



# Save the Homes

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# 1 Executive Summary

This report presents the monitoring data plan for the two pilots.

The data monitoring plan defines which specific measurements and measuring protocols (from T2.4) should be taken throughout the different steps to obtain data about energy, indoor environmental quality, satisfaction and wellbeing of occupants in all the pilot buildings to evaluate these KPIs before and after renovation.

Data coming from the monitoring campaigns will be stored in common data management structure that will later on allow harmonized data management, handling and sharing, including data privacy (GDPR compliance), addressed in D3.9 Ethics Manual for the two pilots.





## Table of Content

1	Executive Summary.....	- 2 -
2	Introduction .....	- 4 -
3	Save the Homes Customer Journey .....	- 5 -
4	The pilot cities ecosystems .....	- 7 -
4.1	The monitoring of the customer journey.....	- 7 -
4.1.1	Stop 0 – On-boarding .....	- 9 -
4.1.2	Stop 1 – Evaluation.....	- 10 -
4.1.3	Stop 2 – Elaboration .....	- 11 -
4.1.4	Stop 3 – Realization .....	- 13 -
4.1.5	Stop 4 – Validation .....	- 15 -
4.2	The monitoring of the renovation benefits .....	- 18 -
4.2.1	Stop 0 – On-boarding .....	- 18 -
4.2.2	Stop 1 – Evaluation.....	- 18 -
4.2.3	Stop 2 – Elaboration .....	- 19 -
4.2.4	Stop 3 – Realization .....	- 22 -
4.2.5	Stop 4 – Validation .....	- 23 -
5	Follower cities.....	- 26 -
6	Conclusions.....	- 27 -
	Annex 1 - StH Document 8: Monitoring data templates .....	- 28 -
	Annex 2 – Best practices map deployment plan.....	- 33 -





## 2 Introduction

Investments in renovations of homes are vital for the environment, economy, and people's quality of life. Europe is struggling with an aging housing stock where only 10% of buildings currently have A or B class energy performance certificates. Next to that, the condition of a house is increasingly related to health due to demographic and climate change. Living in unrenovated homes can have major implications for your health while improved housing conditions may save lives, reduce health risks and increase quality of lives.

In order to limit the global warming, the carbon dioxide emissions have to be recused to zero. Buildings are responsible for more than 30% of the global energy consumption, so to reach the near zero-emissions goal, the global emissions from existing housing stock must have been decreased by 80-90% in 2050 compared to the levels of 2010. To achieve this reduction, the renovation rate of the EU existing building stock has to increase. The building stock has a large energy saving potential by i.e. improving thermal insulation, energy efficiency of technical installations.<sup>1</sup>

Thus, by renovating residential buildings, an opportunity presents to achieve major improvements in health, comfort and well-being, and energy savings. However, the renovation process is complicated and unattractive for citizens due to many barriers in the renovation industry, such as the uncertainty of the results and related benefits (and co-benefits) and lack of available and reliable quality checks.

Save the Homes wants to stimulate home renovation demand and increase the home renovation rate in the EU while simultaneously improving people's health, living comfort, and well-being. This will be done by introducing within the Citizen Hub the needed monitoring services and protocols to demonstrate results and co-benefits and build trust in energy renovation processes and results. Therefore, the Citizen Hub will make renovation easier, faster and more affordable by providing Monitoring and verification of work, quality assurance, and independent support.

**This Deliverable 3.8 deals with the monitoring data plan in the context of the two pilot ecosystems, defining which specific measurements and measuring protocols (from T2.4) should be considered throughout the different steps to obtain data about energy, indoor environmental quality, satisfaction and wellbeing of occupants in the pilot buildings. This will be effectively implemented during WP4 activities according to the real development of each Citizen hub services.**

These will be the base to evaluate KPIs before and after renovation; and the common data management structure will later on allow harmonized data management, handling and sharing (always considering data privacy -GDPR compliance-, addressed in D3.9 Ethics Manual for the two pilots).

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<sup>1</sup> IPCC, 'Summary for Urban Policy Makers: What the IPCC special report on global warming of 1.5°C means for cities', 2018



### 3 Save the Homes Customer Journey

The customer journey describes the experiences, behaviour, and decisions of a customer when interacting with a brand, service or company in the process towards purchasing of goods or services. The full process describes the entire journey. From the very first contact until completing the actions and being an ambassador after. The journey consists of several steps that are walked through from the customers perspective, the exact number of steps depend on the customer journey model, however when comparing different models for a renovation customer journey a general built-up can be seen<sup>2</sup>: For Save the Homes, we translated these steps for renovations as seen in table below:

customer journey model	Save the Homes model
1. Awareness and orientation	1. Onboarding
2. Seeking advice	2. Design
3. Selecting option	3. Elaboration
4. Execution	4. Construction
5. Experience (and inspire)	5. In-use

Table 1.- Customer journey steps

These steps are the base of the customer journey model and follow the decision-making process of the customer. The transition from one step to the next is crucial. The points of interaction between the customer and the company or brand are so-called 'touchpoints. The touchpoints link directly to the experience of the customer in each step of the journey. Each step has its own drivers and barriers which show the reasons for the potential customer to continue or to quit the process.

Providing the right information and support at the right moment is crucial. This includes clear, and meaningful information about the renovation process, financial options, energy performance, IEQ and well-being impacts. What kind of *touchpoints*, information, and guidance is needed depends on the emotions, needs and wants of the customer at that point in their journey. These aspects are included in the customer journey as *drivers and barriers*. Relevant drivers and barriers are of course very person specific, therefore several possible drivers and barriers have been included in the general Save the Homes customer journey and these can be further narrowed down and specified when considering a persona specific customer journey. Knowing the emotions and barriers of a customer means that also the risks, which are possible *dropout moments* for the customer, can be defined per phase. The insight that is gained by mapping these risks and the reasons behind them helps in optimising the journey and preventing, or minimising, the dropout risks.

**This potential dropout moments are the focus of this Deliverable, which intend to provide evidence of the benefits (and co-benefits) of the energy renovation process in terms of objective measurable indicators from building quantitative data and subjective qualitative impressions from users.**

According to Objective 4. To deliver real benefits to citizens and other stakeholders in two cities as a result of the Citizen Hubs operating locally, the objective is not only to provide the integrated renovation services to the specific homeowners groups identified in the two cities (Rotterdam, Valencia) but also to demonstrate the potential of the Citizen Hub concept to all relevant stakeholders in other municipalities, to regain trust and interest in building renovations and to further expand the Citizen Hub business model. Specifically, the Monitoring Plan implementation should provide:

- Feedback about operation of the Citizen Hub business model

<sup>2</sup> N. Nieboer and A. Straub, 'How do customer journeys regarding energy investments look like?' Conference papers of the European Network for Housing Research (ENHR 2018): More together, more apart: Migration, densification, segregation ENHR, 2018.



- Evidence of the well-functioning Citizen Hubs to homeowners, follower cities and the involved European umbrella organisations.
- Evidence of the delivered impact to involved and interested stakeholders.
- Guidance and lessons learnt offered to two follower cities (Sant Cugat, Spain and Ljubljana, Slovenia), to ensure smooth replication of this concept (a framework ready to be implemented);
- Promotion of the concept to other municipalities on a national level.
- Barriers that should be avoided to create a well-functioning Citizen Hub

The monitoring data plan for each pilot will help reaching the following Save the Homes goals:

- a) Citizens who underwent renovation informed about the achieved benefits and follow the buildings performance based on the monitored data (The 1100 renovated homes (monitored homes renovated in the first two years of the project; see impact calculations in section 2.1.1, 1st layer, sum of year 2021 and 2022) in Valencia and Rotterdam. This information is visualized to homeowners where 75% of those find this information interesting and easy understandable)
- b) Promotion of the concepts based on actual evidence-based benefits. The aggregated data visualized to other stakeholder groups and communicated at the events organized by municipalities creating peer-to-peer renovation communities (Citizens in the targeted neighbourhoods across the two pilots are aware of the initiative and interested to know more due to ongoing awareness campaigns; additional 800 homeowners decide for renovation during the 3rd year based on the provided evidence-based results, see impact calculation in section 2.1.1, 1st layer, year 2023).
- c) The Municipality of Valencia working closely with the Municipality of Sant Cugat and City of Rotterdam with City of Slovenia to ensure that the proven Citizen Hub blueprints, engagement campaign frameworks and customer journey methodologies and other lessons learned are taken advantage of in the replication phase (Follower cities having close collaboration with the pilots leading towards the decision to adopt the concept, ensuring the replication during -and after- the project duration; awareness campaigns targeting 2000 citizens organized).

Each phase of the customer journey intends to ease the renovation process and makes the whole experience user-friendly and appealing, and each has its own goal in terms of monitoring. The figure below represents in visual the key monitoring objectives for each of the customer journey phases:

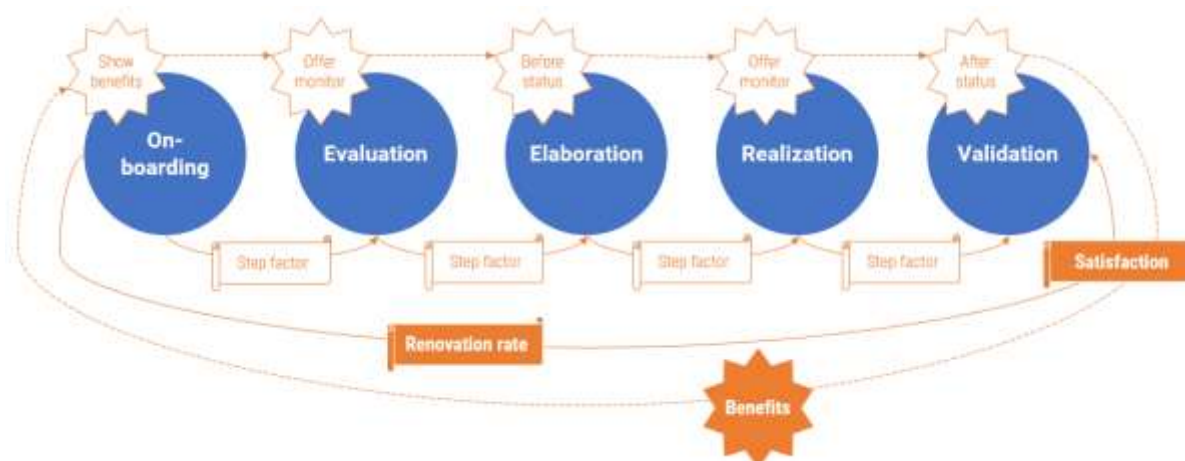


Figure 1.- Key monitoring milestones

## 4 The pilot cities ecosystems

According to Objective 1 (to make home renovation easier, faster and more affordable for homeowners by designing an economically sustainable citizen-oriented OSS model, 'Citizen Hub', to be deployed by municipalities), the 'Citizen Hub' is an OSS model endorsed by a municipality, a trustworthy entity ensuring that the process is independent, transparent and of high quality for their citizens. It is specifically focused on enhancing the homeowners' experience throughout the home renovation journey, and therefore, the Citizen Hub modules (technical renovation kits, financing offers, audits, etc.) are to be developed by relevant local experts and combined into a holistic offer endorsed by municipalities.

Sav€ the Homes will create innovative 'integrated home renovation services' within already established frameworks for OSS networks at the City of Rotterdam, the Netherlands, and Municipality of Valencia, Spain. The project builds upon the existing climate targets set by the two cities (according to the initiative of Covenant of Mayors (CoM) for Climate & Energy, 15% of the mitigation actions and 9% of the adaptation actions proposed by cities in their Sustainable Energy and Climate Action Plans address residential buildings<sup>3</sup>).

**In this context, monitoring data plan approach is twofold: on the one hand, for the evaluation of real-time data (T4.5) in terms of renovation benefits, on the other, for the evaluation of the customer journey (T4.6) in terms success rates for deployed services. Finally, also the results' integration into a web based IS (T4.7) is considered.**

### 4.1 The monitoring of the customer journey

This approach concerns the realization and reporting of the Sav€ the Homes customers satisfaction within the whole customer journey:

- At the physical office, this plan will ensure that building owners are getting holistic renovation service by covering the technical package (assistance on choosing the right technical renovation package through a cocreation), financing package (to find the most suitable financing option for them), regulatory package (offering a contractual template and guidance on the legal aspects). It will be evaluated how many channels have been used efficiently.
- The protocol will be used to validate the Citizen Hub offers at the two pilots and its success. The following questions will be addressed: Is the Citizen Hub facilitator helping the homeowner to achieve their goals; is the network of Citizen Hub network working as foreseen? Is it a user-friendly system? How aware are the citizens of the service provided by the Citizen Hub facilitator? Are the objectives in terms of dwellings and/or buildings renovated reached?
- Complaint system will be set up to take into the account the complaints from the homeowners. The Citizen Hub facilitator takes a role of a mediator to ensure the process is resolved to the client's satisfaction. It will be evaluated if during the renovation enough interaction with homeowners has been ensured. The Citizen Hub model will be improved for further roll-out if a repetitive issue is identified during this review.

Therefore, this section deals with both Monitored data (quantitative) and User perception data (qualitative).

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<sup>3</sup> Covenant of Mayors figures: <https://www.covenantofmayors.eu/about/covenant-initiative/covenant-in-figures.html>



For the pilot ecosystems, D3.2 defined customer journeys implementation strategy and D3.6 platform functionalities, fitting a series of stops, steps and user profiles. As an example, the Valencia Region case is summarized in the table below:

Stop 0 - ON-BOARDING					
	AWARENESS		INTERACTION		
demand	friendly solutions & checklist	best practices, regulations, grants, FIs	citizen school workshops		
supply					
Stop 1 - EVALUATION					
	SELF EVALUATION		ASSISTED EVALUATION		
demand	friendly tool		personal appointment		
supply			EPC, design tools, solution templates		
Stop 2 - DESIGN & FORMALIZATION					
	DESIGN	SELECTION	FORMALIZATION		
demand		registries & lists	contract templates		
supply	technical solutions & checklist				
Stop 3 - REALIZATION					
	TRAINING		ASSESSMENT	MEDIATION	QUALITY ASSURANCE
demand	micro-training	workshops	workplan checklist	citizen school personal appointment	follow-up report & questionnaire
supply	evaluation for registries & lists		workplan template		
Stop 4 - VALIDATION					
	FEEDBACK	COMPARISON	MONITORING	CERTIFICATION	
demand	satisfaction/ complaints/ sharing questionnaires	friendly tool, EPC	before-after	best practices	
supply		2 best practices	2 best practices		

Figure 2.- customer journey & functionalities

In this section, for each stop, the specific measurements and measuring protocols (from T2.4) will be defined, to obtain data about the services provided through the whole renovation process; and the data collection and storage structure that will allow harmonized data management, handling and sharing, will be described.

The Rotterdam case is at this moment still discussing the final form how to operate as a citizen HUB. The approach described in the following steps could be followed but depends on the actual form the HUB will get. When it becomes part of the municipality, the GDPR guidelines become stricter, and can have an influence on the outcome.



#### 4.1.1 Stop 0 – On-boarding

The objectives of this stage related to needs and expectations are to establish contact with the citizen with the aim to create an emotional response and then provide more information to increase interest. When citizens take the step of getting involved and do their own research, they go into stop 1.

Potential touchpoints are managed through functionalities, services or tools such as campaigning at popular places/events in the city, community meetings or newsletters, social media, newspapers or radio or word of mouth (local heroes, videos or open house). Next sub steps are managed through Information sessions, Website with information & interactive tools or Sign up for playful/ simple home assessments, while stepping into next stage can be done through Contact form, Phone call or Physical hub walk-in visit.

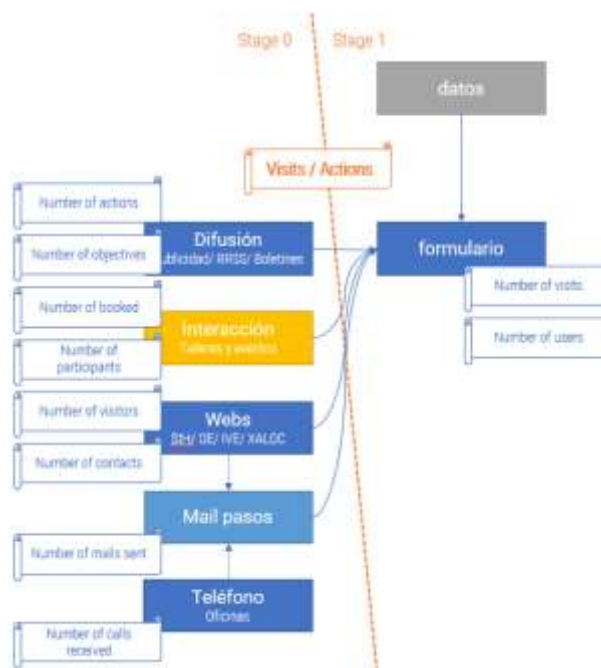


Figure 3.- Touchpoints & Services monitoring in stage 0

**Fout! Verwijzingsbron niet gevonden.** summarizes the touchpoints and monitoring actions to be implemented in this stage. As for monitoring actions, Citizen hub could count:

- Number of actions of dissemination (Social media messages, newsletters, mass media)
- Number of targeted audiences for each of the previous ones
- Number of persons booking a seat on an event or workshop, presential or virtual
- Number of persons assisting to that event or workshop, presential or virtual
- Number of users/ visitors to Citizen Hub ecosystem websites (Save the Homes, IVE, VRCP, Xaloc network, Energy Office, VCE)
- Number of users asking for information through previous websites contact mechanisms (e-mail and/or telephone)
- Number of general information (customer journey steps and services) mails sent.

For monitoring the success rate of these actions and calculate the step factor, it should be counted:

- Number of visits/ users of the preliminary questionnaire (i.e., auto evaluation tools). Distinction between users and visits is due to the fact that many users will be Citizen Hubs staff helping customers to diagnose their buildings, so the user will be repeated, but the visit will be distinctive.

Main step factor is the relation between **visits or users of the auto evaluation tool and the actions deployed in order to get users there**, but there are other interesting partial success factors, to evaluate which kinds of actions are more effective or efficient, such as:

- Relation between dissemination actions and objectives
- Relation between participants and interested in events
- Relation between website/ phone contacts and website visits
- Access to auto evaluation tools from dissemination links, from events, from website links, and from general information mail link

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
<b>Dissemination success rate</b>	Visits to auto evaluation tools; target of dissemination action; number of dissemination actions	(Origin of auto evaluation tools access/ (dissemination actions* target))* 100	Effectiveness of action
<b>Events success rate</b>	Visits to auto evaluation tools; participants to event; event capacity; number of events	(Origin of auto evaluation tools access/ (events* event capacity))*100 AND (Origin of auto evaluation tools access/ (events* event participants))*100	Effectiveness of action AND Success of action
<b>Website success rate</b>	Visits to auto evaluation tools; visits to website;	(Origin of auto evaluation tools access/ (websites visits))* 100	Effectiveness of action
<b>Mailing success rate</b>	Visits to auto evaluation tools; visits to website; contact form; phone calls; mails sent	(Origin of auto evaluation tools access/ (mails sent))* 100	Effectiveness of action
<b>On-boarding step factor</b>	All previous ones	(Visits to auto evaluation tools/ (summatory of actions))* 100	Effectiveness of step

Table 2.- customer journey Monitoring Plan for onboarding stage 0

In this stage, monitoring methods are limited to counts and registers, and calculating rates between them, and no other protocol than **keeping the same counting criteria** is used.

### 4.1.2 Stop 1 – Evaluation

The objectives of this stage related to needs and expectations are to provide information & tools to citizens so they can gain more insights and orientate themselves for simplified version of a home assessment, renovation packages tailored to building type and persona needs and drivers, financial online tools (provided by different banks), and advise on suitable and available financial schemes such as loan options, subsidies, and grants, or simple and clear overview available (on the website and/or in a physical brochure). Then to get a personal appointment and personalized advice on renovation package to improve the performance of the home in a confidential manner.

Potential touchpoints are managed through functionalities, services or tools such as tools & information (on website and/or brochures), automated advice by the tools, contact form/information, appointment and finally advice fee (first real commitment).

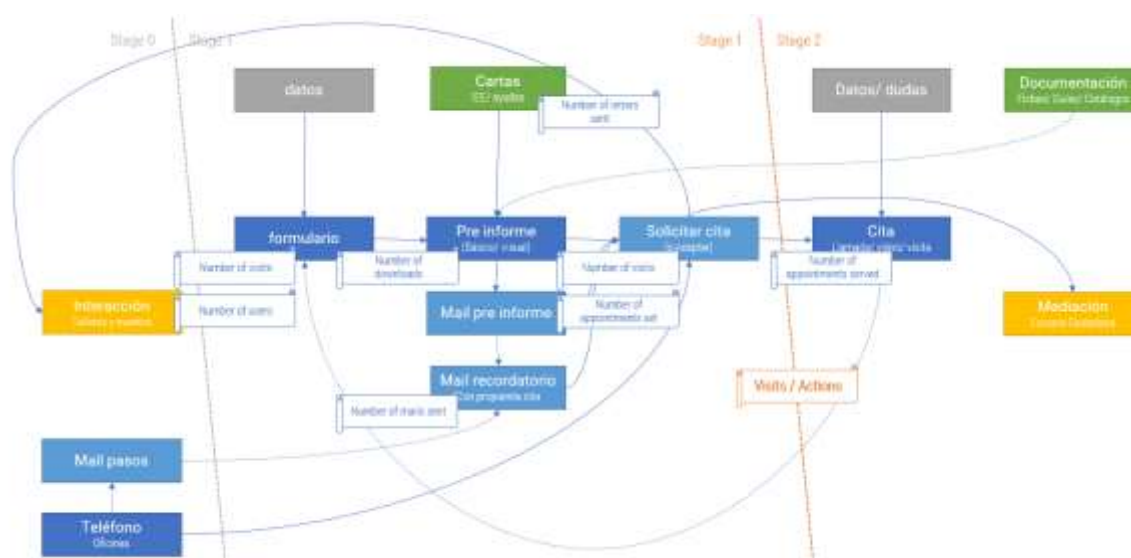


Figure 4.- Touchpoints & Services monitoring in stage 1

Figure 4 summarizes the touchpoints and monitoring actions to be implemented in this stage. As for monitoring actions, Citizen hub could count:



- Number of visits/ users of the preliminary questionnaire (i.e., auto evaluation tools tool) . Distinction between users and visits is due to the fact that many users will be Citizen Hubs staff helping customers to diagnose their buildings, so the user will be repeated, but the visit will be distinctive (counted already for previous stage success rate calculation).
- Number of downloaded pre-reports from auto evaluation tools (i.e., how many visits went to the end of the tools)
- Number of customized pre-diagnosis letters sent (to buildings older than 50 or which have asked for subsidies in previous years)
- Number of reminder mails sent
- Number of visits/ calls to the scheduling system
- Number of appointments set

For monitoring the success rate of these actions and calculate the step factor, it should be counted:

- Number of appointments served (personal call, videocall, visit or meeting)

Main step factor is the relation between **appointments served and the actions deployed in order to get users there**, but there are other interesting partial success factors, to evaluate which kinds of actions are more effective or efficient, such as:

- Relation between auto evaluation tools visits and pre-reports downloaded
- Relation between number of visits to the scheduling systems and number of pre-reports sent by letter/ downloaded
- Relation between number of visits to the scheduling systems and reminder letters sent
- Relation between appointments set and visits to scheduling system
- Relation between appointments served and appointments set

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
auto evaluation tools success rate	Visits to auto evaluation tools; pre-reports downloaded	(pre-reports downloaded/ visits to auto evaluation tools)* 100	Effectiveness of tool
Pre-reports' success rate	Visits scheduling system; pre-reports downloaded; letters sent	(Visits to scheduling system/ (pre-reports downloaded AND/OR letters sent))* 100	Effectiveness of actions
Reminders' success rate	Visits scheduling system; reminders sent	(Visits to scheduling system/ reminders sent)* 100	Effectiveness of action
Scheduling system success rate	Visits scheduling system; appointments set	(Appointments set/ visits to scheduling system)* 100	Effectiveness of system
Users' reliability (demand side)	Appointments set/ appointments served	(Appointments served/ appointments set)* 100	Respectability of citizen hub
Evaluation step factor	All previous ones	(Appointments served/ (summatory of actions))* 100	Effectiveness of step

Table 3.- customer journey Monitoring Plan for evaluation stage 1

In this stage, monitoring methods are limited to counts and registers, and calculating rates between them, and no other protocol than **keeping the same counting criteria** is used.

#### 4.1.3 Stop 2 – Elaboration

The objectives of this stage related to needs and expectations are to organize the financing, renovation packages, decision making and preparing for the construction of the renovation works, where real complexity of renovation arises, ensure sufficient support to citizens; guide through process in a holistic and understandable way; assist in choosing the right renovation package; provide contact information of trusted installers and contractors, or support in obtaining the financing.

Potential touchpoints are managed through functionalities, services or tools such as Home assessment, Meeting renovation advice, Meeting financial guidance, Final plan (= renovation advice + financial advice), Offer(s) and finally Signed contract.

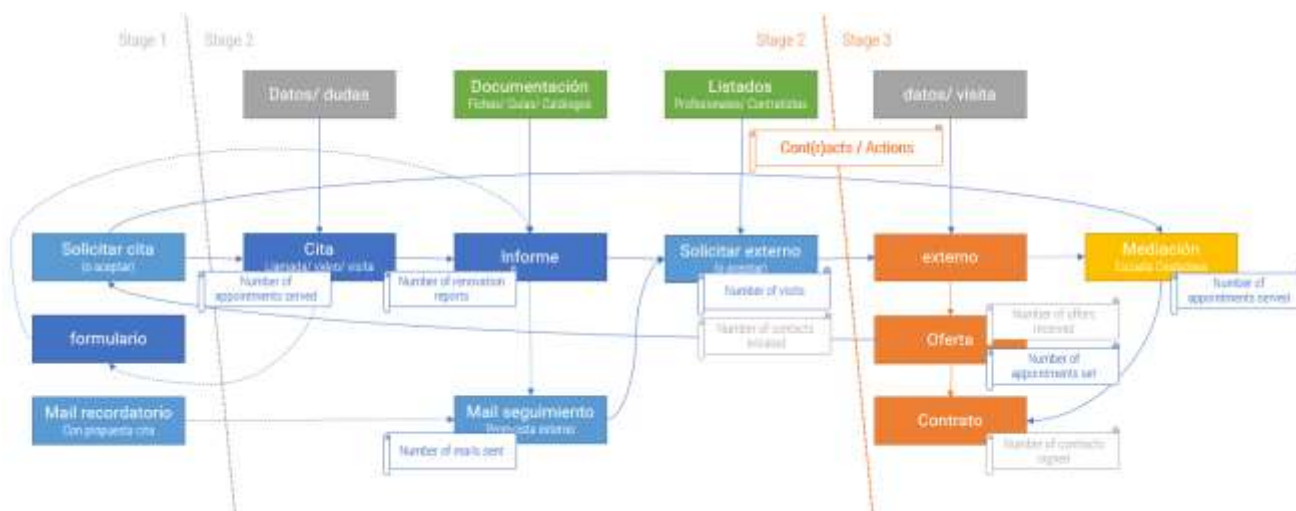


Figure 5.- Touchpoints & Services monitoring in stage 2

Figure 5 summarizes the touchpoints and monitoring actions to be implemented in this stage. As for monitoring actions, Citizen hub could count:

- Number of appointments served (personal call, videocall, visit or meeting), counted already for previous stage success rate calculation.
- Number of renovation reports prepared
- Number of reminders sent
- Number of visits to external resources (professionals, contractors, installers...) booking system
- Number of contacts initiated with external resources
- Number of offers received from external resources
- Number of appointments set (mediation – Citizen hub helps understand and/or compare offers)
- Number of appointments served
- Number of contracts signed

For monitoring the success rate of these actions and calculate the step factor, it should be counted:

- Number of contracts signed

Main step factor is the relation between **contacts (or contracts) established (or signed) with 'external' suppliers (professionals, contractors, etc...)** and **the actions deployed in order to get users there**, but there are other interesting partial success factors, to evaluate which kinds of actions are more effective or efficient, such as:

- Relation between appointments served and renovation reports prepared (which should be 100%)
- Relation between number of visits to external resources booking system and renovation reports and/or reminders sent
- Relation between number of contacts initiated and number of visits to booking system.
- Relation between offers received and contacts initiated
- Relation between number of appointments for mediation set and offers received
- Being some of these indicators difficult to measure in real circumstances (since external resources get out of the Citizen hub control), it can be interesting (and feasible) to measure the relation between the number of appointments for mediation set and the number of visits to booking system.

- Relation between number of appointments for mediation served and set
- Relation between number of contracts signed and number of initiated contacts or offers received

Finally, since the number of contracts signed or agreements achieved between customers and external resources can fall out of control of the citizen hub, the step factor could be assessed according to the answer to another reminder mail sent in next stage.

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
Personal appointments' success rate	appointments served; renovation reports prepared	(Appointments served/ renovation reports prepared)* 100	Effectiveness of service
Reports' success rate	visits to booking system; renovation reports	(Visits to booking system/ renovation reports)* 100	Effectiveness of action
Reminders' success rate	visits to booking system; reminders sent	(Visits to booking system/ (reminders sent)* 100	Effectiveness of action
Booking system success rate A	contacts initiated; visits to booking system	(Contacts initiated/ visits to booking system)* 100	Effectiveness of system
Users' reliability (supply side) A	offers received; contacts initiated	(Offers received/ contacts initiated)* 100	Respectability of citizen hub
Users' reliability (supply side) B	appointments for mediation set; offers received	(Appointments for mediation set/ offers received)* 100	Users' transparency
Booking system success rate B	appointments for mediation set; visits to booking system.	(Appointments for mediation set/ visits to booking system)* 100	Effectiveness of action
Users' reliability (demand side)	appointments for mediation served; appointments for mediation set	(Appointments for mediation served/ appointments for mediation set)* 100	Respectability of citizen hub
Offers success rate	contracts signed; offers received	(Contracts signed/ offers received)* 100	Effectiveness of action
Elaboration step factor	All previous ones	(Contracts signed/ (summatory of actions))* 100	Effectiveness of step

Table 4.- Customer journey Monitoring Plan for elaboration stage 2

In this stage, monitoring methods include counts and registers, and calculating rates between them, so **keeping the same counting criteria** is needed.

#### 4.1.4 Stop 3 – Realization

The objectives of this stage related to needs and expectations are to realise renovation according to the plan agreed, assess quality during and after the renovation works (verified parties), provide tools (personal project dashboard) where both the homeowner and the professional can track the progress, and, when the renovation works are finished, provide a final report on the taken measures, quality evaluation and benefits.

Potential touchpoints are managed through functionalities, services or tools such as Personal progress dashboard, Satisfaction questionnaires (for homeowner and contractor during renovation works) or (Periodic & final) reports.

Figure 6 summarizes the touchpoints and monitoring actions to be implemented in this stage. As for monitoring actions, Citizen hub could count:

- Number of appointments set for mediation related to renovation works (citizen hub helps understand requirements, setbacks or alternative solutions occurring during the renovation works)
- Number of appointments served for mediation related to renovation
- Number of reminder mails sent to check whether the works were realized or not, including a satisfaction questionnaire (on the works and on the process)
- Number of visits/ users opening the questionnaire



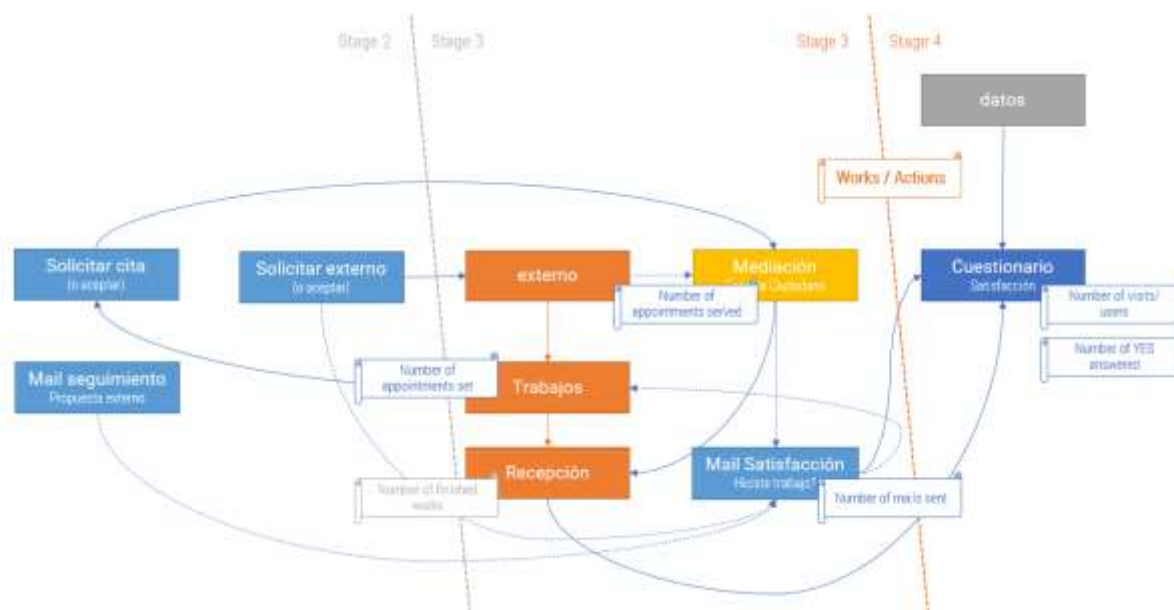


Figure 6.- Touchpoints & Services monitoring in stage 3

For monitoring the success rate of these actions and calculate the step factor, it should be counted:

- Number of questionnaires answered
- Number of questionnaires answered YES (Number of finished works)

Main step factor is the relation between **finished renovation works and the actions deployed in order to get users there**. Nevertheless, it is to be noted that the number of finished works can fall out of control of the citizen hub, therefore the step factor might better be assessed according to the answer to the reminder mail. Also, there are other interesting partial success factors, to evaluate which kinds of actions are more effective or efficient, such as:

- Relation between number of appointments set and served for mediation related to renovation
- Relation between visits to questionnaire and reminders sent
- Relation between number of questionnaires answered and number visits to the questionnaire
- Relation between number of questionnaires answered YES and number of questionnaires answered

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
<b>Users' reliability (demand side)</b>	appointments for mediation served; appointments for mediation set	(Appointments for mediation served/ appointments for mediation set)* 100	Respectability of citizen hub
<b>Reminders' success rate</b>	visits to questionnaire; reminders sent	(Visits to questionnaire/ (reminders sent)* 100	Effectiveness of action
<b>Questionnaire success rate</b>	Questionnaires answered, visits to questionnaire	(Questionnaires answered/ Visits to questionnaire)* 100	Effectiveness of action
<b>Reno success rate</b>	Questionnaires answered YES, questionnaires answered	(Questionnaires answered YES/ questionnaires answered)* 100	Effectiveness of citizen hub
<b>Realization step factor</b>	Questionnaires answered YES; appointments set & served; reminders sent	(Questionnaires answered YES/ (summatory of actions))* 100	Effectiveness of step

Table 5.- customer journey Monitoring Plan for elaboration stage 3

In this stage, monitoring methods are limited to counts and registers, and calculating rates between them, and no other protocol than **keeping the same counting criteria** is used.



#### 4.1.5 Stop 4 – Validation

The objectives of this stage related to needs and expectations are to monitor the performance of the dwellings by showing the original dwelling's performance compared to the performance of the improved dwelling, to train about the home improvement and the (optional) installing of smart meters or behavioural changes or offer the opportunity to share their opinion on the renovation works itself and the fully guided process of the hub.

Potential touchpoints are managed through functionalities, services or tools such as Validation report (comparing before-planned-after), Information/ usage guide on smart monitoring or behavioural change tips or Sharing questionnaires or templates.

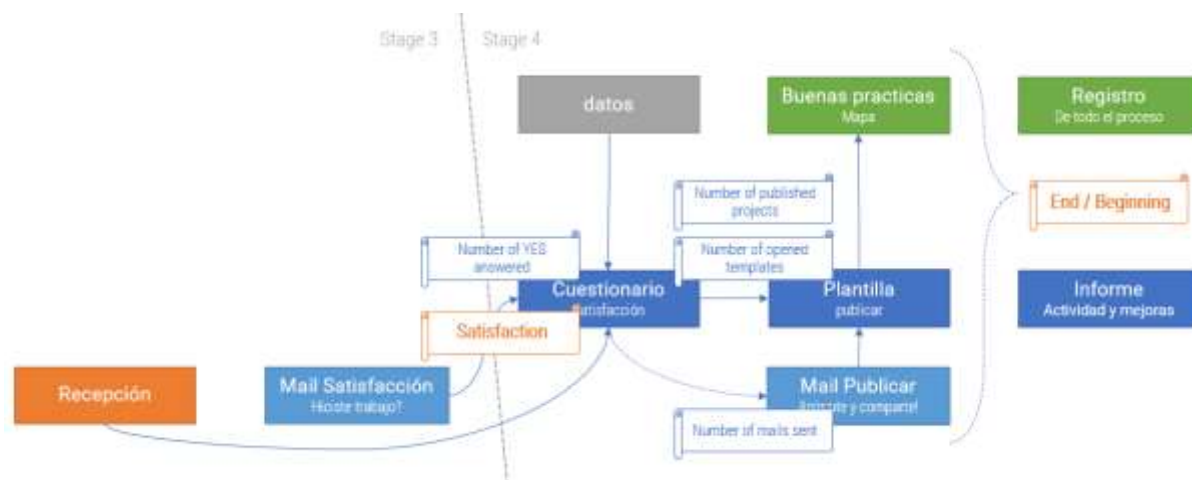


Figure 7.- Touchpoints & Services monitoring in stage 4

Figure 7 summarizes the touchpoints and monitoring actions to be implemented in this stage. As for monitoring actions, Citizen hub could count:

- Number of questionnaires answered YES (already counted for previous stage)
- Number of opened templates (and its origin: questionnaire or reminder e-mail)
- Number of reminder e-mails sent

For monitoring the success rate of these actions and calculate the step factor, it should be counted:

- Number of published works

Step factor in this stage related to the circle closing, so to engage new customers based on their neighbours' experiences, and it is defined as the relation between **the number of published works and the number of declared finished works** (answered YES to the questionnaire), but there are other interesting partial success factors, to evaluate which kinds of actions are more effective or efficient, such as:

- Relation between number of opened templates (considering its origin) and declared finished works (who answered YES to the questionnaire)
- Relation between published works and visits to the publishing template



Indicator	Variables involved	Method/ Protocol/ Tool	Objective
<b>Users' interest</b>	Visits to the template; reminders sent; questionnaires answered YES	(Visits to the template (by origin AND total)/ (questionnaires answered YES AND reminders sent))* 100	Effectiveness of service
<b>Users' satisfaction</b>	published works; visits to the template	(Published works/ opened templates)* 100	Quality of service
<b>Validation step factor</b>	All previous ones	(Published works/ (summatory of actions))* 100	Effectiveness of step

Table 6.- Customer journey Monitoring Plan for validation stage 4

In this stage, monitoring methods include counts and registers, and calculating rates between them, so **keeping the same counting criteria** is needed.





A. Customer journey overall assessment

Therefore, and as a conclusion, main success indicator for the citizen Hub services is defined in terms of **before-after comparison**, with several approaches:

- Relation between declared finished works (answered YES in stage 4) and initial actions deployed in order to get users there (in stage 0)
- Relation between declared finished works (answered YES in stage 4) and users/buildings joining the Citizen Hub on any of their actions

Also, a natural part of stage 4 is the satisfaction monitoring, meaning not the measurement of the citizen hub success in terms of objective data collection, but in terms of subjective perception. For this, the **satisfaction questionnaire** at the beginning of this stage will be designed to capture these feelings and allow the citizen Hub to improve their services accordingly. Nevertheless, this questionnaire will be also provided when the customer journey instantiation detects a dropout of the process (i.e., when a customer does not react to the reminders schema), in order to learn the reason and help filling the potential gaps of the services provided.

All the results obtained through the application of this protocol should be collected in an **annual report** including the corresponding indicators and together with the lessons learnt and the next year improvements' implementation program.

Data collection will use a common **evaluation template** (see Annex 1 - StH Document 8: Monitoring data templates) connected with a data **dashboard** for monitoring and reporting KPIs and impacts. Version included in this Deliverable is kept very simple, in order to further develop in detail each register, if needed, on each pilot basis during WP4 activities.

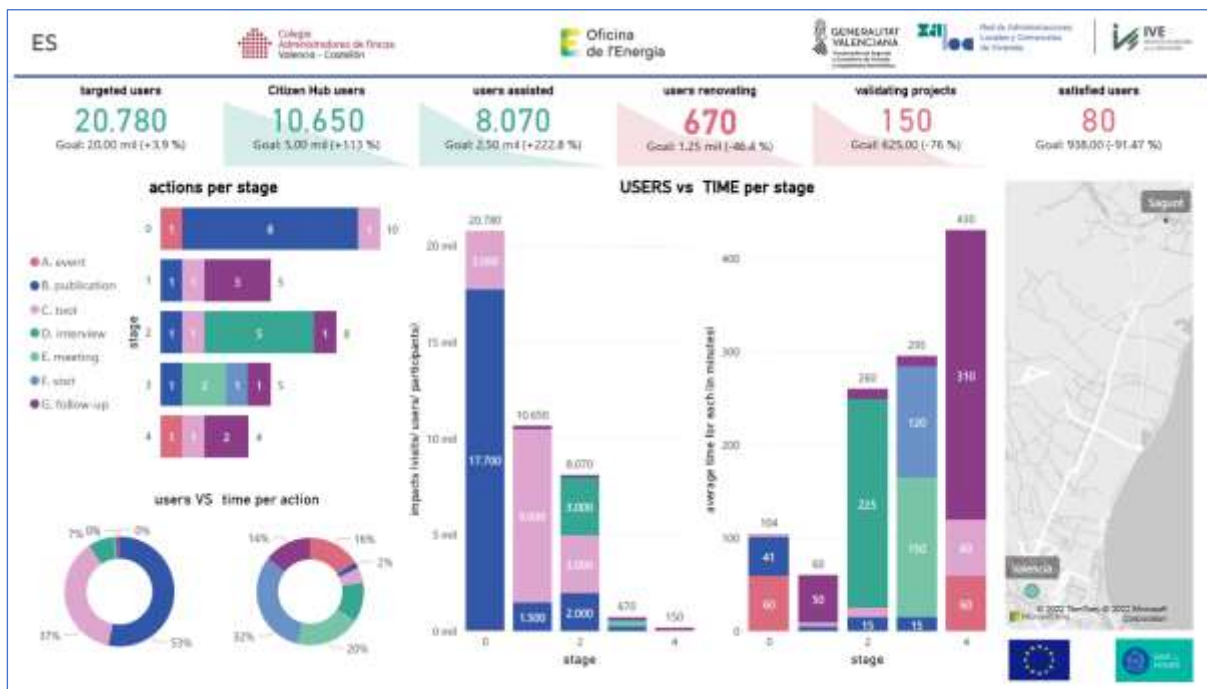


Figure 8.- (Synthetic data) Spanish customer journey evaluation dashboard

## 4.2 The monitoring of the renovation benefits

The relevant data related to building’s energy performance and IEQ (well-being of occupants) will be stored, analysed and translated into information relevant for homeowners and local governments and municipalities, taking advantage of new generation of holistic user-friendly Energy Performance Certificates (from H2020 U-CERT, TripleA-reno) that will be provided to the renovated buildings.

Therefore, this section deals with both Monitored data (quantitative) and building descriptions data (qualitative).

Therefore, in this section, for each stop, the specific measurements and measuring protocols (from T2.4) will be defined, to obtain data about energy, indoor environmental quality, satisfaction and wellbeing of occupants in all the pilot buildings; and also, the data collection and storage structure that will allow harmonized data management, handling and sharing, will be described.

### 4.2.1 Stop 0 – On-boarding

The objectives of this stage related to needs and expectations are to establish contact with the citizen with the aim to create an emotional response and then provide more information to increase interest. (co)benefits of renovation are to be measured, such as energy savings, IEQ and wellbeing of occupants, in order to connect with their motivations, which in this stage means to offer **best practices visualization**. For doing so:

- Examples of more representative buildings will be disseminated
- Maps and/or dashboards will be placed in the ecosystem websites

**Fout! Verwijzingsbron niet gevonden.** summarizes renovation benefits promotion within the touchpoints of this stage.

Main activity is the deployment and dissemination of results, but there are also interesting indicators to evaluate effectiveness of monitoring, such as:

- Share of On-boarding step factor coming from best practices related actions

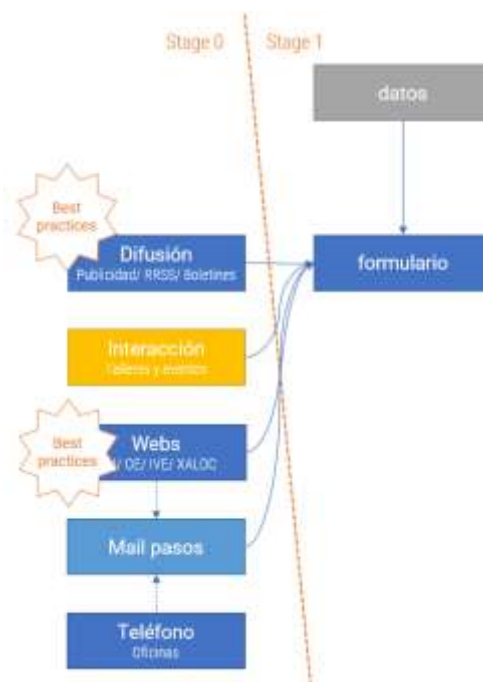


Figure 9.- Touchpoints & Benefits monitoring in stage 0

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
Share of success coming from best practices related actions	On-boarding step factor; visits to onboarding tools; visits of best practices maps or dashboards	(Visits of best practices/ (sumatory of all onboarding actions))* On-boarding step factor	Effectiveness of monitoring

Table 7.- Benefits Monitoring Plan for onboarding stage 0

In this stage, monitoring methods are limited to counts and registers, and calculating rates between them, and no other protocol than **keeping the same counting criteria** is used.

### 4.2.2 Stop 1 – Evaluation

The objectives of this stage related to needs and expectations are to provide information & tools to citizens so they can gain more insights and orientate themselves. Then to get a personal appointment and personalized advice on renovation package to improve the performance of the home in a confidential manner. (co)benefits of renovation are to be measured, such as energy savings, IEQ and



wellbeing of occupants, in order to connect with their motivations, which in this stage means to **offer monitoring tools**, such as:

- Wellbeing questionnaires
- IEQ sensors
- Energy monitors
- Energy bills
- Access to utilities’ monitoring systems

So the Citizen hub could count:

- Monitor offers (including all the tools)
- Monitors accepted/ hired

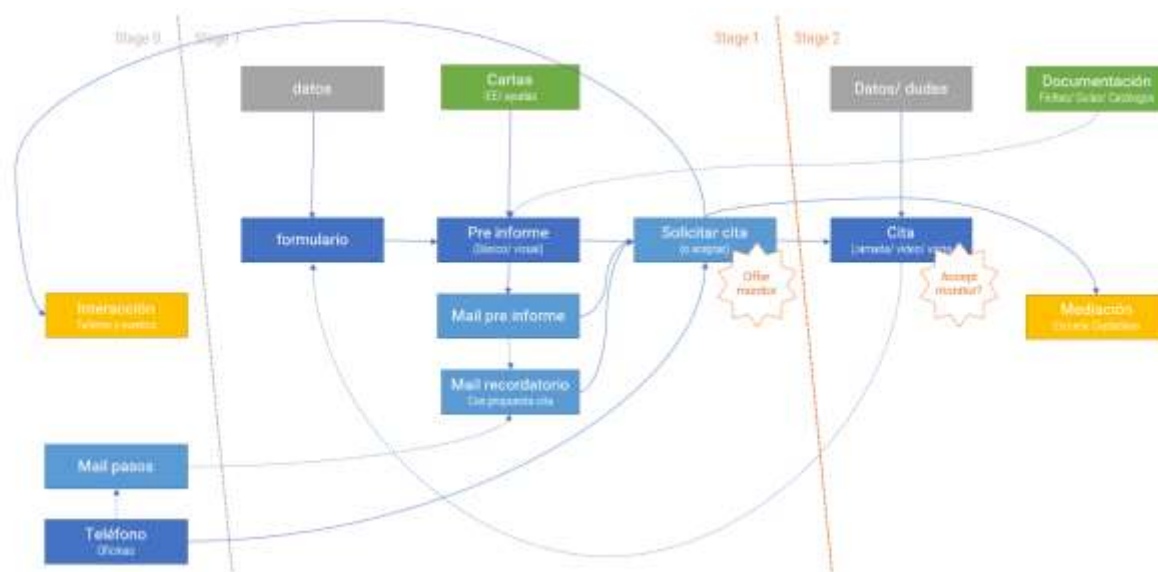


Figure 10.- Touchpoints & Benefits monitoring in stage 1

Figure 10 summarizes renovation benefits promotion within the touchpoints of this stage. Main activity is the monitoring offer, but there are also interesting indicators to evaluate effectiveness of monitoring, such as:

- Rotation of monitors
- Share of Evaluation step factor coming from monitoring actions

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
Monitoring offer success rate	Monitor offers (by tool); Monitors accepted	(Monitors accepted/ Monitors offers (total AND by tool))* 100	Success of action OR Penetration of monitoring
Share of success coming from monitoring offer	Evaluation step factor; Monitors offered; visits to evaluation tools	(Monitors offered/ (sumatory of all evaluation actions))* Evaluation step factor	Effectiveness of monitoring

Table 8.- Benefits Monitoring Plan for evaluation stage 1

In this stage, monitoring methods are limited to counts and registers, and calculating rates between them, and no other protocol than **keeping the same counting criteria** is used.

### 4.2.3 Stop 2 – Elaboration

The objectives of this stage related to needs and expectations are to organize ideas, solve doubts, decision making and define the final renovation works. (co)benefits of renovation are to be measured,



such as energy savings, IEQ and wellbeing of occupants, in order to connect with their motivations, which in this stage means to offer the monitoring tools to customers who previously rejected or were not offered, and to **include a real data ‘before-status’ assessment in the elaboration report.**

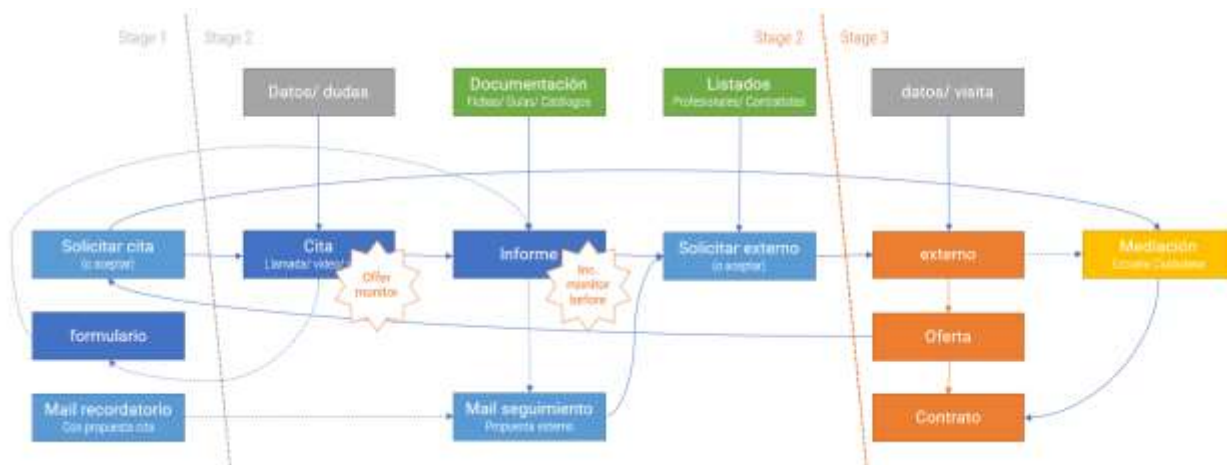


Figure 11.- Touchpoints & Benefits monitoring in stage 2

Figure 11 summarizes renovation benefits demonstration within the touchpoints of this stage. Main activity is the monitoring campaigns and related pre-renovation real data assessment report, but there are also interesting indicators to evaluate effectiveness of monitoring, such as:

- Monitoring sets efficiency
- Monitoring campaigns effectiveness
- Share of Elaboration step factor coming from monitoring actions

For which it could count:

- Number of monitoring sets available (which will be installed in one dwelling during monitoring campaign)
- Number of monitoring campaigns performed (with number of monitoring sets installed on each one)

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
Monitoring sets performance	Monitoring campaigns – with sets used on each one; monitoring sets (= dwellings or reports)	(Monitoring campaigns inc. sets/ Monitoring sets)	Cost-effectiveness of service
Monitoring campaigns success rate	Monitoring campaigns – with sets used on each one; monitoring sets (= dwellings or reports)	(Monitoring campaigns inc. sets/ Monitoring sets* Monitoring campaigns)* 100	Effectiveness of action
Share of success coming from monitoring campaigns	Elaboration step factor; Monitor campaigns; summatory of all elaboration actions impacts	(Monitoring campaigns/ (summatory of all elaboration actions))* Elaboration step factor	Effectiveness of monitoring

Table 9.- Benefits Monitoring Plan for elaboration stage 2

In this stage, monitoring methods include counts and registers, and calculating rates between them, so **keeping the same counting criteria** is needed. Nevertheless, when considering the benefits monitoring to be included in the ‘before-status’ assessment, it is preferable that an existing protocol is followed. In this case, **TripleA-reno Monitoring Protocol**, an adaptation of US-EPA IEQ Monitoring Protocol and the International Performance Measurement and Verification Protocol (IPMVP) will be followed because of its simplicity and relationship with the combined (energy and comfort) labelling scheme developed in the project (this protocol was already referred to in D2.4). This means that:

- IEQ measurements should comply with **Fout! Verwijzingsbron niet gevonden.** requirements in order to fulfil TripleA-reno standards, but alternatively hourly records can be used and both Globe



temperature, Air velocity and TVOC are not mandatory (it will depend on the sensing kits cost-efficiently available for the citizen Hub)

Measurement	Mandatory	Type	Units	Range	Tolerance	Resolution
Air temperature	Y	Time series (each 5 min)	°C	-20 to 50	+/- 0,5	0,1
Globe temperature	Y	Time series (each 5 min)	°C	0 to 70	+/- 0,5	0,1
Relative Humidity	Y	Time series (each 5 min)	%	10 to 90	+/- 4	0,1
Air velocity	Y	Time series (each 5 min)	m/s	0 to 5		0,01
CO2	Y	Time series (each 5 min)	ppm	0 to 10.000	+/- 75	1
TVOCs	Y	Cumulative/ spotty	µg/m³			
Formaldehyde	N	Cumulative/ spotty	ppb			
PM2,5	N	Cumulative/ spotty	µg/m³			
PM10	N	Cumulative/ spotty	µg/m³			
Noise Level	N	Time series (each 5 min)	dB(A)	30 to 110	+/- 1	0,1
Illuminance level	N	Time series (each 5 min)	lux	50 to 30.000	3 to 7,5%	1

Table 10.- IEQ measurements according to TripleA-reno Monitoring Protocol

Measurement	Location	Type	Units	Tolerance	Resolution
Delivered energy demand	inside	Time series (recommended each 5 min – as much continue as possible)	Watts/h	+/- 1	1
		(As much disaggregated as possible)			

Table 11.- Energy measurements according to TripleA-reno Monitoring Protocol

**Have you been feeling in the last hour....?**  
(Please answer every question even if you don't have any symptoms)  
A rating of 0 means that you did not experience that feeling at all. A rating of 6 means that this feeling was a very important part of your last hour.

	Not at all	1	2	3	4	5	6	Very much
Fatigue	0	1	2	3	4	5	6	
Feeling heavy-headed	0	1	2	3	4	5	6	
Headache	0	1	2	3	4	5	6	
Dizziness	0	1	2	3	4	5	6	
Difficulty concentrating	0	1	2	3	4	5	6	
Itching, burning, or irritation of the nose	0	1	2	3	4	5	6	
Visual disturbances: blurring, difficulty focusing on objects	0	1	2	3	4	5	6	
Unpleasant stuffy or runny nose	0	1	2	3	4	5	6	
Nausea, bloating	0	1	2	3	4	5	6	
Respiratory problems such as cough, shortness of breath, difficulty breathing, hoarseness	0	1	2	3	4	5	6	
Breathing difficulty	0	1	2	3	4	5	6	
Other (please specify)	0	1	2	3	4	5	6	

**Have you been bothered by any of the following factors at your home in the last hour?**  
A rating of 0 means that you did not experience that feeling at all. A rating of 6 means that this feeling was a very important part of your last hour.

	Not at all	1	2	3	4	5	6	Very much
Draught	0	1	2	3	4	5	6	
Stuffy, "dead" air	0	1	2	3	4	5	6	
Stale air	0	1	2	3	4	5	6	
Unpleasant odour	0	1	2	3	4	5	6	
Noise	0	1	2	3	4	5	6	
Light that is dim	0	1	2	3	4	5	6	
Light that causes glare and/or reflections	0	1	2	3	4	5	6	
Heat and air	0	1	2	3	4	5	6	

**How have you been feeling at your home in the last hour?**

Hot  
 Warm  
 Slightly warm  
 Neutral  
 Slightly cool  
 Cool  
 Cold

**What kind of clothes are you wearing now?**

Naked  
 Light clothing (E.g. Shirt or short-sleeved shirt / Long sleeve shirt  
 Medium clothing (Sweater or jersey, typical business suit, etc.)  
 Heavy clothing (Jacket or other outerwear, dressing gown, etc.)

**What kind of activity have you been doing in the last hour? ...**

Sedentary (reading, watching TV, mostly seated)  
 Moderate (working on PC/laptop or similar)  
 Active (cleaning, tidying up, arranging, Dining)  
 Intense (mostly moving/ making any kind of intense effort or training)

Figure 12.- Well-being data collection according to TripleA-reno Monitoring Protocol

- Energy measurements should comply with **Fout! Verwijzingsbron niet gevonden.** requirements, but alternatively, calculations derived from energy bills, data accessed through utilities platforms, or Energy Performance Certificates can be used, as far as the measurement criteria is kept during the whole process
- Wellbeing self-perception should be collected according to **Fout! Verwijzingsbron niet gevonden.** content
- Measurement campaigns should be planned as described in **Fout! Verwijzingsbron niet gevonden.**



Day	Activity
<b>Pre-Monitoring</b>	
	Initial visit
	Calibrate monitors
<b>Week of Monitoring</b>	
Monday a.m.	Travel Meeting with building manager Supply information and tools to occupants
Monday p.m.	Collect data about the residential unit (for characterization and EC forms) Verify monitoring location Assemble instruments Set-up fixed-site sampling locations Deploy samplers if needed (TVOC) Take spotty measurement 1 Start fixed-site continuous monitoring Check connectivity to storing system (if applicable)
Tuesday to Sunday	Continue fixed-site continuous monitoring
Monday a.m.	Collect samples (and ship to laboratory) Take spotty measurement 2 Finish fixed-site continuous monitoring Download data Validate integrity of data Pack equipment Change to next residential unit (if applicable)
<b>Post-Monitoring</b>	
	Check documentation completeness and validate data Send to task leader

Table 12.- Monitoring campaign planning according to TripleA-reno Monitoring Protocol

- And finally, data should be collected under a common schema (see Annex 1 - StH Document 8: Monitoring data templates) in order to be able to build the monitoring labels, similar to the one in Figure 13 below, and include them in the reports.

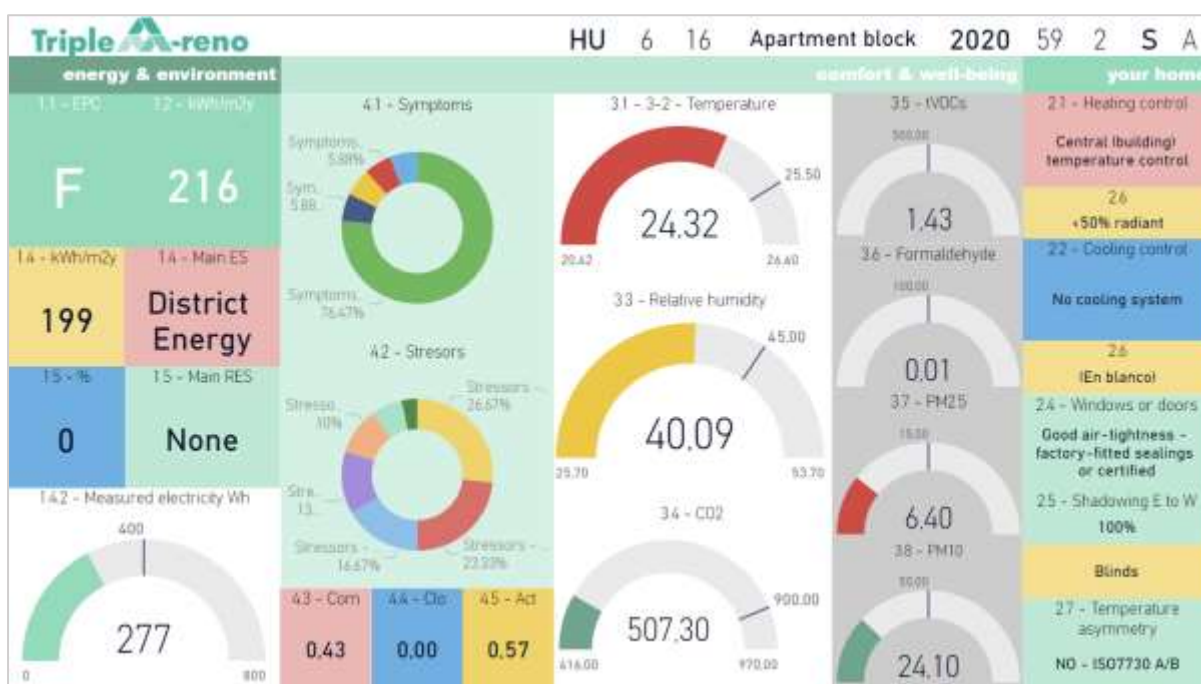


Figure 13.- TripleA-reno monitoring label example

#### 4.2.4 Stop 3 – Realization

The objectives of this stage related to needs and expectations are to realise renovation according to the plan agreed. (co)benefits of renovation are to be measured, such as energy savings, IEQ and wellbeing of occupants, in order to connect with their motivations, which in this stage means to offer,



again, the **monitoring tools**, used for the before-status assessment or just for an after-status assessment in case the user didn't use the monitoring service before. So the Citizen hub will also count:

- Monitor offers (including all the tools)
- Monitors accepted/ hired

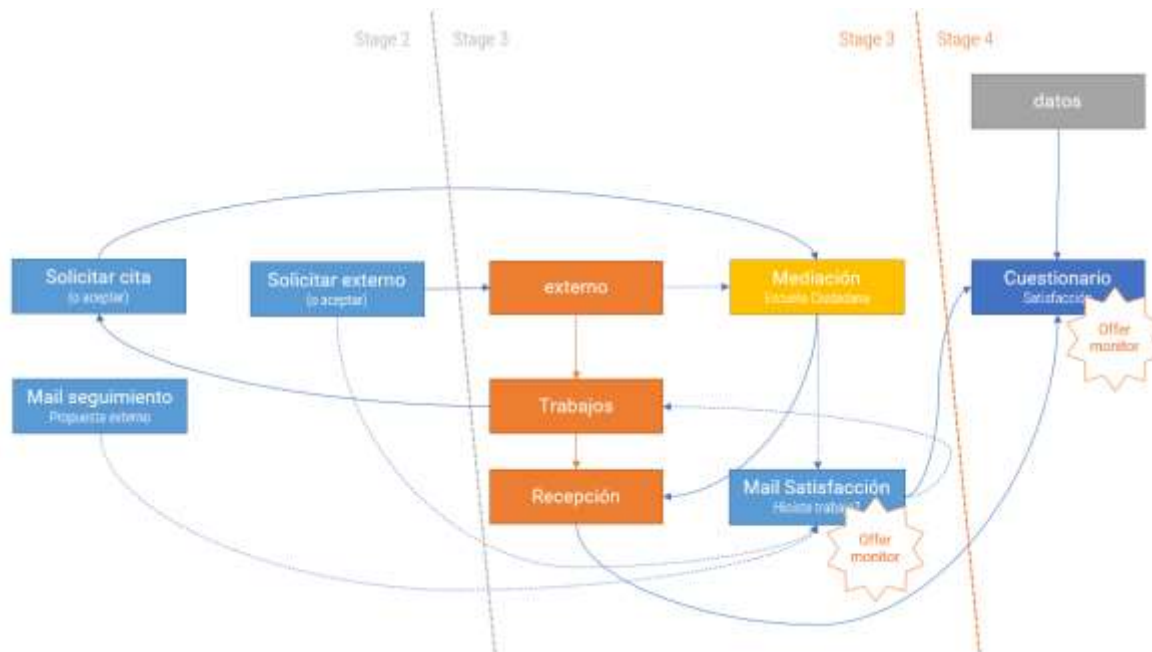


Figure 14.- Touchpoints & Benefits monitoring in stage 3

Figure 14 summarizes renovation benefits promotion within the touchpoints of this stage. Main activity is the monitoring offer, but there are also interesting indicators to evaluate effectiveness of monitoring, such as:

- Rotation of monitors
- Share of Realization step factor coming from monitoring actions

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
Monitoring offer success rate	Monitor offers (by tool); Monitors accepted	(Monitors accepted/ Monitors offers (total AND by tool))* 100	Success of action OR Penetration of monitoring
Share of success coming from monitoring offer	Realization step factor; Monitors offered; summatory of realization actions impacts	(Monitors offered/ (summatory of all realization actions))* Realization step factor	Effectiveness of monitoring

Table 13.- Benefits Monitoring Plan for elaboration stage 3

In this stage, monitoring methods are limited to counts and registers, and calculating rates between them, and no other protocol than **keeping the same counting criteria** is used.

#### 4.2.5 Stop 4 – Validation

The objectives of this stage related to needs and expectations are to monitored the performance of the dwellings by showing the original dwelling's performance compared to the performance of the improved dwelling. (co)benefits of renovation are to be measured, such as energy savings, IEQ and wellbeing of occupants, in order to connect with their motivations, which in this stage means to offer the monitoring tools to customers who previously rejected or were not offered, and to **include a real data 'before-after-status' assessment in the sharing template**, not only for publishing the best

practice **for on-boarding matters**, but also to translate them into a **final report** on the renovation works performed.

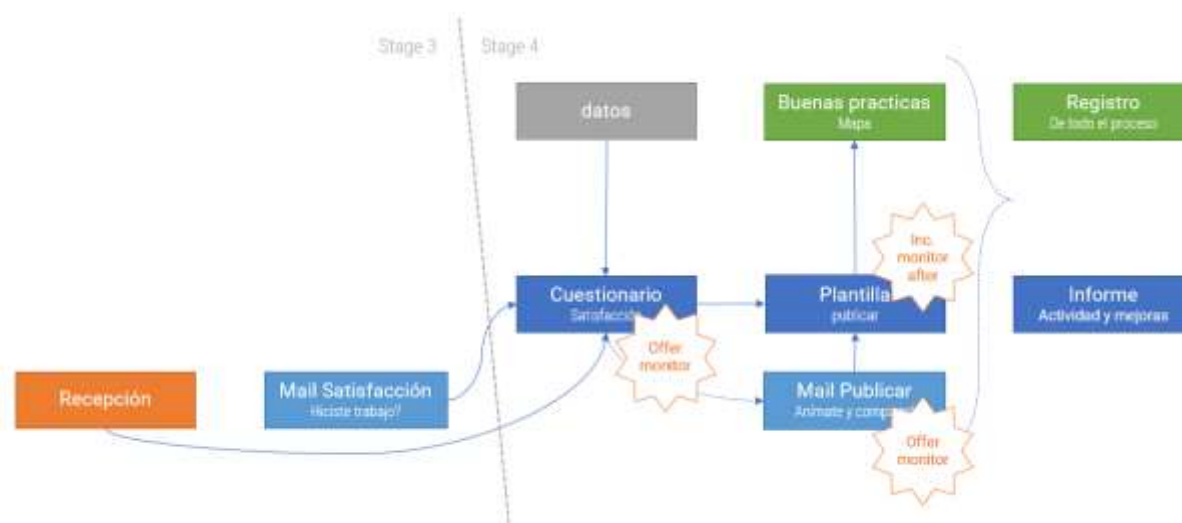


Figure 15.- Touchpoints & Benefits monitoring in stage 4

Figure 15 summarizes renovation benefits demonstration within the touchpoints of this stage. Main activity is the monitoring campaigns and related pre-renovation real data assessment report, but there are also interesting indicators to evaluate effectiveness of monitoring, such as:

- Monitoring sets efficiency
- Monitoring campaigns effectiveness
- Share of Validation step factor coming from monitoring actions

For which it could count:

- Number of monitoring sets available (which will be installed in one dwelling during the monitoring campaign)
- Number of monitoring campaigns performed (with number of monitoring sets installed on each one)

Indicator	Variables involved	Method/ Protocol/ Tool	Objective
Monitoring sets performance	Monitoring campaigns – with sets used on each one; monitoring sets (= dwellings or reports)	(Monitoring campaigns inc. sets/ Monitoring sets)	Cost-effectiveness of service
Monitoring campaigns success rate	Monitoring campaigns – with sets used on each one; monitoring sets (= dwellings or reports)	(Monitoring campaigns inc. sets/ Monitoring sets* Monitoring campaigns)* 100	Effectiveness of action
Share of success coming from monitoring campaigns	Validation step factor; Monitor campaigns; summatory of all validation actions impacts	(Monitoring campaigns/ (summatory of all validation actions))* Validation step factor	Effectiveness of monitoring

Table 14.- Benefits Monitoring Plan for validation stage 4

In this stage, monitoring methods include counts and registers, and calculating rates between them, so **keeping the same counting criteria** is needed. Nevertheless, when considering the benefits monitoring to be included in the ‘after-status’ or ‘before-after-status’ assessment, it is preferable that an existing protocol is followed. In this case, **TripleA-reno Monitoring Protocol** will be followed because of its simplicity and relationship with the combined (energy and comfort) labelling scheme developed in the project (this protocol was already referred to in D2.4), same as in the ‘before-status’ assessment.



## B. Benefits monitoring overall assessment

Therefore, and as a conclusion, main benefits renovation demonstration activity is defined in terms of **before-after comparison**, with several approaches:

- Individual comparison, for the final user
- Overall evaluation, for the municipality or citizen hub

First one will be handled in the form of a certificate or label according to sister project developments (TripleA-reno or U-CERT outcomes), and shared as a best practices or success stories example for new users; while second will be monitored in a data management dashboard, together with the rest of the results obtained through the application of this protocol, which should be collected in an **annual report** with the corresponding indicators and the lessons learnt, for the next year improvements' implementation program.

Data collection will use a common **description & data collection template** (see Annex 1 - StH Document 8: Monitoring data templates), connected with a database and web map service for providing **best practices** information. Version included in this Deliverable is kept very simple, in order to further develop in detail each register, if needed, on each pilot basis during WP4 activities.

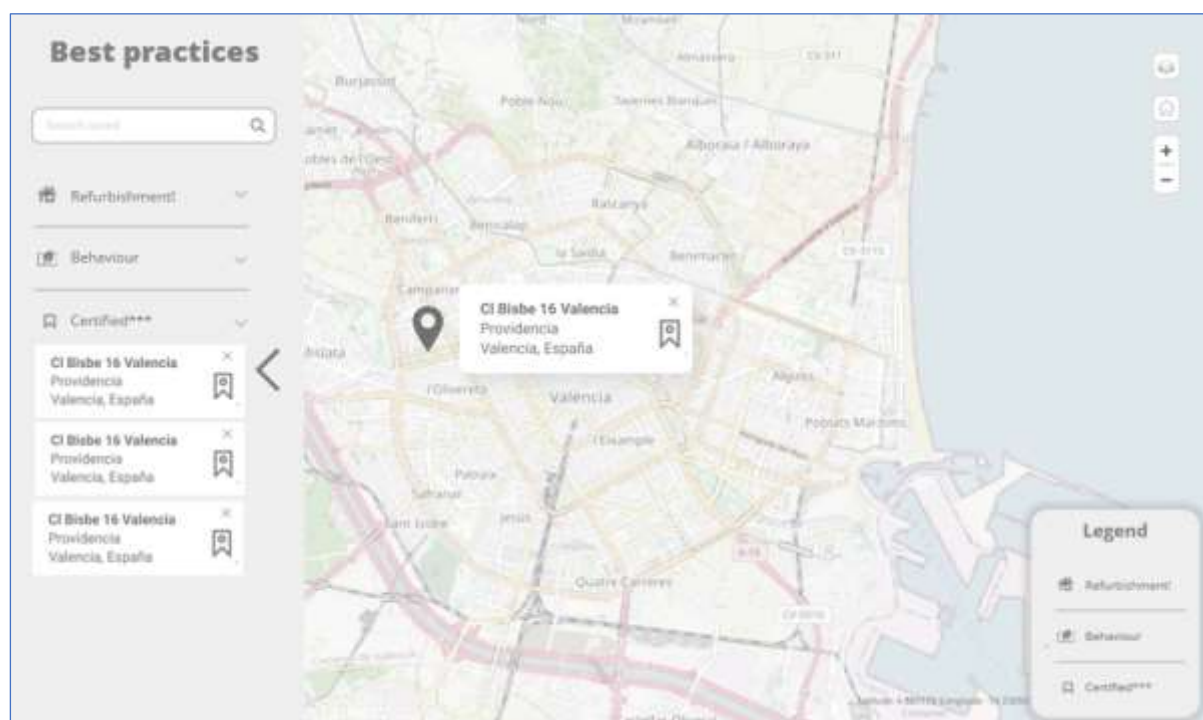


Figure 16.- Best practices viewer mock-up

Figure 16 represents this 'best practices' map, and deployment plan for the Spanish case can be consulted in Annex 2 – Best practices map



## 5 Follower cities

According to Objective 4 (To deliver real benefits to citizens and other stakeholders in two cities as a result of the Citizen Hubs operating locally), the objective is not only to provide the integrated renovation services to the specific homeowners groups identified in the two pilot cities (Rotterdam and Valencia) but also to demonstrate the potential of the Citizen Hub concept to all relevant stakeholders in other municipalities, to regain trust and interest in building renovations and to further expand the Citizen Hub business model.

In this context, and in order to roll out the Citizen Hub concept on a wider scale (regional, national and European), the Citizen Hub models developed for Valencia (ES) and Rotterdam (NL) will be one-on-one assessed with the two follower cities, Sant Cugat (ES) and Ljubljana (SI).

After defining the monitoring plan together with the cities of Valencia and Rotterdam during the implementation activities of WP4, a meeting to discuss them will be set-up with follower cities Sant Cugat and Ljubljana to find out current initiatives and lessons learned. With this in mind, both cities receive this draft methodology for building their Monitoring Plan (assisted by templates that can be found on Annex 1 - StH Document 8 **Fout! Verwijzingsbron niet gevonden.**) and assess its applicability in their context.

### **Sant Cugat – ES**

The objective is to test the replication in the same country for Spanish pilot in Valencia and follower city Sant Cugat. The aim is to analyse all the benefits of having the structure and services developed in national language and based on national circumstances, legislation, culture and habits.

Sant Cugat Municipality is assessing the methodology and feedback will be reported during WP4 and WP5 activities for pilot experiences and replication and exploitation activities.

### **Ljubljana – SI**

The objective is to test the replication between EU countries where the Citizen Hub mapping methodology and results for the Dutch city of Rotterdam will be replicated for the City of Ljubljana in Slovenia. The aim is to validate the effectiveness of the replication process between the different EU countries.

The city of Ljubljana is assessing the methodology and feedback will be reported during WP4 and WP5 activities for pilot experiences and replication and exploitation activities





## 6 Conclusions

From **D3.1** for the definition of a StH customer journey framework, **D3.2** included an implementation strategy for each of the pilot cities based on a combined top-down bottom-up approach, where existing local needs have been defined as sub-stops, and applicable local tools and services have been matched within them. **D3.7** deployed and integrated that conceptual strategy to real pilot context and activities. Is from this point where the Monitoring data Plan applies with several objectives in mind:

- The Citizen hub services quality in terms of **effectiveness and efficiency** demonstration: by monitoring users and activities in all the customer journey touchpoints (statistical description).
- The Citizen Hub services quality in terms of **user satisfaction** demonstration: by deploying an specific questionnaire in both the final step of the process and on any dropout circumstance detected (statistical description)
- The Citizen Hub services quality in terms of **energy savings and other benefits** demonstration: by sensing a set of early adopters' buildings whose real benefits will be presented to public for onboarding matters (statistical description) and used for calculating **project impacts** in combination with the effectiveness of the services indicators (statistical inference)

But this is still an ideal conception, and Monitoring Program is to be defined by each pilot Hub in **WP4** demonstrating activities. Their results will conform the definitive guideline to be included in **WP5** replication and exploitation activities.









## B. Benefits Monitoring template

- **Building description:**

**Hoja1** Tab (themes and variables):

Location	Building	Dwelling	Data
reg	buildinguse	floor	energyconsumptionkwhm2yrfrombills
country	buildingtypology	numberletter	energycertificate
building	buildingform	orientation1	primaryenergyconsumptionkwhm2yrfromcertificate
unit	market	orientation2	whopaysforenergy
region	b_height	refurbishmentsyear	mainnonres
city	year	u_area	mainres
climatezone	b_area	u_height	heatingcontrol
	b_numberofoccupants	numberoffloors	coolingcontrol
	numberofresidencialunits	u_numberofoccupants	windows
		userprofile	shadowing
			heatingsystem
			coolingsystem
			asymmetry
		shadowingsystem	
		respercentage	
		resproductionkwhm2y	

**Location** Tab:

reg	country	building	unit	region	city	climatezone
int	select	int	int	string	string	select

**Building** Tab:

Reg	Building	buildinguse	buildingtypology	buildingform	market	b_height	year	b_area	b_numberofoccupants	numberofresidencialunits
from Location	int	select	select	select	select	select	int	int	int	int

**Dwelling** Tab:

Building	Dwelling	floor	numberletter	orientation1	orientation2	refurbishmentsyear	u_area	u_height	numberoffloors	u_numberofoccupants	userprofile
from building	int	int	string	select	select	int	int	double	int	int	select





Other data Tab:

Dwelling	Data	energyconsumptionkwhm2yrfrombills	energycertificate	primaryenergyconsumptionkwhm2yrfromcertificate	whopaysforenergy	mainnonres	mainres	heatingcontrol
<i>From Dwelling</i>	<i>int</i>	<i>int</i>	<i>select</i>	<i>int</i>	<i>select</i>	<i>select</i>	<i>select</i>	<i>select</i>

coolingcontrol	windows	shadowing	heatingsystem	coolingsystem	asymmetry	shadowingsystem	respercentage	reproductionkwhm2y
<i>select</i>	<i>select</i>	<i>select</i>	<i>select</i>	<i>select</i>	<i>select</i>	<i>select</i>	<i>int</i>	<i>int</i>





• **Monitoring data description**

**Hoja1** Tab (themes and variables):

reg	country	building	unit	season	phase	family	variable	timestamp	value
<i>from alldes</i>	<i>from alldes</i>	<i>from alldes</i>	<i>from alldes</i>	Winter	Ante	Energy	Home energy consumption		
				Summer	Post	IndoorEQ	CO2		
						Wellbeing	Air Temperature		
							Relative humidity		
							Illuminance level		
							TVOC		
							Formaldehydes		
							PM2.5		
							PM10		
							Activity		
							Clothing		
							Stressors-		
							Symptoms-		
							Thermal comfort		

**Measurements** Tab (description):

unit	measurement	season	phase	family	variable
<i>from Dwelling</i>	<i>int</i>	<i>select</i>	<i>select</i>	<i>select</i>	<i>select</i>

**Values** Tab (data collection):

measurement	timestamp	value
<i>int</i>	<i>timestamp</i>	<i>double/string</i>

**Variables** Tab:

season	phase	family	variable
Winter	Ante	Energy	Home energy consumption
Summer	Post	IndoorEQ	CO2
		Wellbeing	Air Temperature
			Relative humidity
			Illuminance level
			TVOC
			Formaldehydes
			PM2.5
			PM10
			Activity
			Clothing
			Stressors-
			Symptoms-
			Thermal comfort







## Annex 2 – Best practices map deployment plan

Based on the benefits monitoring data, 'best practices' map deployment plan for the Spanish case is based on a twofold approach. On one hand, automatic data coming from public/ open data sources:

Data	Unit	Source	Priority	Notes
<b>DWELLING DATA</b>				
Cadastral reference	-	IEE/CAT	1	IEE: 14 Digits CAT: 20 Digits CEE: 20 Digits
Year of construction	-	IEE	1	In CAT it is also available but it changes when it appears a renovation
Current regulation	-	CEE	2	
Nº Floors	-	IEE/CAT	2	
Nº Dwellings	-	IEE	2	
Listed building	-	IEE	2	
Building typology	-	IEE/CAT/CEE	1	IEE*: PB2, PB3, PM2, PM3, UA2, UA3, UH2, UH3 CAT: 111 open building, 112 closed block, 121 single family homes, 122 terrace houses, 131 rural house CEE: Individual dwelling, single family home, Residential building (whole block). *CEE does not indicate if it open building or closed block.
Case typology	-	IEE/CEE	1	Individual dwelling, single family home, Residential Building (whole block) IEE are always Residential Building (whole block) CEE can be Individual dwelling, single family home, Residential Building (whole block)
Address	-	CEE	1	Is it available in CAT and IEE?
Type of renovation	-	CAT	2	R: Integral renovation O: Total renovation E: Medium renovation I: Minimum renovation
Year of renovation	-	CAT	2	
Surface	m2	CAT	2	
Cadastral category	-	CAT	2	1 excellent - 9 bad
Cadastral photograph	-	CAT	1	
Before and after photographs	-	GOO	2	
<b>RENOVATION INDICATORS</b>				
<b>Pre-renovation state</b>				
Energy certification date	-	IEE/CEE	1	
Link to EPC	-	CEE	2	
<b>Energy needs</b>				
Heating energy demand	kWh/m2year	IEE	2	
Cooling energy demand	kWh/m2year	IEE	2	
<b>Energy use</b>				
Overall non-renewable primary energy use	kWh/m2year	IEE/CEE	1	
Domestic hot water non-renewable primary energy use	kWh/m2year	IEE	2	
Heating non-renewable primary energy use	kWh/m2year	IEE	2	
Cooling non-renewable primary energy use	kWh/m2year	IEE	2	
Energy efficiency rating	-	IEE/CEE	1	Not available before 2018
<b>Carbon dioxide emissions</b>				
Overall carbon dioxide emissions	kgCO2/m2year	IEE	1	
Domestic hot water carbon dioxide emissions	kgCO2/m2year	IEE	2	
Heating carbon dioxide emissions	kgCO2/m2year	IEE	2	
Cooling carbon dioxide emissions	kgCO2/m2year	IEE	2	
Environmental impact (CO2) rating	-	IEE/CEE	1	
<b>Post-renovation state</b>				
Energy certification date	-	IEE/CEE	1	
Link to EPC	-	CEE	2	
<b>Energy needs</b>				
Heating energy demand	kWh/m2year	IEE	2	
Cooling energy demand	kWh/m2year	IEE	2	
<b>Energy use</b>				
Overall non-renewable primary energy use	kWh/m2year	IEE/CEE	1	
Domestic hot water non-renewable primary energy use	kWh/m2year	IEE	2	
Heating non-renewable primary energy use	kWh/m2year	IEE	2	
Cooling non-renewable primary energy use	kWh/m2year	IEE	2	
Energy efficiency rating	-	IEE/CEE	1	Not available before 2018
<b>Carbon dioxide emissions</b>				
Overall carbon dioxide emissions	kgCO2/m2year	IEE	1	
Domestic hot water carbon dioxide emissions	kgCO2/m2year	IEE	2	
Heating carbon dioxide emissions	kgCO2/m2year	IEE	2	
Cooling carbon dioxide emissions	kgCO2/m2year	IEE	2	
Environmental impact (CO2) rating	-	IEE/CEE	1	

Figure 17.- Automatic data for benefits monitoring map





Where:

- IEE is Building Evaluation Report
- CAT is Cadastral database
- CEE is Energy Performance Certificate
- GOO is Google Street view

On the other hand, data introduced by the user:

Data	Unit	Options	Notes
<b>RENOVATION INFORMATION</b>			
<b>MEASURES</b>			
Envelope improvement: Thermal insulation	-	yes/no	
Envelope improvement: Windows replacement	-	yes/no	
Systems replacement: Aerothermal for heating, cooling and DHW	-	yes/no	
Systems replacement: Aerothermal for DHW	-	yes/no	
Energy production: photovoltaic panels	-	yes/no	
Description	-		Description of the intervention
<b>ECONOMIC COST</b>			
Total cost (whole building)	€		
Total cost (per dwelling)	€		
Total cost per m2 per dwelling	€		
Received grant (whole building)	€		
Received grant (whole building) - percentage	%		
Received grant (per dwelling)	€		
Monthly cost/per dwelling/24 months (inc. grants)	€		
Estimated Next Generation grant (whole building)	€		
Estimated Next Generation grant (whole building) - percentage	%		
Estimated Next Generation grant (per dwelling)	€		
Estimated Next Generation monthly cost/per dwelling/24 months	€		
<b>OTHERS</b>			
Photographs	-		Photographs of the renovated state, detail of rehabilitation elements (windows, photovoltaic...)
<b>COMBINED PERFORMANCE LABEL ON ENERGY, IEQ AND WELL-BEING</b>			
<b>ENERGY INDICATOR</b>			
Energy Class	-	Align with national energy performance certification (EPBD)	
Calculated total primary energy use	kWh/m <sup>2</sup> a	Align with EN 15603 and EN ISO 13790, or EN ISO 52000 standard series	
Calculated delivered energy use	kWh/m <sup>2</sup> a	Align with EN 15603 and EN ISO 13790, or EN ISO 52000 standard series	
__Calculated delivered energy use (fuel)	kWh/m <sup>2</sup> a	Align with EN 15603 and EN ISO 13790, or EN ISO 52000 standard series	
__Calculated delivered energy use (electricity)	kWh/m <sup>2</sup> a	Align with EN 15603 and EN ISO 13790, or EN ISO 52000 standard series	
__Calculated delivered energy use (district energy)	kWh/m <sup>2</sup> a	Sum of all calculated delivered energy use	
Measured delivered energy use	kWh/m <sup>2</sup> a	Based on measurement or energy bills. Energy consumption without any correction	
__Measured delivered energy use (fuel)	kWh/m <sup>2</sup> a	Based on measurement or energy bills. Energy consumption without any correction	
__Measured delivered energy use (electricity)	kWh/m <sup>2</sup> a	Based on measurement or energy bills. Energy consumption without any correction	
__Measured delivered energy use (district energy)	kWh/m <sup>2</sup> a	Sum of all measured energy use	
Share of RES	%	Renewable primary energy use divided by total primary energy use	
Area weighted average thermal transmittance	W/m <sup>2</sup> K	Regarding above ground structures. $U_{avr} = \frac{\sum A_i \cdot U_i}{\sum A_i}$	

Figure 18.- Manual data for benefits monitoring map (I - input)





Data	Unit	Options	Notes
<b>RENOVATION INFORMATION</b>			
<b>COMBINED PERFORMANCE LABEL ON ENERGY, IEQ AND WELL-BEING</b>			
<b>ENERGY INDICATOR</b>			
<b>WELL-BEING AND IEQ</b>			
<b>QUALITY WELL-BEING AND IEQ</b>			
Control of heating system	-	No heating system No control Central (building) temperature control Apartment temperature control Room temperature control	
Control of cooling system	-	No cooling system No control Central (building) temperature control Apartment temperature control Room temperature control	
Fresh air Flow (mechanical ventilation) per number of occupants	l/s	No mechanical ventilation EN 16798-1 category I or category II EN 16798-1 category III Less than EN 16798-1 category III	
Air tightness of winders and doors	-	Poor air-tightness: warped, poorly fitted or unsealed windows and doors. Medium air-tightness: windows and doors with well fitted sealings. Good air-tightness: factory-fitted shaped sealing profiles or certification document according to EN 12207 Class 4.	
Exterior shading in windows from East to west	%	100% 90-99% 80-89% 70-79% 60-69% 50-59% 40-49% 30-39% 20-29% 10-19% 0-9%	
Radiant heating and/or cooling system	%	≥ 50% of the conditioned floor area < 50% of the conditioned floor area	
Radiant temperatura asymetry	-	ISO 7730:2005 Category A or B ISO 7730:2005 Category C or worst	
<b>MEASURED WELL-BEING AND IEQ INDICATOR</b>			
Operative temperature – heating season	°C	No heating system No measurement EN 16798-1 Category II EN 16798-1 Category III EN 16798-1 Category IV or worst	- Selection of the category: 85% of the measured values shall meet the selected category.
Operative temperature – cooling season	°C	No cooling system No measurement EN 16798-1 Category II EN 16798-1 Category III EN 16798-1 Category IV or worst	- Selection of the category: 85% of the measured values shall meet the selected category.
Relative humidity of indoor air is between 30 % and 70 %	%	No measurement 30% ≤ RH ≤ 70% RH < 30% or RH > 70%	- Selection of the category: 85% of the measured values shall meet the selected category.
CO <sub>2</sub> concentration	ppm	No measurement EN 16798-1 Category II EN 16798-1 Category III EN 16798-1 Category IV or worst	- Selection of the category: 85% of the measured values shall meet the selected category.
TVOC	µg/m <sup>3</sup>	No measurement TVOC < 500 µg/m <sup>3</sup> TVOC ≥ 500 µg/m <sup>3</sup>	- Selection of the category: 85% of the measured values shall meet the selected category.
Formaldehyde	ppb	No measurement Formaldehyde < 100 µg/m <sup>3</sup> Formaldehyde ≥ 100 µg/m <sup>3</sup>	- Selection of the category: 85% of the measured values shall meet the selected category.
PM <sub>2,5</sub>	µg/m <sup>3</sup>	No measurement PM <sub>2.5</sub> < 15 µg/m <sup>3</sup> PM <sub>2.5</sub> ≥ 15 µg/m <sup>3</sup>	- Selection of the category: 85% of the measured values shall meet the selected category.
PM <sub>10</sub>	µg/m <sup>3</sup>	No measurement PM <sub>10</sub> < 50 µg/m <sup>3</sup> PM <sub>10</sub> ≥ 50 µg/m <sup>3</sup>	- Selection of the category: 85% of the measured values shall meet the selected category.

Figure 19.- Manual data for benefits monitoring map (II - selection)



Data	Unit	Options	Notes
<b>RENOVATION INFORMATION</b>			
<b>COMBINED PERFORMANCE LABEL ON ENERGY, IEQ AND WELL-BEING</b>			
<b>MONITORING BENEFITS OF RENOVATION</b>			
Air temperature	°C	Priority 1	
Globe temperature	°C	Priority 2	
Relative temperature	%	Priority 1	
Air Velocity	m/s	Priority 2	
CO2	ppm	Priority 1	
TVOCs	µg/m³	Priority 2	
Delivered energy demand	W/h	Priority 2	It can be provided by bills

Figure 20.- Manual data for benefits monitoring map (III - upload)

Then web map service will show, for each location, a pin. When click in the pin, a pop-up will show the summary data (coming from the automatic dataset):

**DWELLING**


Address Avda. de las Ferias, nº10-pta.43  
 Cadastral Reference [1459903YJ2716A0043LE](#)

Individual dwelling

Open building


1995

Case typology Building typology Year of construction

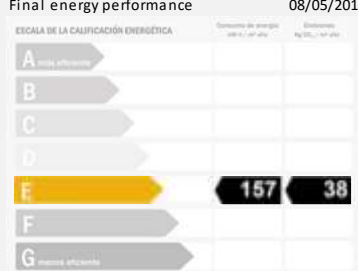


**RENOVATION INDICATORS**

Initial energy performance 12/09/2014



Final energy performance 08/05/2015



Energy use savings

24 kWh/m2a

13,3 %

CO2 emissions savings

7 kgCO2/m2a

15,6 %

[Is it your dwelling? Add information](#)



[More information](#)

Figure 21.- Best practice pop-up information mock-up

If the user wants to update the best practice case and add the manual information, they can do it directly on the web map, by clicking on the 'Add Information' button. If the information is already input, when clicking the 'More Information' button, the user will be shown a set of structured information in several tabs:

### DWELLING

Dirección Avda. de las Ferias, nº10-pta.43  
Referencia Catastral [1459903YJ2716A0043LE](#)






**Individual dwelling**  
Typology

<b>Open building</b> Building typology	<b>1995</b> Year of construction	<b>NBE-CT-79</b> Current regulation	<b>2014</b> Year of renovation	<b>R</b> Type of renovation
<b>-</b> Nº Floors	<b>-</b> Nº Dwellings	<b>NO</b> Listed buildings	<b>49</b> Surface - m2	<b>5</b> Cadastral category

Figure 22.- Best practice case building/dwelling information

### RENOVATION INFORMATION


#### MEASURED

-  Insulation improvement (+)
-  Windows replacement (+)
-  Aerothermal: heating, cooling, DHW (+)
-  Aerothermal: DHW (+)
-  Photovoltaic panels (+)

#### DESCRIPTION OF THE INTERVENTION

Housing belonging to a block of flats built in the year 2000 whose owner has the social bond. The current sliding aluminum windows are replaced by others made of PVC of the tilt-and-turn type, with double glazing and a solar factor of less than 0.5 in south and east orientations. The existing blinds are also replaced by others made of PVC, improving the tightness of the whole. The renovation of windows and shutters is complemented by the installation of a highly energy-efficient centralized heat pump for air conditioning in the home, replacing the existing equipment. The installation is also equipped with regulation and control elements, zoning and conditioning independently of each of the rooms.

#### PHOTOGRAPHS



#### ECONOMIC COST

DWELLING			NEXT GENERATION GRANT ESTIMATION		
Total cost	<b>2.000 €</b>	<b>82 €/m2</b>	Grant estimation	<b>1.000 €</b>	<b>50%</b>
Received grant	<b>500 €</b>	<b>25 %</b>	Final cost with grant	<b>1.000 €</b>	<b>20 €/m2</b>
Final cost with grant	<b>1.500 €</b>	<b>31 €/m2</b>	Monthly final cost/24 months	<b>42 €</b>	
Monthly final cost/24 months	<b>63 €</b>				

Figure 23.- Best practice case renovation information (if one dwelling)



Figure 24.- Best practice case renovation information (if whole building)

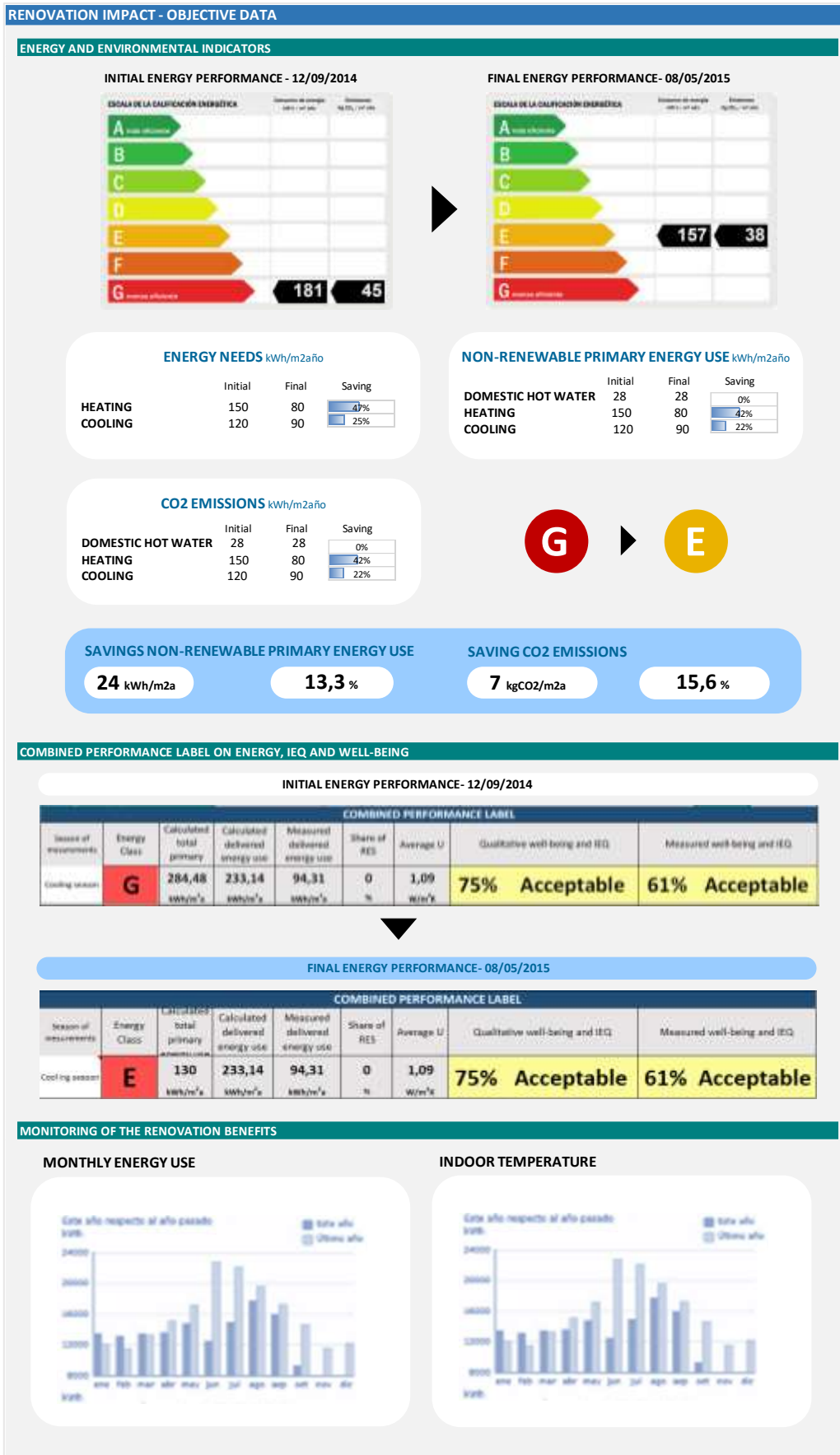



Figure 25.- Best practice case impact information (measurable data)



As a complement, the success story can also be uploaded and shared with the users community:

EXPERIENCES

EXPLANATORY VIDEO



TESTIMONIES

**Emilio Borreda - Resident**

*"Now we have a building façade that is envied by the rest of the local community"*

**José Carbonell - Resident**

*"I have already changed to low consumption bulbs throughout the house and I have noticed the effects on my energy meter"*

**Emilio Borreda - Resident**

*"We have changes the boiler to a condensing boiler. It consumes less, is more eficiente and is quicket in supplying hot water"*

**Ludivina García - Resident**

*"You can already feel the difference, the heat doesn't come in like it used to and I suppose that the thing will happen with the cold"*

PHOTOGRAPHS






Figure 26.- Best practice case impact information (perceived data)