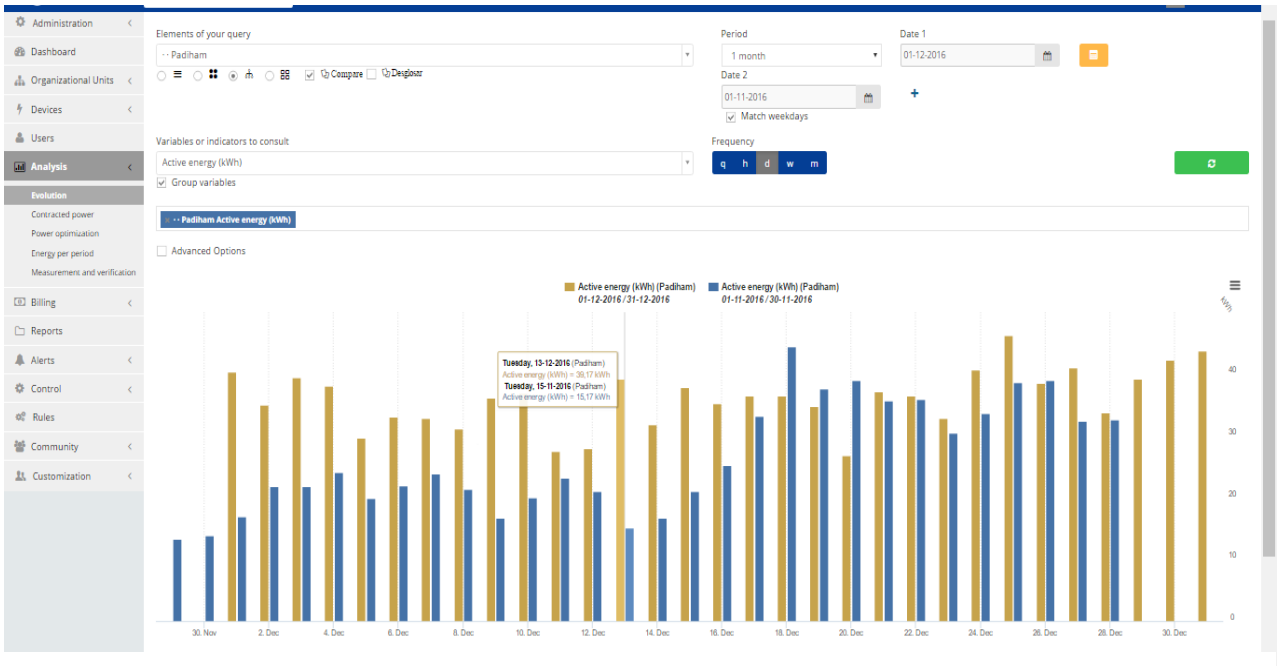


Figure 39: Graphical display by column

The platform can show the data in quarterly hour, hourly, daily, weekly and monthly intervals**.** The platform can display a comparison between time periods. The time periods can be selected between dates set by the user

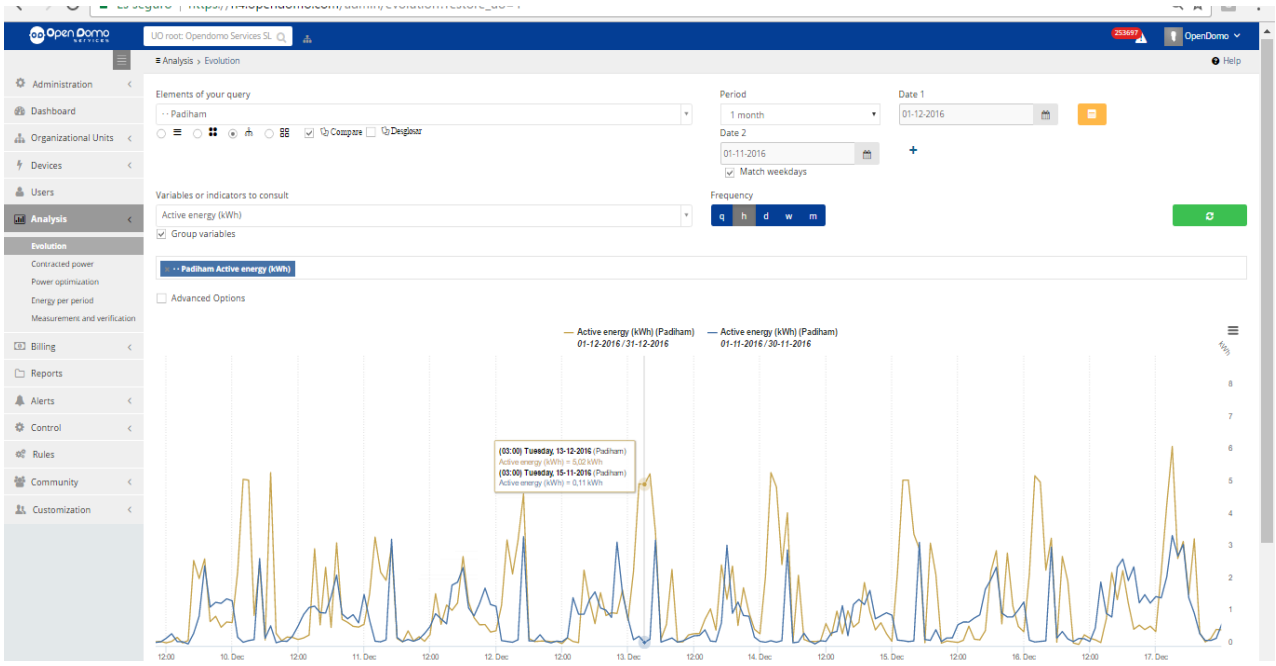


Figure 40: Dynamic analysis

Dynamic analysis:

The platform can display an alarm and the contracted capacity when the limit of pre-selected consumption by users is (nearly) reached**.** There is also the possibility to display a comparison between volumes of consumption in different periods and a visualization of when during the interval the limit was reached.

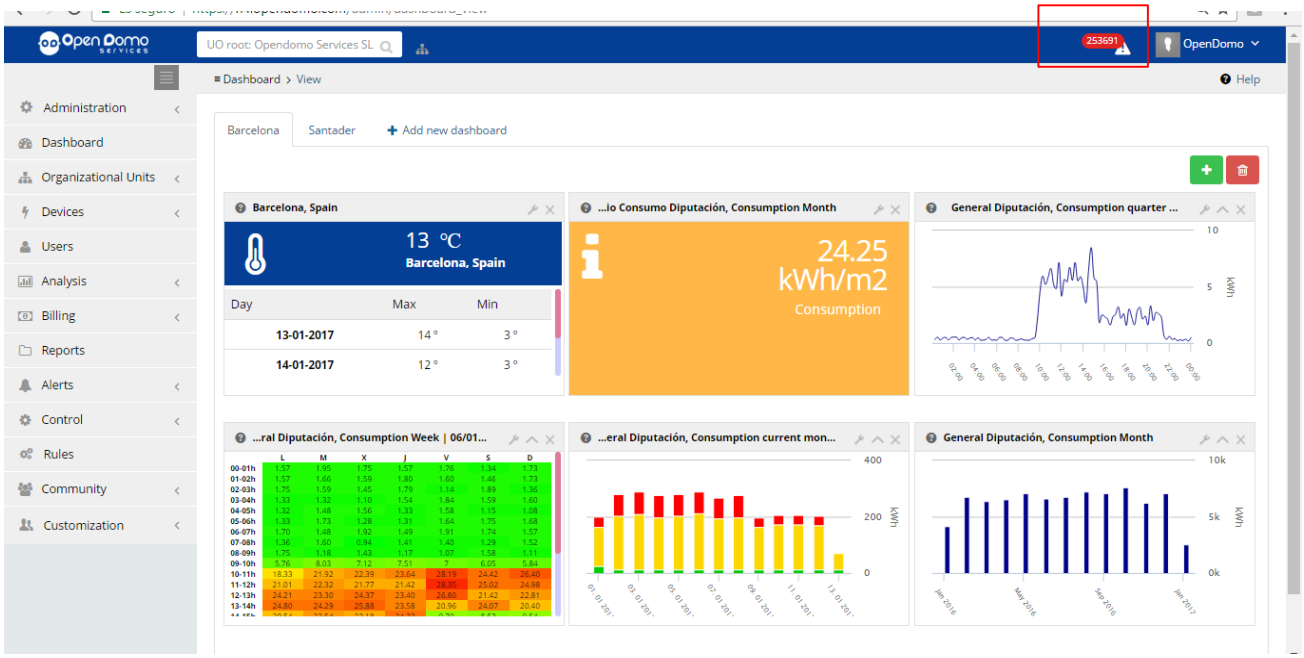


Figure 31: Dynamic analysis

Optimizing capacity

The platform makes a periodic energy consumption analysis and can display a presentation of the peak demand periods and off-peak demand periods to support companies in deciding on the best choices of energy tariffs.

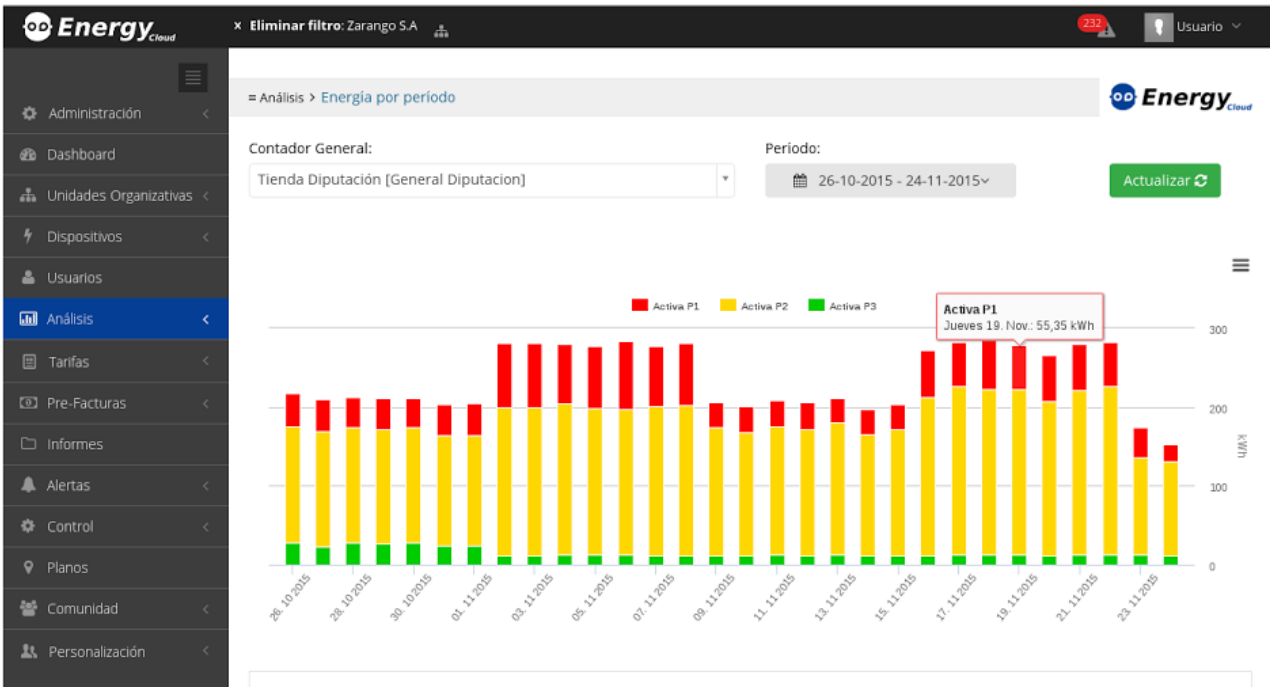


Figure 32: Optimizing capacity display

13.4.1 List of questions addressed to BO´s

- What are the key options that you consider important to develop in the platform?
- What are the mandatory types of energies and scales of consumption that you want to have displayed in the platform?

13.4.2 BO´s feedbacks: list of important options

UK	• Platform in English • Display the improvement of energy efficiency of the buildings thanks to the renovations. • Integrate an option related to social indicators/satisfaction of tenants
Sweden	• Platform in English (minimum) and ideally in Swedish • Display the improvement of energy efficiency of the buildings thanks to the renovations. • Develop an option related to the optimization of energy consumption
Italy	• Platform in Italian • Display the improvement of energy efficiency of the buildings thanks to the renovations • Optimize the use of renewable energy thanks to the software • Display the CO2 impact of the buildings' consumption (ATER wants to control the emissions of CO2). And an option to display the CO2 savings after the renovations compared to other similar buildings not renovated.

13.4.3 BO´s feedbacks: preferences for energy type & scales

UK	Electricity	Individual consumption of the monitored dwellings Average consumption per archetype Extrapolation for the entire pilot site
	Heating (electricity and gas)	Individual consumption of the monitored dwellings Average consumption per archetype Extrapolation for the entire pilot site
Sweden	Electricity	Collective consumption of the pilot buildings Consumption of each monitored building (the plan is to install a meter for the electric consumption of each building)
	Heating	Collection consumption of the pilot buildings (data from the supplier) Consumption of the monitored 5th building (n°11) - The plan is to install a meter for heating and domestic hot water in the building n°11 Aggregated consumption of the renovated 4 buildings (the plan is to install a sub-meter for the 4 renovated buildings)
Italy	Electricity	Global collective consumption in the collective spaces or the collective equipment Lights (even if the consumption related to lightning is low) Elevators Pumping system Ventilation Individual consumption of the monitored dwellings
	Heating	Individual gas consumption for the heating of each households

13.5 Organizational Units module (OU)

Open Domo presented the service called « Organizational units module » that allows to create groups of data displayed and compare according to parameters set by the users.

The existing Open Domo platform already integrates OU: organizational units of different types (building type, geographical area, company, etc.) which offers an organizational structure in tree-form that is open and flexible for users.

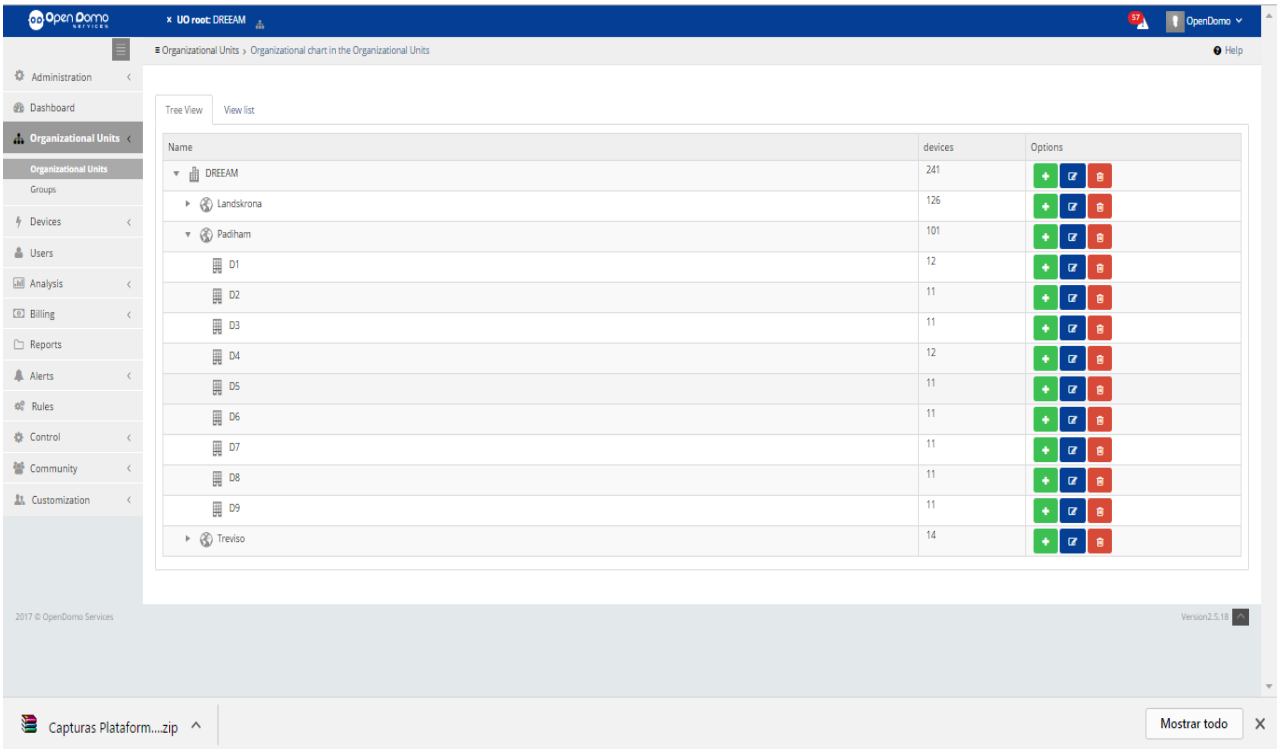


Figure 33: Organization unit module

Open Domo explained that we could develop geographical area units for the DREEAM project following existing or new groups of censors such as “Organizational Units” for collective equipment in the parking, in corridors, per floor level, per group of dwellings, between different buildings, etc. The OU allows to easily group the data by type facilities defined according to different parameters. This hierarchical structure allows also to create users with different levels of permission and different access to such organizational units.

13.5.1 List of questions addressed to Building Owners’ employees

- Is this type of organization modules relevant to your organization?
- Which types of organizational units (OU) or groups of data are the more interesting according to you?
- Which direct application can you imagine with the DREEAM pilot buildings?

13.5.2 BO´s feedbacks: Organizational Units Module (OU)

UK	PfP would ideally like to have organizational units in the platform integrating technical and social indicators: **Technical indicators:** Display the data by groups of dwelling archetypes and allow comparison between them. Ideally the organizational units should allow to: • Group the data by archetypes • Display the consumption data by archetypes • Compare the consumption between similar archetypes • Allow the comparison between properties of different archetypes. The key technical archetypes parameters for PfP that we should integrate are: • Group1: by property size • Group 2: by similar dwelling type • Group 3: by similar energy type dwellings **Social indicators:** Ideally the platform should allow to compare the consumption between different archetypes of tenants. The key social archetype parameters to integrate for PfP are: • Group 4: working tenants • Group 5: not working tenants. Ideally it would be good to see the difference between the working tenants, non-working tenants and stay at home families in terms of energy consumption and the impact on fuel poverty • Group 6: elderly people • Group 7: not elderly people • Group 8 and more: different family structures.

Sweden	The platform should create 3 organizational units at the minimum, in order to allow the comparison between the different consumption data collected in the different buildings (data consumption from suppliers and from meters installed in the DREEAM project). At the moment, the assumption would be to allow comparison between 3 groups: Group 1: Collective electricity consumption for each building renovated Group 2: Collective Heating & domestic hot water consumption for building n°11 Group 3: Collective Heating & domestic hot water consumption of the 4 renovated buildings
Italy	The platform should allow the comparison between the energy consumption of pilot buildings and the average consumption of similar buildings in the area. Treviso: *« We have to add general consumption of Treviso and the Veneto area in similar buildings. This way we could compare consumption of the pilot buildings after renovations with the consumption on other similar buildings of the area not renovated with the DREEAM approach ».* At the moment, the assumption would be to allow comparison between 2 groups: • Group 1: energy consumption of pilot buildings (meters type to be determined later) • Group 2: average energy consumption of similar buildings in the area (data type to be determined later)

13.6 Time scales display

The existing Open Domo platform displays "Analysis Module"

The Analysis Module allows the graphic or textual visualization of any variable stored in the cloud, either received or uploaded.

This module features many different visualization opportunities:

- Graphic visualization through lines or bars of every variable available in the cloud for a selected period. They can be displayed all at once, or it is possible to highlight different types of variables in order to see the relationship between them or to overlap different periods to compare past and present consumption;
- Tools to highlight contracted power, peak demand periods, line of maximum and minimum (for an easy and quick reading of the data), and consumption trend lines of the selected period;
- Data can be shown in quarter hourly, hourly, daily, weekly and monthly intervals. It allows zooming in and out in order to carry out a more accurate analysis. It allows for the comparison of periods, as well as monthly comparisons by matching the days of the week instead of the numerical day of the month;
- After selecting the variables to be displayed, the period and the frequency, the graphics are downloadable in different formats and the data can be downloaded in csv format (Excel).
- Labels and comments can be added to the graphs to mark anomalies or incidents and make them easier to read and be understood by an unexperienced user. These labels can be viewed by everyone or only by the person that generated them and can indicate whether or not you want them to appear in reports.

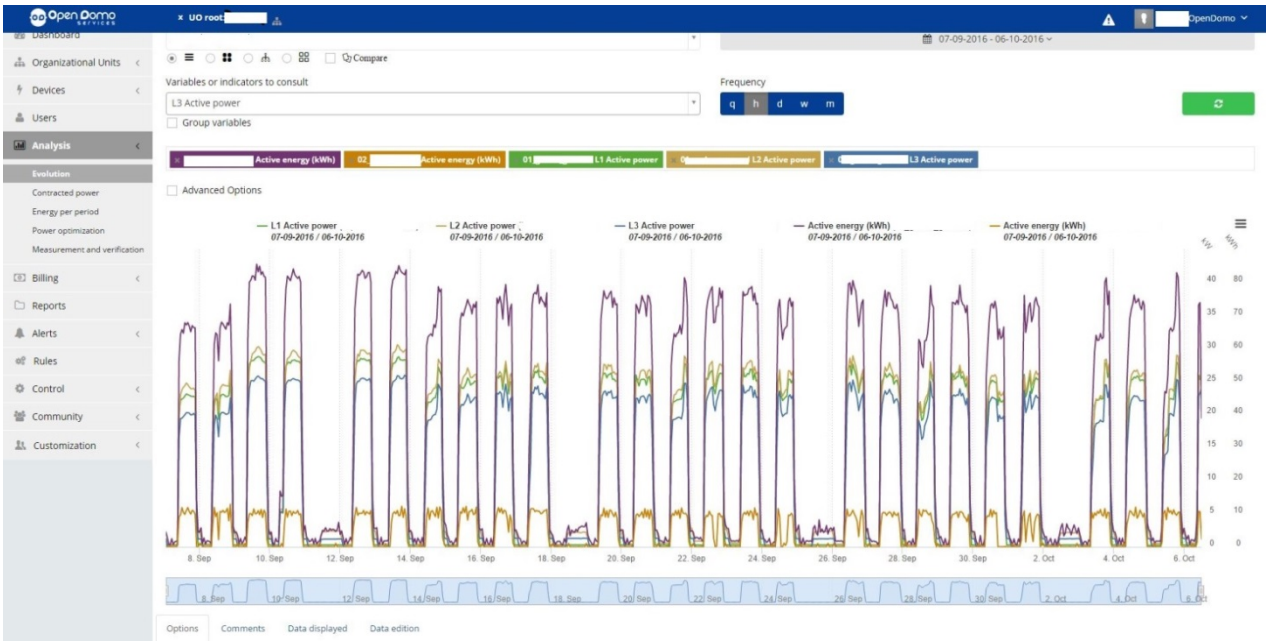


Figure 34: Time scale display example

13.6.1 Questions addressed to building owners

The Open Domo platform allows to display the data collected on energy consumption in a various range of scales: quarter hourly, hourly, daily, weekly, monthly and yearly data. We have questioned future users about the time intervals that are important for their work. How would they like time to be visualized on the dashboard in the platform (such as a general view on the default page of the daily energy consumption of each of the pilot buildings).

13.6.2 BO´s feedback: type of time scales to display

UK	Mandatory: • Monthly • Yearly display	The most used time patterns: • Monthly consumption of each building • Yearly consumption of each building
Sweden	Mandatory: • Monthly • Yearly display • Daily display with the possibility to select a precise date with 24h of consumption	The most used time patterns: • Monthly consumption of each building • Yearly consumption of each building • The display per day
Italy	Mandatory: • Monthly • Yearly display • Daily display with the possibility to select a precise date	The most used time patterns: • Monthly consumption of each building • Yearly consumption of each building

At last, during the interviews with building owners, we have noticed that 3 additional options for time display seem interesting to develop and we should ask Building Owners more precisely about these options during the 2nd User Tests in 2017:

- **Option 1:** the comparison between week days and week-end days that allow to see differences between behavioural patterns and opportunities in terms of tenants related energy savings;
- **Option 2:** the possibility to compare similar weeks & days between different months (such as a comparison between the Mondays, or Sundays in order also to identify consumption patterns and savings opportunities linked to behaviour;
- **Option 3**: the possibility of a deep analysis & understanding of tenants' behavioural patterns. Are building owners really interested in the display of consumption data on a daily or even quarter hourly

interval? How does this help them in their analysis of the habits of their tenants? This deep knowledge could allow building owners and DREEAM partners to develop communication tools for tenants adapted to their real-life practices, in order to help them to better control their consumption and their energy budget. This last option is very interesting especially since many households are in a situation of fuel poverty in the UK and Italy pilot sites.

Questions to address during the 2nd Users Test

Also, we will establish with building owners if we should create two accesses: 1 for building owners' employees and 1 for their tenants. One user friendly access for tenants with a very simple view on the energy consumption of their buildings or their dwellings could be very interesting to promote saving behaviours, and limit misuse of new equipment, but we need to define this option and its feasibility in 2017.

For the tenants, Open Domo could develop a simple dashboard like the example below in collaboration with the sociologist of Savills and the 3 building owners:

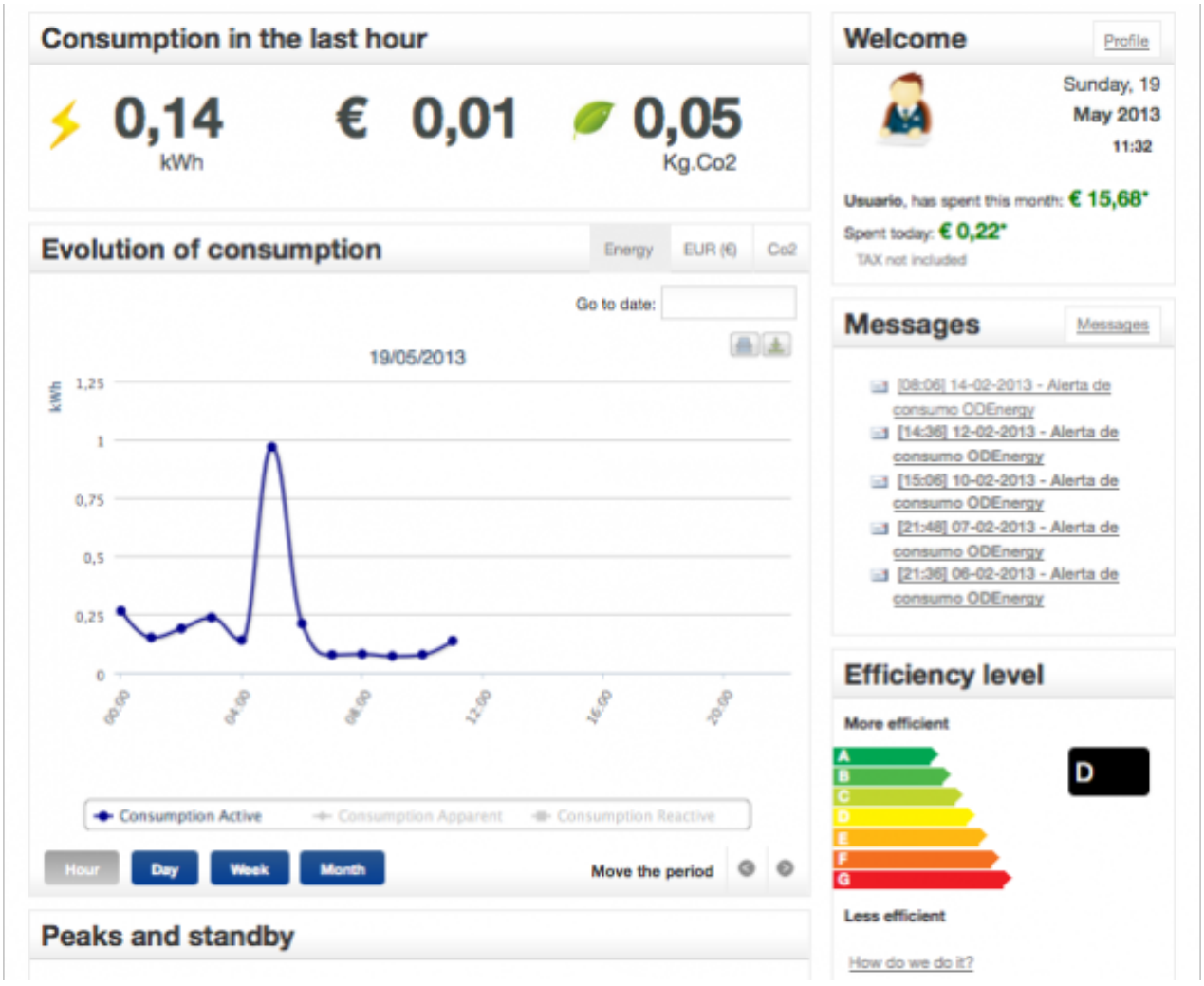


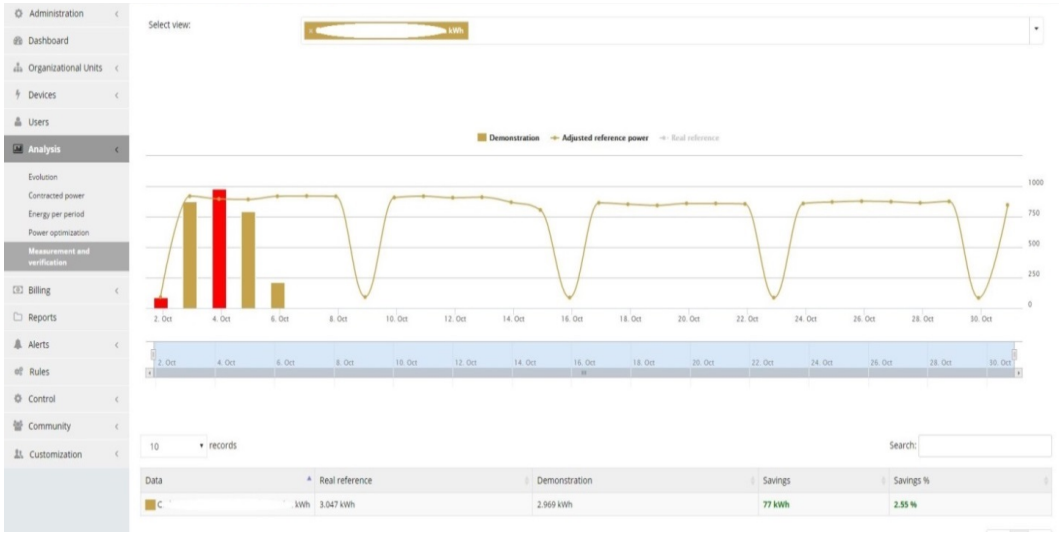
Figure 35: example of interface for tenants

13.7 Energy per period module

Open Domo presented the analysis capacity of the platform with the “Energy per period module”.

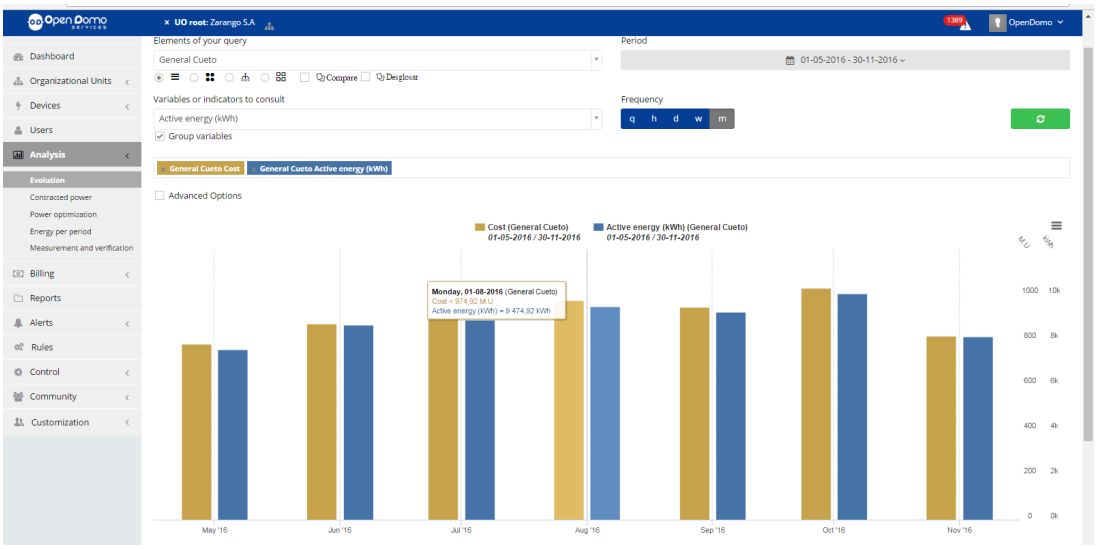
The platform currently allows to display:

- First a baseline consumption: the platform generates a baseline depending on dynamic and static variables for the proper monitoring of consumption
- An analysis of energy consumed per period
- An analysis of the cost per period set by the user
- A line presenting the average, maximum and minimum consumption during the period
- A consumption trend line of the selected period.



Design of the module:

The ergonomic choice is currently to present the data in 2 different options: by volume or by cost (for example with a graph displaying columns of kWh used or by cost made for a specific period of time).



13.7.1 List of questions addressed to building owners

- What is the key service that the platform should offer in the context to the project and the multi-building renovations approach?
- Is it the baseline consumption? And in that case, what are the key variables you normally integrate in your methodology that we have to take into consideration?
- How do you normally calculate/figure out the baseline consumption and how do you establish that the consumption has been higher or lower when comparing periods?
- What are the most relevant options according to you?
    - An analysis of energy consumed per period
    - An analysis of the cost per period set by the user
    - A line presenting the average, maximum and minimum consumption for the period
    - A consumption trend line of the selected period.
    - What additional variables could we try to develop?

13.7.2 BO´s feedback: Energy per period module

It is important to make a statement here that the analysis of the energy used for a specific period with a comparative approach is a key expectation of the 3 building owners.

The expectations are indeed very high that the platform will allow simply, visually but with a very rigorous statistical model to prove and show the energy savings obtained thanks to the renovation scenarios of the DREEAM approach.

Example: In the UK, the employees of PFP mentioned that the platform can be specifically interesting for the definition of Pre-Investment and Post-Investment strategies. Additionally, other services will be interested in following the results from the platform: Environmental Sustainability, Asset Management and the Neighbourhood officer. For PFP, ideally the platform should allow to estimate the savings obtained with the renovation scenarios and to model the potential of replication in other buildings.

In order to be aligned to BO´s expectations such as the ones described before (PFP), we have to build together with building owners a simple and understandable description of the methodology used in the platform to calculate the baseline, the consumption comparisons between periods and the estimation for other buildings.

During the 2nd Users Tests in 2017 we will work on clarifying first the key parameters used in the energy efficiency monitoring and assessment methodology used in the WP4, and how this methodology is « translated » into the Open Domo platform. We will determine if and why the methodology can have weaknesses according to building owners and their existing expertise/work process. We will also build a training document/user guide dedicated specifically to building owners staff to help them to understand and use the platform.

Our goal is to build consensus on the quality of the methodology used to assess the energy efficiency of the buildings after the renovations, and on the quality of the visualization in the DREEAM platform so that building owners are satisfied with the tool at the end of the project, and the platform can be integrated in the dissemination/promotion of the DREEAM approach.

13.7.3 BO´s feedback: Energy per period module

UK	▪ Historical comparison before/after renovations ▪ Ideally identification/comparison of energy efficiency linked to renovations ▪ Energy consumption linked to behavioural factors	Comparison of pre-and post-renovations energy consumption of dwellings Ideally also comparison of the monitored tenants' energy consumption pre- and post-renovations A key concern of PFP is to be able to calculate the difference between the energy efficiency of dwellings and equipment and the potential impact of tenants on this energy efficiency (especially the potential risk of increase in energy consumption of tenants). Indeed, PFP employees are concerned about the fact that the global energy consumption calculated for dwellings after the renovations may increase/remain the same as tenants might increase their thermal comfort to a level they can now afford. This phenomena called in sociology « rebound effect » will be addressed during the sociological analysis post-renovations.
Sweden	▪ Possibility to set a precise date to display the comparison from 1 date to another ▪ Monthly consumption of building n°11, and the group of 4 renovated buildings and comparison between months ▪ Yearly consumption of building n°11, and the group of 4 renovated buildings and comparison between years	Consumption comparison from date to date after the renovations. The platform must allow to select the dates to make the comparison. The way Landskronahem would like to make historical comparison before/after renovations is not yet clear especially if they intend to compare consumption periods before the renovations to consumption periods after the renovations, or if they will only base their evaluation on the final energy audit with the evaluation of the renovated buildings' energy efficiency. We should pay a lot of attention to the parameters (such as occupancy rate, outside temperature ponderation, etc.) used both by Open Domo and Landskronahem in order to guarantee that they compare the same groups of data with a similar method as the way Landskronahem makes their own energy efficiency calculation.
Italy	Comparison between selected periods	Most commonly used will be the comparison between months and years. The results from the final energy efficiency assessment will also be a key result for ATER.

13.8 Alarm options

Open Domo showed to building owners how the services alarms work, and the page where users can create an alarm and the different settings they can choose.

The customer can create, edit and delete their own alarms with different variables. The BO in DREEAM project will have access to the following indicators and alarms:

- Electricity, domestic hot water and heating.
- Temperature (inside, outside, any type of censors installed)
- Humidity

The alarm options allow to quickly detect any abnormality. Building owners can personalize when alarms are sent: hours, days, regular reports.

The alarms can automatically be sent by email: these alarms, in addition to being registered in the cloud in the section on notifications are sent by mail to the chosen users.

Several examples of the types of alarms that can be set have been displayed live to building owners, as well as how they are presented next in the alert emails.

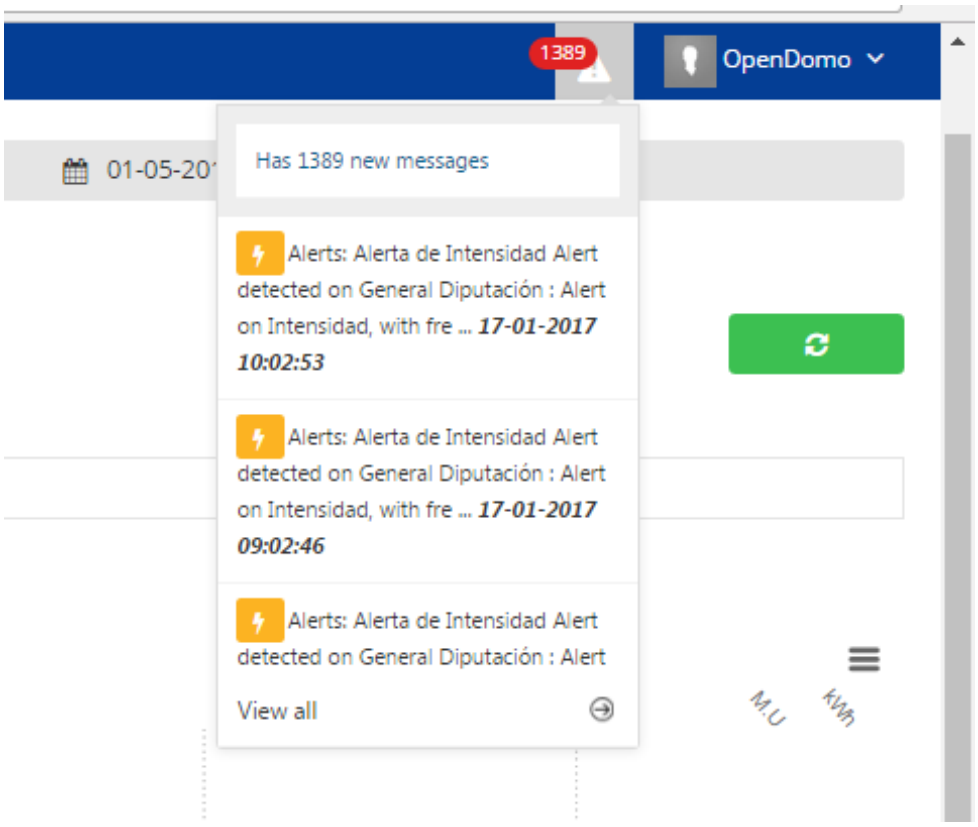
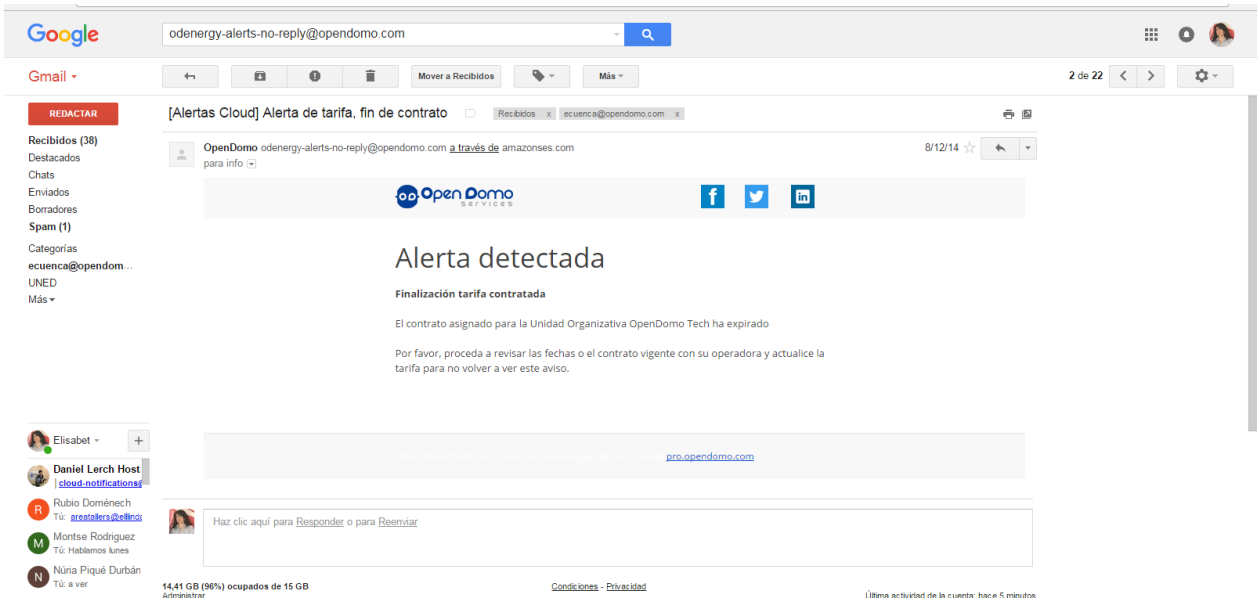
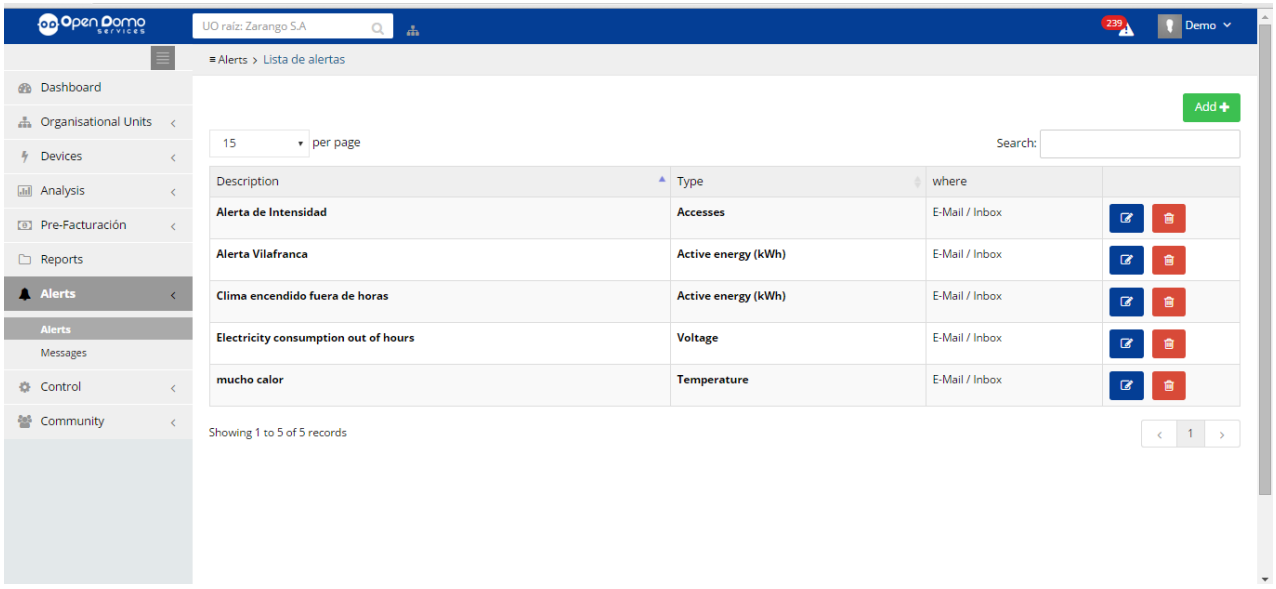


Figure 36: alarm option module





13.8.1 BO´s feedback: alarm options

UK	Yes	Interest in alarm options such as detection of potential problem like excessive or to low consumption
Sweden	Yes	Interest in alarm options such as detection of potential problem like excessive or to low consumption
Italy	Yes	Interest in alarm options such as detection of potential problem like excessive or to low consumption

13.9 Additional data to display based on direct BO´s requests

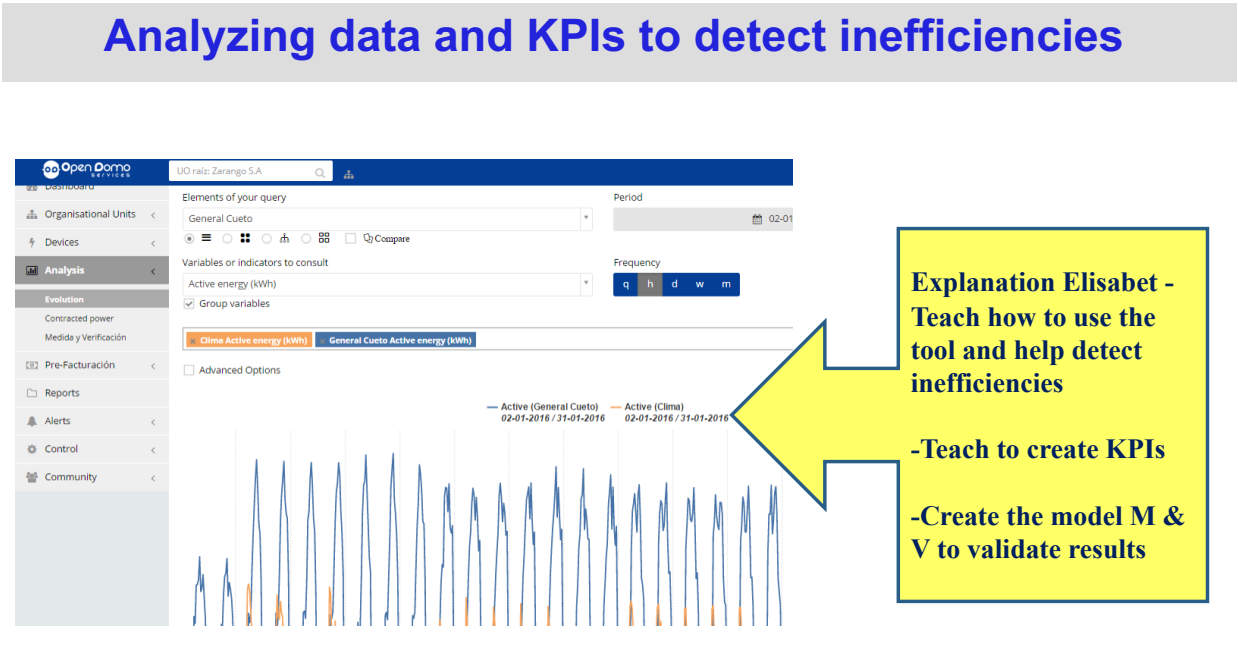
1.1.1 BO´s feedback: temperature and humidity display

UK	• External temperature • Inside temperature • Humidity	Expected data to integrate in the statistics and to display: In the 9 monitored dwellings: • Outside temperature (1 local censor) • Inside temperature (2 censors, 1 in a bedroom and 1 in a living-room at a different floor) • Humidity censor (2 censors, 1 in a bedroom and 1 in a living-room at a different floor)
Sweden	• External temperature • Inside temperature • Outside and inside humidity	Expected data to integrate in the statistics and to display: In the future monitored dwellings: • External temperature (this data can be sourced from the official weather institute) • Inside temperature (we would collect the existing indoor temperature sensors in the dwellings) • Outside and inside humidity. We could install 2 censors in the selected group of monitored dwelling. Only the Swedish building owner has requested to have the outdoor and indoor humidity measures integrated in the platform and the statistics.
Italy	• External temperature • Inside temperature • Inside humidity • Outside humidity	Expected data to integrate in the statistics and to display: • Outside temperature censors • Outside humidity censors • For outside temperature and humidity, we should also collect in addition the official data already used by ATER must be integrated in the platform. The official reference is ALPA that gives ATER the outside temperature during the year (open data). We have to integrate the data from ALPA in 2017 In the 7 monitored dwellings: • Inside temperature sensors (2 censors, 1 in a bedroom and 1 in a living-room at the same floor)

13.10 Capacity optimization module (1/2)

Open Domo showed to building owners how the optimization module works:

Option 1: the system creates a KPI to establish the optimal temperature with the air conditioning or heating



Option 2: The platform analyses the peak demand periods and estimates the optimal adjustment of power contracted/ contracts based on the national energy tariffs. There are 2 key processes to estimate the peak demand and the optimal adjustment:

- Yearly bills: you can calculate the peak demand of the last 12 bills and get the adjusted power contract (at peak demand) and the optimum capacity (taking into account the costs for penalties);
- Analysis from quarter-hourly curves: in this case, optimum capacity is closer to reality to be able to analyze if the peaks are punctual or continuous.

13.10.1 List of questions addressed to BO´s

- What are your specific needs in terms of identifying optimization opportunities of consumption?
- Do you already have a lot of knowledge on peak and off-peak periods in your buildings? And in the specific pilot buildings?
- Do you use KPI´s, and do you understand how it works?

13.10.2 BO´s feedbacks

For the 3 building owners, the optimization concept is interesting but more information is required to understand how it can work with the renovation scenarios finally selected for each pilot site. This specific option of "Optimization module" to detect inefficiencies and the optimal adjustment of equipment or energy contracts is particularly interesting for all the building owners, and especially for Landskronahem as one of their expectations is the optimization of their Building Management System.

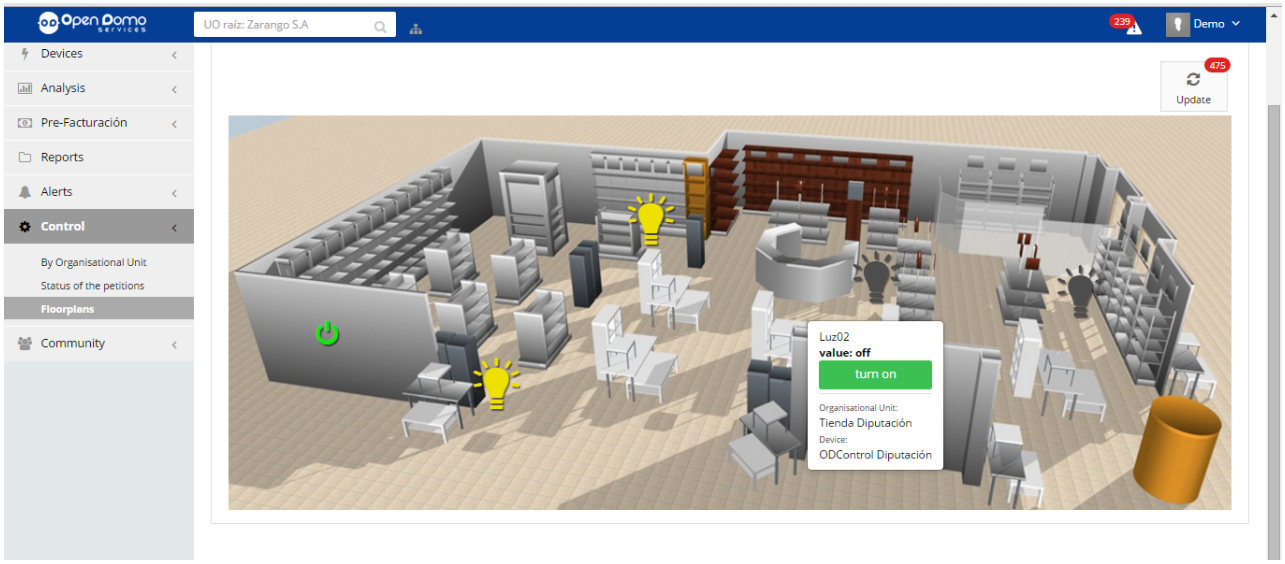
The 3 UX meetings allowed us to understand that the detailed methodology used by energy platforms to calculate the baseline, to calculate the evolution of energy efficiency of buildings and to generate KPI´s are not always clear and understandable for staff of building owners.

The statistical methods used to generate those tools remain complicated for some building owners' employees who are not specialized in statistics. We believe that it would be interesting to develop a simple and **dedicated training program for building owners' employees on the methodological aspect of energy efficiency assessment and visualization**, and we would like to integrate it in the WP4 strategy.

During the 2nd Users Test in 2017, we will address in detail the level of **statistical knowledge of building owners' employees**, to identify what level of knowledge transfer, information and training we need to develop to make sure that the methodology used for the energy efficiency assessment and the visualisation in the platform developed are **completely understandable** by the future users.

13.11 Automation and remote control

Open Domo has given a description of the remote-control options offered by the platform. At this step of the platform development, we have only asked the building owners if the **concept of control** is interesting for them or not in the context of the DREEAM project.



1.1.2 List of questions addressed to BO

- Define automation rules: what is relevant and what is not?
- Is the control of electrical equipment in the collective areas interesting for your organization? The control of heating system, the control of collective lights, other? Can you describe us the automation options that you would need?
- What type of remote-control you really don't want?
- Can you provide floorplans of your buildings to upload them into the platform?
- What type of equipment/censors already exist in your pilot building and can be used in case you want to develop automation/control options in the DREEAM platform?
- What are the new equipment/options that we could install in the buildings or flats?
- Is the graphic display or controlling option easy to understand and useful?

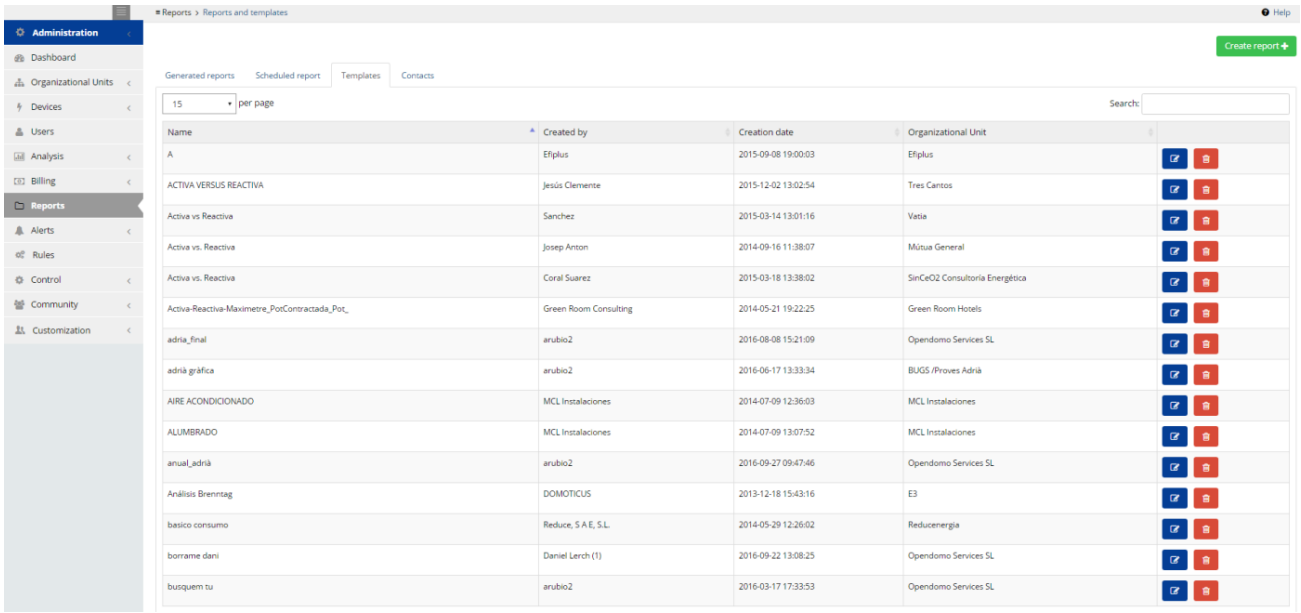
13.11.1 BO´s feedbacks

UK	It was uncertain at the time of the meeting in 2016, as the renovation scenarios were not yet validated to determine what type of remote control options were interesting for PFP. This topic will be addressed during the 2nd User Meeting in 2017.
Sweden	Control of the good delivery of the temperature. The temperature delivered inside dwellings can't be lower than 20 degrees.

	An alarm related to the district heating system could be installed and displayed in the platform.
Italy	ATER would like to know the possibilities of the system to control the energy of the tenants. This topic will be addressed again during the 2nd User Meeting in 2017.

13.12 Export Open Domo displays and produce report

There are different types of predefined reports and different graphics that the customer or the consultant can use to create their own report template in the Open Domo platform. Reports can be generated at the time being or be scheduled for weekly or monthly delivery. The reports generated are editable, in order to allow the customer to add appropriate comments on each graph or table incorporated in the report before sending them to the responsible officers.
The module includes the creation of two costumed reports (technical or financial one). The available widgets are used to homogenize the information to be sent to the responsible party.



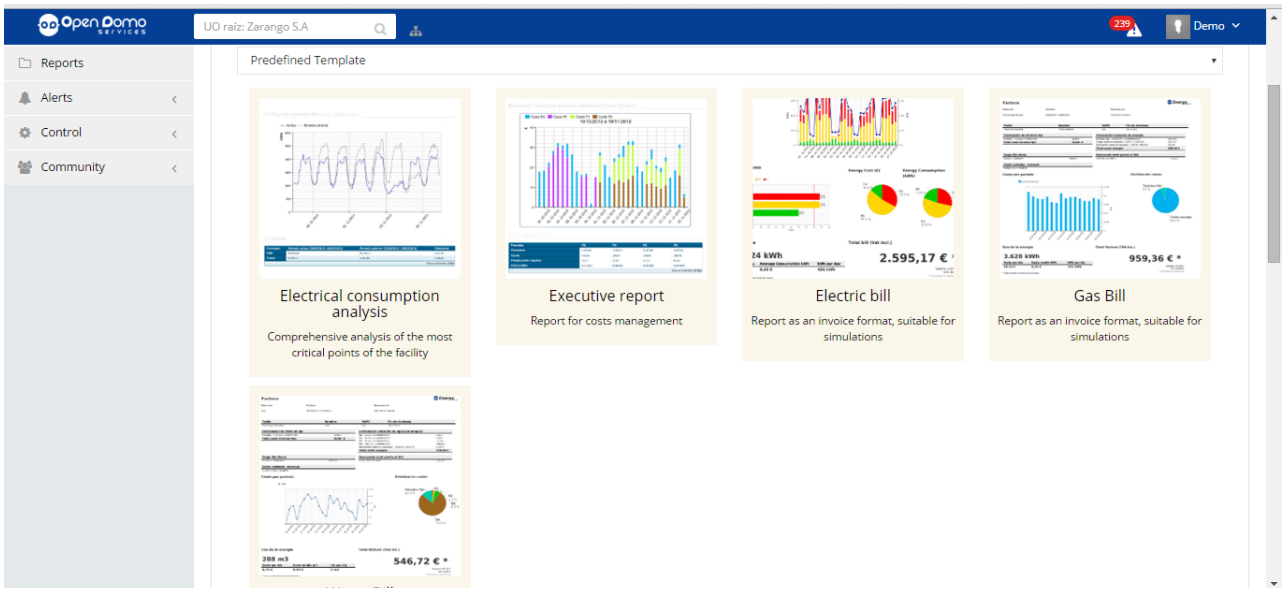
Open Domo presented the different reporting options that are available for building owners in the platform:

Graphics are downloadable in different formats and data are downloadable in csv format (Excel). The downloaded data will be the data that has been chosen to be plotted (electricity consumption, temperatures, KPI´s, etc.) with the frequency indicated in the selection. The system allows adding tags in graphics and comments to mark anomalies or incidents. These labels can be viewed by all or only by the person who has generated the report.

Reports module.

Several different predefined reports, as well as different graphics are available in the Open Domo platform. Reports can be generated at real time or be scheduled for weekly or monthly delivery. The reports generated are editable so that the customer can add appropriate comments on each graph or table incorporated in the report before sending it to the responsible officer.

Example of automatic generation of reports:



1.1.3 BO´s feedbacks: interest of reporting thanks to the platform

UK	Yes, the visualization and reports developed in the platform could be used for internal reports. Reports from the future DREEAM platform could be interesting for several departments at PFP: Environmental sustainability, Asset management, Neighborhood officer.
Sweden	Landskronahem already has an internal reporting system
Italy	Not really a particular interest ATER has no need in terms of reporting from the future DREEAM platform

13.13 Who are the future users of the Open Domo platform ?

Open Domo presented to building owners' employees the possibilities offered by the platform to create different levels of access and different users' profiles:

There is a possibility to:

- Create multi-user profiles and the way they have access to displays and controls.
- Create as many users as desired, who will be assigned to which OU within the hierarchical tree has access.
- In addition, you can define which modules a user can or cannot see, so that elements that do not have access disappear from the platform.

The dashboard module is a configurable module per user,

- Each user can see different information (in the limits of information the user profile has been granted) and therefore is adaptable to the individual need.
- There are several widgets but we can create added custom widgets (examples?)
- The users can create their own dashboard and modify it according to their needs.
- The access is available on computer, tablet and smart phone.

1.1.4 List of questions addressed to BO´s:

- We would like to understand who exactly in your company will regularly and professionally use this platform in the project?
- What will be the key user profiles/access rights that you need?
- Do you need other types of User restrictions and modules?
- Do the options of graphic extraction fit your regular needs?
- Define the necessary reports depending on the type of users.
- Define who and how often reports need to be delivered.
- Can we imagine a public report for tenants to help them follow the DREEAM project?

1.1.5 BO´s feedbacks: the future users of the DREEAM platform

UK	The key departments that will use the DREEAM platform will be: - Pre-investment - Post Environmental sustainability - Asset management - Neighbourhood officer
Sweden	The key employees who will use the DREEAM platform will be: - Project managers - Technical managers - Software engineers
Italy	The key employees who will use the DREEAM platform will be: - Project Managers

13.14 Interface for tenants

We have questioned building owners' employees on 2 aspects:

- What are the data available from tenants that we could integrate in the DREEAM platform and that is interesting for them?
- Are you interested in an interface dedicated to tenants and with what options?

13.14.1 What are the energy data available from the tenants?

UK	Monitored tenants Possibility to compare the historical bill data and the monitored data of the 9 households equipped with meters.	Historical data available with bills collected for a group of 15 interviewed households including the 9 monitored households. So we could build detailed comparisons with the data collected before and after renovations.
Sweden	Not possible	The bills are individual and Landskronahem won't collect the bills in the Swedish pilot site (electricity supplier choice and billing is individual, building owners have no access to these data).
Italy	Monitored tenants Meters can be installed in a tenants group and their bills are collected like in the UK	Electricity supplier choice and billing is individual but ATER has collected the bills with a selected group of tenants to interview and monitor like in the UK pilot site. So we could build detailed comparisons with the data collected before and after renovations.

13.14.2 Does a specific interface for tenants is interesting for Building Owners?

UK	Yes	It could be interesting for tenants to get the data/information but it should be kept simple. **The 5 key services to give to tenants for PFP:** 1. The platform should at the minimum present the same information than those displayed on the pre-payment meter: • Current consumption (time pattern displayed to determine) • Pounds meter: display the money left to use for the electricity with a deduction between the money put in the pre-payment meter and the electricity already used on this amount. 2. Monitor and show kWh consumed by tenants (monitored group) every day. 3. A specific day could also ideally be chosen by tenants and displayed. 4. Energy spent in Pounds based on energy consumption + precise energy tariff and contracts of each of the 9 households 5. The dedicated platform should help to experiment communication tools with tenants to help them both to better manage their budget, to better use the low energy tariff, ideally to help them to remember better the precise hours of low energy tariff.
Sweden	Yes	Landskronahem needs more detailed proposals of what the services/options of tenants could be at this point but the platform is interesting as one of the goals in the Swedish pilot site area is to develop smart solutions. Proposals of options/services we could develop for tenants should be proposed for the next User Experience meeting in 2017. **According to Landskronahem, to have a real interest in terms of behaviours the platform should propose a minimum of 4 options:** 1. Show to tenants the hours/period with peak demands with a time energy consumption analysis 2. Support tenants to limit their use of energy 3. Limit/correct tenants' misbehaviours that have an impact on the energy efficiency of the building 4. Help/participate to the implementation of ICT solutions in renovated homes
Italy	Yes	ATER has no social activity with their tenants, so this part is not yet established and the possibility of an interface for the tenants in the 2nd pilot site will be discussed by middle 2017, as many tenants are old without computers access. **Though, a platform could potentially be interested for ATER team with the 3 following options:** 1. Information/ comparisons between electricity tariffs and interesting options like low energy hours' contracts 2. Support to build the trust between the tenants and ATER by giving advises and information 3. Electricity bills issued by suppliers to tenants are likely to be incorrect, tenants would benefit from knowing their real consumption

13.14.3 Behavioural opportunities identified by BO´s employees with their tenants

UK	There are 3 key behavioral levers in the UK pilot site: 1. Change in pre-payment contract Important money saving opportunities exist for tenants who are eligible to change from a pre-payment meter to a direct meter. There is a behavioral lever with these tenants if good information is given to them about why to switch to a normal contract instead of a pre-paid contract (pre-paid contract is more expensive). It would also require giving good advice and control tools for these tenants to allow them to have the same control over their budget with a direct meter compared to their pre-payment meter (tenants on pre-paid meter have no economic margins and can't take the risk of any bill "surprise" and debt). 2. Suppliers costs and service comparison The idea of a "trip advisor" of energy costs and suppliers was discussed during the UX test, with comments on prices, services and reliability of energy suppliers. It could be an interesting option for tenants. 3. Information about their billing system Help tenants to understand their own bills or the annual statement received by tenants with the pre-payment meter. 4. Behavioral changes with advises: like better use of the low energy tariff and better use of equipment such as economy buttons, efficient programs.
Sweden	Tenants have their own electrical contract and they already have applications with their electricity consumption offered by the energy company itself. Landskronahem is interested to receive proposals on the particular matter of behavioral ICTs solutions.
Italy	There are 2 tools that ATER think we could maybe try with tenants: • Informing/displaying information about the most consuming equipment. • Giving advices with precise opportunities to make energy savings*: "We were talking about creating a list of phrases (tips) that encourage tenants to reduce their energy consumption" (ATER, 2016)*

14 Conclusion

14.1 Final synthesis of the building owners' requirements from 1st Users Tests (2016)

Thematic	PFP	Landskronahem	ATER
No captivity to any platform	Yes	yes	yes
National langage	Yes	English and ideally Swedish	Italien
Review of the language accuracy and commands usability	Okay to participate	Okay to participate	Okay to participate
Experience of energy platform	Yes, in commercial properties Not residential	Yes – BMS system Regin & Ecoguard	Yes- CAME HOME Automation
Most useful services from previous experiences	Historical comparison Yearly reporting part of ISO 50001	Heating control Optimization	Historical comparison Sociological /behavioural options
Key requirements	Visualize Energy efficiency results Social indicators/satisfaction tenants	Display the improvement of energy efficiency of the buildings thanks to the renovations. Develop an option related to the optimization of energy consumption	Display the improvement of energy efficiency of the buildings thanks to the renovations Optimize the use of renewable energy thanks to the software Display the CO2 impact of the buildings' consumption (ATER wants to control the emissions of CO2). And an option to display the CO2 savings after the renovations compared to other similar buildings not renovated.
Energy scales monitoring & display - Electricity	Individual consumption of the monitored dwellings Average consumption per archetype Extrapolation for the entire pilot site	Collective consumption of the pilot buildings Consumption of each monitored building (the plan is to install a meter for the electric consumption of each building)	Global collective consumption in the collective spaces or the collective equipment Lights (even if the consumption related to lightning is low) Elevators, Pumping system, Ventilation, iIndividual consumption of the monitored dwellings
Energy scales monitoring & display - Heating	Individual consumption of the monitored dwellings Average consumption per archetype Extrapolation for the entire pilot site	Collection consumption of the pilot buildings (data from the supplier) Consumption of the monitored 5th building (n°11) - The plan is to install a meter for heating and domestic hot water in the building n°11 Aggregated consumption of the renovated 4 buildings (the	Individual gas consumption for the heating of each households

		plan is to install a sub-meter for the 4 renovated buildings)	
Organizational Units (OU)	OU with technical and social indicators The OU should allow to group the data by archetypes, to compare between similar & different archetypes Technical: • Group1: by property size • Group 2: by similar dwelling type • Group 3: by similar energy type dwellings Social: • Group 4: Working tenants • Group 5: not working tenants. • Group 6: Elderly people • Group 7: not elderly people • Group 8 and more: different family structures.	The platform should create 3 organizational units at the minimum, in order to allow the comparison between the different consumption data collected in the different buildings (data consumption from suppliers and from meters installed in the DREEAM project). At the moment, the assumption would be to allow comparison between 3 groups: Group 1: Collective electricity consumption for each building renovated Group 2: Collective Heating & domestic hot water consumption for building n°11 Group 3: Collective Heating & domestic hot water consumption of the 4 renovated buildings	The platform should allow the comparison between the energy consumption of pilot buildings and the average consumption of similar buildings in the area. At the moment, the assumption would be to allow comparison between 2 groups: Group 1: energy consumption of pilot buildings (meters type to be determined later) Group 2: average energy consumption of similar buildings in the area (data type to be determined later
Thematic	**PFP**	**Lands**	**ATER**
Time Display	Monthly & yearly consumption of each building	Mandatory: Monthly Yearly display Daily display with the possibility to select a precise date with 24h of consumption	Mandatory: Monthly Yearly display Daily display with the possibility to select a precise date
Energy per period module	Analysis of the energy used for a specific period of time with a comparative approach is a key expectation of building owners & visualization of energy savings	Possibility to set a precise date to display the comparison from 1 date to another Monthly consumption of building n°11, and the group of 4 renovated buildings and comparison between months Yearly consumption of building n°11, and the group of 4 renovated buildings and comparison between years	Comparison between selected periods

Comparison before/after renovations	Historical comparison before/after renovation Identification of energy efficiency linked to renovations or linked to behavioral factors. Check the "rebound effect" A key concern of PFP is to be able to calculate the difference between the energy efficiency of dwellings and equipment and the potential impact of tenants on this energy efficiency (especially the potential risk of increase in energy consumption of tenants).	Consumption comparison from date to date after the renovations. The platform must allow to select the dates to make the comparison. The way Landskronahem would like to make historical comparison before/after renovations is not yet clear especially if they intend to compare consumption periods before the renovations to consumption periods after the renovations, or if they will only base their evaluation on the final energy audit with the evaluation of the renovated buildings' energy efficiency.	Most commonly used will be the comparison between months and years. The results from the final energy efficiency assessment will also be a key result for ATER.
Alarm options	Yes, to detect abnormal consumption	Interest in alarm options such as detection of potential problem like excessive or to low consumption	Interest in alarm options such as detection of potential problem like excessive or to low consumption
Additional data to display	External temperature Inside temperature Humidity	External temperature Inside temperature Outside and inside humidity	External temperature Inside temperature Inside humidity Outside humidity
Capacity optimization module (1/2)	Yes - For the 3 building owners, the optimization concept is interesting but more information is required to understand how it can work with the renovation scenarios finally selected for each pilot site.	Yes - For the 3 building owners, the optimization concept is interesting but more information is required to understand how it can work with the renovation scenarios finally selected for each pilot site.	yes - For the 3 building owners, the optimization concept is interesting but more information is required to understand how it can work with the renovation scenarios finally selected for each pilot site.
Interest of remote control	It was uncertain at the time of the meeting in 2016, as the renovation scenarios were not yet validated to determine what type of remote control options were interesting for PFP. This topic will be addressed during the 2nd User Meeting in 2017.	Control of the good delivery of the temperature. The temperature delivered inside dwellings can't be lower than 20 degrees. An alarm related to the district heating system could be installed and displayed in the platform.	ATER would like to know the possibilities of the system to control the energy of the tenants. This topic will be addressed again during the 2nd User Meeting in 2017.

Reporting	Yes. Reporting system will be interesting for environmental sustainability, asset management, neighborhood officer	Landskronahem already has an internal reporting system	Not really a particular interest ATER has no need in terms of reporting from the future DREEAM platform
Future users of the DREEAM platform	4 key departments: - Pre-investment - Post environmental sustainability - Asset management - Neighborhood officer	Project Managers Technical managers Software engineers	Project managers
Data available on tenants for the platform	Monitored tenants Possibility to compare the historical bill data and the monitored data of the 9 households equipped with meters.	Not possible	Monitored tenants Meters can be installed in a tenants group and their bills are collected like in the UK
Interest of BO´s for a platform dedicated to tenants	Yes (5 options identified)	Yes (4 options identified)	ATER has no social activity with their tenants, so this part is not yet established and the possibility of an interface for the tenants in the 2nd pilot site will be discussed by middle 2017, as many tenants are old without computers access.

14.2 Key objectives of the DREEAM platform described in the DOW

For building owners, assessment and visualization of multiple buildings' efficiency is a key factor for taking an appropriate investment decision regarding the energy renovation programs at the scale of several buildings. However, nowadays institutional building owners of social and public housing have very limited possibilities to access information about the energy performance of the building stock, its financial evaluation as well as its future energy needs. Therefore, building owners lose opportunities to take informed decisions about the energy optimization strategies that would approach NZE standards, and they do not achieve maximum benefits from the renovation programs performed.

In the DOW, the original objectives by developing the platform are the following:

1. **DISPLAY A SET OF RELEVANT INDICATORS to BO´s on their buildings**

   The DREEAM monitoring tool will be a software application, which provides the building owners with a set of data indicators on their building portfolio (example: indicators about energy consumption per dwelling type, family type, or/and indicators of energy consumption per floor/dwelling orientation, etc.)

2. **HELP BO´s to VISUALIZE ENERGY EFFICIENCY**

   The tool will inform the building owners about the energy usage in the common areas and the building to evaluate a potential for different scenarios of energy reduction strategies. Thanks to the DREEAM platform, the building owners will learn more about the detailed energy usage of a group of monitored dwellings, and thanks to this precise monitoring they will be able to extrapolate the impact on other dwellings, and to take decisions for renovations and improve tenants' life quality.

3. **DEVELOP RELEVANT SERVICES for the SIMULATION & OPTIMIZATION of energy consumption**

   The tool through its machine learning algorithms developed by Open Domo will recommend very specific actions for the energy optimization.

4. **DEVELOP RELEVANT SERVICES supporting the MULTI-BUILDING OPTIMIZATION & DECENTRALIZATION**

   The tool will incorporate the renewable energy monitoring and the overall energy supply management. Consequently, building owners will have a possibility to exploit optimizations between the buildings, including the load management in combination with benefits of the decentralized energy supply.

14.3 Table of the work performed in the task 4.4 compared to the DOW

Open Domo has performed a feasibility checking of the different options to develop according to building owners' requirements collected in 2016.

We describe below the conclusion related to:

⇒ The comparison between the DOW and the approach that we have presented ⇒ with the work we have finally performed in 2015/2016/2017 and the options that Open Domo will develop.

Shortly, the development of the DREEAM platform will be aligned to 3 of the 4 objectives described in the DOW. The 4th objective will be analyzed now that the final renovations scenarios are defined for each pilot site.

Description in the DOW	Work performed	Conclusion alignment/deviation
Development of DREEAM platform with a User Centered approach and interactive tests with future users (the BOs)	3 in-depth User Tests organized in 2016 with each of the 3 building owners team in presence of Savills, Open Domo, SinCEo2, Chalmers and BO employees	Done & Aligned
Full analysis of 1st building owners' requirements expressed during the User Tests in 2016 and detailed reporting	Analysis and presentation of the requirements expressed by the 3 building owners are ready for the 2nd step of the DREEAM platform development (that will start when renovations scenarios are received from WP1/WP2)	Done & Aligned
Review by the 3 building owners of the key requirements from the 1st User Tests		Done & Aligned
Preparation of the 2nd User Tests with BO after reception of the renovation scenarios	The 2nd User Test questions are already partly ready and will be updated in April/May with the final renovations scenarios received from WP1/WP2. During this 2nd User Tests, BOs will be able to visualize the metered energy consumption of their buildings on the platform.	**Preparation on-going for a meeting by middle of 2017 Aligned**
Objective 1: display a set of relevant indicators to BOs on their buildings	Feasibility checking of the existing indicators in the DREEAM platform and possibility to develop additional indicators requested by BOs confirmed by Open Domo	**Aligned**
Objective 2: help BOs to visualize energy efficiency	Feasibility checking of the existing indicators in the DREEAM platform and possibility to develop additional indicators requested by BOs confirmed by Open Domo	**Aligned**
Objective 3: develop relevant services for the simulation & optimization of energy consumption	Feasibility checking of the existing indicators in the DREEAM platform and possibility to develop additional indicators requested by BOs confirmed by Open Domo	**Aligned**
Objective 4: develop relevant services supporting the multi-building optimization & decentralization	The feasibility checking of this objective was not possible to perform as the final renovations scenarios were not known yet during the deliverable redaction. This objective will be analyzed in April/May by Open Domo.	**Possible deviation**

14.4 Conclusion on the alignment & minor deviation from the DOW

✓ The objectives 1 & 2 are confirmed and integrated in the development road map

The interviews carried out in 2016 with the 3 building owners of the DREEAM project and their employees show that the support of software to visualize the existing efficiency of buildings, and to calculate and visualize the impact of renovations programs on these buildings would be particularly valuable, which correspond to the original objectives 1 and 2.

The interviews with building owners showed us that we should concentrate our efforts during the first stage of the development on the visualization of the renovations' impact on buildings energy efficiency. This visualization instrument is a key element to develop in our platform to prove to building owners that the DREEAM approach reaches the expected results. The experience in other European Research programs tends to show a similar concern of building owners nowadays: **measure, assess and visualize the real final impact of renovations compared to the results expected,** and also ideally **visualize the ROI post-renovation** with the final efficiency measures **compared to the ROI projections**.

KEY EXPECTATIONS OF BO´s:

What appears to be a key tool for the visualization in the future platform for PFP, Landskronahem and ATER is the comparative approach. For building owners' employees, the comparative options should ideally allow to make both:

- Historical comparisons: before/after renovations;
- Group comparisons: between different buildings/ dwellings / groups of tenants & also between renovated and non-renovated buildings.

The interviews and Users tests also demonstrated that the visualization of the energy efficiency of buildings in the DREEAM platform should propose various settings and be adapted to the local/national standards used by the building owners, but also their in-home rules and processes. This last aspect is the more complex one as different building owners have different approaches to evaluate the impact of energy renovations on their buildings, so we have integrated in our approach various exchanges with building owners on the methodological approaches to assess energy efficiency in their organizations, and the methodological approach to assess energy efficiency in the DREEAM project. In 2017, we will have even more in-depth exchanges with building owners on the methodologies used both in their organizations and in the platform in order to identify potential improvements requested by building owners, misunderstanding/important methodology differences if existing, and to develop information material such a user guide for building owners' employees (describing how the platform collects the data, calculates the statistics and the energy performance).

Following the Users Tests and the feasibility checking executed by Open Domo, we can now state that the objectives no.1 and no.2 are included in the development road map of the platform with the implementation of various indicators (objective 1) and the development of visualization options (objective 2). The development should start in 2017 with the implementation of electricity tariffs of the 3 pilot sites. In order to simplify the transfer of data related to energy tariffs, Open Domo has developed a more flexible platform that allows to integrate tariffs from different countries in a quick

and easy way. At the beginning of 2017, exchanges with building owners have been organized in order to collect the energy tariffs from the UK, Italy and Sweden with the help of SinCeo2.

✓ **The objective 3 is confirmed and integrated in the development road map**

The interviews show that some building owners are particularly interested in receiving advice to **optimize and to simulate a better/different use of equipment or energy contracts, and to identify issues**. According to building owners' employees, the optimization of the existing energy consumption should be supported by the platform thanks to several tools such as consumption alerts, optimization of contracts of equipment's settings & remote control options.

Following the feasibility checking, Open Domo has confirmed that the development of optimization & simulation options (objective 3) in the DREEAM platform based on the first BO´s requirements is possible and is integrated in the road map of the platform development for 2017.

❖ **The objective 4 of MULTI-BUILDING OPTIMIZATION & DECENTRALIZATION will be analyzed by Open Domo in April/May**

At the time of the production of this deliverable, the final renovation scenarios for each pilot site were not fully known yet. Therefore, the development of options to visualize, manage and optimize decentralized energy and load shift management for the renovated buildings were not requested yet as we didn't know the type of equipment that will be installed in the pilot buildings. The feasibility of objective 4 will be determined in April/May by Open Domo based on the final renovation scenarios of each pilot site established by the WP1 and WP2.

14.5 Next steps

The DREEAM platform development team will concentrate its effort in the middle of 2017 on:

- Analyze the renovations scenarios and the feasibility of the objective 4;
- Proposing adequate improvements of the existing platform based on the key first requirements expressed by Building Owners on the 3 objectives that are: Indicators display (objective 1), energy efficiency visualization (objective 2), simulation and optimization (objective 3);
- Organizing the 2nd Users Tests with the 3 building owners during the middle of 2017.