Save the Homes

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WP: 2 - Mapping demand and supply side

Deliverable: D2.4.- Mapped suitable protocols and methods for quality control of the renovation works (including skills definition) and for buildings performance monitoring

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1 Executive Summary

The overall aim of **Sav€ the Homes** is to contribute to an increase of an annual renovation rate of > 5% by offering attractive OSS services to homeowners, managed and implemented by municipalities as being trustworthy entities for citizens. This is achieved by the implementation of OSS Citizen Hub concept, offering renovation offices, both as physical hubs and web-based virtual hubs at local level based on the concept of medium-sized cities and to maximize replicability, at national and EU level.

Sav€ the Homes will:

1. Offer a full customer journey in 5 stops:
   - Stop 0 Onboarding
   - Stop 1 Design: Social design by co-creation with the homeowners
   - Stop 2 Elaboration: Organizing the financing, purchasing of renovation kits and the preparations for the construction of the renovation works
   - Stop 3 Construction: Realization of proven quality in interaction with homeowners and a peer-to-peer Renovation Community, as part of the Citizen Hub
   - Stop 4 In-use: Monitoring of total performances in practice for ensuring sustainable quality of building and user experience
2. Create strong networks and trustworthy partnerships with local actors in the whole chain
3. Create locally developed and organized financing and investment pipelines

The integrated home renovation services will be established within already established OSS networks at the city (City of Rotterdam) and regional (Comunitat Valenciana) level in two EU countries, building upon existing energy targets and networks so far well established at the city levels where it brings a new method and mechanism on how to improve the existing interactions between the relevant organizations and stakeholders. It holistically connects renovation advisory, products and services, finance opportunities and legal advice with a building owner at a single point. By involving relevant EU umbrella organizations, the concept will be further promoted in other member states to come to a harmonized method applicable at EU level.

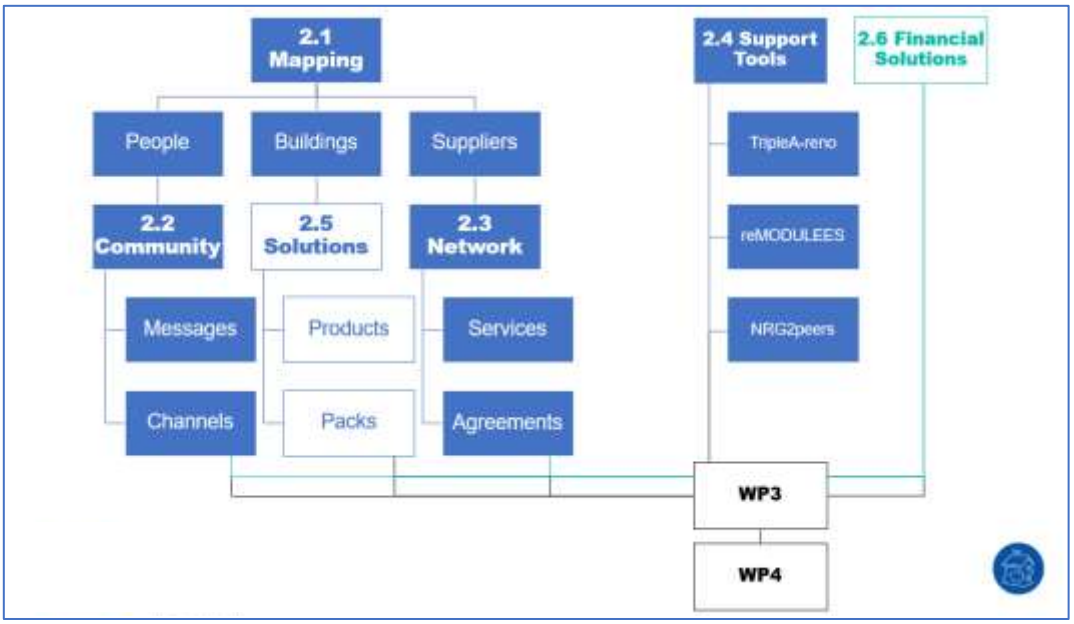

Figure 1.- WP2 activities workflow

The **WP2** objective is mapping of the demand and supply side as a foundation to build successful Citizen Hubs. The demand side aggregation helps understanding who the customers are, their pain

points and motivational drivers for the renovation. Supply side aggregation is fundamental to provide optimal offer, improve trust and awareness of homeowners, reduce renovation costs and time, and mainstream innovative technical solutions adapted to the local context, allowing for regional replicability and business risks reduction.

But the Citizen Hub does not offer only holistic home renovation personal assistance but also supporting services. In this task (2.4) **already available methods, tools and services suitable for the renovation process** are mapped.

2 Introduction

This deliverable deals with the mapping of suitable protocols and methods for quality control of the renovation works (including skills definition) and for buildings performance monitoring, this is, the **already available methods, tools and services suitable for the renovation process**, beyond the holistic home renovation personal assistance offered by the Citizen Hub, such as:

- quality control of the renovation works
- definition of skills
- energy, comfort and IEQ performance monitoring
- data processing and display to present information in an attractive and understandable way to homeowners.

First, the EU applicable protocols will be mapped. Then, for each pilot, locally available and suitable methodologies will be further detailed to provide a clear and transparent methodology to be used in T2.5 solutions definition, T3.2 customer journeys design and T4.1 pilot markets' activation. Furthermore, it is investigated what **other local activities and organizations could help pave the way for efficient Citizen Hub roll-out** (e.g., existing energy or housing offices).

Therefore, this report starts with a review of the tools used or created by similar initiatives at EU level, regarding the different stages of the renovation process; then an analysis of the pilot cities' demand and supply side ecosystems, existing tools and practices are mapped; and finally local initiatives around pilot cities are scouted and assessed to establish their replicability potential.

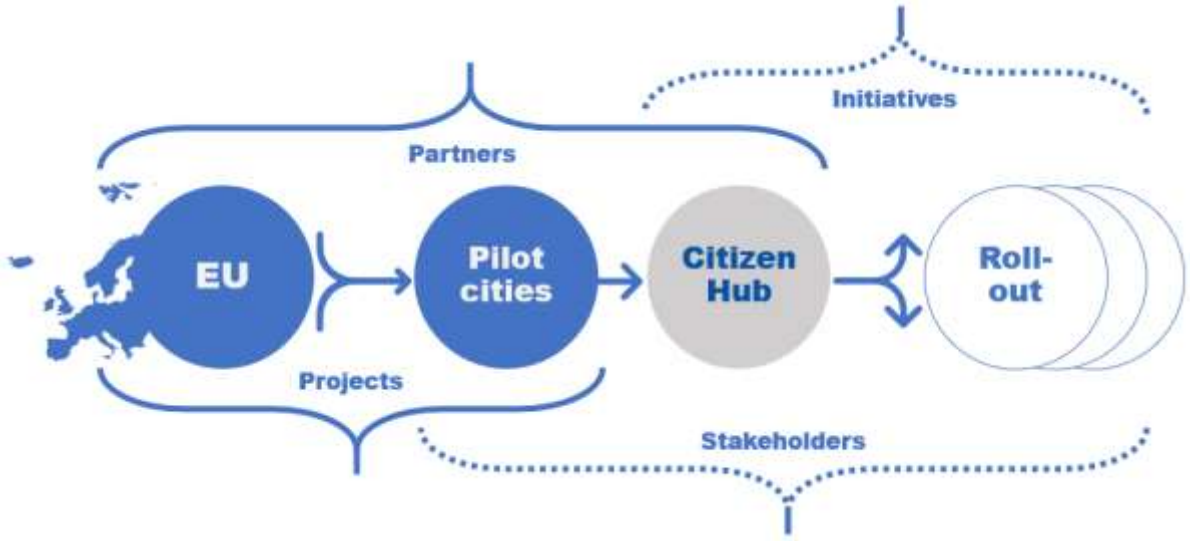

Figure 2.- Task 2.4 strategy: from general to particular, and beyond

The mapping methodology for building the Citizen Hub supporting services collection can be found on the Annex 1, to be used by the follower cities, or any other interested city or region.

3 The EU context

Beyond the traditional on-site quality control to guarantee proper conditions and compliance with project specifications and applicable regulations, the Save the Homes project intends to consider other **cross-cutting methods/processes to ensure quality control of retrofitting works**.

The complementary means considered, through which quality control could be ensured, have been grouped into the following three categories:

- Adequate **training** of technicians and installers involved in renovation works.
- **Certification** schemes/systems for products/processes/techniques.
- **Follow-up** after completion of the works.

A. Training

Improvements to the quality of new construction and renovation, that are associated with the introduction and mainstreaming of new products and techniques are often found to be held back significantly by **low levels of quality delivered by the workforce in the sector**. Against this backdrop, one of the six leading actions enshrined in the European Renovation Wave Strategy focusses on increasing the capacity of technicians to perform renovation projects as well as on **developing trainings to re- and upskill workers**[1], as the low quality of on-site construction works directly influences the energy efficiency in buildings.In the last decade several initiatives were launched, to provide training to workers in the construction sector[2]. In 2011, for instance, the **BUILD UP Skills** initiative was launched in Europe to increase the number of qualified professionals through the development of qualification platforms and roadmaps and by providing training on energy efficiency and renewable energy in buildings. Since then, a number of EU-funded projects were implemented across Europe to drive this initiative forward:

- **BUILD UP Skills CrossCraft**[3] *(April 2013-June 2016)***.** Based on the recommendations of the previous BUILD UP Skills Austria project, this project initiated the development of a national training standard and curricula for a modular national training scheme in Austria. While targeting all professionals in the construction industry, emphasis was placed on across-the-crafts training of e.g., general foreman, foremen, skilled workers, craftsmen, and unskilled workpeople. For example, one of the courses developed was aimed at craftsmen with several years of experience to train them as on-site quality coaches.
- **BUILD UP Skills QualiBuild**[4] *(November 2013 -July 2016).* This project aimed to establish a new baseline in relation to energy training for crafts people in the construction sector in Ireland. The target audience was general operatives (construction workers without a specific craft qualification), craft apprentices and craft workers. A Foundation Energy Skills (FES) Programme was also conducted for 200 building construction workers on how to carry out construction and develop higher quality and workmanship standards.
- **BUStoB – BUILD UP Skills to Business**[5] *(March 2015-August 2018)*. This project addressed the skills gap at a national scale in the Netherlands by developing quick skill assessments and training modules. Quality assurance was one of the topics covered in the training modules.

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[1] *"Sustainable Energy Skills in the Construction Sector":* https://www.mdpi.com/2504-3900/65/1/27

[2] *"Construction skills: Equipping building professionals with new skills to achieve European energy targets":* https://cordis.europa.eu/article/id/400910-construction-skills-equipping-building-professionals-to-achieve-european-energy-targets

[3] http://buildupskills-crosscraft.at/moodle/

[4] https://www.buildup.eu/en/explore/links/qualibuild-build-skills-project

[5] https://cordis.europa.eu/article/id/227566-training-construction-workers-on-energy-efficient-building-practices

- **Train-to-NZEB – The Building Knowledge Hubs**[6] *(June 2015-November 2018).* In the frame of this project, seven Building Knowledge Hubs were established in five Central and East European countries (BG, CZ, RO, TR, UA). These training centres combined theoretical lessons with practical hands-on exercises. Their concept was further developed through the Fit-to-nZEB project.
- **Fit-to-nZEB – Innovative training schemes for retrofitting to nZEB-levels**[7] *(June 2017-June 2019)*. Through this project, a compendium covering the knowledge, skills and competences required for deep energy retrofit was developed and based on the compendium, a set of practical training programmes was produced to address them. Beyond that, educators were trained, pilot courses were conducted, and MoU were signed with education and training providers to use the training materials. There were eight countries involved (AT, BG, CZ, GR, HR, IE, IT, RO), three of them already involved in the Train-to-NZEB project.
- **IngREeS – Setting up Qualification and Continuing Education and Training Scheme for Middle and Senior Level Professionals on Energy Efficiency and Use of Renewable Energy Sources in Buildings**[8] *(March 2015-February 2018).* This project addressed the skill and knowledge needs of middle- and senior-level construction professionals in three countries (AT, CZ, SK). National qualification standards and training programmes were developed for the Czech Republic and Slovakia.
- **PROF-TRAC – PROFessional multi-disciplinary TRAining and Continuing development in skills for NZEB principles**[9] (*March 2015-February 2018).* This project addressed the need for upskilling building professionals in zero energy construction and renovation. An open training platform including a voluntary EU-level training and qualification scheme was developed, as well as free self-assessment tools for professionals to evaluate skills and identify knowledge gaps and train-the-trainers programmes and webinars.
- **MEnS – Meeting of Energy Professional Skills**[10] *(March 2015-August 2017).* This project worked closely together with PROF-TRAC project. It focused on developing the skills needed by professionals to create and operate more energy efficient buildings, and especially on how to retrofit housing stock for NZEB standards. The training programme combined nationally accredited professional courses, e-learning and webinars and real case studies.
- **Net-UBIEP – Network for using BIM to Increase the Energy Performance**[11] *(July 2017-January 2020)***.** This project developed Building Information Modeling (BIM) training, certification, and qualification systems to address the energy skills gap in the construction sector. BIM training, such as a distance learning course for technicians, was also provided.
- **BIMEET – BIM-based EU-wide Standardized Qualification Framework for achieving Energy Efficiency Training**[12] *(September 2017-February 2020).* This project aimed to upgrade the skills and capacities of the EU construction workforce. A specific methodology was developed to identify functions, capabilities and training needed in BIM applied to energy efficiency and also a training portal with content from different BIM-related data sources, as a source of repositories and a database of available BIM courses.
- **BIMplement – Towards a learning building sector by setting up a large-scale and flexible qualification methodology integrating technical, cross-craft and BIM related skills and competences**[13] *(September 2017-August 2020)*. This project focused on training and qualification

[6] https://cordis.europa.eu/article/id/227570-promoting-handson-energy-efficiency-training
[7] https://cordis.europa.eu/article/id/411697-innovative-training-on-energy-efficient-building-renovations
[8] https://cordis.europa.eu/article/id/227567-green-training-for-construction-managers
[9] https://cordis.europa.eu/article/id/227569-new-platform-delivers-zero-energy-training-resources
[10] https://cordis.europa.eu/article/id/227568-developing-energyefficient-competencies-in-tomorrows-building-managers
[11] https://cordis.europa.eu/article/id/411698-increasing-energy-efficiency-with-building-information-modelling/
[12] https://cordis.europa.eu/article/id/411694-tailored-bim-training-for-construction-professionals/es
[13] https://cordis.europa.eu/article/id/411695-bim-trained-on-site-workers-deliver-better-nearly-zero-energy-buildings

programmes using digital technologies (BIM), to address the lack of interaction between modellers and blue-collar workers. The project focused on on-site training for construction companies and on-site workers, and specifically on ventilation and airtightness.

- **BIMcert – 1. Construction skills, 2. Energy efficiency, 3. Regulating supply chains, 4. Tackling climate change**[14] *(March 2018-January 2020).* This project developed a training scheme with different modules (owners, facility managers, public administrators, investors, etc.) and different construction activities (new or renovated buildings). Users can get a BIM Skills Passport and, through a project's third-party certification, easily have their skills acknowledged anywhere in Europe.
- **TripleA-reno – Attractive, Acceptable and Affordable deep Renovation by a consumers orientated and performance evidence-based approach**[15] *(May 2018 – October 2021)*. The project focused on overcoming market barriers for deep renovation and enhancing the attractiveness of decision making on retrofitting to consumers and end-users. One of the specific objectives of the project was the implementation of targeted CPD (Continuous Professional Development) and specific training to improve quality control and, therefore, the quality level of the deep renovation actions.
- **CEN-CE – CEN standard Certified Experts EU-wide qualification and training scheme based on EPBD mandated CEN standards**[16] *(June 2018-November 2020).* Within the framework of this project, a series of specific training programs were developed, based on the standards established by the European Committee for Standardization, aimed at intermediate and senior HVAC professionals, and including both workshops and face-to-face sessions. An e-learning system was also implemented, and a post-training exam was offered to them to certify as a CEN-EC expert, allowing their inclusion in a list of certified professionals publicly available from CEN-EC.
- **CraftEdu – Setting up national qualification and training scheme for craftsmen in the Czech Republic and developing the further offer of training courses in Slovakia, Austria and Bulgaria**[17] *(June 2018-November 2021)*. This project aimed to develop qualification and training schemes for craftsmen and on-site workers, initially for the Czech Republic, based on the achievements of the StavEdu project in Slovakia. CraftEdu sought to provide a full qualification package for eight key established professions: HVAC installers, carpenters, low-voltage electricians, high-voltage electricians, hydro-insulators, stove and chimney builders, inspecting technicians and window installers.
- **NEWCOM – New competence for building professionals and blue-collar workers – certified qualification schemes to upgrade the qualification for building nZEBs**[18] *(September 2017-November 2020)*. This project developed nZEB training schemes and a competence database to help standardise mutual recognition of skills across Europe, developed in cooperation with the BIMplement project. The training modules developed focused on three topics, namely: flat roofs and roof waterproofing (including planning and installation of green roofs and energy efficiency measures), ventilation installations (including heat recovery, noise protection, controlled airflow, and smart demand systems) and quality assurance in the planning, construction, and operation phase of nZEBs (including air quality, quality of the thermal building envelope and the energy system and cost-efficiency measures).

[14] https://cordis.europa.eu/article/id/411693-new-skills-certification-system-for-a-bim-savvy-construction-sector
[15] https://cordis.europa.eu/project/id/784972/
[16] https://cordis.europa.eu/article/id/411696-setting-the-standard-for-energy-efficient-construction-and-renovation/es
[17] https://cordis.europa.eu/article/id/430567-e-learning-platform-ensures-green-construction-skills-in-czechia-and-slovakia
[18] https://cordis.europa.eu/article/id/430568-enhancing-and-standardising-skills-for-energy-efficient-buildings

- **TRAIN4SUSTAIN – Establishing future-oriented training and qualifications quality standards for fostering a broad uptake of sustainable energy skills in the European construction sector**[19] *(May 2020-October 2022)*. In addition to establishing a competence quality standard and a European Skills Registry (ESR), this project will promote the Skills Passport as a tool to facilitate the comparison of skill levels among different professions on a transnational level. It will be an additional document/annex to complement existing certificates for qualifications.
- **BUSLeague – Energy-skilled workforce for the construction industry**[20] *(September 2020-February 2023)*. This project addresses the rise in demand for energy-skilled and experienced workers in the construction industry. It will raise awareness and knowledge on energy skills across Europe and implement proven training methods and techniques, such as BUILD UP Skills and Construction Skill. The project is being implemented at national and regional level, focusing on demand stimulation and complemented by the activities to improve local and regional workforce skills.
- **BUS-GoCircular – Boosting the demand for green energy skilled workforce**[21] *(September 2021-February 2024).* This project also aims to tackle the challenges associated with stimulating demand for sustainable energy skills in the building sector and seeks to increase the number of skilled building professionals. It will develop and implement a circular constructions skills qualification framework specifically focusing on multifunctional green roofs, facades, and interior elements. Lastly, the project will support legislative change efforts to mainstream circular green procurement and enhance the recognition of skills.

The presented project list is non-exhaustive, but provides a helpful overview of efforts to address the lack of training schemes in the European construction sector. It should be noted that recognition of skills acquired through training is, in most countries, voluntary and is neither required by the government nor by customers. Moreover, there is hardly any recognition of continuing education in energy efficiency and retrofitting, and national systems are not internationally recognized[22].

Finally, just mention the range of EU funding instruments for upskilling and reskilling[23] accessible through financial intermediaries, national authorities, or the European Commission; and the ones from the EU Skills Agenda[24].

B. Certification

Originally, the different **quality seals or certificates of sustainability and energy efficiency** did not only focus, or did not focus so much, on energy or CO2 emissions but rather on the comfort, wellbeing, and sustainability of buildings in general. Nevertheless, **energy certification schemes** for buildings have become an essential method since their appearance in the early 1990s.

Energy Performance Assessment & Certification in the framework of EU projects

Numerous past and present EU-funded projects focus on energy certification schemes in the framework, largely focusing on addressing deficiencies associated with current Energy Performance Certificates (EPCs):

- **QualDeEPC – High-quality Energy Performance Assessment and Certification in Europe Accelerating Deep Energy Renovation**[25] *(September 2019-August 2022).* This project aims to

[19] https://cordis.europa.eu/project/id/894514
[20] https://cordis.europa.eu/project/id/892894
[21] https://cordis.europa.eu/project/id/101033740
[22] https://busleague.eu/compilation-of-previous-experiences-according-to-the-recognition-of-energy-efficiency-skills-in-the-building-sector/
[23] https://ec.europa.eu/social/main.jsp?catId=1530&langId=en
[24] https://ec.europa.eu/social/main.jsp?catId=1223&langId=en
[25] https://cordis.europa.eu/project/id/847100

enhance the convergence and quality of EPC schemes across the EU and the link between quality-enhanced EPCs and deep renovation (their issuance, design and use, as well as their recommendation).

- **ePANACEA – Smart European Energy Performance AssessmeNt And CErtificAtion**[26] *(June 2020-May 2023)*. This project aims to create a holistic methodology for energy performance assessment and certification of buildings, addressing existing problems in current EPC schemes (inaccuracy, gap between theoretical and actual consumption, lack of protocols to include smart and novel technologies). A Smart Energy Performance Assessment Platform will be developed under this project, which will be based on advanced techniques in dynamic and automated simulation modelling, big data analysis, machine learning and inverse modelling.
- **D^2EPC – Next-generation Dynamic Digital EPCs for Enhanced Quality and User Awareness**[27] *(September 2020-August 2023).* This project will develop the next generation of dynamic EPCs for buildings, based on the "digital twin" concept to advance BIM and a new set of energy, environmental, financial and well-being indicators.
- **EPC RECAST – Energy Performance Certificate Recast**[28] *(September 2020-December 2023)*. This project aims to develop a well-structured process and a toolbox to support the development, performance, and validation of new EPCs, with a particular focus on existing residential buildings with high retrofit needs. To engage end users, certification should propose concrete paths towards ambitious targets that respect the overall quality of buildings and increase energy performance. One of the specific impacts of the project is to increase users' awareness of building energy efficiency by improving user-friendliness through a user-centred approach.
- **EUB SuperHub European Building Sustainability performance and energy certification HUB**[29] *(June 2021-May 2024)*. This project will support the creation of a harmonised certification process in the EU, by developing a scalable methodology to view, assess and monitor the buildings throughout their life cycle.
- **TIMEPAC – Towards Innovative Methods for energy Performance Assessment and Certification of buildings**[30] *(July 2021-June 2024)*. This project aims to improve the current EPC system, by combining EPC databases with other data sources and considering buildings as dynamic entities, thus transitioning from a single, static certification to a more holistic and dynamic one. The findings of the project will be used to develop training resources on certification processes.
- **crossCert – Cross Assessment of Energy Certificates in Europe**[31] *(September 2021-August 2024)*. This project will create a product testing methodology for new EPC approaches. The aim will be to improve the accuracy and usability of the EPCs and boost homogeneity across Europe. Beyond that, the project will conduct research and issue guidelines on linking next-generation of EPCs to energy audits, logbooks, and Building Renovation Passports, and EPCs and one-stop-shops for building renovation.
- **iBRoad2EPC – Integrating Building Renovation Passports into Energy Performance schemes for a decarbonised building stock**[32] *(September 2021-August 2024).* This project will explore energy efficiency assessment schemes and certification practices to promote and showcase the integration of Building Renovation Passport elements into EPC schemes.

[26] https://cordis.europa.eu/project/id/892421
[27] https://cordis.europa.eu/project/id/892984
[28] https://cordis.europa.eu/project/id/893118
[29] https://cordis.europa.eu/project/id/101033916
[30] https://cordis.europa.eu/project/id/101033819
[31] https://cordis.europa.eu/project/id/101033778
[32] https://cordis.europa.eu/project/id/101033781

In the field of **housing**, energy efficiency/improvement has been the primary focus of existing quality seals/certification schemes in the last years. In general, the assessment of other aspects such comfort or spatial quality has been rather considered in a complementary way. Currently, and due to recent events, the health, well-being, and comfort of occupants are also becoming priority areas in the various quality seals/certifications.

Beyond the certification/control of finished works in dwellings, it is essential to also consider **pre-execution tests and on-site checks** during the works. Regarding the evaluation of the works, pre-execution testing and on-site checks during works tend to be covered by regulations (European directives transposed into national legislation). **Quality seals** linked to products / techniques / systems and listing registers of suppliers/installers are usually considered in the case of pre-execution testing.

As for quality parameters, there is a strong case for featuring them in the deep renovation definition to ensure good implementation and that all benefits are achieved. A specific analytical focus is given here to one of them: the maximum number of steps in the case of a staged deep renovation, and how this could be linked to the Building Renovation Passport. Due to financial constraints, technical incompatibility or disruption from a renovation, building owners often do not want to renovate their building deeply at once. The Passive House renovation certification, the NOM renovation, and the French BBC renovation standard, for example, address this phenomenon by facilitating staged deep renovations. The Passive House standard does not define a minimum or maximum number of steps but provides pre-certification when a first step with 20% primary energy reduction is achieved.

Mandatory residential certification schemes

EPCs were first introduced by the Energy Performance of Buildings Directive in 2002 (2002/91/EC).

In 2010, the recast EPBD added a set of new requirements to improve the quality, usability, and public acceptance of EPCs[33]. Two years later, Directive 2012/27/EU established a set of binding measures to help the EU reach its 20% energy efficiency target by 2020. One of the measures adopted throughout the EU included mandatory energy efficiency certificates accompanying the sale and rental of buildings[34].

All EU Members had introduced EPC regimes by 2015, implying that more than 28 EPC frameworks exist in the EU and the UK[35]. Since Member States were offered flexibility in how to establish their EPC framework, there is a significant heterogeneity in the design of EPCs and in the information they contain[36]. Some countries have designed their EPCs to consider the possibility of carrying out step-by-step renovations to improve energy performance in stages over time[37].

In 2021, the European Commission started the revision of those policies needed to deliver on the GHG reduction targets agreed in the European Climate Law. The update of the EPC requirements and overall framework is one of the main elements being taken into consideration in the current text of the EPBD[38].

[33] https://www.construction21.org/articles/h/overview-current-status-of-energy-performance-certification-in-europe.html
[34] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en
[35] https://x-tendo.eu/wp-content/uploads/2020/05/X-TENDO-REPORT_FINAL_pages.pdf
[36] https://euroace.org/wp-content/uploads/2021/09/EPBD_EuroACE_PP_2021-1.pdf
[37] https://www.construction21.org/articles/h/overview-current-status-of-energy-performance-certification-in-europe.html
[38] https://euroace.org/euroace-positions/energy-performance-buildings-directive-epbd/

Voluntary residential certification schemes

The market for voluntary building certification schemes is mainly directed towards and used in commercial buildings.

At the European level, the most popular quality seals or **certification schemes being applied in residential buildings** are BREEAM, LEED and PassivHaus. Energy is a major theme in all of them (Passivhaus, in fact, only deals with energy), followed by the health and well-being of building occupants and broader environmental sustainability:

- **BREEAM**. This label assesses the entire project development process as well as the materials and technologies used. In addition to environmental issues, it also considers energy efficiency and other factors such as the health and wellbeing of the occupants.
- **LEED**. In addition to energy efficiency, the rating system takes into account aspects such as the training of the work team, location, transport, water efficiency and innovation, among others.
- **DGNB & HQE**. Initially, this label mostly focused on the non-residential sector (tertiary, offices, retail industrial), but has since grown into an internationally recognised rating system that is broadly used for all building types. DGNB examines building performance in a holistic way, including life-cycle considerations.
- The **certification COPILOT** for both new and existing buildings is also worth mentioning, as it offers independent certification of due diligence of technical systems (HVAC) and building commissioning (onsite verification of design-installation-operation of technical systems). COPILOT is also the name of the company having developed the certification, which is also part of the QUEST project consortium. **QUEST – Quality Management Investments for Energy Efficiency**[39] *(June 2019-May 2022)* integrates quality management services into energy efficiency projects, to address the existing "performance gap" between predicted energy savings and actual savings achieved in energy efficiency projects, to de-risk investment decisions. QUEST has developed certifiable post-project evaluation processes that can be integrated into or applied in parallel with the abovementioned certificatons.

C. Monitoring

Building performance assessments tend to be carried out in the **short term** after completion of the works (**evaluation of customer satisfaction** in relation to perceived quality), whilst in the **medium/long term**, performance is typically monitored and calibrated by controlling **building operation** (via the provision of building maintenance tools).

Building monitoring and data processing tools are key to follow-up. Specific **tools and methodologies** that exist or are under development are summarised in earlier sections, hence the following overview focusses on complementary established and emerging monitoring protocols.

The review of protocols reveals that

Building monitoring protocols

A collection of **existing monitoring protocols, guidelines, and methodologies,** developed within the framework of previous research projects or by other initiatives, is shown below. Some of them have been developed by organizations of relevance on a supra-state or even international scale.

These methodologies include the monitoring of energy, comfort and IEQ and the translation of data into understandable information. All these tools have been intended to help make retrofitting more

[39] https://cordis.europa.eu/project/id/846739

attractive and more reliable for consumers/end-users by providing them with more user-friendly and easier-to-understand information on the performance of their renovated homes.

- **IPMVP – International Performance Measurement and Verification Protocol**[40] was developed **by EVO** (Efficiency Valuation Organization) in 1997, with updates being made over the years. This protocol lays out the core concepts of a Measurement and Verification (M&V) Plan, including: common principles and terms, contents and requirements, project framework and attributes as well as saving reports. However, it does not define the activities for every application and each project must be designed individually.
- **Guideline 14: Measurement of Energy and Demand Savings**[41] **by ASHRAE** (2002). The guideline was developed to address the need for a standardized set of energy (and demand) savings calculation procedures. It provides guidance on minimum acceptable levels of performance to determine energy and demand savings, using measurements, in commercial transactions. Determining savings with measurements in accordance with this guideline involves measuring post-retrofit energy use and comparing that to the measured pre-retrofit use, adjusted or normalized, to act as a proxy for the conditions that would have prevailed had the retrofit not been performed.
- **Standardized protocol for characterizing IAQ (Indoor Air Quality) in large office buildings**[42] (2003) was developed **by the U.S. EPA** (Environmental Protection Agency). It covers three major areas: comfort and environmental measurements, building and HVAC characterization as well as an occupant questionnaire.
- **M&V-Net-ZEBs**[43] *(October 2008 – September 2013),* a monitoring and verification (M&V) protocol for Net ZEBs was developed **by the IEA** (International Energy Agency). An adapted protocol focused on the energy performance and IEQ of NZEBs was developed in the context of an international research initiative involving the SHC (Solar Heating and Cooling) and the ECBCS (Energy Conservation in Buildings and Community Systems) programmes. The aim was to develop a common understanding (harmonized international definitions framework, tools, innovative solutions, and industry guidelines) for net-zero, near net-zero and very low energy buildings, derived from the whole-building monitoring approach of the IPMVP.
- **GSEP Energy Management Working Group – M&V Task Force.** The Global Superior Energy Performance (GSEP[44]) Partnership was announced in 2010 to accelerate energy efficiency improvements throughout industrial facilities and large buildings to significantly cut global energy use. In 2014, the task force published a report on M&V of energy performance[45], to provide assistance and guidance to global M&V practitioners, resulting in increased stakeholder confidence in M&V data quality and more informed decision making when analyzing measured or derived M&V data.
- **The Level(s) EU framework for sustainable buildings**[46] (2015) is a voluntary and standardized framework for assessing and reporting on the sustainability performance of residential buildings or offices, through a stablished system for measuring and supporting improvements. Three different levels of assessment are proposed:
    - Common performance assessment.
    - Comparative performance assessment.

[40] https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp
[41] https://www.techstreet.com/ashrae/standards/guideline-14-2002-measurement-of-energy-and-demand-savings?gateway_code=ashrae&product_id=1645226
[42] https://www.epa.gov/indoor-air-quality-iaq/standardized-epa-protocol-characterizing-indoor-air-quality-large-office
[43] https://task40.iea-shc.org/Data/Sites/11/documents/ECBCS_Annex_52_Factsheet.pdf
[44] https://www.energy.gov/eere/buildings/global-superior-energy-performance-partnership
[45] https://www.cleanenergyministerial.org/sites/default/files/2018-08/EMWG_energy_demand_performance.pdf
[46] https://ec.europa.eu/environment/levels_es

- Performance optimisation assessment.

- **IPMS – International Property Measurements Standards: Residential Buildings** (2016). This shared international standard was developed by the International Property Measurement Standards Coalition (IPMSC) with the goal of ensuring that property assets are measured in a consistent way at an international level, to create a more transparent marketplace, greater public trust, stronger investor confidence and increased market stability.

In addition to the established protocols mentioned above, a number of European research projects have explored or are exploring monitoring protocols, guidelines or methodologies. A selection of these are identified and described below.

- **BRITA in PuBs – Bringing Retrofit Innovation to Application in Public Buildings**[47] *(May 2004 – April 2008).* In the frame of this project, a Quality Control-tool box including a Monitoring Guideline for Energy Efficient Buildings was developed. This guideline provides a methodology for planning, managing, and reporting building monitoring campaigns in a very summarized way, including information such as parameters to be monitored, monitoring duration/conditions and some data analysis considerations.
- **BEEM-UP – Building Energy Efficiency for Massive market UPtake**[48] *(January 2011-December 2014)* defined a set of actions to be implemented in monitoring processes for refurbishment projects. The common guideline developed was based on two main dimensions:
  - A clear monitoring procedure that identifies each step in the implementation of the monitoring program and indication of the specific tools required and when.
  - The use of IPMVP (International Performance Measurement and Verification Protocol).
- **HERB - Holistic energy-efficient retrofitting of residential buildings**[49] *(October 2012 – April 2016).* In the context of this project, a measurement protocol was followed for monitoring the retrofitting of residential buildings. Different types of sensors were installed and used in all dwellings of a social housing apartment building in Athens to monitor different rooms and parameters. Investigations were carried out to assess:
  - Infrared thermography.
  - Airtightness & ventilation rates.
  - Energy use.
  - Building environmental parameters.
  - Meteorological parameters.
  - Lighting measurements.
- **SSO – Smart Sustainable Offices**[50] *(January 2014 – December 2017).* The project conducted tests in real-life living lab conditions (real-office scenario) that took into account human factors (office users), to establish a correlation between indoor environmental quality (IEQ), health, well-being and productivity. A set of protocols was developed to obtain data on IEQ parameters and energy consumption as well as data about health, subjective well-being and building occupant performance. Monitoring in 15 offices was conducted in three phases: a first pilot measurement was carried out to validate the set of protocols in winter 2014/2015 and two more measurements, using validated protocols, were carried out next winter (Winter pilot) and summer (Summer pilot) to collect proper data.
- **ENCOMPASS – Engineering COMPASS**[51] *(October 2016 – February 2020).* With the goal to validate an integrated socio-technical approach to behavioural change for energy saving, innovative user-

[47] https://cordis.europa.eu/project/id/503135/es
[48] https://cordis.europa.eu/project/id/260039/es
[49] https://cordis.europa.eu/project/id/314283/
[50] https://www.climate-kic.org/success-stories/smart-sustainable-offices/
[51] https://cordis.europa.eu/project/id/723833/

friendly digital tools for making energy data consumption available and understandable were developed (D7.1.V1.0). For validation purposes, the project assessed three different types of buildings (residential buildings, schools, and offices), located in three EU areas with different climate conditions.

- **MOBISTYLE – MOtivating end-users Behavioural change by combined ICT based tools and modular Information services on energy use, indoor environment, health, and lifestyle**[52] *(October 2016 – June 2020).* The project developed a methodology based on ICT services to provide consumers attractive personalized information on their energy use. This endeavour was motivated by the goal to trigger behavioural change by raising consumer awareness. The protocol provides information on the parameters to be monitored, the sensor typologies to be used for collecting them and defines Key Performance Indicators (KPIs) for energy, IEQ and health. The monitored data is translated into KPIs, which in turn are translated into useful and understandable information for end-users.
- **Pro-GET-OnE – Proactive synergy of integrated Efficient Technologies on buildings' Envelopes**[53] *(May 2017 – April 2022).* In the context of this project, post-retrofit energy is monitored to compare it to the already measured pre-retrofit use. The developed monitoring process is based on the ASHRAE Guideline 14 on Measurement of Energy and Demand Savings, a protocol which was designed for the following six performance categories: energy, water use, thermal comfort, indoor air quality, lighting, and acoustics. The goal is to assess and compare the performance of the building before and after retrofit.
- **TripleA-reno – Attractive, Acceptable and Affordable deep Renovation by a consumers orientated and performance evidence-based approach**[54] *(May 2018 – October 2021)*. An open end-user centred gamified platform was developed in this project. The platform was conceived to include an array of practical applications, to be demonstrated under real life operating conditions in seven cases. The project focused on overcoming market barriers for deep renovation by making decision making on retrofitting attractive for consumers and end-users.
- **DRIVE 0 – Driving decarbonization of the EU building stock by enhancing a consumer centred and locally based circular renovation process**[55] *(October 2019-September 2023).* A monitoring protocol has been developed in the frame of this project, including procedures to collect data (physical data and user perception), technologies to be used and timelines to be followed. Furthermore, the protocol defines tests for evaluating the monitoring performance and for following-up the information and communication to (end) users and user experience. The protocol has been tested through demonstrators, used for feedback to adjust them. Implementation guidelines for future use of these protocols will be drafted.

[52] https://cordis.europa.eu/project/id/723032/
[53] https://cordis.europa.eu/project/id/723747/
[54] https://cordis.europa.eu/project/id/784972/
[55] https://cordis.europa.eu/project/id/841850

4 The pilot cities ecosystems

According to Objective 1 of the project Save the Homes (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, and it is specifically focused on enhancing the homeowners' experience throughout the home renovation journey.

Save the Homes creates innovative 'integrated home renovation services' in the City of Rotterdam, the Netherlands, and the Municipality of Valencia, Spain. The establishment of new or upgrade of existing renovation hubs is aligned with the climate targets set by the two cities. Indeed, according to the Covenant of Mayors (CoM) for Climate & Energy initiative, 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[56], and therefore, their occupants, managers, owners or 'regulators'.

It should be noted, however, that the project pilots do not address the whole city but rather the district -level. A methodological framework was therefore designed, to target the different stakeholders at this scale (described in D2.1), to focus efforts and tailour communication strategies so as to maximise citizen engagement (T2.2), to maximise impacts achieved by prioritising most-in-need buildings (T2.5), and to offer the best methods, services and solutions for renovation (T2.3 & T2.4). This deliverable serves to underpin the delivery of quality renovations by mapping suitable protocols and methods for quality control of the renovation works (including skills definition) as well as for buildings performance monitoring. Learnings from this review of **already available methods, tools and services suitable for the renovation process**, together with an understanding of the supply side (network and products and services provided, covered in D2.3) and specific renovation solutions (D2.4) will be harnessed to define holistic home renovation personal assistance offerings for the Citizen Hubs in Valencia and Rotterdam. The following sections examine the methods, tools and services in the pilot cities, to identify opportunities for the introduction of new, or the improvement of existing approaches.

4.1 Comunitat Valenciana – ES

The geographical scope for this pilot will initially focus on local implementation, before expanding to the regional level during the replication phase. In light of the ambition to scale up and replicate the Save the Homes model, cities engaged include not only the City of Valencia (815,440 inhabitants) as front-runner and partner of the project, but also follower cities in the region. The project has secured the interest (Letters of Support) from the City of Elche (230,000 inhabitants), the City of Gandía (74,000), Municipality of Onda (12,000 inhabitants) and City of Alcoi (59,000 inhabitants) and is furthermore supported by the Regional Government.

Considering that methods and tools developed by the Save the Homes consortium can be transposed or easily adapted to other geographical contexts, there is great potential for further replication beyond the regional cluster of cities. The consortium is presently in the process of mapping additional interested local governments at a wider geographical scope, to encourage an even broader adoption of Save the Homes solutions in future.

[56] Covenant of Mayors figures: https://www.covenantofmayors.eu/about/covenant-initiative/covenant-in-figures.html

Therefore, we will use in this deliverable the national (NUTS0) and regional (NUTS2) levels as a proximity criterion, and the municipality physical and socioeconomic characteristics as a similarity criteria, depending on the topics addressed.

4.1.1 The existing resources in place

This section is twofold, for each category of supporting services: on the one hand, the existing initiatives at EU-level that can be used in the ecosystem are listed, and on the other hand, the existing local initiatives or in-house know-how is examined.

A. Training

> The objective of defining the existing and applicable training resources in place is to enhance the quality of the renovation works assisted by the OSS services through the formalization stage functionalities, where external contracting is facilitated.

The mapping summarised in earlier sections - as well as research conducted in the context of the project's Task 3.2 on defining customer journey definitions - provides a useful overview of needed functionalities and available tools. The following table summarizes the existing training and capacitation support services in place. Integrating or promoting these offerings would help improve the quality of the renovation works facilitated by the Citizen Hub and delivered by local professionals, installers and/or contractors registries.

EU (applicable results)	**In-house** (partners resources)	**local** (initiatives)
PROF-TRAC	IVE's training offer	Construction Labour Foundation (FLC)
BIMplement	VCE's training workshops	
TripleA-reno		
BUSLeague		
BUS-GoCircular		

Table 1.- Existing and applicable training resources in place

Within the framework of the **BUSLeague** project, to carry out awareness-raising campaigns and develop a training programme for employees and installers in energy efficiency, a first batch of 10 micro-trainings has been launched, divided into the following 10 topics: Introduction to EE-buildings, How to improve the EE, User behaviour, Insulation, Windows, Thermal installations, Existing thermal installations, Lightning, Home appliances, and Renewable energies.

In terms of in-house resources on the part of the project partners, the **IVE** has an up-to-date training offer at both building and city level. There is a wide range of programs of different duration and recognition, from free short videos to university degrees. Due to the wide variety of training available, both in terms of content and format, there is also the possibility of organizing "tailor-made" training with personalized training itineraries. It should be noted that certain training courses are recognized at regional level and passing them means being able to appear on certain regionally recognized official lists.

The **Valencia Energy Office** (part of VCE), on the other hand, also offers training workshops, aimed mainly at citizens, to advise them on energy saving, the implementation of renewable energies and the energy retrofitting of their homes.

At the local level, there are other training initiatives closely aligned with the objectives pursued in this project such as the **Construction Labour Foundation** training platform (*Fundación Laboral de la*

Construcción, FLC). FLC is a reference entity in the construction sector with a wide offer of training actions for construction workers[57].

B. Certification

The objective of defining the existing and applicable certification schemes in place is to proof the quality of the renovation works facilitated through the OSS services as a last step of the assisting process.

Based on the mapping presented in this report and the Task 3.2 customer journey definition, a number of certification schemes have been identified that are being applied or have the potential to be implemented in Valencia and replication cities. The schemes listed in the below table can or could help ensure the quality of the renovation works facilitated by the Citizen Hub.

EU (applicable results)	**In-house** (partners resources)	**local** (initiatives)
HAPPEN	IVE Certification Body	Residential Building Evaluation Report (IEE.CV)
		Quality Register in the Built Environment

Table 2.- Existing and applicable certification schemes in place

In the framework of the EU-funded project **HAPPEN – Holistic APproach and Platform for the deep renovation of the Med residential built ENvironment**[58] *(April 2018 – December 2022)*, a MedZEB Voluntary Certification Scheme was developed based on a step-by-step approach. The requirements of this scheme are set out in a MedZEB protocol, which establishes the quality conditions for the good execution of renovations at all levels (technical, energy, environmental, well-being, etc.). The MedZEB Voluntary Certification Scheme is issued after each step of the renovation has been completed to evaluate compliance with the requirements established in the MedZEB protocol. Partners from seven countries (CY, ES, FR, GR, HR, IT, SI) were involved in this project and the IVE was one of the three partners involved in Spain.

In terms of in-house resources on the part of the project partners, the IVE has its own Certification Body[59], whose purpose is the evaluation and certification of buildings, parts of buildings, companies, or professionals in the construction sector, based on the certification schemes approved by its Certification Committee. The experience of this body in two particular quality certifications could be exploited:

- **BES Certification**[60]. Although this is a label for offices and workspaces, much could be gained from the protocols to analyse the protection of the environment, the health and well-being of users and the quality of spaces.
- Retrofitting Quality Profile (PdC, *Perfil de Calidad de rehabilitación*). The IVE developed the technical instruction for evaluating the renovation of residential buildings to obtain the PdC voluntary label, which evaluates the quality levels of renovated buildings, based on energy savings and sustainable use of natural resources, among other aspects.

At the local level, the **Residential Building Evaluation Report** (IEE.CV, *Informe de Evaluación del Edificio de Viviendas)* for the Valencia region is a document that describes the constructive characteristics, state of conservation, accessibility, and energy efficiency conditions of existing buildings, pointing out the corresponding deficiencies detected and providing guidance on the necessary actions to guarantee an adequate state of conservation, as well as to improve their energy

[57] https://www.cursosenconstruccion.com/
[58] https://cordis.europa.eu/project/id/785072
[59] https://www.five.es/certificacion-edificios/entidad-de-certificacion/
[60] https://www.five.es/oficinas/

efficiency. It is a mandatory document for buildings over 50 years old, or for all those which, regardless of their age, wish to benefit from grants for renovation.

Lastly, it should be noted that a **Quality Register in the Built Environment** *(Registro GHC)* has been established at Valencia's regional level. The tool includes information on professionals as well as products and showcases good practice examples in the field of construction. The IVE has been highly involved in the development of both this register and the IEE.CV tool.

C. Monitoring

The objective of defining the existing and applicable monitoring protocols is to ensure the quality of the renovation works facilitated through the OSS services by accompanying clients from the beginning to the end of the works.

The following table summarizes the existing supporting services in place to monitor and thereby ensure the quality of renovation works in Valencia and the wider region. Higher quality renovations delivered by adopting such approaches would improve customer satisfaction and create greater demand for Citizen Hub services.

EU (applicable results)	In-house (partners resources)	local (initiatives)
SSO	Energy consumption test	Through VCE's users advisory services
TripleA-reno	Self-assessment tool for tourist homes	
DRIVE 0		

Table 3.- Existing and applicable monitoring protocols and services in place

At the local level, there are a number of resources which may be in certain ways appropriated for the energy consumption monitoring.

- The Energy Consumption Test for Homes in the Valencian Community (*Test de consumo energético para hogares de la Comunitat Valenciana)* is a tool developed by the IVE for the citizens of the Valencia region, which allows them to know the overall energy consumption of their homes. By answering a series of questions, citizens obtain an estimate of their consumption, compared with the average consumption of the region (obtained from a study of energy consumption habits in the region, also developed by the IVE: *Estudio de hábitos de consumo de energía en hogares de la Comunitat Valenciana)* and personalized advice and energy saving measures. Although it is not a specific tool for consumption monitoring per se, it could be used as a self-monitoring application by the users themselves, who could use it to take a kind of snapshot prior to the renovation.
- Another tool also developed by the IVE, although not a monitoring tool as such, is the self-assessment tool for tourist homes (*Mejora tu vivienda turística*) which allows the user, after answering a series of questions anonymously, to obtain personalized advice on how to improve their home in terms of thermal and acoustic comfort, environmental protection, quality of spaces and inclusive design. Like the energy consumption test above, this is a tool that could be used to monitor thermal, acoustic and consumption characteristics of dwellings prior to intervention. This tool can also be used to evaluate dwellings in terms of the quality of the spaces and inclusive design aspects, such as accessibility.

4.1.2 The Citizen Hub supporting services proposal

The main objective in this task is to list and allocate the analysed existing supporting tools and protocols in the corresponding stage of the OSS customer journey service offer.

D. Services menu

The objective of defining a supporting services proposal is to get a clear view of the available and applicable existing resources helping ensure the quality of the works facilitated through the OSS services on each stage of the process

On the basis of the assessment carried out in previous sub-section, the ecosystem proposal for supporting services to ensure quality of works are listed below:

stage	Training	Certification	Monitoring
0 - onboarding	Mentioned EU projects	EPC improvements suggestions	IVE tools for self-assessment SSO / TripleA-reno / DRIVE 0
1 - evaluation	IVE training offer		
2 - elaboration	VCE training offer	Quality Register	
3 - construction	FLC training offer/ BUS suite	HAPPEN Vol. Certif. Scheme	
4 - validation	IVE training offer	IVE Certification Body	idem stage 0

Table 4.- Spanish OSS supporting services proposal

It is recommended that the identified aligned/appropriate existing resources are used in the different stages of the customer journey according, taking into account the justifications provided in the previous sub-section.

- In the case of education, the **training resources** generated within the framework of the different **EU projects** described above will be particularly useful in the initial phases of the renovation process. Although these resources are mainly aimed at the supply side - as in the case of the **IVE training offer** - the use of additional material aimed at users, such as the **training actions offered by the Valencia Energy Office (VCE),** should also be considered.
- Regarding **certification**, and taking into account the voluntary nature of the vast majority of existing certification schemes, the **HAPPEN scheme** and the internal expertise of the **IVE's certification body** will be applied in the final stages of the customer journey to ensure the quality of the work performed. In connection, the recently developed Registry for Quality in the Built Environment, a general information tool on professionals, products and good practices in the construction sector, should also be highlighted as a valuable tool.
- In relation to quality assurance, **monitoring tools** will be used that were developed within the framework of **EU projects** in which the IVE is or was involved. Additionally, other tools that are not strictly monitoring tools will be harnessed that allow an **initial self-assessment by the users** to enable a later comparison of the behaviour of their households.

Main gaps are focused on the monitoring services and efforts will be made to identify further resources that could support the elaboration and construction stages of the energy renovation process.

4.1.3 The Citizen Hub roll-out proposal

As presented in the introduction, the objective of this task is not only to review the existing supporting services available and applicable to offer and/or use within the OSS services menu, but also to examine existing local sister initiatives that could be integrated into the Citizen Hub to expand spatial reach or functions, thereby enhancing the Save the Homes ecosystem and its impact.

E. Decentralization (pop-up)

The objective of decentralization based on existing sister initiatives is to extend reach of the OSS services and facilitate access, to maximize project impact

Based on D2.2 and D2.3 as well as Advisory Boards' activities, existing initiatives complementary to pilot experience in terms of services provided or territorial scope can be found in table below:

initiative	Stage/ What (Services to be provided)	Territory/ Where (Geographical scope)	Periodicity/ When (Temporal scope)
XALOC	Integral service for building retrofitting	Valencia region	First offices created in 2020 Decree 199/2021 signed in Dec.21
OTEA	Assistance on energy saving, energy efficiency, and renewable self-consumption	Valencia region	Launch in Dec.21 Operation planned until 2023
Other physical offices	Integral services	Other ES regions	See D.2.1 (*The previous experiences,* p.7-8)
Web tools/platforms	Search of professionals Requesting quotes	ES national context	See D.2.1 (*The previous experiences,* p.8-9)
Professionals' directories or associations	Misc.: provision of services, promotion of retrofitting, search of professionals, etc.	ES national context	See D.2.1 (*The previous experiences,* p.9)
In-store assistance	Intermediaries between users and professionals	Some ES regions	See D.2.1 (*The previous experiences,* p.9)

Table 5.- Spanish OSS roll-out proposal

At the regional level, the following initiatives stand out in the Valencia Region, which are fully aligned with the activities and scope of the Save the Homes project:

- **XALOC** (Network of Local and County Housing Administrations, *Red de Administraciones Locales y Comarcales de Vivienda*), a network of local offices to offer citizens a comprehensive service of management, information, social mediation, and advice on housing, building retrofitting and urban regeneration. During 2020 and 2021, the Valencian regional government signed agreements with several local housing entities for cooperation and collaboration. Following the results of these experiences, the creation of the network emerged to provide these offices with a stable legal framework. Last December, the Decree creating this network was approved.
- **OTEA** (Office of Energy Transition and Accompaniment, *Oficina de Transición Energética y Acompañamiento*), an office to provide promotion and assistance service on energy saving, efficiency and renewable self-consumption that will cover the municipalities of the region until 2023. It will provide a permanent, telematic and itinerant triple service to inform and help optimise energy expenditure, as well as to offer guided technical assistance to create energy communities or install photovoltaic panels for self-consumption.

It should be noted that **VCE** already offers a similar service (a quasi-hybrid of the two previous initiatives) through the **Energy Office**, but only to residents of Valencia city.

At the national level, several previous experiences were already analysed in deliverable *D2.1: Save the Homes demand & supply side mapping,* including, among others, the experience of physical offices in operation in other regions. Other national web tools/platforms were also highlighted, as well as the relatively recent services provided by building materials/supplies sales companies themselves.

4.2 Rotterdam - NL

The geographical scope for this pilot experience will be local at first instance, and then regional, (as a replication phase). Rotterdam is one of the top 5 cities in the Netherlands. As per January 1, 2021, Rotterdam has 651,269 inhabitants, and more than 315,000 buildings. Prins Alexander is the largest of the city's fifteen districts with a population of 95,445 and 45,869 dwellings.

City district Prins Alexander consists of eight residential neighbourhoods: Kralingseveer, 's-Gravenland, Prinsenland, Het Lage Land, Oosterflank, Ommoord, Zevenkamp, and Nesselande. There is an energy community active in Prins Alexander, called Alex Energie. This energy community has a focus on Prinsenland and Het Lage Land but is active in the city district Prins Alexander. This energy community is one of five energy communities that are active in the City of Rotterdam. These five are part of a larger community, called Energie voor Rotterdam, EVR (Energy for Rotterdam).

neighborhood	total # dwellings (2020)	# owner-occupied (2020)	# terraced houses (2020)	# houses built <1990 (2020)
Het Lage Land	5,904	2,100	1,169	5,052
Kralingseveer	738	483	632	587
Nesselande	4,510	3,141	3,520	81
Ommoord	**13,183**	**4,525**	**4,853**	**12,115**
Oosterflank	5,587	1,708	1,520	4,947
Prinsenland	5,153	1,768	1,790	2,272
's-Gravenland	3,499	1,762	2,274	245
Zevenkamp	7,295	2,905	3,722	6,868
Total Prins Alexander	45,869	18,392	19,480	32,167

Table 6.- Data on houses in district Prins Alexander (source: Onderzoek010, retrieved in March 15, 2021)

neighborhood	total # dwellings (2020)	# owner-occupied (2020)	# terraced houses, owner-occupied (2020)	# terraced houses built <1990, owner-occupied * (2020)
Het Lage Land	5,904	2,100	946	865 (15%)
Kralingseveer	738	483	460	355 (48%)
's-Gravenland	3,499	1,762	1,483	165 (5%)
Prinsenland	5,153	1,768	1,199	161 (3%)
Oosterflank	5,587	1,708	1,002	974 (17%)
Ommoord	**13,183**	**4,525**	**3,289**	**3,173 (24%)**
Zevenkamp	7,895	2,905	2,489	2,404 (33%)
Nesselande	4,510	3,141	2,779	64 (1%)
Total Prins Alexander	45,869	18,392	13,647	8,161 (18%)

* The percentages refer to the share of terraced, owner-occupied houses built before 1990 in the total housing stock of the neighborhood.

Table 7.- Data on houses in district Prins Alexander (source: municipal data bases, StH D2.1 page 47, 48)

The data show that:

- Prins Alexander has a total of 45,869 dwellings
- 18,392 of those are owner-occupied
- of those owner-occupied houses, 13,647 are terraced houses
- of those 13,647 owner-occupied terraced houses, 60% (8,161) are built before 1990, and 56% (7,648) are built in the period 1960-1989 (not shown in Table 9)

In absolute terms, Ommoord has the highest number of homes that meet the criteria. In relative terms, Kralingseveer has the largest part of its housing stock that meet the criteria, whereas the

absolute number of houses is very low. Zevenkamp is an in-between that has a high percentage of the housing stock and a high absolute number of dwellings that meet the criteria. Prinsenland, 's-Gravenland, and Nesselande are the most unfavourable neighbourhoods.

Although it may be practical to choose one neighbourhood within Prins Alexander to direct all efforts towards, it is not strictly necessary. Ommoord has received quite a lot of attention in a previous project (Triple-A), and the residents indicate to have grown tired of the city's messages. Therefore, even though Ommoord presents the best figures, it may be wise to choose one or more other neighbourhoods for Save the Homes.

Within Save the Homes Alex Energy is on board to participate as part of the HUB-functionality. From that point on the municipality of Rotterdam aims for an upscaling from this community towards the other four energy communities, via Energie Voor Rotterdam. This is the first upscaling within the city. More local communities are needed to cover the whole city, but for now this is the starting frame of the Rotterdam situation. As Alex Energie is already active in two neighbourhoods of Prins Alexander (Prinsenland and Lage Land) this two areas will be the main focus for Save the Homes.

The local communities should consider all the renovation process stages to design the best services to offer, according to target groups and zones. But possible with a central back office for the whole city. However this process has not been looked at yet, and will be part of the business case study. For an in-dept explanation of the area for Save the Homes, please go to the rapport of D3.6.

4.2.1 The existing resources in place

This section is twofold for each category of supporting services:

- The existing initiatives at EU level that can be used in the ecosystem will be listed;
- The existing local initiatives or in-house know-how will be put together.

A. Training

The objective of defining the existing and applicable training resources in place is to enhance the quality of the renovation works assisted by the OSS services through the formalization stage functionalities, where external contracting is facilitated.

From previous section mapping and Task 3.2 customer journey definition, with needed functionalities and available tools, the next table summarizes the existing supporting services in place, regarding training and capacitation for ensuring quality of the renovation works facilitated by the Citizen Hub through the professionals, installers and/or contractors registries.

EU (applicable results)	**In-house** (partners resources)	**local** (initiatives)
PROF-TRAC	Alex energy	Leerwerkakkoord
BIMplement		Energy coaches
TripleA-reno		
BUSLeague		
BUS-GoCircular		

Table 8.- Existing and applicable training resources in place

B. Certification

The objective of defining the existing and applicable certification schemes in place is to proof the quality of the renovation works facilitated through the OSS services as a last step of the assisting process.

From previous section mapping and Task 3.2 customer journey definition, with needed functionalities and available tools, next table summarizes the existing supporting services in place, regarding certification of the quality of the renovation works facilitated by the Citizen Hub.

This section is approached in terms of **in-house resources**. In the Netherlands we have the **energy label** that is used and shows how energy-efficient a home is. Owners are obligated to make an energy label available to the buyer or tenant when selling and renting. This obligation also applies if owners have built a new home. The energy label indicates:

- Whether a house consumes a lot or little energy (energy performance). The highest label is A++++ and these houses are the most energy efficient. The least energy efficient get the label G
- How to make your home more energy efficient, such as insulating the roof or installing solar panels
- Whether the house can be easily switched off gas.

The energy label also has advantages for the homeowners, the buyers and new tenants:

- Buyers and new tenants can immediately see whether a home is energy efficient or not
- The energy label gives buyers and tenants an indication of the energy bill
- The energy label shows with examples how an owner can make his house more energy efficient
- The energy label can have a positive influence on the final sale or rental price of a home
- A green energy label can speed up the sale or rental of a home.

From August 1, 2021, the energy label will also indicate whether a home can easily get rid of gas. And whether the roof, floor or windows need (extra) insulation to switch to an electric heat pump or a connection to a heat network. In poorly insulated homes, a heat pump or connection to the heat network makes no sense. The energy label indicates how well a home is insulated (so-called insulation level). And how the roof, floors and windows of a house can be optimally insulated (so-called target values). The target values for an old house are lower than for a new house. If a roof, floor or window is optimally insulated, the energy label states that it meets the standard for home insulation.

The energy label is mandatory for the sale, rental and delivery of houses and apartments. An energy label is not mandatory for some homes or special buildings. For example, at a protected monument or factory hall.

C. Monitoring

The objective of defining the existing and applicable monitoring protocols available in place is to ensure the quality of the renovation works facilitated through the OSS services by accompanying clients from the beginning to the end of the works.

From previous section mapping and Task 3.2 customer journey definition, with needed functionalities and available tools, next table summarizes the existing supporting services in place, regarding monitoring for ensuring quality of the renovation works facilitated by the Citizen Hub through the comparison before-after renovation, this is, from the beginning to the end of the process.

EU (applicable results)	**In-house** (partners resources)	**local** (initiatives)
TripleA-reno	Sensi Sensors	Energy consumption
		Feedback of execution

Table 9.- Existing and applicable monitoring protocols and services in place (Netherlands)

At the local level, there are a series of resources which may be in certain way appropriated for the energy consumption monitoring. But the quality of a renovation is not only measured by the energy reduction. It is also measured by how the home owner appreciates the solution.

One of the ideas is that there is a feedback loop , that allows people to mention their experience with the contractor. This acts like a Google or Zoover review. This can also be formalised and executed by the HUB. It than acts as a control instrument for the HUB customer journey.

PERFORMANCE INDICATOR	HOW TO MEASURE?
Resident satisfaction	Surveys in the neighborhood and in-depth questionnaires with households that have dropped out of the customer journey
Duration of renovation	Date of 1st contact with residents up to and including the date of delivery of the contract (measured based on the 10-step IHRS model)
Resident satisfaction product-process implementation	Number of service complaints after completion of the renovation delivered
Quality of work	Sample for quality by independent instance
Ratio of cost price product and process	Ratio construction costs material costs incl. storage and labor costs incl. storage

Table 10.- Feedback indicators

Another way to measure the quality of a renovation is through the climate of the building before, during and after renovation. The Sensi Sensors, developed during the TripleA-Reno project, can be used in an easy adaptable way by home-owners to gain insight in their indoor climate. These Sensi Sensors are combined with the combined labeling scheme developed during the TripleA-Reno research project, in order to ensure data comparing can be done equally even though different methods have been used to measure the data.

4.2.2 The Citizen Hub supporting services proposal

The main objective in this task is to list and allocate the analysed existing supporting tools and protocols in the corresponding stage of the OSS customer journey service offer.

D. Services menu

The objective of defining a supporting services proposal is to get a clear view of the available and applicable existing resources helping ensure the quality of the works facilitated through the OSS services on each stage of the process

From previous sub-section, the ecosystem proposal for supporting services to ensure quality of the works are listed below:

stage	Training	Certification	Monitoring
0 - onboarding			
1 - evaluation			Energy consumption
2 - elaboration			Feedback of execution
3 - construction			
4 - validation	Leerwerkakkoord; Energie coaches	Energie Label	

Table 11.- Dutch OSS supporting services proposal

4.2.3 The Citizen Hub roll-out proposal

As presented in the introduction, the objective of this task is not only reviewing the existing supporting services available and applicable to offer and/or use within the OSS services menu, but also scouting the existing local sister initiatives that could host temporarily or eventually part or the whole OSS

services in areas out of the Citizen Hub territorial or functional competences, in order to expand its reach in terms of the ecosystem scope.

E. Decentralization (pop-up)

> The objective of decentralization based on existing sister initiatives is to extend reach of the OSS services and facilitate access, to maximize project impact

Starting from D2.2 and D2.3 and Advisory Boards' activities, existing initiatives complementary to pilot experience in terms of services provided or territorial scope are to be scouted. This is still work in process due to the late incorporation of Rotterdam municipality and specially AlexEnergie, and will be delivered in the context of WP4 demonstration Tasks.

5 The follower cities test

According to Save the Homes 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.

So, 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 replicated in the two follower cities, Sant Cugat (ES) and Ljubljana (SI).

For this stage, follower cities will receive the draft methodology for designing the citizen engagement strategies (final version can be found in Annex 1 – StH Document 4:) and assess its applicability in their context.

Sant Cugat – ES

(Fittingness in same country context)

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

Sant Cugat Municipality is assessing the methodology and feedback will be reported during WP4. Findings will be reflected in WP5 activities to maximise the impact of replication and exploitation activities.

Ljubljana – SI

(Fittingness in different country context)

The objective is to test the replication between EU countries, by applying the Citizen Hub mapping methodology in the 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 where socio-economic conditions and policy frameworks are likely to differ significantly.

The city of Ljubljana is assessing the methodology and feedback will be reported during WP4. Learnings from the pilot-to-follower replication will help inform WP5 activities to enhance EU-wide replication and exploitation activities

6 Conclusions

The Citizen Hub service menu covers the whole customer journey, in accordance with its preliminary definition in **D3.1**, and the demand side profiles, building typologies and supply side offer, as mapped in **D2.1, D2.2** and **D2.3**. As an overarching framework, the menu does reach the level of detail to address specific holistic home renovation solutions. Activities documented in this report relate to mapping of already available methods, tools and services for quality control of those renovation works, including definition of skills, and suitable monitoring methodologies, data processing and supporting methodologies to display and present this information in an attractive and understandable way to homeowners.

The mapping of **EU applicable protocols** has identified a number of products and projects dealing with the matter, with very **different degrees of applicability** in the pilots, depending on the geographical context of the original project. Another limitation is the time when project outputs were created, since regulations related to energy efficiency and sustainability in the residential building sector change 'by the day'.

To complement the compilation and analysis of relevant EU projects, the mapping also includes an investigation of **locally available and suitable methodologies**, to take advantage of methods and tools that already exist, are in use and may already be tailored to local contexts. Examining local and in-house approaches revealed that in many cases local tools and methods can be harnessed in the context of Save the Homes. Building on these, rather than attempting to 're-invent the wheel', will support a smoother and faster roll-out of each of the pilot initiatives. Lastly, it should be noted that the mapping exercise has revealed certain **gaps** for quality assurance during some of the customer journey steps. Save the Homes partners will strive to address these in the final design of the services menu.

By adopting both a top-down and bottom-up approach, the mapping for each pilot has unearthed valuable resources to inform the deployment of the solutions defined in **T2.5** as well as the final offer design of the citizen hub that is linked to **WP3** tasks.

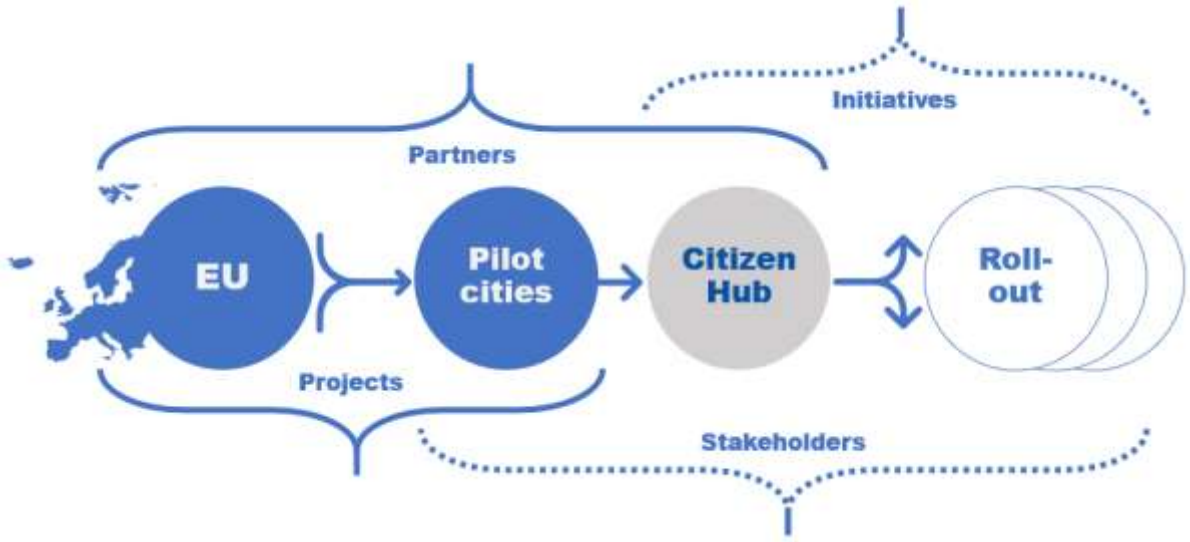
Annex 1 – StH Document 4: Supporting services map

This document will help your Municipality or Region define your local context supporting services in order to design a proper long-term quality control, skills uptake and performance monitoring of the offered solutions, to continue designing your OSS service and implement your own Citizen Hub. It is structured as a series of tables to be filled, in a step-by-step process that will lead to the definition of your own supporting services for each step of your customer journey. This document is completed with the corresponding spreadsheet file and both are available on the project web site.

StH - Itinerary methodology – checklist

Introduction

First of all, keep in mind that this methodology aims to draft a set **supporting services** for ensuring quality of works suited for all the itineraries designed according to previous tasks selected targets and solutions, at the moment of its implementation and for a potential roll-out.



This checklist deals therefore with the mapping of suitable protocols and methods for quality control of the renovation works (including skills definition) and for buildings performance monitoring, this is, the **already available methods, tools and services suitable for the renovation process**, beyond the holistic home renovation personal assistance offered by the Citizen Hub, such as:

- quality control of the renovation works
- definition of skills
- energy, comfort and IEQ performance monitoring (and data processing and display in an attractive and understandable way)

Furthermore, it is investigated what **other local activities and organizations are applicable for efficient Citizen Hub roll-out** (e.g., existing energy or housing offices).

A. The existing resources in place

Before starting this journey, have Deliverable 2.4 Section 3 at hand.

This section is twofold, for each category of supporting services: in one hand, the existing initiatives at EU level that can be used in the ecosystem will be listed (see Section 3 of the Deliverable 2.4), and on the other hand, the existing local initiatives or in-house know-how are put together.

A. 1. Training

> The objective of mapping the existing and applicable training resources is to **enhance** the quality of the renovation works demanded by the public and assisted by the OSS services in the elaboration stage, where external contracting is facilitated.

First of all, think of the **purpose** of your mapping training resources:

- □ Is it for ensuring the understandability of the proposed quality solutions?
- □ Is it for ensuring the quality of the designed solutions?
- □ Is it for ensuring the quality of the implemented solutions?

First option focuses on demand side and onboarding, evaluating stages; second and third focus on supply side for both design and construction stages, and affect the elaboration stage services provided by the Citizen Hub.

Purpose	Focus	Stages				
a)	Demand					
b)	Supply					
c)	Supply					
Other?						
	To Service Model					

Now, think of the training **sources** available at your context level in order to know better your demand and/or supply side sources of (in)formation when intending to find out or perform the best interventions in the residential building sector (such as YouTube videos, secondary school specialization, professionals' associations training, private academies…):

_____
_____
_____
_____
_____

Now, look at next table, which intends to summarize the existing supporting services related to training, listed above, and classify them keeping in mind why will you be able to **capitalize** them in your service menu definition, this is, because:

- they come from EU projects applicable in your context,
- they belong to you or your partners, or
- they are already working in your area and can find complementarities for both entities.

This is important because the agreements for using them will be different in the different options.

Remember: these are resources in place, regarding training and capacitation, for ensuring quality of the renovation works facilitated by the Citizen Hub through e.g., the professionals, installers and/or contractors registries.

EU (From D2.4 section 3 or others)	In-house (Partners resources)	local (Geographically available initiatives)
To Service Menu		To pop-up

A. 2. Certification

The objective of mapping the existing and applicable certification schemes in place is to **proof** the quality of the solutions proposed and renovation design, works and results facilitated through the OSS services through an independent body (impartial third person).

First of all, think of the **purpose** of your mapping certification resources:

- □ a) Is it for proofing the quality of the proposed solutions?
- □ b) Is it for proofing the quality of the designed solutions?
- □ c) Is it for proofing the quality of the implemented solutions?

First option focuses on demand side and onboarding, evaluating stages; second and third focus on supply side for both design and evaluation stages, and affect the elaboration stage services provided by the Citizen Hub.

Purpose	Focus	Stages				
a)	Demand					
b)	Supply					
c)	Supply					
Other?						
	To Service Model					

Now, think of the certification **sources** available at your context level in order to know better your demand and/or supply options to get or provide trusted services (such as mandatory schemes or regulations, voluntary labels or certifications, self-assessment tools, questionnaires or tests…):

_____
_____
_____
_____
_____

Now, look at next table, which intends to summarize the existing supporting services related to certification, listed above, and classify them keeping in mind why will you be able to **capitalize** them in your service menu definition, this is, because:

- they come from EU projects applicable in your context,
- they belong to you or your partners, or
- they are already working in your area and can find complementarities for both entities.

This is important because the agreements for using them will be different in the different options.

Remember: these are resources in place regarding certification of the quality of the renovation works facilitated by the Citizen Hub through e.g., the solution packs, including products and materials, the energy assessment or the results evaluation.

EU (From D2.4 section 3 or others)	In-house (Partners resources)	local (Geographically available initiatives)
To Service Menu		To pop-up

A. 3. Monitoring

The objective of mapping the existing and applicable monitoring protocols available in place is to **demonstrate** the quality of the renovation works facilitated through the OSS services by the 'seeing is believing' mechanism.

In this case, your **purpose** focuses on the demand side and tackles their (in)ability to read complex data, indicators or results from certifications documents or regulations and the (lack of) time to train. This mechanism is based on the simple before-after comparison of the real performance of the homes.

Purpose	Focus	Stages				
unique	Demand					
Other?						
	To Service Model					

Now, think of the monitoring **sources** available at your context level in order to know better your demand side options to get friendly, understandable, relatable information about their homes' performance (such as stand-alone devices, services related to energy supply contracts or specialized companies…):

_____
_____
_____
_____
_____

Now, look at next table, which intends to summarize the existing supporting services related to monitoring, listed above, and classify them keeping in mind why will you be able to **capitalize** them in your service menu definition, this is, because:

- they come from EU projects applicable in your context,
- they belong to you or your partners, or
- they are already working in your area and can find complementarities for both entities.

This is important because the agreements for using them will be different in the different options.

Remember: these are resources in place regarding monitoring of the improvements provided by the renovation works facilitated by the Citizen Hub through the comparison before-after renovation, this is, from the beginning to the end of the process through e.g., the (pre)evaluation and (post)validation services.

EU (From D2.4 section 3 or others)	In-house (Partners resources)	local (Geographically available initiatives)
To Service Menu		To pop-up

B. The Citizen Hub supporting services proposal

The main objective in this step is to list and allocate the analysed existing supporting tools and protocols in the corresponding stage of the OSS customer journey service offer.

B. 1. Services Model

The objective of defining a supporting services model is to get a clear view of the **targets** and purposes of the offered services that guarantee the quality of the works facilitated through the OSS services and on which **stages** of the process

Now, remember your **purpose** for collecting supporting services on each domain: training, certifying, monitoring; and define your quality check model, by just **colouring** the cells according to your needs:

Stage:			Training	Certification	Monitoring
0 - onboarding					
1 – evaluation/ design					
2 – elaboration/ formalization					
3 - construction					
4 - validation					
Focus:	Demand	Supply	To Service Menu		

B. 2. Services Menu

The objective of defining a supporting services proposal is to get a clear view of the available and applicable existing **resources** helping ensure the quality of the works facilitated through the OSS services according to your model – and identify the **gaps**!

Now, use the previously coloured table and fill the coloured cells with the **best fitting resources** that you can capitalize in any way and therefore offer through your citizen hub implementation. It is considered that you will use the most aligned/appropriate existing resources in the different stages of the Customer Journey according to the previous steps.

Stage:			Training	Certification	Monitoring
0 - onboarding					
1 – evaluation/ design					
2 – elaboration/ formalization					
3 - construction					
4 - validation					
Focus:	Demand	Supply	To Implementation strategy (& platform functionalities) - gaps to pop-up		

This table will help design the implementation strategy and local platform functionalities of your local Citizen Hub according to the customer journey and identify functionalities or services gaps for which alternatives need to be provided.

C. The Citizen Hub roll-out proposal

Finally, the objective of this step is to not only reviewing the existing supporting services available and applicable to offer and/or use within the OSS services menu, but also scouting the existing local sister initiatives that could host temporarily or eventually part or the whole OSS services in areas out of the Citizen Hub territorial or functional competences, in order to expand its reach.

C. 1. Decentralization strategy (pop-up)

The objective of decentralization based on existing sister initiatives is to **extend reach** of the OSS services and facilitate access, to maximize project impact

First of all, be aware that some initiatives or services have been listed in previous steps, since they provide specific services related to training, certifying or monitoring, but there might be others not so specific but **rooted, popular or trusted** sources of information regarding dwelling or energy issues (e.g. energy cooperatives, neighbours associations…)

Starting from previous steps local (geographically available) initiatives, try to fill the table below to find out which are your potential allies depending on:

- the services they can provide according to their usual activities and actual spaces (remember gaps from previous step!),
- the targeted reach they enable,
- the proposed schedule for public attention, and
- the mutual benefits enabling the collaboration.

Ask your partners and do not limit to initiatives listed above: there might be others, complementary to your designed Citizen Hub concept!

initiative	Stage/ What (Services to be provided)	Territory/ Where (Geographical scope)	Periodicity/ When (Temporal scope)	Benefits/ Why (Collaboration framework)
To Implementation strategy (and platform functionalities)				

This table will help design the implementation strategy and local platform functionalities of your local Citizen Hub according to the customer journey and the identified functionalities or services gaps.