CBDC powered Smart PerFORrmance contracTs for Efficiency, Sustainable, Inclusive, Energy use

D2.1 End-user and pilot requirements and use cases description

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Abbreviations

AC	Alternating current
AHU	Air handling unit
B2G	Business-to-Government
BIPV	Building Integrated PhotoVoltaics
BMS	Building Management System
CBDC	Central Bank Digital Currency
CIM	Common Impact Model
CO_2	Carbon dioxide
CSAT	Customer satisfaction
DHW	Domestic Hot Water
DREEM	Dynamic high-Resolution dEmand-sidE Management
EC	European Commission
EED	Energy Efficiency Directive
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contract / Energy Performance Certificate
ESCO	Energy Service Companies
ESIE	Efficient, Sustainable and Inclusive Energy
ETD	Energy Taxation Directive
ETS	Emissions Trading System
EU	European Union
FCU	Fan coil unit
FM	Facility Management
GHG	Greenhouse gas
HVAC	Heating, Ventilation and Air Conditioning
ICT	Information and Communication Technologies
KPI	Key Performance Indicator

LPG	Liquefied petroleum gas
NGO	Non-governmental Organization
PIR	Polyisocyanurate
PLN	Polish zloty (national currency of Poland)
PV	Photovoltaic
RES	Renewable Energy Sources
SEAP	Sustainable Energy Action Plan
VRV	Variable Refrigerant Volume

Executive Summary

This deliverable is part of FORTESIE WP2 “Design of Combined Service Packages” and specifically, it represents the work conducted for T2.1 “Analysis of end user requirements and definition of services”.

The deliverable offers a detailed review of the relevant policies for the building renovation sector at different levels: European level and National and Regional level for the countries in which the Demos will be implemented. In addition, a search was also done in each country for alternative financing schemes that are already being applied to this sector. Special focus was put on the Green-euro, based on the transformation of carbon credits into this new currency, which is one of the main aspects that will be tested during the project.

This deliverable also describes the methodology followed to extract the end user and pilot requirements. To do this, CIM methodology is used to understand their strategic needs and limitations of existing ESIE and renovation technologies, adding also other specific methodologies for capturing the current situation (before doing the renovation) and for capturing the stakeholders’ requirements.

The specified methodologies were applied to each of the Demos in an individual way, as the type of building, type of renovations to be done, type of users and type of needs and expectations differ a lot from one another. As a result, all the Demos provided information for:

- The description of the pilot site, detailing the characteristics of the building and why the renovation was needed.
- The analysis of the current situation, focusing on the existing measuring systems and data.
- The analysis of the end users and stakeholders’ requirements, which was described using “use cases”, “personas” and “user stories”.

After this analysis was complete, all the information gathered in each of the Demos was joined to extract the requirements for FORTESIE, resulting in a total of 13 functional and 16 non-functional requirements. The rest of the tasks of WP2 will continue working with these requirements to define the services with the needed technical aspects.

In a parallel way to the requirements definition, the “Dynamic high-Resolution dEmand-sidE Management” (DREEM) model was proposed to assess the saving potential and cost-effectiveness of the ESIEs in the pilots. After studying the specific use cases proposed by the Demos, it was concluded that the DREEM model will be useful to model and simulate different scenarios in 5 of the 7 Demos.

1 Introduction

This deliverable is part of FORTESIE WP2 "Design of Combined Service Packages" and specifically, it represents the work conducted for T2.1 "Analysis of end user requirements and definition of services". As this is the first deliverable for WP2, there are not previous works to take into consideration.
This deliverable describes FORTESIE in two main aspects:

- The current state of each Demo. This is the starting point of the project, so it is essential to know the reality of the different Demos at the present time. This will involve determining the characteristics of the buildings, the needs for renovation, the availability of energy consumption data, etc.
- The expected final state of each Demo. Through a detailed analysis of the different stakeholders involved in each Demo, their expectations from the FORTESIE project will be gathered.

As a result, this deliverable sets the starting point and defines the requirements to be fulfilled at the end of the project. The rest of the tasks of WP2 and the following WPs will describe the development of the FORTESIE tools needed to achieve the expected state from each Demo.

1.1 Project Introduction

The overall vision of FORTESIE is to design, demonstrate, validate and replicate innovative renovation packages in the building industry with Smart Performance-Based guarantees and financing, aiming at Efficient, Sustainable and Inclusive Energy (ESIE) use to accelerate the Renovation Wave in Europe. The renovation packages will combine state-of-the-art construction materials and technologies components (prefabricated facades, BIPV, heat pumps, etc.), innovative digital technologies for measurement and verification, and attractive financing (e.g. contractual frameworks for smart performance guarantees, financing mechanisms, engagement techniques, green-euros, etc.), to raise the overall EPC value proposition. The renovation packages will be tailored to specific target groups needs and optimised to improve the ESIE performance considering energy, CO_2 and comfort. Each package will be demonstrated and validated in real life use cases and customised for replication in all other partner countries for immediate market take-up.
Methodologies from Social Sciences and Humanities (SSH) will be adopted for:

a. the creation of collaborative business models that boost the Renovation Wave by considering all stakeholders' value and revenue streams,
b. novel incentivisation and behavioural change models that aim to stimulate long term engagement with focused interactions to adopt green behaviour
c. the incorporation of a digital currency, green-euro, (€G) for financing, rewarding and creating an inclusive / collective narrative in the fight against climate change
d. the collection of feedback for recommendations to policy and business stakeholders,
e. Mapping and understanding the complex interplay between the different stakeholders to deliver an engagement strategy across the value chain.

These demonstrations will potentially constitute the green-euro as a retail Central Bank Digital Currency (CBDC), hence revolutionising the financing of renovation approaches. An online marketplace, will be offering first level advice, directing consumers through the value chain of stakeholders and facilitating access to these "packaged" renovation services.

1.2 Deliverable Purpose

The main goals of this deliverable are the following:

- To detail the relevant policies in relation to building renovation at European, National and even regional (where applicable) level.
- To describe the most relevant characteristics of each Demo and their renovation needs.
- To describe the expected actions that should be accomplished during FORTESIE for each Demo.

- To collect the expectations from the Demos in a set of functional and non-functional requirements for FORTESIE.
- To determine how the DREEM model can be incorporated in the Demos to better accomplish the requirements.

It can be concluded that the objectives related to this deliverable have been achieved in full.

1.3 Structure of the Document

This deliverable is structured as follows:

- Section 1 provides the introduction of the deliverable.
- Section 2 describes the European, national and regional building renovation policies that are applicable to the Demos.
- Section 3 describes the methodology that was followed during the task.
- Section 4 shows a general overview of the pilots.
- Sections 5 to 14 describe in detail each of the Demos.
- Section 15 gathers the requirements for FORTESIE.
- Section 16 presents the DREEM model and its implication in the Demos.
- Section 17 holds the conclusions.
- Section 18 groups the main references throughout the text.

2 Relevant policies for the building renovation sector

2.1 EU Policies

With the European Green Deal, which was presented in December 2019, the EU is committed to transitioning to a climate-neutral economy by 2050.

The current EU's **2030 climate and energy framework** includes several EU-wide targets and policy objectives for the 2021 to 2030 period.

The key targets for 2030 are [1]:

- At least **40%** cuts in greenhouse gas (GHG) emissions (from 1990 levels).
- At least **32%** share for renewable energy.
- At least **32.5%** improvement in energy efficiency.

In this context, **energy efficiency** is considered **one** of the **key pillars**, not only to meet the climate-neutrality objective, but also to reduce dependence on fossil fuels, increase the security of supply as, well the use of renewable energy. Therefore, the European Commission (EC) has developed an **EU legal** and **financial energy-efficiency framework**, while special emphasis is also given to the **energy performance of the building sector**. The main legislative actions/initiatives considering energy efficiency and energy consumption in the building sector are the Energy Efficiency Directive (EED)[1], the Energy Performance of Buildings Directive (EPBD)[2], and the Renovation Wave[3][2].

Nevertheless, lately, the EC has published the "**Fit for 55"** package and the "**REPowerEU" plan**, which set a first series of legislative proposals to revise the entire EU 2030 climate and energy framework, mainly regarding the reduction of GHG emissions, and the increased energy efficiency and renewable energy share targets. More specifically, it is suggested to expand the Emission Trading System (ETS) in the building and transport sectors, increasing the emission reduction target from 40% to 55%, the energy efficiency target of 13% and the share of renewable energy from 32% to 45%, by 2030 [3,4].

In the following sub-sections, we present the current EU policy, regulatory, and market framework to identify potential policy gaps and developments that could facilitate the roll-out of innovative renovation packages in the EU.

2.1.1 Energy Efficiency Directive (EED)

- *Energy-saving obligation on Member States*

The **EED** was adopted in 2012, with its latest revision being in 2018, setting rules and obligations for achieving the EU's 2020 and 2030 energy-efficiency targets, respectively [5,6]. Since then, Member States have been required to implement energy-efficiency policy measures that save a minimum amount of end-use energy. The Directive's Article 7 establishes this requirement. Member States are required to meet a **cumulative energy-saving objective** over a specific period by implementing an Energy-Efficiency Obligation Scheme (EEOS), alternative measures, or both. The first period spanned from 2014 to 2020 and the second runs from 2021 to 2030.

[1] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en.
[2] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en#:~:text=As%20of%202021%2C%20all%20new,conditioning%20systems%20must%20be%20established.
[3] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en#:~:text=The%20Renovation%20Wave%20initiative%20builds,and%20climate%20plans%20(NECPs).

- *Energy-Efficiency Obligation Schemes (EEOS)*

Under EEOS regulators **require obligated parties**, such as energy companies, energy distributors, or suppliers/retailers, to implement **certain activities that deliver energy savings**, letting the utilities choose the most effective way to achieve them [7]. As of 2019, EEOS in 16 different European countries were enabled [8], making it one of the most commonly used policy tools to meet energy saving obligations.

- *Energy savings accounting required methodologies*

To count energy savings derived from policy measures, in the context of Article 7, Member States should follow methodologies in compliance with a set of requirements. These requirements are described in Annex V of the EED, as well as in a relevant guidance note issued on this by the EC [9]. Indicatively, Member States must address issues of **materiality**, i.e., to indicate that their action is the origin of savings. They should also address **additionality** requirements, meaning that they should isolate the impact of the policy from the energy savings that would have occurred either way. Moreover, the amount of energy savings needed by each obligated party must be expressed by the Member States in terms of **primary** or **final energy consumption**.

- *Obligation on central government buildings*

Article 5 of the EED foresees that, without prejudice to Article 7 of the Directive, each Member State shall conduct energy efficiency **renovations** to **at least 3%** of the total floor area of **buildings owned** and **occupied** by its **central government** on an **annual** basis. This scope is also expected to be extended to all public administrative levels [10].

- *Energy-audit obligation of buildings in the private sector*

The current Article 8 of the Directive mandates Member States to **oblige** large companies and incentivise Small- and Medium-sized enterprises (SMEs) to conduct **energy audits**. Large enterprises are obliged to conduct regular energy audits every four years, while SMEs are not. They are only encouraged to undertake energy audits and apply the resulting recommendations [5].

- *Current Articles 9 and 10 of the EED*

Articles 9 and 10 of the EED 2012/27/EU, which were amended in 2018, cover issues related to **metering** and **billing** of energy consumption.

According to the current version of Article 9, Member States shall ensure that competitively priced individual meters are provided to electricity and natural gas consumers, so as to **reflect their actual energy consumption** and provide accurate information on their time of use [6].

In addition, Article 9 defines requirements for Member States when introducing **smart-metering** systems. These concern the information provided to customers about their energy consumption, data privacy issues, and technical guidance for the final customers.

Article 10 relates to **natural gas and electricity billing information**. It foresees that Member States should ensure that billing information is provided in an accurate and reliable way, based on users' actual consumption. In addition, final consumers should have access to complementary information regarding bills and their historical consumption free of charge [5].

- *Promotion of the energy service markets*

The current Article 18 of the EED, obliges Member States to promote the **energy-service markets**, while guaranteeing that SMEs can participate in them. To do so, all the useful information about available energy service contracts, financing instruments, and relevant incentives that promote energy efficiency projects should be freely available and easily accessible. In this respect, Member States should provide customers with updated lists of the available certified energy-service providers, along with their qualifications [5].

- *Proposed recast of the EED*

To step up its climate targets and following the latest developments in the energy markets, the EU has proposed the **recast of the EED**. The EC's proposal on the EED recast raises the level of **ambition** of the EU energy-efficiency targets. It makes it binding by **requiring Member States** to collectively ensure an additional reduction of energy consumption **of 9%** by 2030 compared to the projections of the 2020 reference scenario. However, in the "REPowerEU" plan, that was presented in May 2020, the EU raises the ambition of further reducing the EU's reliance on fossil-fuel imports. Therefore, energy efficiency is severely prioritised by increasing the binding EU energy-efficiency target **from 9% to 13%**, compared to the 2020 Reference Scenario.

Moreover, it is also proposed to **almost double** the annual **energy-saving obligation** (Article 8), which is one of the EED's primary policy tools for achieving its main targets. Consequently, Member States should increase their annual savings from 0.8% of final energy consumption to 1.5% for the period 2024 to 2030. This tool will lead to significant energy savings in important end-use sectors such as industry, buildings, and transport.

The recast also proposes that the **public sector** should achieve a **1.7% annual energy consumption decrease**. This is part of enhancing the significant role of the public sector towards a wide range of activities (e.g., transport, buildings, street lighting, etc.). Member States are also obliged to expand the annual renovation rate of 3% of the total floor area of central governmental buildings to **all the public administration buildings**. Furthermore, when public entities obtain products, services, buildings, or construction projects, they must systematically consider energy-efficiency criteria [11,12].

2.1.2 The Energy Performance of Buildings Directive (EPBD)

Buildings are considered **essential** to meeting the energy and environmental targets of the EU. Better and more energy-efficient buildings will raise living standards for residents, reduce energy poverty, and will increase the general economic, social, and health benefits. In this respect, a legal framework is put in place at the EU level, which mainly includes the **EPBD** [13]. The Directive was initially introduced in 2010 and amended in 2018. The amendment of the Directive introduced new elements and sent a strong political signal to the EU's commitment to **modernise the buildings sector** considering the technological improvements and the increase of building renovations [14].

- *Energy Performance Certificates (EPCs)*

One core element of the EPBD is the establishment of the **EPCs** [15]. EPCs were initially introduced in 2002's Article 4 of the original EPBD, while additional guidelines about them were included in the Directive's recast in 2010.

In the Article 11 of the EPBD, it is stated that "*Member States shall take the necessary measures to establish a system of certification of the energy performance of buildings*" making **EPCs mandatory for any real estate transaction of new and existing buildings**. Furthermore, EPCs are also required for

the case of buildings occupied by public authorities, or for buildings frequently visited by the public [16]. While, in the 2002 version of the Directive, this requirement was applied to buildings with a total useful floor area over 1,000m², this threshold was decreased to 500m², in the 2010 recast, and further decreased to 250m² in 2015. Additionally, in such cases, EPCs are anticipated to be positioned in a prominent place, so as to be easily visible [17].

Under the EPBD, EPCs should include **information on the energy needs/consumption** of a building, including reference values that enable the comparison and evaluation of buildings' energy performance. Moreover, EPCs must provide **recommendations** for **cost-effective improvements** that could raise the energy performance rating of buildings. In most countries, ratings are expressed on a letter scale (i.e., A to G, where A is very efficient, and G is very inefficient). Finally, the EPBD requires EPCs to be issued by **independent assessors** using a standard calculation methodology, in such a way that energy performance can be compared to reference values (i.e., buildings of the same type) [18].

- *Obligations that facilitate the procurement of energy-efficiency buildings and renovations*

The first version of the EPBD required all new buildings to be nearly zero-energy by the end of 2020 (2018 for new public buildings) [19]. Member States also had to implement cost-optimal **Minimum Energy Performance Standards** for new buildings, existing buildings undergoing major renovations, and for the replacement or retrofit of building elements like heating and cooling systems, roofs, and walls [17].

- *Smart readiness of buildings*

There is also an optional European scheme for rating smart readiness of buildings, which also promotes the use of **smart technologies**. In this respect, the EC has developed the '**smart readiness indicator**' to assess a building's ability to adapt to advanced technologies in terms of its performance capacity and energy flexibility. More specifically, the Directive introduced requirements for the installation of building automation and control systems, and devices that regulate temperature at room level. It addresses health and well-being of building users, for instance through the consideration of air quality and ventilation.

- *Proposed recast of the EPBD*

In October 2020, the EC published the "**Renovation wave**" strategy, as part of the European Green Deal. The strategy contains an action plan with concrete regulatory, financing, and enabling measures to boost renovation of buildings. Its objective is to at least double the annual energy renovation rate of buildings by 2030 and to foster deep renovation. **One of its key initiatives is the revision of the EPBD** [20].

As a follow up, in December 2021, the EC proposed a **recast of the EPBD**, which is currently under consideration. The revision sets **higher ambitions** and **more pressing needs** in climate and social action, while **upgrading** the existing **regulatory** framework and **providing** EU countries with the **flexibility** needed to consider the **differences in the building stock** across Europe.

Moreover, it sets out the ways that Europe could **fully decarbonise** its **building stock**. The proposal increases the **renovation rates**, especially for the worst-performing buildings, aims to **modernise** the building stock, supports the **digitalisation** of energy systems, while focusing on better **air quality** and the development of **sustainable transportation**. Furthermore, the recast proposal enables more **focused financing** of investments in the building sector, adding to the existing EU tools that aim to **support vulnerable customers** and **alleviate energy poverty** [21].

2.1.3 Renovation Wave

To pursue the dual ambition of energy gains and economic growth, the EC published the "Renovation Wave" strategy (2020) to **boost energy-efficiency renovations** in the EU. The strategy aims at **doubling** the **annual energy-renovation rates** until 2030. By doing so, it also aims to reduce the building sector's emissions, enhance the quality of life for the inhabitants and users of buildings, as well as provide green job opportunities.

The "Renovation Wave" lies mainly around three pillars:

(i) the first pillar concerns **addressing energy poverty** and the **worst-performing buildings**,
(ii) the second pillar concerns **public buildings** and **social infrastructure**, while
(iii) the third pillar focuses on the **decarbonisation of heating** and **cooling** in buildings.

The strategy was published along with a supportive document that presents available EU **funding budget options**, such as direct investments, leveraging private investments, etc., which could foster the renovation wave in different ways.

Finally, the initiative builds on the **national long-term building renovation strategies**[4], other aspects of the **EPBD**, and building-related aspects of each EU country's **National Energy and Climate Plans** (NECPs).

2.1.4 Energy Taxation Directive (ETD) and Emissions Trading System (ETS)

The **ETD,** which was established by the EC in 2003, sets specific EU rules on the **taxation of energy products** and **electricity**. It applies to fuels for motors or heating, and electricity. The Directive establishes **minimum levels of taxation** and allows Member States to set their national rates as they see fit [22].

The taxation framework described in the ETD was evaluated in 2019. The outcomes of this evaluation highlighted the inconsistencies, overlaps, and gaps between the directive and the EU's energy and environment, climate change, and transport objectives, such as fostering the reduction of GHG emissions. Moreover, it is stated that **current taxation mechanisms do not reward sustainable energy consumption**. No significant distinctions are made depending on the environmental consequences of the different types of fuel in terms of GHG produced. This is because taxation is based more on the quantity of consumption rather than on the environmental consequences of the different energy sources [23]. In this respect, the EC has proposed the **revision of the Directive**, aiming to align the energy products' taxation with the recent EU climate and energy policies [24].

On the other hand, the current EU ETS covers about 45 % of the EU's GHG emissions. As part of the "Fit for 55" package, the EC has presented a legislative proposal for the **revision** of the **EU ETS** including the development of a **parallel ETS system** covering the emissions produced by the use of fossil fuels in the **building** and **transport sectors** [3]. Putting a price on carbon emissions related to energy use in buildings could create an **increased need for building renovations** and **innovative business models** to foster them.

2.1.5 Electricity Market Rules

The **new electricity market rules**, as outlined by the EC in 2019. require Member States to ensure that both the national Transmission System Operators (TSOs) and Distribution System Operators (DSOs) consider demand-side resources in their network planning [17,25]. They must promote **energy-**

[4] https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-long-term-strategies_en.

efficiency measures, where these services alleviate, in a cost-effective way, the need to upgrade, or replace electricity capacity, and secure the **safe** and **efficient** operation of distribution and transmission systems.

Moreover, the new electricity market regulations also stipulated that **Market Reform Implementation Plans** should be submitted by Member States with adequacy concerns in order to enable energy-efficiency and demand-side measures [17].

Finally, in the context of the energy market crisis seen in 2022, EU heads of government called on the EC to work swiftly on the **structural reform of the electricity market**, with the dual objective of **securing European energy sovereignty** and **achieving climate neutrality**.

2.1.6 European Strategy for Data

The **European Strategy for Data** intends to establish a single data market to ensure **Europe's global competitiveness** and **data sovereignty**. The common European data spaces aim to ensure that more data will be **available** for use in the economy and society while **keeping control** over the companies and individuals that generate them.

To further ensure the EU's leadership in the global data economy, the EC proposed a **Regulation on harmonised rules on fair access to and use of data** (**Data Act**) [26]. This strategy intends to (i). establish **legal measures** for data management, reuse, and access, (ii). increase data **availability/accessibility** by releasing valuable **publicly owned datasets** across the EU and enabling their **unrestricted reuse**, (iii). invest in creating large **data processing infrastructures**, tools for sharing data, architectures, and governance frameworks, as well as to federate reliable and energy-efficient infrastructures and related services, and (iv). enable **access to fair**, **secure**, and **competitive cloud services**, by supporting the set-up of a procurement marketplace for data processing services and providing clarification regarding the appropriate regulatory framework on the cloud.

The **European Strategy for Data** also states that data will **transform** the way society produces, consumes, and lives, resulting in **significant benefits** in almost **every aspect** of people's **lives**, such as more conscious energy use [27]. Furthermore, data-driven applications can also **benefit citizens** and **businesses** by **improving sustainability** and **energy efficiency**.

Moreover, as part of the European Strategy for Data, the EC has published a **Business-to-Government** (**B2G**) data sharing report. The report contains several **policies**, **funding**, and **legal recommendations** to make **B2G data sharing** in the public interest a scalable, accountable, and sustainable practice in the EU [28].

2.1.7 The Recovery and Resilience Facility (RRF)

The RRF is the centerpiece of the "NextGeneration EU", the EU's recovery plan. It strives to strengthen Europe's resilience and prepare it for the challenges and opportunities of the green and digital transitions, also assisting the way out of the Covid-19 crisis.

In this context, each Member State should develop "*national recovery and resilience plans*" that will be assessed by the EC, to obtain financing. The plans should be targeted around six main pillars: (i). **green transition**, (ii). **digital transformation**, (iii). **smart, sustainable, and inclusive growth**, (iv). **social and territorial cohesion**, (v). **health, and economic, social, and institutional resilience**, and (vi). **policies for the next generation, i.e., children and youth**.

Furthermore, each plan should effectively address **challenges identified in the annual cycle of economic and social policy coordination in the EU**. Plans should also focus on the green and digital

transitions (with spending targets of respectively 37% and 20%) and make society and the economy more robust to future crises [29].

Finally, measures in the national plans should not harm the environment. In this respect, the EC has published the "**Technical Guide on the application of the 'no significant harm' principle under the Recovery and Resilience Mechanism Regulation**" (DOUE 58 of 18 February 2021), which states that the measures included in the Recovery and Resilience Plan should not cause significant harm to environmental objectives. The guide outlines how the "no significant harm" principle should be applied [30].

2.2 National and Regional policies

FORTESIE will be tested in six different countries that, although all of them apply the EU Policies from the aforementioned section, they have different legislation terms that have to be taken into account. In the following sections it is described the main aspects of each country, in terms of policies regarding renovations of buildings. In addition, where applicable, not only nation-level legislation is described, but also regional-level legislation, as in some cases (as in Spain) regional laws have been created for these aspects.

In addition, a description for legislation in Slovakia is included, as this country will be involved in the replication phase at a later stage, although it does not host a Demo.

2.2.1 Greece

2.2.1.1 Energy/renovation national and regional strategies

Legislation & standards

Law 3661/2008 on the "Measures to reduce energy consumption in buildings and other provisions" was the main law for the transposition of the first EPBD. According to the law, construction of new buildings and major renovation of existing ones shall be based on the Greek Regulation for the Energy Efficiency of Buildings (KENAK). Law 4122/2013 on the Energy Performance of Buildings harmonizes Greek legislation with EPBD. The Energy Efficiency Act (Law 4342/2015) transposed the EED. The Building Energy Performance Regulation (KENAK, 2017) defines the relevant calculation methodology, minimum requirements for the energy performance of buildings, the Energy Performance Study of buildings, the procedure for energy inspections of buildings and heating and cooling systems, the EPC issuance, etc. New buildings and existing ones subject to major renovations are addressed. KENAK sets minimum requirements for the thermal resistance of building elements (i.e. maximum U-values), as well as for energy losses and gains for the whole building envelope, and minimum requirements for the efficiency of heating, cooling and hot water production systems. For existing buildings under major renovation, it is compulsory to upgrade the energy performance of the building up to class B at least. By the Ministerial Decision YPEN/DEPEA/85251/242 (2018), a building is defined as NZEB when its primary energy consumption is in the range of 33–50% of the primary energy consumed in a reference building, and assigned with class A (Bololia, 2020).

Strategies

The Fourth National Energy Efficiency Action Plan (2011-2020) identified the measures required to renovate residential buildings, public buildings, and commercial buildings (NEEAP-GR, 2017). A long-term strategy for mobilizing investment in the renovation of the national building stock (residential and commercial buildings, both public and private) (LTRS) was submitted in 2017 and updated in April 2018. The strategy provides a very good and detailed description of the building stock, a detailed analysis of the barriers to energy efficiency, as well as a description of a comprehensive package of measures supporting building renovation, as well as a section on cost-effective approaches.

The strategy was developed by taking into account two scenarios for residential buildings created by combining a constant renovation rate with various types of renovation (moderate and deep). According to those scenarios, a 40% renovation of residential buildings at a cost of EUR 1.7 billion would result in a total primary energy savings of 236 ktoe by 2030, while a 60% renovation at a cost of EUR 2.5 billion would result in a total primary energy savings of 354 ktoe. For the period 2020-2030, special emphasis is placed on measures aimed at improving building energy performance and KENAK implementation, the use of RES in residential and tertiary-sector buildings, the development of energy management systems in public- and tertiary-sector buildings, raising awareness, promoting the provision of energy services (ESCOs), supporting research and technological development in RES-related, energy-saving, and other technologies, and the development of environmentally-friendly products. The National Plan for Increasing the Number of Nearly Zero-Energy Buildings (NZEB-GR, 2017) was submitted in December 2017, but no national definition of NZEB was available at the time. The existing building policies and measures proposed by NZEB include pilot projects to improve the energy performance of public buildings (owned or rented for 20 years or more) through major renovations carried out by ESCOs with cofinancing from the public investment program.

According to the National Energy and Climate Plan, 600,000 dwellings, or 12-15% of the building stock, will be renovated by 2030. To accomplish this, the renovation rate will be raised to 1.6%. (doubling the 2015 one). In particular, by 2050, 45-49% of residential building envelopes and 19-20% of non-residential building envelopes must be renovated in accordance with the most recent LTRS (SWD(2021) 365 final/2). The plan calls for the establishment of tailored funding schemes to improve the EE of 'vulnerable consumer' homes. After December 31, 2023, all public-sector buildings must be classified as energy category B or higher using the EPC (NECP-GR, 2019).

2.2.1.2 Initiatives in place

The 'Energy upgrade of buildings' program is the main facility used to combat the challenges of energy poverty and the goals of reducing energy consumption at the level of residential buildings (currently Exoikonomo, heretofore Save). It is a continuation of the 'Energy Savings at Home' program, which is aimed at low-income households. The 'Energy Savings at Home' program began in 2011, and provides financial incentives to households, including low-income households, to replace window frames and install shading systems, install thermal insulation in the building envelope, including the flat roof/roof and 'pilotis'[5], and upgrade the heating and hot water system. The financial assistance consists of non-repayable grants and low-interest loans, as well as interest rate subsidies and coverage of the cost of energy inspections.

The measure has been extended until 2021 through the "Exoikonomo-Autonomo" program, following continuous improvements that enabled the implementation of the most cost-effective interventions to improve the energy efficiency of residential buildings. The new phase of the Exoikonomo (Save) Programme is being funded by the Recovery and Resilience Fund, with the goal of reducing primary energy costs by 30% per household and increasing energy efficiency by three grades. By 2025, the program aims to renovate and scale up 105,000 households. The RRF is expected to be Greece's primary funding instrument for energy efficiency and combating energy poverty in the coming years. By 2025, it is expected that the RRF's Green Transition pillar will provide investments of up to 3.1 billion EUR for energy upscaling of residential buildings in Greece, with a share of 1.6 billion EUR provided through subsidies.

The programmes ‘Save’ and ‘Save II’ provide grants aiming at the energy upgrading of energy-intensive public buildings, exploiting the potential for energy savings and improving energy efficiency in the public building sector, as an example to mobilise the entire economy. According to ‘Save II’ (Ministry of Environment and Energy, 2018a), the energy upgrade of public buildings shall exceed the minimum

[5] Pilotis, or piers, are supports such as columns, pillars, or stilts that lift a building above ground or water.

required energy efficiency levels or, if economically and technically feasible, be upgraded to energy classes B+, A, A+, or to NZEB. The energy upgrades include, inter alia, interventions, such as adding thermal insulation, replacing window frames and glazing, replacing heating systems/boilers/piping with a RES system, replacing old air conditioning systems, passive solar systems, etc. The programme is funded by the ERDF through operational programmes within the National Strategic Reference Framework (NSRF) 2014-2020. The total public expenditure of the operation amounts to EUR 244.93 million. The 'Save energy at home' (2007-2013) programme was initiated to improve the energy performance of residential buildings. It succeeded to allocate 95% of its EUR 548 millions of available funding, supporting over 50,000 beneficiaries. Average energy savings of 43% surpassed the initial 30% target. The maximum eligible funding per applicant was EUR 15,000. The grant varied between 15 and 70%, depending on the family income. Most interventions have been in old, energy-intensive buildings. Nearly half of the programme's budget was allocated to the replacement of doors and windows, with the rest split between heat insulation and heating system projects. The scheme counts as one of the most advanced schemes available, providing direct benefits to citizens, but also, in terms of employment (over 3,000 new jobs a year) and turnover to companies (especially SMEs) and professionals in the Greek construction sector. The 'Save energy at home II' (2014-2020) programme (Ministry of Environment and Energy, 2018b) involves implementation of interventions to improve the energy performance of residential buildings that are proven to have low energy performance and belong to owners who cannot fully fund the energy upgrade of their residence, or in buildings where interventions aim to achieve a higher level of energy performance than the minimum required. Aid is granted either directly to the beneficiary or in the form of a grant coupled with an interest-free or low-interest loan. Eligible interventions include replacement of window frames with new thermal insulated/break frames with double glazing, installing thermal insulation in the building envelope, including the flat roof/roof and pilotis, upgrading of the heating system (with RES). The programme is funded by the ERDF trough operational programmes of NSRF 2014-2020. The total public expenditure of the programme amounts to EUR 292.18 million. The eligible budget of interventions per application may not exceed EUR 250 per square meter with a maximum cost of interventions per house / apartment of EUR 25,000 including VAT. Approximately, 45,000 applications have been submitted (50% of applications are for buildings built before 1980). The programme 'Improving the energy efficiency of SMEs', starting in 2018, aims to support micro, small and medium-sized enterprises from manufacturing, handicraft, trade, services, tourism and shipping sectors to improve their EE (Ministry of Environment and Energy, 2018c). The action involves, inter alia, performing interventions in the building envelope such as adding thermal insulation, replacing window frames/glazing, adding shading systems, along with energy inspections and/or energy audits before and after assessing the energy outcome, certification of the energy management system according to ISO 50001 and project consultation. The action is funded by the ERDF through the Operational Programme 'Competitiveness, Entrepreneurship, Innovation' 2014-2020. The total budget of the action amounts to EUR 64.06 million and the total public expenditure amounts to EUR 32.3 million.

Furthermore, the Greek Ministry of Environment has announced ELECTRA, a new energy upgrade program for public buildings. The program's goal is to save at least 30% of annual primary energy, improve the energy class of a large number of public buildings by two categories on average, and use new innovative design standards and digital models in public buildings. The program's total budget is € 640 million, which, when combined with leverage, will mobilize funds up to € 1 billion. The remaining € 170 million will come from the Recovery and Sustainability Fund's resources and a loan from the European Investment Bank.

2.2.1.3 Other initiatives (green loans, banking financing, etc.)

- Green consumer loans for green upgrades are available from all banks under similar terms(eg Piraeus Bank provides Green consumer loans without collateral for green repairs and interventions to improve a property's energy performance and save water, Green consumer loans of up to €30,000 are also available from NBG for all "green" purchases of products and

services to improve the energy efficiency of residential homes or to purchase energy-saving products on favorable financing terms.)

- Greek institutions and research centers took part in several projects under the European programmes: a) H2020 Programme, such as PRODESA, QualitEE, ENERFUND, PUBLEnEf, ODYSSEE-MURE, CAIV_EPBD, EPC+, STEAM-UP, EnPC-INTRANS, multEE; b) INTERREG MED Programme such as SHERPA, IMPULSE, PEGASUS and PrioritEE; c) INTELLIGENT ENERGY EUROPE (IEE), such as RePublic_ZEB, thus creating favourable conditions for the development of national know-how based on best practices and recent achievements in the field of EE of buildings in Europe.

2.2.2 Spain

2.2.2.1 Energy/renovation national and regional strategies

The renovation strategies in Spain are being implemented through mandatory compliance legislation and incentives to facilitate the implementation of measures that promote their goals. They are subdivided into several levels based on the public administration or organization issuing them, thus being of scope.

1. National: In many cases, they are laws that are formulated to comply with a transposition of the European Commission directives or are strongly influenced and are consistent with union policies.
2. Regional: The Spanish state is divided into 17 regions known as Autonomous Communities, which have delegated certain competencies, such as those affecting the housing area, so they can establish their own laws in relation to them.
3. Local: Local entities (also known as Town Halls or Municipalities) also have their own strategies or complementary norms to the above, in addition to the management competencies in the application of the higher-ranking regulation, for example, granting urban licenses or monitoring the duty of conservation of buildings.

Therefore, there is a normative disparity that greatly complicates the scalability of activities in different territories of the Spanish state as it is very difficult for citizens and companies to know all the regulation that they must apply.

Although some of the norms that affect us are transversal to all sectors and do not derive directly from the strategies (such as the Waste or Consumer Laws), we will establish this order to refer to them:

1. National scope Strategies
2. National scope Legislation
3. Regional scope strategies (Asturias)
4. Regional scope Legislation (Asturias)
5. Regional scope strategies (Castilla y León)
6. Regional scope Legislation (Castilla y León)
7. Municipal Legislation

Now, each of these regulations are described:

2.2.2.1.1 National scope Strategies

In Spain there are National strategies designed to achieve the aforementioned European directives and are essentially translated to citizens and the economic sector through two main types of measures:

1. Legislation: consisting of laws, regulations, or regulations that oblige compliance with the objectives.
2. Incentives: promoting the implementation of non-mandatory measures. These incentives can be of various types:

a. Subsidies: amounts given to the final recipient without an obligation to repay the recipient, (also called non-repayable financial aids).
   i. Direct: when granted directly to the recipient.
   ii. In competitive concurrence: when granted to the highest scorer among all the requests received.
b. Loans: financing under better conditions than market conditions.
c. Tax incentives: deductions in rates or taxes

Transversally, from the administrations, calls for expressions of interest and other public information and consultation processes are held, through which the public and businesses can contribute their suggestions or needs so that they are considered in the lines or measures to be implemented.

The most important national scope strategies would be:

- **Spain's Recovery, Transformation, and Resilience Plan**

This Plan was approved by the Council of Ministers Agreement on April 27, 2021, complying with the mandate contained in Regulation (EU) 2021/241 of the European Parliament and Council, of February 12, 2021, which imposed on the Member States of the Union that were interested in joining the so-called Recovery and Resilience Mechanism the obligation to submit to the European Commission, before April 30, 2021, their respective national recovery and resilience plan. The Plan sets the roadmap for modernizing the Spanish economy, recovering economic growth, and creating jobs, for solid, inclusive, and resilient economic reconstruction after the COVID crisis, and for responding to the challenges of the next decade.

The Plan has a budget of almost 70,000 (approximately half will be distributed through financing mechanisms and the other half as non-repayable aids) and focuses on the first phase of execution, detailing the investments and reforms corresponding to the 2021-2023 period.

The Plan addresses specific measures for housing renovation and urban regeneration, sustainable mobility, or energy transition, among others.

- **ERESEE 2020 Long-term Strategy for Energy Renovation in the Building Sector in Spain.**

The Directive 2010/31/UE previously mentioned was modified by (UE) 2018/844, in its Article 2 bis, establishes that each member state must develop a long-term strategy for the renovation and renovation of each country's building stock, adapting them to new high-efficiency energy and fully decarbonized construction standards by 2050. Spain meets this mandate through successive strategies (ERESEE 2014, ERESEE 2017, and the currently in force ERESEE 2020). As a novelty compared to the previous ones, this strategy includes: policies and actions aimed at all public buildings; the establishment of a roadmap with measurable progress indicators established nationally; addressing the problem of energy poverty; and finally, conducting a public participation process that allows to gather the vision of the different sectors that play a decisive role for the energy renovation of buildings, at the intensity and desired ratios, to be a reality.

- **Energy and Climate Strategic Framework.**

It establishes the foundations for the modernization of the Spanish economy, job creation, Spain's leadership in renewable energies and technologies for the next decade, the development of the rural environment, improvement of people's health and the environment, and social justice. In short, a transformation of the Spanish economy in which the country will gain: energy security, innovation, health, job generation, and energy independence, among other benefits.

The framework is, in turn, composed of 3 documents:

a) Climate Change and Energy Transition Draft Law
b) 2021-2030 Integrated National Energy and Climate Plan (PNIEC)
c) Just Transition Strategy

2.2.2.1.2 National scope Legislation

- **Law 38/1999, on Building Regulations.** The purpose of this Law is to regulate the construction process in its essential aspects, presenting the obligations and responsibilities of the agents involved in said process, as well as the necessary guarantees for its proper development, in order to ensure quality through compliance with the basic requirements of buildings and adequate protection of the interests of users.
- **Law 2/2004, of October 29, on urgent measures in the field of land and housing.** The law sets obligations and deadlines for the renovation of buildings in those determined by the Urban Plan of each municipality and maximum sale prices in the case of publicly assisted housing that may affect the viability of energy renovation actions.
- **Royal Legislative Decree 7/2015** presented the revised text of the Land and Urban Renovation Law. In force since October 31, 2015 of the consolidated text of the Land and Urban Renovation Law. The final objective of the consolidated text is focused on avoiding the dispersion and division of the provisions that include the state legislation on land and renovation, regeneration and urban renewal so that the Royal Legislative Decree 2/2008, of 20 June, by which the consolidated text of the Land Law and Law 8/2013, of June 26, on urban renovation, regeneration and renewal will be produced, whose normative references will be understood to be made to the corresponding precepts of the consolidated text that will be proof.
- **In Spain, the Technical Building Code (CTE), which includes the Regulation of Thermal Installations in Buildings (RITE)**, incorporates requirements regarding existing buildings and their energy renovation, as well as other aspects related to protection against noise. The CTE, modified in 2019, requires existing buildings to which it applies conditions that substantially improve the efficiency of the building and contribute to the decarbonisation of the building stock, although levels of almost zero energy consumption are not reached in buildings. However, it is indicated that, in the future, when technical and economic conditions allow it, all existing buildings may be incorporated into the almost zero-energy building stock.
- **Royal Decree-law 36/2020, of December 30, approving urgent measures for the modernization of the Public Administration and for the execution of the Recovery, Transformation and Resilience Plan.** Among other things, it establishes guidelines for coordination between different public administrations as well as management instruments and a series of modernization measures that will substantially modify relationships with citizens and businesses.
- **Law 9/2022, of June 14, on Architecture Quality.** Among other aspects, the law aims to increase the number of almost zero energy consumption buildings, not only in new construction, but also through comprehensive approaches in the renovation of the existing building stock.
- **Law 10/2022, of June 14,** on urgent measures to promote Building Renovation activity in the context of the Recovery, Transformation and Resilience Plan.
  The Law includes, with modifications, the measures included in RDLey 19/2021, of October 5. Promotes the renovation and energy improvement of buildings with personal income tax deductions and guarantees. Modifies articles 9, 17 and 21 of the Horizontal Property Law to facilitate agreements, extend the scope of the reserve fund and fight against delinquency; Article 9 TR Land Law, to improve financing and add to the Building Law the principle of not harming the environment. Its purpose is to face the challenges in terms of renovation and improvement of the housing stock, which is characterized by a high age, with more than half of the residential buildings dating back to 1980, a circumstance to which is added that, in relation to their energy rating, more than 81% of the buildings are located in the letters E, F or G, in terms of emissions, and more than 84% in the case of energy consumption.

- **Law 49/1960, of July 21, on horizontal property.**
  The Spanish building stock is constituted mostly by collective housing buildings owned by its inhabitants. Owners share common spaces, so to manage the common property, they are configured as legal entities called Property Owners Associations. This law regulates the relationships between owners and, among other things, the necessary majorities in agreements for contracting works for the implementation of renovation measures in the buildings.
- **Royal Decree Legislative 1/2007, of November 16, approving the consolidated text of the General Law for the Defence of Consumers and Users and other complementary laws.**
  Property Owners Associations, in those buildings that mainly have a residential purpose and do not have a commercial or business activity, are considered as consumer subjects in their relationships with suppliers or contractors of works. This obliges companies to comply with a series of additional conditions and incorporate clauses in defence of consumer rights in their contracts.
- **Royal Decree 390/2021, of June 1, approving the basic procedure for the certification of energy efficiency of buildings.**
  This Royal Decree develops, among other things, the procedure for the preparation and registration in databases of energy efficiency certificates, which will allow the collection of data on measured or calculated energy consumption of buildings, as well as the linking of financial incentives for improving energy efficiency to the savings of energy foreseen or achieved.
- **Law 7/2022, of April 8, on waste and contaminated soils for a circular economy.**
  It imposes a series of obligations for the management and reuse of waste from, among other things, renovation or renovation works of the building stock.
- **Royal Decree 56/2016 of 12 February 2016 transposing Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency as regards energy audits, accreditation of energy service providers and auditors and promotion of energy supply efficiency**
  It establishes a regulatory framework to develop actions aimed at improving an organisation's energy efficiency, promoting energy savings and reducing greenhouse gas emissions, in order to contribute to the EU's objectives.

2.2.2.1.3 Regional scope Strategies (Asturias)

- **EREEPA: Energy Renovation Strategy for Buildings in Asturias.**
  This strategy aligns with the United Nations' Sustainable Development Goals, the Recovery, Transformation, and Resilience Plan, and the Building Energy Renovation Program (PREE), approved by the Council of Ministers on August 4, 2020, and managed by the Autonomous Communities.
  In addition, EREEPA considers the 4th report on the state of the Energy Union, where the European Commission enshrines the principle of "first, energy efficiency" to advance in the energy transition, achieve the goals of the Paris Agreement and contribute to modernizing the European economy and industry.

2.2.2.1.4 Regional scope Legislation (Asturias)

- **Decree 63/2022 of October 21 (BOPA 3/11/2022) Approving the Land Use and Urban Planning Regulation of the Principality of Asturias.**
  Regulates renovation of buildings through a joint, compulsory, or negotiated process between the property, builder or rehabilitator and the public administration. It also regulates the procedures for obtaining building or renewable energy installation licenses and other permits.

2.2.2.1.5 Regional scope Strategies (Castilla y León)

- **EEE-CyL: Energy Efficiency Strategy of Castilla y León**, where the Junta de Castilla y León assumed the commitment to comply with the 2030 Agenda and the Sustainable Development Goals, by means of a decision adopted on 28 September 2017.

It serves to establish, both for the Administration of Castilla y León and the different agents involved, industries, local administrations, citizens, the path to follow to achieve the objectives related to the reduction of energy consumption, in line with achieving compliance with the objectives set out in the Europe 2020 Strategy.

2.2.2.1.6 Regional scope Legislation (Castilla y León)

- **AGREEMENT 177/2022, of 6 October (BOCyL 10/10/2022), of the Junta de Castilla y León, by which energy saving and efficiency measures are adopted in the General and Institutional Administration of the Community of Castilla y León.**
  This establishes rationalisation measures for the management and use of public buildings and resources, in addition to those already considered in Royal Decree-Law 14/2022 of 1 August.

2.2.2.1.7 Municipal scope Legislation

In addition to the national and regional legislation, each building renovation will have to comply with specific municipal ordinances of the corresponding city.

2.2.2.2 Initiatives in place

There are different initiatives supporting grants that vary in the scope they can be applied into:

2.2.2.2.1 National scope Initiatives

- **Royal Decree 737/2020, of August 4th, subsidies.**
  This is the central government program for the promotion of energy renovation in existing buildings and regulates the direct grant of subsidies from this program to the autonomous communities and cities of Ceuta and Melilla. The coordination of the program is done from the Ministry for Ecological Transition and Demographic Challenge through the IDAE (Institute for Diversification and Energy Saving), and the management of subsidies is carried out by the autonomous communities and cities. Although no more applications are currently accepted, it regulates those that have not yet been completed.
- **Royal Decree 691/2021, of August 3rd, for municipalities with less than 5000 inhabitants.**
  Regulates the grants to be granted to energy renovation actions in existing buildings, as part of the Program for energy renovation of existing buildings in municipalities with a demographic challenge (Program PREE 5000), included in the Program for regeneration and demographic challenge of the Renovation and Urban Regeneration Plan of the Recovery, Transformation and Resilience Plan, as well as its direct grant to the autonomous communities. BOE August 4, 2021.
- **Royal Decree 853/2021, of October 5th, which regulates the programs of aid in the field of residential renovation and social housing of the Recovery, Transformation and Resilience Plan.**
  The objectives of this royal decree are the renovation of buildings as a key piece in the reactivation of the construction and real estate sector and the fulfilment of European and national commitments in the fields of energy, climate, and digitalization; the fight against energy poverty; the renovation and improvement of homes and residential environments or the decarbonization of heating and cooling, among others.

2.2.2.2.2 Regional scope Initiatives (Asturias)

- **Resolution of September 24, 2020, by the Ministry of Social Rights and Well-being**
  Approves the grants for the energy renovation program for existing buildings. (To date, the funds are exhausted, and it is unknown if there will be a new opening of grants).

- **Resolution of October 18, 2021, by the Ministry of Social Rights and Well-being**
  Grants for the energy renovation program in existing buildings in demographic challenge municipalities, i.e., those with less than 5000 inhabitants (PREE 5000 Program). (To date, the funds are exhausted, and no new opening of grants is expected).
- **Resolution of November 21, 2022, by the Ministry of Social Rights and Well-being**
  Establishes the procedure for selecting proposals for funding renovation activities at the neighbourhood level under the Recovery, Transformation, and Resilience Plan. The proposals must be submitted by local entities (municipalities).

2.2.2.2.3 Regional scope Initiatives (Castilla y León)

- **Subsidies for the programme of aid for renovation actions at building level (year 2022)**
  The purpose of which is to award grants on a non-competitive basis, both in urban and rural areas of the Community of Castile-Leon. This call is made in the framework of the 'Programme of aid for renovation actions at building level'.

2.2.2.3 Other initiatives (green loans, banking financing, etc.)

No initiatives for this type have been identified for Spain.

2.2.3 France

2.2.3.1 Energy/renovation national and regional strategies

2.2.3.1.1 National scope

France has a variety of tools in place to help the housing sector make wise energy performance decisions.

- Since 2022, the performance indicator has evolved to include the double standard of energy and CO_2. The least performant of the two indicators will determine the performance building letter.
- All of France's incentives and policies are measured on this scale: subsidies, zero interest loans, tax breaks, white certificates,
- All of France's building stock and renovation indicators are measured on this scale.

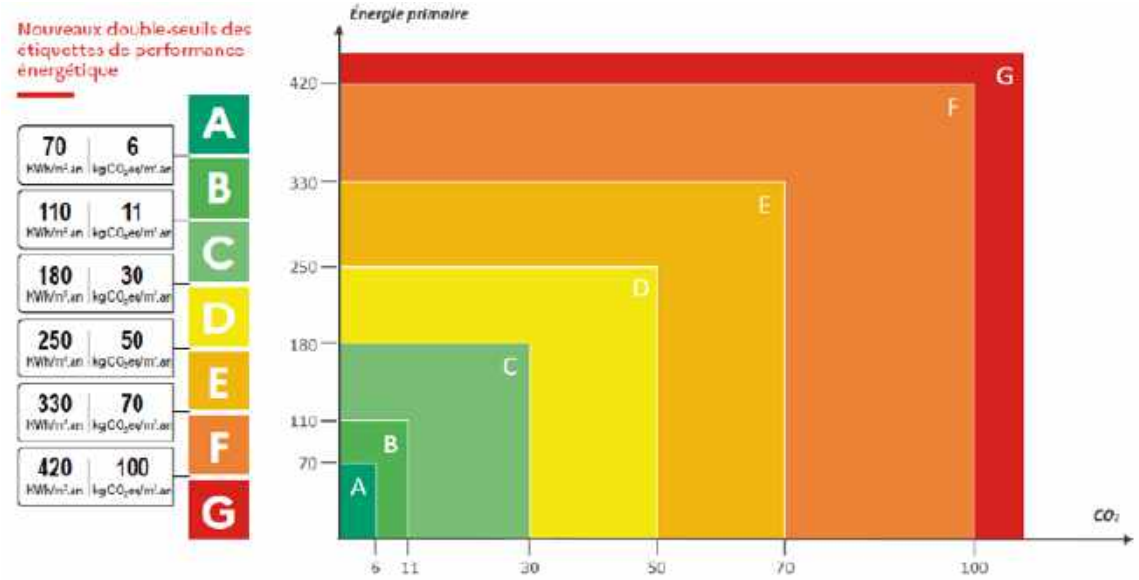


Figure 1 Scale of measurement in France

Most recently, the law “Climat et Résilience”, LOI n° 2021-1104 August 22 2021, set these thresholds.

- Starting in 2022, an energy audit will become mandatory upon the sale of a property, in addition to the already mandatory energy performance diagnosis (DPE).
- Starting in 2023, the owner of a "thermal draft" (housing classified as F or G on the energy performance diagnosis) will no longer be able to increase the rent between two rentals. To do so, they will be required to carry out energy renovation work.
- Starting in 2025, the progressive ban on renting the most energy-intensive housing will begin. Before these dates, the owners must have carried out energy renovation work in order to exit the energy-intensive classes of the DPE in order to rent out their property.
  - In 2025, housing classified as G on the DPE will be banned from being rented out,
  - In 2028, the ban on renting will be expanded to include housing classified as F on the DPE,
  - In 2034, the ban on renting will be expanded to include housing classified as E on the DPE.

This is a real shock for the housing sector, and details on how this law will be enforced and controlled are still in the making.

2.2.3.1.2 Regional and Local scope

The Grand Est Region Climate, Air and Energy Regional Scheme (Schéma Régional Climat, Air, Energie or SRCAE) is a regional plan that outlines the strategies and actions to be taken to address the challenges of climate change, air quality and energy efficiency in the Grand Est region, with goals set for 2050. **The Region has one subsidy for housing renovation audits: from 1000€ to 5000€ depending on income and work performance.** Oktave is a direct tool related to address the housing renovation goals.

At a local level, some departments or some cities also offer various schemes to financially support households. It is quite difficult to keep track of the different subsidies, and each households needs support in understanding what it is eligible for. This subsidy landscape is constantly evolving (also making it confusing for consumers to understand what they could obtain as support or subsidies from various actors). This chapter will be obsolete before FORTESIE ends.

2.2.3.2 Initiatives in place

Here is a list of the National initiatives currently available.

- MaPrimeRénov' (MPR)

MPR is aimed at supporting homeowners and landlords in carrying out energy renovation work in their homes depending on :

  - Income levels
  - Renovation work planned, done by qualified SMEs

It can subsidies up to 20.000€

- White certificate (CEE)

The white certificate CEE stands for “Certificat d’Economie d’Energie. It is thus an **energy** based subsidy. Launched 15 years ago, the scheme was not taking CO_2 into account. Today, in its 5th period (from January 1st 2022 to December 31st 2025) for some equipment, the CO_2 emissions are taken into account.

CEE have been designed to be a “market based instrument”. A new law is forcing energy supplier to incentivize their customers to buy less energy (thus to induce a schizophrenic behaviour of energy supplier). The potential reduction in energy consumption is based on the kWh saved by the new installation multiplied by the lifespan of the material or technology, and actualized over his lifetime. The

energy saving is thus measured in kWhcumac standing for kWh cumulated and actualized (a sort of kWh Net Present Value). The law is imposing each energy supplier to report a quantity of kWhcumac during the period of the law. Energy supplier can buy kWhcumac from economic agent performing energy saving refits. A specific refit taxonomy classify any refit operation with a corresponding kWhcumac quantity.

In theory the economic agent will sell his kWhcumac to the best offer (market based approach). In practise, installers offer "all in one services", with the CEE value directly included in their quote. They capture all the value of CEE which does not benefit to the final user.

In addition, there is a great inequality for all energy supplier with this instrument. Fuel providers in France can collect kWhcumac and pass on this price collection to their final customers by increasing their price list. Electricity and gas suppliers can not do so, as electrical and gas prices are regulated in France by an organism called CRE. They have thus to absorb the price of collection of kWhcumac, which is thus a new cost to them. In 2013, the French court of Audit reported that for the biggest energy supplier, the national French electricity producer (EDF) the total cost of CEE was € 1 bn…or 25% of the €4 bn capital increase made by EDF in 2014 and subscribe by the French State. The CEE cost is thus huge for public finances.

CEE is thus a new tax imposed on a little set of tax payers (less then 50 energy suppliers). This tax is not even directly collected by the French State (reestablishement of the principle of the "ferme générale" abolished in 1794 by guillotine of the last general farmers…

CEE can provide subsidies from 2.000€ to 5.000 euros depending on the type of work and income level of the household.

Given the complexity and constant changes of all available subsidies, plus the fact the French government promotes a new motto "**Proposing simpler, fairer, and more effective subsidies".** MPR and CEE are thus today the main two instruments. Additional instruments are

- Energy check Massiréno project call for social housing
- Multi-year works plan in condominiums
- Eco-social housing loan (Éco-PLS)
- Zero-interest eco-loan (Éco-PTZ)

  The ECO-PTZ is a loan whose interest rate is paid by the State directly to the bank. A homeowner can get up to 50.000€ at 0% interest, over 20 years reimbursement.

- "Habiter mieux" from the National Housing Agency (Anah) to address energy poverty

Improving information and households' journey

- France Rénov', the unique public service for energy renovation, in office advice.
- Energy performance diagnosis (DPE).
- Getting away from oil heating.
- Eliminating energy leaks.

Accelerating energy renovation of tertiary buildings

- Action Program for Territorial Authorities for Energy Efficiency (ACTEE)
- Investment plan for facilities for dependent elderly people (EHPAD) and inclusive housing
- "Energy renovation of State and territorial authority buildings"
- "Energy renovation of sports facilities" of the National Sports Agency
- Accompanying local elected officials in energy renovation of their buildings
- Energy renovation tax credit for SMEs
- Ecological transition and energy renovation of SMEs Eco Tertiary Energy (EET)

Organizing the professional's competence increase

- SMEs energy renovation qualification (RGE)
- Fighting fraud

Piloting public policy for energy renovation

- National Observatory for Energy Renovation (ONRE)

2.2.3.3 Other initiatives (green loans, banking financing, etc.)

The 3 main national tools are:

- MaPrimeRénov'
- White certificate (CEE)
- Zero-interest eco-loan (Éco-PTZ)

In addition, the Region has one subsidy for housing renovation audits: from 1000€ to 5000€ depending on income and work performance.

- MaPrimeRénov'

MPR is aimed at supporting homeowners and landlords in carrying out energy renovation work in their homes depending on:

  - Income levels
  - Renovation work planned, done by qualified SMEs

It can subsidies up to 20.000€

- White certificate (CEE)

Based on the European carbon market, the white certificates are added to MPR. They give a fixed value of subsidy to each work based on the CO_2 saved multiplied by the lifespan of the material or technology.

- Zero-interest eco-loan (Éco-PTZ)

The ECO-PTZ is a loan whose interest rate is paid by the State directly to the bank. A homeowner can get up to 50.000€ at 0% interest, over 20 years reimbursement.

In addition to these main tools, specific niche energy poverty subsidies exist.

2.2.3.4 Other initiatives: Green Euro

We would like to mention here a private initiative from Compte CO2 (CCO2), a member of FORTESIE consortium, that is focused on Climate rather than energy. CCO2 is promoting a transformation of carbon credits into a new currency, so-called Green-euros.

Green euros are euros backed by a reduction in CO_2 emissions. They are only issued if a reduction in CO_2 emissions has taken place.

They are issued according to two rules:

  a. a main emission in exchange for loans similar to traditional euros, and
  b. a secondary emission in exchange for a reduction in greenhouse gas emissions.

When an economic agent reduces its CO_2 emissions (typically after a refit of its house by removing a fuel boiler), it creates a certain amount of green euros determined by the carbon tax of its member state (44.60 € in France for one ton of CO_2 abatted). The measurement of the reduction in CO_2 emissions is carried out every year and ensures the efficiency of the system. The interests on the loans taken out are repaid with the generated green euros.

Governments and central banks will be encouraged to develop green euros if the community using these currencies is large.

Energy housing renovation seems the perfect sector to deploy Green euros based on CBDC. It could be an extra financing source to help and incentivise homeowners to renovate their homes.

2.2.3.5 Energy vs Climate in French policies

Since 1974 many laws were passed and various types of subsidies distributed with a focus on Energy and in particular to manage energy supply and energy stocks that are not located in Europe.

The French example is a good way to illustrate how current energy policies should be stopped and be replaced by Climate policies. Indeed, this energy focus, rather then climate focus, is still a big problem as it will not help resolve the very first priority of the European Comission, i.e. **the green deal**.

The figure shown in section 2.2.3.1.1 is a replacement of the following figure:

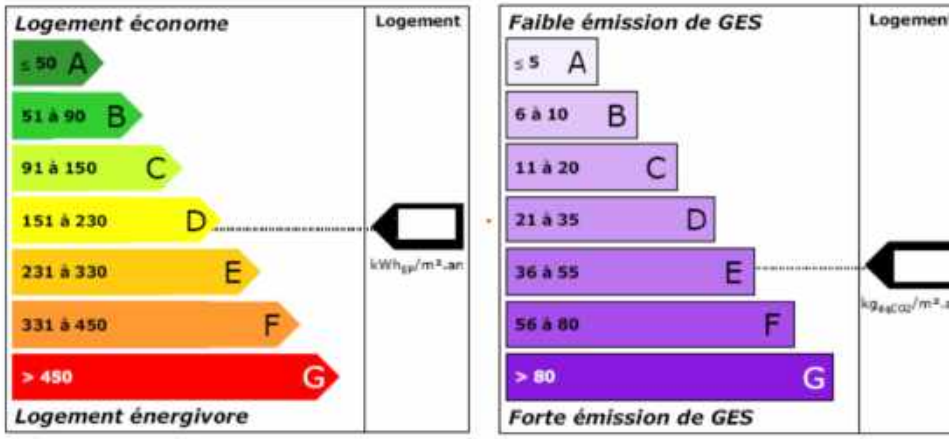


Figure 2 Energy and Climate labels prior to 2022 in France.

As shown on this figure, it is very possible to have different scoring for energy and climate. For example, a large house, poorly insulated consuming a lot of kWh per square meters, but heated with electricity (heat pump), so not emitting CO_2. Thus a grade G on energy, and A on CO_2. The new label does not allow this any more, and it is a big step backwards. This distinction is essential to teach the whole society that **energies are not equal** from a climate perspective. They do not have all the same carbon content.

Getting rid of this double scoring, by introducing in 2022, Figure **1** to measure all of France's building stock and renovation indicators on this scale is adding complexity (a new rule) a fake climate information.

- The "two indicators" of Figure **1** are in fact only one indicator (quasi linear graphic). This is because the Y axis displays the "**primary energy**" as opposed to plug the **final energy** consumed. In France, the production of electricity is nuclear at 72%. The primary energy used is thus uranium. Fission of uranium generates heat that in turns generates electricity. The heat/electricity conversion is not optimal and to get 1kWh of electricity you need 2.58 (now shrunk to 2.3) kWh of heat. This ratio could be useful for engineers making energy **analysis** to compare of various type of energies. In particular to manage the **supply of energy**, and the **import of those energies** in France.
- However, from a climate point of view, what matters is the final energy consumption. Electricity is considered in France to be green (recent EU green taxonomy), and thus the **carbon content of 1kWh of electricity is equal to ZERO g of CO_2**.
- From a climate perspective a large house, poorly insulated, heated with electricity will not emit CO_2, while a small house with the latest insulation standards but heated with gas will emit CO_2. From a

climate perspective, it is urgent to switch today fuel boilers to heat pump, and then later to insulate the house, if the house owner can not financially afford to do both works at once.

- Policy makers should have kept only the climate violet label… We are thus facing in France a huge issue to fight climate change: the problem is still not understood by policy markers, and consequently does not print in the population.

This shortcomings of the French State in the fight against climate change, characterized by the judgment of the Administrative Court of Paris pronounced on February 3, 2021, highlight the lack of effectiveness of current public policies. On October 14, 2021, the Administrative Court condemned the State for climate inaction and enjoined it to take "all necessary measures to repair the consequences of its failure to combat climate change" before December 31, 2022.

In the Netherlands, on 20 December 2019, the Dutch Supreme Court, the highest court in the Netherlands, upheld the previous decisions (2015) in the Urgenda Climate Case, finding that the Dutch government has obligations to urgently and significantly reduce emissions in line with its human rights obligations.

FORTESIE will thus try to bring back this climate perspective ahead of an energy perspective.

2.2.4 Portugal

2.2.4.1 Energy/renovation national and regional strategies

Following the publication of the article 2ºA of the European Directive 2010/31/UE, in which obligates the state members to set a strategy to support, until 2050, the renovation of the residential and non-residential buildings. That includes a roadmap with measures and goals to achieve in 2030, 2040 e 2050. This context sets the framework of the *Estratégia de Longo Prazo de Renovação dos Edifícios* (ELPRE), Long term strategy for building renovation which consists in measures in seven fields of actuation like building renovation, development of innovation in the targeted buildings and formation and qualification of the professionals working in building performance and energy efficiency. It sets the following goals:

- Increasing the renovated building area to 747 953 071 m^2;
- Primary energy savings to 34% in 2050;
- Reduction of the housing discomfort hours to 56% by 2050.

2.2.4.2 Initiatives in place

No initiatives for this type have been identified for Portugal.

2.2.4.3 Other initiatives (green loans, banking financing, etc.)

In terms of financial tools/ and initiatives to promote building renovation, Portugal developed in 2017 a financial incentive for building renovation in residential and services building, in which represents 28% of the primary energy consumption. It is called the financial instrument for urban renovation and revitalization, in which applies the incentives from national and regional operation and sustainability programmes to support communities with poor residential conditions and support the energy efficiency. It consists on enabling financial loans, on more enabling conditions, in which the applicant presents its investment project as whole, uniting the energy efficiency and building renovation solutions.

It got support from the most important financial institutions, generation a financing capacity of 1.4 billion euros, generating an investment of 2 billion euros.

In terms of national financing, the Portuguese government developed financial funds for citizens and companies to implement energy efficiency measures in its buildings. The first, an investment program

included in the Recovery and Resilience programs, called *Edifícios Mais Sustentáveis* (More sustainable buildings). It includes energy efficiency improvement measures for residential and services buildings, like replacing more efficient windows, application of thermal insulation, installation of photovoltaic panels, and sustainable heating equipment like heat pumps. Each typology has an investment cap and co-financing percentage. This financing program had a large demand, and it reached 96 million euros for funding this energy efficiency measures for more than 106 thousand applications.

The second, it's a fund for people that have the social tariff in Portugal (which is a financial instrument for citizens/families that are economically vulnerable), called *Vale Eficiência*, Efficiency Voucher. It's main purpose it's to give a 1600€ voucher to these citizens, so they can invest in similar interventions like the ones identified in *Edifícios Mais Sustentáveis*. This program aims to deliver 100 000 vouchers.

2.2.5 Poland

2.2.5.1 Energy/renovation national and regional strategies

Energy Policy of Poland until 2040 (PEP2040) sets the framework for the energy transition in Poland. The main objective of this policy is maintaining energy security while ensuring the competitiveness of the economy, energy efficiency and the reduction of the environmental impact of the energy sector. Among specific objectives figure a) optimal use of own energy resources, to be achieved by transition of coal regions - abandonment of coal use in households in cities by 2030, in rural areas by 2040, b) expansion of electricity generation and grid infrastructure, to be obtained inter alia by implementation of smart grids - a significant increase of installed capacity in photovoltaics of approx. 5-7 GW in 2030 and approx. 10-16 GW in 2040, to be accompanied by investments in energy storage technologies as well as smart metering and energy management systems, c) diversification of supply and development of network infrastructure for natural gas, crude oil and liquid fuels, enabled inter alia by the construction of the Baltic Pipe, d) development of energy markets by, amongst others, development of electromobility, e) implementation of nuclear power - the first nuclear power plant power unit with a capacity of about 1-1.6 GW will be commissioned in 2033, f) development of renewable energy sources by implementation of offshore wind energy - the installed capacity will reach: approx. 5.9 GW in 2030 up to approx. 11 GW in 2040, g) development of district heating and cogeneration - the heating needs of all households will be covered by district heating and by zero- or low-emission individual sources by 2040, h) improvement of energy efficiency - a target of 23% reduction in primary energy consumption in relation to PRIMES2007 forecasts has been set for 2030.

In 2022 Poland adopted a Long-term Building Renovation Strategy (DSRB), which aims to improve the comfort of living by enhancing the energy efficiency of buildings along with the air quality and decreasing CO_2 emissions by 2050. The preparation of this strategy results from Art. 2a of Directive 2010/31/EU of the European Parliament and Council of 19 May 2010 on the energy performance of buildings (Journal of Laws L 153 of 18.6.2010, p. 13, as amended). According to a calculation carried out in the process of creating the strategy, there are 14.2 million buildings in Poland, out of which almost 40% are single-family residential buildings. A significant part of the buildings is characterised by low energy efficiency and will require thermal modernization in the coming years, which will generate new job opportunities. Between 2020 and 2030 thermal modernization of 236,000 buildings per year is foreseen. In the subsequent years 2030-2040 - 271 thousand. buildings, in the years 2040-2050 - 244 thousand. buildings, and in 2021-2050 - 7.5 million thermal modernizations are planned to be implemented. Hence, according to the strategy, by 2050 approximately 7.5 million thermo modernization investments will be carried out, including 4.7 million deep thermo modernization projects. An average annual rate of thermal modernization is estimated at the level of approx. 3.8%, assuming that by 2050 65% of buildings will achieve an EP index not higher than 50 kWh/m2·year. In essence, this strategy intends to cost-effectively transform the national building stock into nearly zero-energy buildings.

National Energy and Climate Plan for the years 2021-2030, developed as per the obligation set out in Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action. This Plan outlines the objectives, targets, policies and measures in five dimensions of the Energy Union: 1. decarbonisation, 2. energy efficiency, 3. energy security, 4. internal energy market and 5. research, innovation and competitiveness. Among targets to be achieved until 2030 figure: 7% reduction of CO_2 emissions in non-ETS sectors (compared to 2005), 14% renewable energy in transport in 2030, 21-23% RES in gross final energy consumption, RES increase in heating and cooling by an average of 1.1 percentage point per year, 23% increase in energy efficiency (23% reduction of primary energy consumption in comparison with PRIMES2007 forecast).

All of the three above-mentioned strategies are the target of criticism coming from environmental organisations such as ClientEarth, an environmental law charity and Institute of Green Economy, focused on containing the climate crisis. The critics point out the fact that the European Climate Law obliges each EU Member State to include reduction targets and climate neutrality in national actions, plans and strategies. That being said, all of the adopted strategies will require changes so that their implementation does not contradict the European goal of climate neutrality by 2050. One of such changes, for instance, is the need to revise the so-called Range Act of 2016, which prohibits new onshore wind energy projects due to the restrictive location source. Liberalising amendments are currently underway as the part of the National Recovery and Resilience Plan (NRP) Commission's go package, while mired in controversies - falling a victim of fractional wrangling.

The Polish ESCO market is significantly developing recently but still there are not many companies acting as ESCO as well as there is not much interest among the potential clients. There is a need to involve different raising-awareness institutions in activities supporting the market.

When it comes to strategies at the regional level - the Development Strategy of the Mazowieckie Voivodeship until 2030 - Innovative Mazovia. It draws attention to the problem of ensuring energy security, crucial due to deteriorating technical conditions of power grids. The grid - the energy transmission and distribution systems - should be modernised and expanded in order to minimise losses during energy transmission (including through the construction of smart grids) and diversified sources and directions of energy supply, including enabling robust reverse feeding into the grid from micro and mezzo decentralised sources.

As per the policies applicable at the municipality level the Guidelines for the Heat, Electricity and Gas Supply Plan for the Góra Kalwaria 2015-2030 was adopted. This document stresses the chief deficits and sets the key remediation measures to be implemented. As per the effective heat management, the deficits to be tackled include the lack of heat metres, regulatory devices, low efficiency of heat sources, high heat losses in installations, but also large heat losses of existing buildings, often significantly exceeding the current standards. Energy savings generated after removing the above-mentioned defects could reach up to 30-40% of the energy used for heating and heating tap water. Making use of these savings could possible after improving the technical condition of the existing heat supply systems and the buildings themselves in the area of the analysed local government unit through: - modernization of heat sources, - thermal modernization of buildings, - modernization of receiving installations (central heating and domestic hot water) and proper thermal insulation of the installation, which will minimise unwanted heat losses. As per electricity savings, a further implementation of investments focused on modernization of street lighting is advised. One of the possibilities involves the installation of more modern, more cost-effective street lighting. Another recommended option involves hybrid lighting systems which acquire energy from wind and solar power. Given that obtaining energy from wind and solar power is free, a lot of financial savings could be generated , enabling Góra Kalwaria to spend this money on development investments. As per gas and fossil fuels refurbishment, implementation of modern gas boilers relying on biofuels (mainly straw and pellet) is advised in order to replace out-of-date coal-fired boilers. This way a significant savings in primary energy can be obtained (39-43%). Additionally, higher efficiency boilers emit less pollutants to the atmosphere, making this energy production process cleaner.

When it comes to the recently introduced emergency due to soaring energy prices, mitigation-oriented measure Góra Kalwaria is to save 10% of the consumed electricity. This is in line with the Art. 37. - [Compulsory reduction of energy consumption by the public finance sector] Specific solutions aiming to protect electricity beneficiaries in 2023 in relation to the state of the energy market in force from December 1, 2022 onwards. This is to be achieved under the local context tailored solutions. In Góra Kalwaria the singled-out measures include switching off street lamps between 0.00-4.30 a.m., as street lighting consumes a total of 52% of electricity paid for by the municipality, temporal close-up of the municipal ice rink this year, since its maintenance, especially in the period of above zero temperatures, is highly energy-intensive.

2.2.5.2 Initiatives in place

Thermo-modernization and Renovation Fund operating since 1999, provides financial assistance to investors undertaking thermo-modernization and refurbishment projects, as well offers financial compensation to owners of residential buildings. Its expected energy savings for the period 2021-2030 are estimated at 70 ktoe/year. Similarly, the Thermo Modernisation Bonus is a tax relief which allows for the deduction of the expenses related to the implementation of thermo-modernization projects in single-family residential buildings from income (revenues). The energy savings obtained thanks to this bonus for the period 2021-2030 are estimated at 200 ktoe/year.

The list of available support instruments and assistance toolkits a la carte, relevant to Góra Kalwaria can be found below:

- List of programs and financial instruments concerning projects intended to improve energy efficiency at the final recipient for which implementation funds from the state budget were obtained
    - Thermo Modernization bonus and renovation bonus paid from the Thermo Modernization and Renovation Fund
    - The "Stop smog" program funded by the Thermo Modernization and Renovation Fund
    - Thermo Modernization incentive as per PIT
    - Polish Governance Fund: Strategic Investment Program
- List of financial programs and instruments regarding projects to improve the energy efficiency of the final recipient, at which the funds were obtained from the European Union budget and the help of the Member States provided by the European Free Trade Agreement (EFTA) or funds from other foreign sources and donors
    - "Environment, Energy and Climate Change" under the Financial Mechanism of the European Economic Area (EEA FM) for 2014-2021. Areas of support: renewable energy, energy efficiency, energy security
    - European Funds for Modern Economy Program for 2021-2027. Priority 3. Greening of enterprises
    - Program European Funds for Infrastructure, Climate and Environment 2021-2027 (FEnIKS). Areas of support: renewable energy, energy efficiency, energy security
- List of programs and financial instruments concerning projects intended to improve energy efficiency at the final customer, for the implementation of which funds from the budgets of local self-government entities were obtained.
  Co-financing or targeted subsidy for projects aimed at improving energy efficiency in households and housing communities consisting of:
    - replacement of heat sources or purchase and installation of a new heat source for the purpose of heating the building or heating the building and preparing domestic hot water as part of:
        - Low Emission Reduction Program,
        - Low Emission Reduction Program,

        - emission reduction program,
        - resolutions in the field of environmental protection
        - implemented in the commune, city or poviat;
    - thermal modernization of residential buildings in the scope of: insulation of building partitions, balcony slabs, foundations and replacement of external woodwork - implemented under resolutions in the field of environmental protection in the commune, city or poviat.
- List of programs regarding projects to improve energy efficiency at the final recipient, at which the funds from the National Fund for Environmental Protection and Water Management were obtained, excluding funds equivalent to revenues from the replacement fee referred to in art. 11 OF THE ACT OF MAY 20, 2016 ON ENERGY EFFICIENCY
    - "Agroenergy". Part 1) Micro installations, heat pumps and associated energy storage
    - "Energy-saving construction". Part 1) Reducing energy consumption in construction
    - "Energy-saving construction". Part 2) PUSZCZYK - Low-emission public buildings
    - "Warm Apartment". Part 1) For final beneficiaries eligible for the basic level of grant
    - "Warm Apartment". Part 2) For final beneficiaries entitled to an increased level of co-financing
    - "Warm Apartment". Part 3) For final beneficiaries eligible for the highest level of grant
    - "Clean Air". Part 1) For beneficiaries entitled to the basic grant level
    - "Clean Air". Part 2) For beneficiaries entitled to an increased level of co-financing
    - "Clean Air". Part 3) For beneficiaries entitled to the highest grant level
    - "Energy Plus"
    - "Climatic Spas". Part 2) Supporting energy efficiency in public utility buildings in spa communes
    - "My Warmth"
    - "Polish geothermal plus". Part 1) Deep geothermal
    - "Improvement of air quality by replacing heat sources in multi-family buildings - a pilot project in the Zachodniopomorskie Voivodeship". Part 3) For housing associations
    - "Improvement of air quality in the most polluted communes - a pilot project". Part 1) For natural persons entitled to the basic level of co-financing
    - "Improvement of air quality in the most polluted communes - a pilot project". Part 2) For natural persons entitled to an increased level of co-financing
    - "Improvement of air quality in the most polluted communes - a pilot project". Part 3) For housing associations
    - "Improvement of air quality in the most polluted communes - a pilot project". Part 4) For municipalities cooperating in the implementation of the Program pilot or creating conditions for this implementation
    - "OWL - outdoor lighting"
- List of programs and financial instruments concerning projects served to improve energy efficiency at the final recipient, for the implementation of which funds from voivodeship environmental protection and water management funds were obtained
    - Voivodeship Fund for Environmental Protection and Water Management in Warsaw. Program "Tasks in the field of air protection"
    - Voivodeship Fund for Environmental Protection and Water Management in Warsaw. Program "Air protection projects supporting the activities of volunteer fire brigades"
    - Voivodeship Fund for Environmental Protection and Water Management in Warsaw. "Modernization of lighting" program

2.2.5.3 Other initiatives (green loans, banking financing, etc.)

"Clean Air '' Programme - a comprehensive programme enabling individuals to improve energy efficiency and reduce emissions of dust and other pollutants released into the atmosphere by single-

family houses. The impact evaluation foresees a reduction of final energy consumption at 21.8 TWh and CO_2 reduction at 32200000 Mg/year.

2.2.6 Latvia

2.2.6.1 Energy/renovation national and regional strategies

The National Energy and Climate Plan 2030 the long-term goal is to promote the development of a climate-neutral and internationally competitive economy. Plan includes around 100 different policy measures, envisaging action in 12 directions, for example, improving the energy efficiency of buildings.

Long-term strategy for building renovation describes the situation in the real estate sector (housing availability, technical condition) in Republic of Latvia, planned investments (also EU funds) in refrubishmet and building new houses.

Covenant of mayors for energy and climate in Latvia signed by 17 Latvian municipalities.

Long-term strategy Strategy for low-carbon Latvia for development until 2050 is a long-term policy planning document designed to simultaneously with limiting and reducing climate change would increase the economic performance of Latvia's economy competitiveness, as well as ensuring a safe living environment for Latvian citizens.

Sustainable Energy Action Plans for municipalities and also Planning regions describes situation, plans and aims.

In accordance with the conditions of the third part of Article 5 of the Energy Efficiency Law, the county municipalities with a territorial development level index of 0.5 or higher and residents the number is 10,000 or more and to state direct administration institutions, owned or owns buildings with 10,000 square meters (hereinafter - m^2) or greater total fuel area, an energy management system must be implemented.

2.2.6.2 Initiatives in place

Latvia is taking a number of initiatives aimed at promoting global climate change prevention, adaptation to the effects of climate change and promoting the reduction of greenhouse gas emissions (GHG), and increasing energy efficiency (e.g. through measures to improve the energy efficiency of buildings in both the public and private sectors, the development and deployment of technologies using renewable energy sources; also by introducing solutions to reduce GHG emissions.

One of the funding sources in Latvia is the Financial Instrument for Climate Change (hereinafter - KPFI) - the State budget programme. KPFI is financed by the sale of State-owned fixed quantity units carried out within the framework of international emissions trading under the conditions of the Kyoto Protocol. So far, the funding of KPFI has provided support:

1. Reduction of GHG emissions in the lighting infrastructure of municipal public areas;
2. complex solutions for reducing GHG emissions - increasing the energy efficiency of local government schools;
3. for the reduction of GHG emissions in the transport sector, for the deployment of electric vehicles and their charging infrastructure;
4. developing public awareness of the importance and capabilities of GHG reductions;
5. for the development of GHG reduction technologies and the implementation of pilot projects in enterprises and municipalities;
6. the use of renewable energy sources in the household sector;
7. improving energy efficiency in Latvian universities and universities;
8. complex solutions to reduce GHG emissions in production buildings, buildings of state and local government vocational education institutions.

Similarly, for energy efficiency improvements, for the reduction of GHG emissions, Latvia has access to the Emission Allowing Instrument (hereinafter - EKII), which is also the State budget programme. The EKII shall finance measures aimed at:

- increasing the energy efficiency of buildings or technological equipment and vehicles;
- extending the use of renewable energy sources;
- promoting adaptation to climate change at national and regional level;
- developing environmental technologies that ensure energy efficiency improvement, renewable energy use, reduction of GHG emissions in technological processes or adaptation to climate change;
- implement climate policy measures aimed at adapting to climate change, as well as preparing research, planning and technical documents needed to integrate into different sectors;
- implement educational measures that improve public awareness and knowledge of climate change and measures to reduce them and ensure adaptation to climate change, and which contribute to changing consumer habits, as well as to the development of a low-carbon economy in Latvia.

The EKII shall be financed from the auctioning of State-owned European Union emission allowances (EUA) and European Union aviation emission allowances (EUAA) pursuant to Commission Regulation (EU) No 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances. In addition, the following support has been provided:

1. Reduction of GHG emissions in the lighting infrastructure of municipal public areas;
2. the use of renewable energy sources **in households;**
3. **private individuals support for the purchase of below and low-emission vehicles;**
4. **protected architectural monuments of national importance;**
5. **the construction of energy-efficient buildings;**
6. The reduction of GHG emissions by smart urban technologies, etc.

In addition, Latvia operates the Modernisation Fund, a new financing mechanism aimed at supporting low-carbon investments by supporting countries' progress towards climate neutrality. The financing of the Modernisation Fund is available to ten EU Member States - Bulgaria, the Czech Republic, Croatia, Estonia, Latvia, Lithuania, Poland, Hungary, Romania and Slovakia. The Modernisation Fund shall be managed by the European Investment Bank and the European Commission together with the Investment Committee of the Modernisation Fund.

The financing of the Modernisation Fund may be used:

- electricity generation and use from renewable energy sources;
- improving energy efficiency, including transport, agriculture and waste management, and building sectors;
- upgrading energy networks, including pipelines used in district heating and electricity networks, capacity building and interconnections between EU Member States;
- with a view to supporting measures relating to the transfer, retraining and training of workers, education.

Latvia can also take advantage of the opportunities provided by the LIFE Programme - the European Commission's financial instrument to deliver innovative and sustainable improvements to environmental quality and climate change. The main objective of the LIFE Programme is to promote the implementation, development and updating of the European Union's environmental and climate policy by co-financing projects that meet the objectives of the LIFE Programme and create additional added value in the EU.

For the financial period of the LIFE Programme, the total amount of investment available for 2021-2024 are EUR 580 million. National co-financing is also available for the implementation of approved projects.

In addition to the above, support is also provided in Latvia with State budget financing for the installation of solar panels by private house owners, increasing energy efficiency and switching to any technologies using renewable energy resources.

Similarly, various institutions in Latvia participate in Horizon, Interreg, etc. projects related to climate, environment and energy efficiency.

2.2.6.3 Other initiatives (green loans, banking financing, etc.)

The aim of individual Latvian banks is also to promote sustainable development and, in the name of this, the commitment to support their clients towards sustainable business solutions. Companies that plan to implement green projects, banks are issuing a Green loan. When granting Green loans, bank revenues are used for low-carbon and climate-friendly projects and investments. Green loans are granted:

1. for renewable energy: wind, solar, small-scale hydro, tidal, geothermal and bioenergy and related infrastructure;
2. energy efficiency;
3. for clean transport, non-emissional or hybrid transport solutions/systems and support infrastructure;
4. waste management - waste recycling energy and methane capture projects, as well as waste reduction projects;
5. reduced emissions of CO_2, SO_x, NO_x, particulate matter, heavy metals and dioxins into the air using physical, chemical and mechanical techniques;
6. for water and waste water management - drinking water production, waste water treatment, water management.

Similarly, Latvia also holds a company called “Development Finance Institution Altum”, which provides loans to companies, to implement energy efficiency measures, to purchase sustainable transport, to purchase renewable energy technologies, to rebuild buildings and to build a new energy-efficient A or A + class building. The “Development Financial Institution Altum” grants a expenditure of up to EUR 5 million, own participation from 10%, credit holidays up to 12 months, reduced collateral requirements.

The “Development Finance Institution Altum” shares company offers individual merchants, micro-enterprises, small, medium and large enterprises, state and local government commercial companies to receive a grant for the performance of energy audits, research and relevant documentation that allows investments to be made for improvements in the energy performance of companies. The programme of the European Investment Bank, ELENA, provides funding of EUR 2 250 000, providing aid of 85% of the eligible costs.

Latvia also has access to the European Union Recovery Fund, which is a centrally managed budget programme of the European Commission (established in addition to the European Union's multi-annual budget for the programming period 2021-2027). The programme aims to support reforms and investments related to the transition to the green and digital economy and to mitigate the social and economic impacts of the crisis. The amount of funding approved for Latvia is EUR 1.82 billion, which will be available by 31 August 2026.

As part of the European Union's programming period 2021-2027 and the European Union Recovery and Stability Mechanism, the implementation of energy efficiency improvement measures provides Latvia with a total of EUR 673.1 millions:

1. improving energy efficiency of multi-apartment houses and private houses and switching to renewable energy technologies (aid in the form of a combined financial instrument);
2. improving the energy efficiency of public buildings (aid in the form of grants);
3. modernisation of transmission and distribution networks (aid in the form of grants);
4. improving the energy efficiency of buildings owned by undertakings (aid in the form of a combined financial instrument).

All the support programmes mentioned above must ensure a reduction of at least 30% of primary energy.

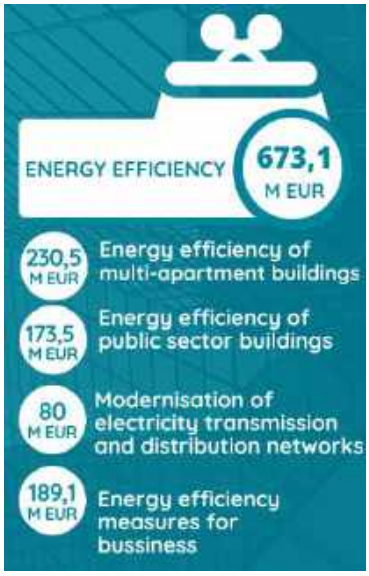


Figure 3 Energy Efficiency measures

Climate and GHG emissions reductions are also funded under the European Union's 2021-2027 programming period and the European Union's Recovery and Stability Mechanism. As part of the policy objective, the €374 millions available for Green Europe. Support is provided for increasing the energy efficiency of municipal buildings and for the reduction of air pollution; implementing measures to reduce air pollution by improving household heating systems; reducing emissions of air pollutants in municipal heating, etc.

Within the framework of the European Union's Recovery and Resilience Mechanism, the amount of investment available to achieve the goals of climate change of EUR 29.30 million, for the improvement of municipal buildings and infrastructure, contributing to the transition to renewable energy technologies and improving energy efficiency.

2.2.7 Slovakia

It has to be noted that Slovakia does not hold any Demo, but the analysis of the renovation policies was also done for this country as they will have an important role in the last phase of the project (Phase 3: Product Assessment & market uptake).

2.2.7.1 Energy/renovation national and regional strategies

The Slovak strategies in place reflect the EU aims implemented through the relevant EU directives. The most relevant ones regarding the FORTESIE project focus are following directive:

- EPBD – EU Energy Performance of Buildings Directive, transposed into Slovak legislation through Act no. 555/2005 Coll. on energy performance of buildings,
- EED – EU Energy Efficiency Directive, transposed into Slovak legislation through Act no. 321/2014 Coll. on energy efficiency,
- RED – EU Renewable Energy Directive, transposed into Slovak legislation through Act no. 309/2009 Coll. on support of renewable energy sources and high-efficient cogeneration, Act no. 251/2012 Coll. on energy and Act no. 657/2004 Coll. on heat energy.

The strategic framework relevant for the FORTESIE focus consists of following documents:

- **Energy Policy of the Slovak Republic (2014)**[6] – defines the energy sector's primary objectives and priorities to 2035 with a view to 2050. The Energy Policy is a component of Slovakia's national economic strategy given that ensuring sustainable economic growth is conditioned by the reliable supply of affordable energy.
- **Integrated national energy and climate plan for years 2021 – 2030 (2019)**[7] – elaborated in line with the Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action.
- **Long-term Strategy for renovation of the building stock (2020)**[8] – The strategy created a framework for demonstration of public priorities in energy efficiency of buildings. Policies and measures defined within the strategy shall fulfil (through defined milestones) the vision of decarbonization of the building stock until 2050.

The strategic framework is established on the national level and there are not specific regional policies or strategies.

Implementation of the policies and measures defined within the strategic documents is actually supported by the implementation of the Recovery and Resilience Plan of Slovak Republic and of the Programme Slovakia 2021 – 2027 based on the ESIF 2021-2027 programming period.

Recovery and Resilience Plan of Slovak Republic[9] tackles the energy and building renovation topics within its Green Economy priority which includes (among others) following areas:

- Renewable Energy Sources and Energy Infrastructure, that covers:
  - Reforms of legislative frameworks in areas of:
    - Energy Efficiency,
    - Power Generation,
    - Support of RES,
  - Investments in:
    - Building new RES power sources,
    - Modernization of existing RES power sources,
    - Increasing of flexibility of energy systems for higher RES integration.
- Renovation of Buildings, that covers:
  - Reforms of:
    - Harmonization of support schemes for renovation of Single-family houses,
    - Increasing transparency and effectiveness of decision making of the Monuments Office,
    - Disposal of construction waste,
  - Investments in:
    - Increasing of energy performance of Single-family houses,
    - Renovation of historical buildings.

Programme Slovakia 2021 – 2027[10] covers the relevant areas especially within its priority Greener Slovakia. The investments will support energy efficiency, reduction of greenhouse gas emissions, energy from renewable sources and energy storage, also reflecting the global situation and the need to reduce the dependence of the Slovak economy on energy sources from Russia. Investments in adaptation to climate change, access to water, strengthening of nature protection, biodiversity, and green infrastructure, as well as sustainable urban mobility will be supported as well.

[6] https://www.mhsr.sk/uploads/files/47NgRIPQ.pdf?csrt=3127367755818335437
[7] https://www.mhsr.sk/uploads/files/IjkPMQAc.pdf?csrt=3127367755818335437
[8] https://www.mindop.sk/dlhodoba-strategia-obnovy-fondu-budov
[9] https://www.planobnovy.sk/
[10] https://www.eurofondy.gov.sk/program-slovensko/index.html

2.2.7.2 Initiatives in place

As regard specific support for renovation of buildings in Slovakia, the following financial initiatives and policies are in place[11]:

Table 1 Renovation of single-family houses

Renovation of Single-family houses			
Policy	**Type of support**	**Supported measures**	**Source of financing**
Subsidies for the insulation of a family house	Grant	Insulation of a family house: - Façade insultation, insulation of the roof - Insulation of dividing structures between heated and unheated space - Replacement of external windows / doors Eligible cost is also heat source replacement	State budget
Renovation of SFH	Soft loan	Façade insulation, insulation of the roof, replacement of external windows / doors	State housing development fund (state budget)
Support for use of RES in family houses	Grant	Photovoltaic panel Solar collector Biomass boiler Heat pump	ESIF (National Programme)
Solid fuel boiler replacement	Grant	Replacement of old solid fuel boiler in SFH	ESIF (National Programme)

Table 2 Renovation of Apartment buildings

Renovation of Apartment buildings			
Policy	**Type of support**	**Supported measures**	**Source of financing**
Elimination of systemic failures of apartment buildings	Grant	Elimination of system fault on apartment building	State budget
Renovation of apartment building	Soft loan	Several measures such as façade insulation, insulation of the roof, replacement of windows, modernization or reconstruction of common parts.	State housing development fund (state budget)
Support for use of RES in apartment buildings	Grant	Solar collector Biomass boiler	ESIF (National Programme)

Table 3 Renovation of public buildings

Renovation of public buildings			
Policy	**Type of support**	**Supported measures**	**Source of financing**
Improving the energy	Grant	Several measures, such as improvement of thermal-technical properties of building structures, modernization	ESIF (National Programme) and

[11] Paksi R., Rajkiewicz A., Vanko L., Koritár Z., Böröcz B, Alceva L., Guidance: How to draft an effective Renovation Strategy (Transferring Visegrad experience with Energy Efficiency Building Policies to North Macedonia), 2021; available at: https://bpb.sk/wp-content/uploads/2021/11/IVF-study_Guidance_final-version.pdf

efficiency of a public building		of heating / air conditioning systems, hot water systems, lighting, installation of measurement and control systems, etc.	Environmental Fund.

The main financial initiatives and policies planned for next period are as follows[12]:

- Reducing the energy intensity of public buildings
- Improving the energy efficiency of SFH
- Renovation of historial public buildings
- Renovation of public buildings
- Improving energy efficiency in companies (buildings)
- Support for increasing the share of RES use in households based on self-consuming energy from RES and communities producing energy from RES.

2.2.7.3 Other initiatives (green loans, banking financing, etc.)

No initiatives for this type have been identified for Slovakia.

[12] Paksi R., Rajkiewicz A., Vanko L., Koritár Z., Böröcz B, Alceva L., Guidance: How to draft an effective Renovation Strategy (Transferring Visegrad experience with Energy Efficiency Building Policies to North Macedonia), 2021; available at: https://bpb.sk/wp-content/uploads/2021/11/IVF-study_Guidance_final-version.pdf

3 Description of the methodology

This chapter aims to define the methodology provided by FORTESIE to collect the end-user & pilots (stakeholders) requirements to better fit and tailor existing ESIE and renovation technologies. Also, this methodology has to include the pathway to represent and define use cases which will be piloted in each demonstration site.

3.1 Methodology for capturing the "before" situation

The first step in FORTESIE for better understand the needs of a Demo is to understand the physical context in which it is located. To gather this information, a set of general questions is defined and should be answered by the partners in charge of the demos. Although the demos are quite different from one another, the set of questions is the same for everyone to facilitate comparison. Nevertheless, as there are questions that do not apply to all the demos, the partners will be advised to not answer all the questions if they do not apply to their site.

In the following sections, the set of questions is listed.

3.1.1 Description of the pilot sites

3.1.1.1 Description of the building

Characteristics of building

- Type of building (for what usage)

- Size of building (square meters)

- Address / location of building (rural/urban)

- Composition of building (main materials)

- Year of dwelling / construction

- Location specification (city center–rural, neighbors)

- Type of building (terrace–detached) and length of ownership/occupation

- Include photos of the building, location in a map, etc.

Characteristics of renovation need:

- Why renovation is needed?

- Temperature and climate situation (heating/cooling/venting needs)

- Energy source situation (primary energy access, storage opts)

- Energy use situation (demand and reduction / transformation need)

- Economical or practical incentives active in pilot region (municipal or national)

- Specific environmental conditions or needs related to the pilot

3.1.1.2 Target groups

Characteristics of all of the different types of users / occupants / owners. Include as many users as needed.

- Type of user / owner /occupant

- Internal users (e.g. inhabitants) / external users (e.g. visitors)

- Main stakeholders of building apart from owners/users/renters

- Number of regular / permanent users / occupants

- Annual budget / household budget

- Characteristics of permanent regular users / occupants and their ages (their main behavior - like tenant, museum/ pool visitor and their direct ability to control/steer building performance in daily use)

- Primary decision makers related to renovation (like before-renovation performance responsible, budget responsible, primary renovation decision responsible, renovation activity responsible, person responsible for / leader of owner/user/occupant, after-renovation performance responsible)

3.1.1.3 The external stakeholders

Characteristics of primary stakeholders:

- Primary stakeholders related to the building and their core interest

- Further details of the pilot that are of interest for external stakeholders (legal aspects, timeline aspects etc)

3.1.2 Analysis of current situation

Situation characteristics:

- Temperature and climate situation (heating/cooling/venting needs)

- Energy source situation (primary energy access, storage opts)

- Energy use situation (demand and reduction / transformation need)

- Further details of the pilot and its timeline

3.1.2.1 Existing measuring systems and data

Characteristics of measuring systems and data sources:

- Building designs, energy bills (energy consumption) of a whole year.

- Record and describe the current technologies used for heating/cooling/ventilation systems (e.g.air handling units, insulation, solar panels, ventilation, water heaters, heat pumps, heat exchangers, remote controllers, any relevant hardware/software, etc.).

- The available measurements (if any) for building conditions should be verified if they are automatically or manually gathered.

- Values of light, indoor environmental quality, acoustics, thermal isolation, humidity, temperature and CO_2 constitute examples of possible measurements.

Table 4 Existing measuring systems - schema to be filled by the demos

System	Details	Current estimated data
Energy consuming equipment and overall consumption		
Energy generating equipment		
Climate control		

Air and humidity control		
Rooftop		
Energy monitoring and other sensors		
Any additional to be added		

3.2 Methodology for capturing end users and stakeholders requirements (to-be situation)

In FORTESIE we define as the "to-be" situation the needs of each stakeholder for each Demo. In order to achieve this, FORTESIE proposes a methodology to define different relevant aspects of the stakeholders in each Demo.

It has to be noted that this methodology is based on the methodology to get user requirements in the H2020 MATRYCS project (deliverable D2.1 State-of-the-art analysis and Big Data Value Chain). This project developed an exhaustive methodology for the whole process in a similar context as FORTESIE, so in order to gain knowledge from an already tested and validated process, FORTESIE adjusted the aforementioned methodology for its own context.

As a result, two phases are defined:

- Phase I: Identify the role of the partners in each Demo.
- Phase II: Identify Use Cases, Target groups, Personas and User Stories.

In FORTESIE, the following definitions are proposed:

Target group: the potential users (beneficiaries) of the Demo service(s).

Persona: fictional character created to represent the needs, wants and behaviours of the target groups to ensure that we are thinking from their perspective. Each persona captures a different point of view of each target group.

User story: description of a service feature, written in a natural language, from the user's perspective.

3.2.1 Phase I

The goal of the first phase is to identify the roles of the partners for each demo so that the partners know how to complement each other.

3.2.1.1 Step 1.1: Identify the roles of the partners

Table 5 Methodology for Step 1.1

Rationale	FORTESIE has a wide number of partners from different areas of knowledge (Universities, IT experts, ESCOs, public authorities, financial experts…). Each of the partners will contribute to FORTESIE using one or more roles. This step will help in the definition of the roles needed for the whole project, also defining a jointly agreed nomenclature for them. Moreover, it will provide a high-level view of the capabilities of the consortium.
Method	A set of initial roles that have been identified will be proposed. A file with a matrix relating the roles and the partners will be shared.

	Each partner will have to identify its role, selecting one or more of the selected roles and/or adding more roles. Final adjustments will be agreed if necessary for nomenclature.
Result	The type of roles that are needed for FORTESIE. A matrix that specifies the role(s) of each partner in FORTESIE.

3.2.2 Phase II

The objective of this Phase is to draft main characters for each Demo, called Personas, and their typical needs or operations, called User Stories.

3.2.2.1 Step 2.1: Identify the use cases

Table 6 Methodology for Step 2.1

Rationale	After defining the role of each partner in the Demo, each Demo needs to specify its basic characteristics and its objectives. Each Demo may have several objectives in which there may be different partners involved.
Method	A file with a template structure of a Use Case Card will be shared. Each Use Case Card will contain 4 sections to complete: • Name: of the Demo and the Use Case • Goals: of the pilot that will allow the potential users to get things done • Metrics: are used to determine if the pilot service(s) delivers on the user's goals • Target groups: these are the potential users (beneficiaries) of the pilot service(s). Each target group will define one or more characters (called Persona) that represents an actor in the stakeholder group. The partners of each Demo will work together to define this section.
Result	One or more Use Case Cards for each Demo containing the goals, metrics, target groups and personas.

3.2.2.2 Step 2.2: Identify the Personas

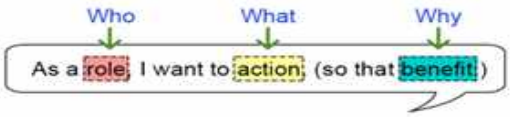
Table 7 Methodology for Step 2.2

Rationale	Each target group may involve different needs, interests, points of view and all of them would need to be managed in the Demo. In order to define this set of characteristics, in this step the Personas are deeply defined.
Method	A file with a template structure of a Persona will be shared. Each Persona template will have 4 sections to complete: • Persona name and appropriate target group • User context: description of the Persona, for example work he/she deploys, where, their main tasks, involvements • Pain points: the main pain points the Persona has and wants from the Demo services to be solved . • Goals: how the Demo services will help this Persona to achieve the goals (solving him/her pains).

	The quantity of the Personas defined may vary for each Use Case. It is recommended to define at least 2-3 Personas per Use Case. The partners of each Demo will work together to define this section.
Result	Several Personas defined for each target group of each Use Case, containing the user context, pain points and goals.

3.2.2.3 Step 2.3: Identify the User Stories

Table 8 Methodology for Step 2.3

Rationale	After having the pain points and goals for each Persona, the last part of the process is to link this information with the potential services features for each Demo. User stories will be used to achieve this, as they are a description of the services features from the user's perspective.
Method	A file with a template structure of a User Story will be shared. User stories are widely used in design processes, and they have to be written using the following schema:  The quantity of the User Stories defined may vary for each Persona. It is recommended to define at least 2-3 User Stories per Persona. The partners of each Demo will work together to define this section.
Result	Several User Stories defined for each Persona, containing the user context, pain points and goals.

At the end of this phase, a workshop for each Demo will be scheduled, where all partners of the Demo should be present. They will explain the work they have done and the rest of the partners that assist to the workshop will provide feedback, ask questions, solve doubts, etc.

3.3 Methodology for CIM

CIM or the Common Impact Model is a tool designed to ensure adaption of new technologies and behaviours at stakeholder and end-user level. It was developed as part of Horizon 2020 E-Land project (Grant Agreement No 824388), where it served as the basis to develop collaboration at stakeholder level to ensure security of supply based on bottlenecks in the grid in areas described as energy islands[13]. In the FORTESIE project the Common Impact Model will be used as the foundation for the conduction of interviews at stakeholder level. In the first instance to validate and further build the findings from the analysis in chapter 3.2 on the end-user and stakeholder requirements.

The work described in chapter 3.2 will as such serve as the basis for using the CIM with a goal to secure consistency across the answers obtained and the User Stories described. The underlying CIM methodology thus contains cross referencing, dynamic mapping and a description of individual and shared visions and goals. The analysis builds on the fact that perception, rationale and definitions differ across stakeholders, even though they are using the same words to describe what they see and what they want. One such example can be described in the work of the Alexandra Institute, when they analysed the requirements for a Smart Home among end-users. They found that there was little to no consistency among end-users expectations for such a system. Rather was it context dependent and contextualised: on a personal level it was based in convenience, safety, security, economy, technology

[13] https://elandh2020.eu/

and indoor comfort factors; on a social level it was based on social interaction, time, design, aesthetics and consumption as a social identity marker; while on societal level it was based on environmental and responsibility factors (doing the right thing).

With the Common Impact Model which was published as part of the proceedings of the Ecocity World Summit in February 2022[14] there is now an established approach to secure alignment and establish a process for engagement over time. The model is based on the analytic deliberation principle, which enables well-structured, multi-stakeholder, informed decisions.

The model as such is best described as an explorative and a case based approach. Based on the initial analysis stakeholders are presented for initiatives in different forms and in different contexts and their feedback is documented and further analysed to understand if and how the solution would fit to their beliefs and ways of working - and to which extent it is consistent across different contextual and situational settings.

The cases or in the case of FORTESIE; User Stories are not necessarily final solutions but available for change as sometimes the feedback is that we need to work and implement in a different way to get the best result or to align expectations. At this point we are focusing on the end user requirements, and the community aspects will be addressed in the third phase of the process.

In schematic form the model is as follows:

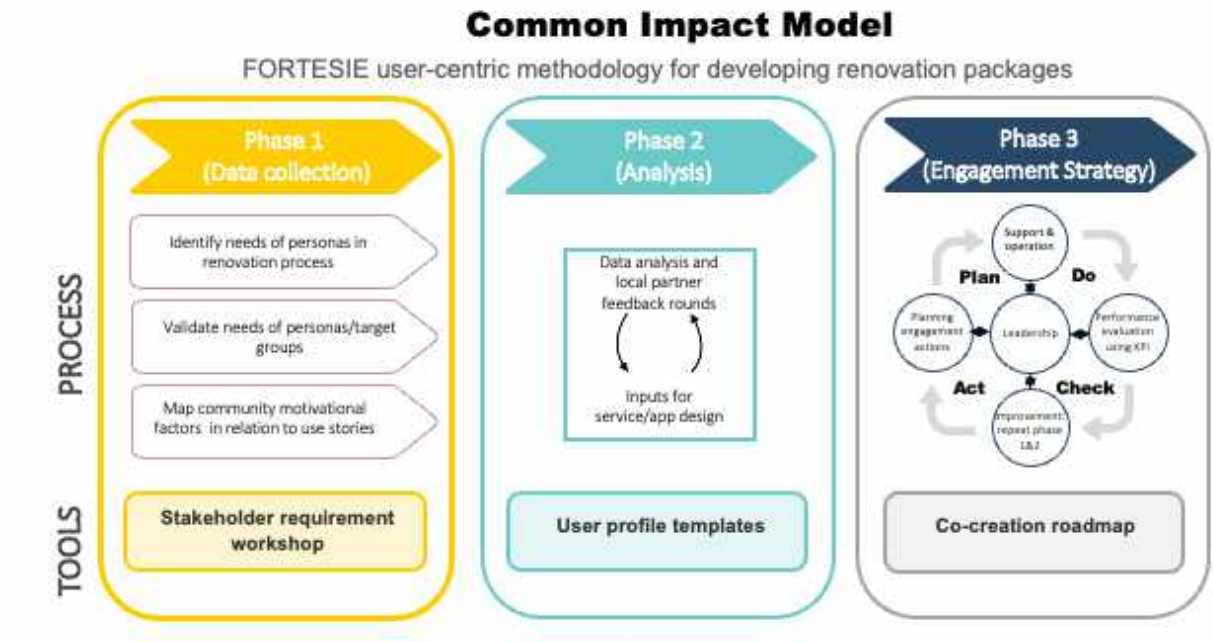


Figure 4 Common Impact Model

In the FORTESIE project the analysis in phase 1 will be conducted based on the MATRYCS methodology as laid forward in section 3.2.1. Phase 2 is the conduction of the end-user and stakeholder analysis as described above and phase 3 is then the actual implementation strategy, which consists of several feedback loops to catch the changes which inevitably occurs when stakeholders and end-users start utilizing new tools and gets accustomed to new habits. Thus the engagement strategy is a continuous work, which sometimes requires minor and sometimes major adjustments to keep the engagement running.

[14]https://iwoe.unisg.ch/publications/the-common-impact-model-a-standardized-methodology-for-community-acceptance-of-decarbonized-multivector-local-energy-systems/

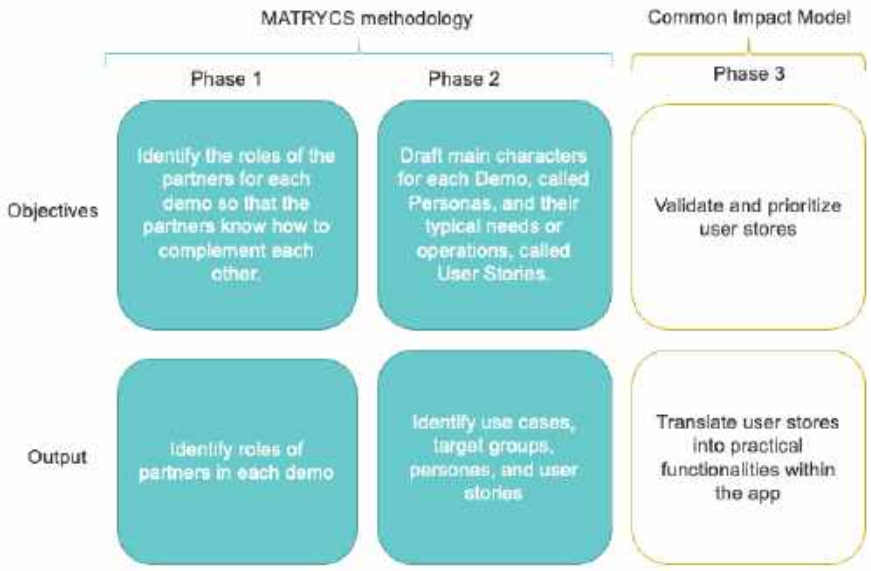


Figure 5 Details of the MATRYCS methodology in relation to the CIM model

To sum up the work from the CIM delivers:

- A process to deliver an engagement and implementation strategy directed at securing the highest impact and adaptation of energy reducing technologies and measures.
- Securing that all stakeholders are heard; their views are taken into consideration and alignments from misconceptions or misinterpretations are adjusted for.
- Interactions with people to get views from stakeholders and participants.
- A feedback loop to ensure maximum impact of the suggested solutions – not only in relation to the impact on energy reductions but also on acceptance and needs of interaction.

3.4 Requirements summary methodology

The elicitation of the requirements ensures the identification of the end-user (as stakeholders) needs and expectations from the planned system and the feasible implementations with the current state-of-the-art technology, as well as with the expertise of the FORTESIE technology partners.

The FORTESIE pilot application experiments/ demos are the main source of stakeholder expectations. Their needs and challenges to face the renovation wave will be analysed, and the expected functionalities, as well as constraints will be identified. The requirements will also be assessed as for their criticality and their value by the end-users. This will provide the final user prioritization of the requirements.

The aim of the requirements' elicitation is not to identify all the potential expectations of the stakeholders, but to find the most important that are relevant to FORTESIE, and can serve as a baseline for both the implementation within the project, as well as the short-term future improvement of the system.

3.4.1 From user stories to requirements

The user stories that should have been gathered in the section "Methodology for capturing end users and stakeholders' requirements" phase are a parallel way to establish the requirements of a system. The user stories focus on the experience of the user: they express what the person using a system wants to be able to do and why. The more traditional approach for the requirements focuses on functionality: what the system should do.

So, in the last phase of the methodology it is proposed to find a set of requirements with more details in the functionality, but without including technical aspects, which would be analysed in task T2.3 of FORTESIE. As a result, a set of functional requirements and non-functional requirements will be defined in this task.

The baseline needed for this are the set of user stories: each Demo should have defined a set of personas which would have also defined a set of user stories. The idea is to extract the common aspects of these personas: it is expected that several of these personas share the need of a system or even a feature inside a system and it is also expected that several of them express this need with different words.

So, using the complete set (from all Demos) of user stories, the activities to be done in this stage are the following:

a) Try to join the different user stories of the different demos to define what is needed to accomplish these user stories.
    a. If the requirement defines a functionality that needs to be implemented through a digital service, it will be called a "Functional Requirement".
    b. If the requirement defines a service that does not need a digital service, it will be called a "Non-functional Requirement".
b) Check the "Persona" description to see if all the goals are covered by the functional and non-functional requirements.

The following figure shows a schema of the expected results:

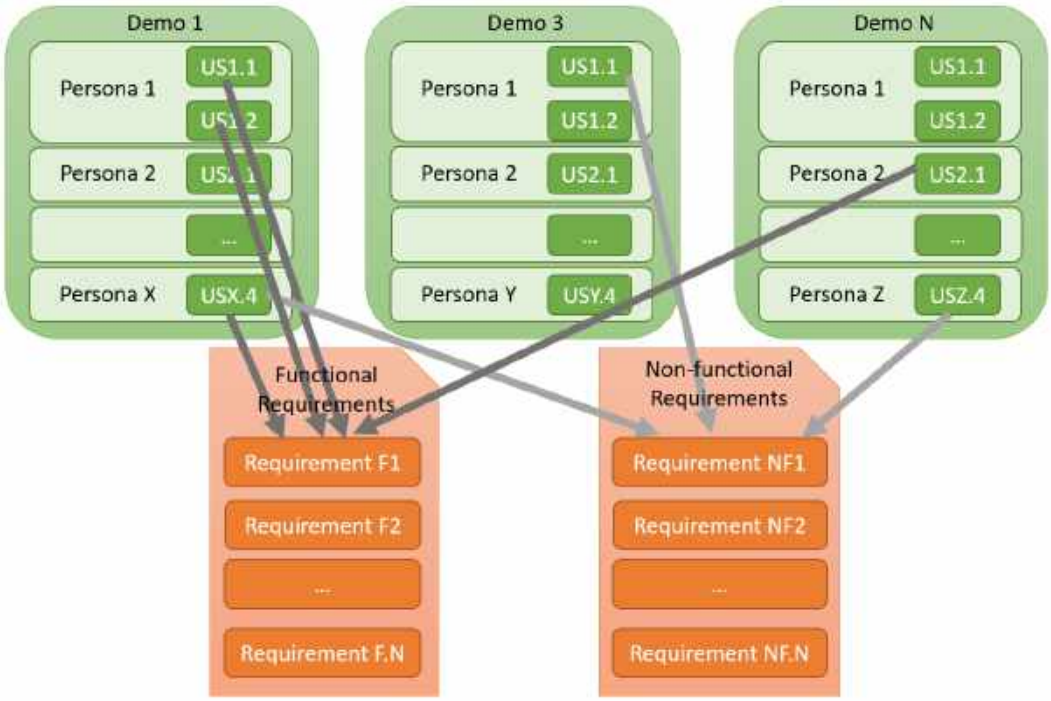


Figure 6 From user stories to requirements

There is not a mathematical rule for joining the user stories. The idea is to think what type of services (both technical and non-technical) are needed to develop that user story. Each of the functional and non-functional requirements is expected to cover several user stories from different Personas.

The requirements will be defined in a general way, as in Task 2.2 and Task 2.3 these requirements will be linked to technical decisions.

4 The pilots

FORTESIE proposes a set of seven Demos will be the pilots of the project. They cover a wide range of countries and types of buildings, as it is shown in the table below:

Table 9 Demos overview

ID	Name	Country	Renovation for	Partners
Demo 1	Unleashing green cultural experience	Greece	Museum of the Society of Hellenism and Philhellenism	TGT (Leader) CRD EEF ED
Demo 2	Green, comfortable and sustainable homes in Spain and France	Spain France	Households in Spain (including existing and new renovation installations) and France (targeting new average income households and energy poverty households)	CTIC (Leader) VEO GAR ENE OKT
Demo 3	Green, comfortable and sustainable homes (Energy poverty houses)	Portugal	Households in Portugal (targeting energy poverty households)	JUST (Leader) GOP
Demo 4	Green and comfortable households through prosumer engagement in Cooperatives	Portugal	Members of COOP Energy Community in Portugal	COOP (Leader) GOP JUST
Demo 5	Green, comfortable working environment	Greece	Office and commercial building in Greece	CRD (Leader) TGT GSIS
Demo 6	Comfortable and sustainable (Public) Pools	Poland	Municipal swimming pool in Góra Kalwaria, Central PL	+48 (Leader) GKW
Demo 7	Comfortable, inclusive and sustainable green Schools	Latvia	Public school in Riga provided by the municipality	MESH (Leader) LEIF DEE

In the majority of the Demos (except for Demo 2), several partners join to develop a renovation in a building, contributing to different aspects. But Demo 2 is slightly different as it will manage three different types of renovation processes, each of them led by one of the partners (VEO, GAR, OKT). These renovations will be deployed in different buildings, and also with different scopes, so an individual analysis has to be done for them.

The other partner in Demo 2 (ENE) will have the role of the deployment of a One-Stop-Shop in Spain, as GKW will do the same for Poland.

As far as personal data are processed, the processing must be compliant with the General Data Protection Regulation (GDPR). The legal and ethical aspects of data processing will be discussed in D1.3 Ethical / Legal Issues Report and GDPR Compliance Plan.

5 The pilots – Demo 1

5.1 Description of the pilot sites

5.1.1 Description of the building

The Museum of the Society of Hellenism and Philhellenism, in Athens, Greece. The mission of the Museum is to present the evolution of philhellenism from the Renaissance to the present day, with an emphasis on its contribution to the national independence of Greece, the cradle of Western civilisation.

Figure 7 Museum of the Society of Hellenism and Philhellenism

The Museum is located in a central area thus affected by heavy CO_2 levels. It is composed of 4 floors of exhibitions of 133 m2 each in floor of offices, and 1 storage floor. Each floor has a separate entrance. There are few visible windows in the building as most windows are covered with plasterboard, and it is used as an exhibit wall. The air is recycled using a few windows that are placed outside the main exhibition halls and in the staircase. Wall insulation is 5cm dow panel placed in between brick layers. In addition, there are no LED lights.

5.1.2 Target groups

The internal users: The daily users/occupants of this building (ie. for the museum) who use it more frequently, who manage it and how have the responsibility of controlling its daily conditions, temperature, humidity, etc. Characteristics of the users that could be relevant could be described: their motivation and interest in the project, and ways that they can contribute to the project success.

Note: It is clarified that during the presentations of the methodologies and the discussions we hold with the museum representatives, we should be clear that we need to identify the roles.

For example, for the Museum the internal users are:

- the owners and administrators: who owns the building and the collection. His interest is to lower the bill of energy, increase work comfort and satisfaction for his employers and ensure that the collection is stored in the optimal conditions of humidity, temperature, etc. He aims to build a

modern museum, demonstrate the potential contribution to the small community around it by improving the overall appearance of the museum, as well as improve the micro-clima around it with the green roof and overall be an emblematic building in the area, a place of interest to those who want to learn about the potential of the green technologies.

- The guide and cashier: who is interested to have comfortable working conditions.

The external users: These are visiting frequently the place/building, but are not everyday there and have limited influence to its conditions control, but have interests in it. For the museum:

The visitors are of diverse target groups, 4500 individuals per year, including individuals, schools, academic institutions, researchers, associations, etc. They may be visiting the exhibitions, or taking part in the activities that are organized by the museum collaborators which include workshops and seminars, theatre and music events, performances, etc. They have an interest to enjoy comfortable visiting conditions and could be actively engaged to contributing to green activities of the museum. For example, they may be involved in requesting the reduction of the temperature of the exhibition if they can contribute to the reduction of the energy bill, they may be engaged in other green activities, for example use the stairs instead of the elevator. These actions will also raise awareness to the public visitors about the project, the potential of their own choices, and these can be adopted in longer term at their everyday life. The active contribution of visitors may be rewarded in Green Euro, which can be used to pay for the souvenirs sold at the museum upon their exit.

5.1.3 The external stakeholders

The external stakeholders for the museum are described in the following table:

Table 10 External stakeholders for Demo 1

Stakeholder	Needs	Challenges
Construction company/Energy Consultant	- To enlarge their business and knowhow on renovation technology. - To improve the service offering for museums by addressing existing challenges which restrict customers investments.	- To convince customers about potential savings and benefits of new technologies - To reduce deployment time - To finance the investments - To access larger market share - To cooperate with complementary service providers
Financing organisation and incentivisation	- To take opportunity of the renovation wave and enter this market - to design and validate appropriate financing services for renovation target groups	- To set up the flow of cash (in-out) - To convince on the benefits of this service and gain trust of both investors and investments
Digitisation technologies Supplier	- To enlarge the business and address the renovation wave needs. - to design and validate appropriate services for renovation target groups	- Difficulty to convince the owners of the facilities about the benefits that the energy efficiency visualization provides.

5.2 Analysis of current situation

5.2.1 Existing measuring systems and data

The following table describes the existing measuring systems and data available.

Table 11 Existing measuring systems and data – Demo 1

System	Details	Current estimated data
Energy consuming equipment and overall consumption	No led lamps Climate control: 4 AC units U5MRT32-60 Inv. (external units) 4 AC units U5MDT32-60 Inv. (internal units) 4 fan units TD SILENT 800/200	Energy consumption is about 2500kwh per month. No monitoring system or analysis of consumption.
Energy generating equipment	N/A	N/A
Climate control	Vrv ac system	N/A
Air and humidity control	No air ventilation system only by windows which is now not possible due to the presence of the exhibition wall. No humidity control equipment	No data.
Rooftop	Insulated by 7 cm dow panels. No specific use of the rooftop	No data.
Energy monitoring and other sensors	No energy monitoring or management system. No other sensor regarding measuring any of the above values.	No data.

5.3 Analysis of end users and stakeholders' requirements

5.3.1 Use cases

Table 12 Use Case Card 1 for Demo 1

Name	Goal
DEMO 1 : Unleashing green cultural experience **Use Case 1: Energy Performance Contract and the Measurement and Verification (M&V) of Energy Savings method (based on IPMVP) supported by Blockchain and Smart Contract Technology (B&SCT) in a cultural site/museum**	**OVERALL GOAL: To become an Museum Show Case adopting the Green Approaches holistically** • to follow Europe's Renovation Wave, by adopting novel and relevant renovation technologies. • to deploy smart energy systems to monitor building performance, analytics and visualisation to support decision making and digital M&V. • to deploy smart systems that allow to control the indoor environmental conditions to ensure comfort of workers and visitors but also ensure the protection of the art collection. • to involve and motivate visitors to support contribute to the green deal and adopt green behaviours during the visit and their personal lives.

<table>
<tr><td></td><td colspan="2">• to Improve the levels of comfort and well-being for both employees and visitors.
• to test and validate M&V and EPC smart contracts.
• to gather and promote evidence for other museums to adopt the tested solutions.</td></tr>
<tr><th>Metrics</th><th colspan="2">Target group</th></tr>
<tr><td rowspan="5">• Reduced energy costs
• Standardised and automated calculation of M&V for energy consumption, air quality and CO_2 level, average internal temperature, humidity, (UV), water management
• Reduced time and cost of renovations packages deployment
• User acceptance and trust metrics</td><td>Target group</td><td>Personas</td></tr>
<tr><td>Museum Owner</td><td>Motivated owner
Demotivated owner</td></tr>
<tr><td>Citizens and Visitors</td><td>Motivated visitors/citizens
Disbelieving/careless visitors/citizens
Demotivated visitors/citizens</td></tr>
<tr><td>ESCO</td><td>ESCO</td></tr>
<tr><td>Employees</td><td>Motivated employees
Demotivated employees</td></tr>
</table>

Table 13 Use Case Card 2 for Demo 1

<table>
<tr><th>Name</th><th colspan="2">Goal</th></tr>
<tr><td>DEMO 1 (GR): Unleashing green cultural experience
Use Case 2: Design and deploy relevant renovation activities to improve the overall building performance assessment
[Building Renovation Company: TGT]</td><td colspan="2">• Cost-effective assessment and certification of building energy performance:
• Design, deployment and testing of a number of state-of the art renovation technologies as a package for market promotion.
• Measure deployment costs and time and adopt approaches for optimising large scale deployment
• Prepare smart contract requirements for EPC
• Prepare financing options for CO_2 and other financing means (GOParity)</td></tr>
<tr><th>Metrics</th><th colspan="2">Target group</th></tr>
<tr><td rowspan="5">• Reduced energy costs
• Standardised and automated calculation of M&V for energy consumption, air quality and CO_2 level, average internal temperature, humidity, (UV), water management
• Reduced time and cost of renovations packages deployment
• User acceptance and trust metrics</td><td>Target group</td><td>Personas</td></tr>
<tr><td>Renovation Company</td><td>Renovation/technical company (in charge of renovation activities) (TGT)</td></tr>
<tr><td>Museum Owner</td><td>Motivated owner
Demotivated owner</td></tr>
<tr><td>ESCO</td><td>ESCO</td></tr>
<tr><td>Suppliers</td><td>Renovation company
Digitisation provider</td></tr>
</table>

5.3.2 Personas

Table 14 Persona 1 – Demo 1

USER	USER CONTEXT
Museum Owner: **Motivated Museum Owner**	Museum owner may be aware of the needs to improve overall building performance through ESIE analysis. He is very concerned about the museum's environmental impact, overall costs,well being of visitors and indoor climate conditions for the collection. In addition, he has trust in the project benefits that can enable wider deployment.
PAIN POINTS	**GOALS**
• Lack of trust and results of an initial financial investment. • Lack of knowledge of the renovation technologies and measurement tools to support their adoption. • Lack of knowledge of experts and renovation technologies potential. • Lack of investment /financing. • Lack of guidance where to start and what are the first steps. • Pressure from the increasing energy costs and uncertain policies	• to adopt ESIE renovation technologies, unambiguous/standardised measurement approaches • to gather and document evidence and design services readily available for the owners to carry renovations to improve ESIE. • to Involve and motivate visitors to support building performance improvements activities • to create a state-of-art green museum and promote it as a showcase museum active for the green deal. • to ensure the optimal indoor environmental conditions of the art collection • to increase building sustainability • to increase the resale value building • to increase number of visitors and social impact of the museum in the long term

Table 15 Persona 2 – Demo 1

USER	USER CONTEXT
Museum Owner: **Demotivated Museum Owner**	Museum owner may not be aware of the need to improve overall building performance through ESIE analysis. He may be unconcerned about the museum's environmental impact. He may disregard building upgrades or renovation and pay the bills without question.
PAIN POINTS	**GOALS**
• Lack of knowledge of the renovation technologies and measurement tools to adopt. • Lack of knowledge of experts and renovation technologies potential. • Lack of investment /financing. • Lack of guidance where to start and what are the first steps. • Pressure from the increasing energy costs and uncertain policies	• to learn about best practice and benefits after the implementation of ESIE measures. • to learn about solutions that address the pains, financing options, motivation options for himself, the visitors and the employees. • to ensure the optimal indoor environmental conditions of the collection • to decrease building costs in any way possible

Table 16 Persona 3 – Demo 1

USER	USER CONTEXT
Citizens/Visitors: **Motivated visitors**	Visitors aware of the need to improve overall building performance, by adopting relevant behaviours. They are willing to Support the gathering of evidence of improved performance, as well as adopt more effective behaviours and accept relevant recommendations. In addition they are willing to support the dissemination of these benefits that enable wider deployment.
PAIN POINTS	**GOALS**
• Lack of knowledge of actions to support their contribution.	• to raise awareness • to further motivate and guide their actions and behaviours (i.e. accept reduced comfort levels and reward for evidenced performance improvement). • to receive rewards for green achievements as further motivation

Table 17 Persona 4 – Demo 1

USER	USER CONTEXT
Citizens/Visitors: **Demotivated visitors**	Demotivated citizens are those who are unconcerned about how their energy consumption affects the environment. They believe that energy efficiency tactics are simply a money-making marketing ploy, as they see no reason to implement energy-saving measures in a location where they do not pay the bill.
PAIN POINTS	**GOALS**
• lack of motivation to participate actively • lack of knowledge of actions to support their contribution. • lack of desire to reduce heating comfort	• to raise awareness about ESIE and the green deal. • to learn about the potential ESIE investments and the value of sustainable solutions. • to become a part of the green deal • to receive rewards for green achievements as motivation/introduction to the benefits of green deal • to learn that the reduced heating comfort is the result of non-sustainable solutions.

Table 18 Persona 5 – Demo 1

USER	USER CONTEXT
Employee: **Motivated Employee**	Motivated employees are people who work at the museum building. They know the existing building conditions and they are aware and easily contribute to improve the overall building performance and enhance the comfort of their working environment. They are willing to actively participate in the dissemination of the benefits that this analysis would provide in terms of consumption, comfort and emissions.
PAIN POINTS	**GOALS**
• other disgruntled employees who do not trust ESIE investments and are resistant to change • lack of knowledge of actions to support the new systems/services	• to raise awareness among those who are less convinced of the usefulness of the system. • to learn about how they can help increase the energy performance and help visitors too but also contribute to create more self-aware energy users • to cultivate eco-friendly behaviour • to boost productivity

	• to further motivate and guide their actions and behaviours • to reach a stage where employees are more satisfied with their jobs • to integrating health and wellness features

Table 19 Persona 6 – Demo 1

USER	USER CONTEXT
Employee: **Demotivated Employee**	Demotivated employees are those who are uninterested regarding the museum's environmental footprint. They are opposed to change, and they are unwilling to alter their working routine. They also do not want any additional responsibilities as a result of these changes.
PAIN POINTS	**GOALS**
• lack of knowledge of actions to support the new systems/services • lack of interest about ESIE • lack of adaptability in new working conditions • lack of interest in changing their behaviour	• to increase trust and knowledge because building performance improvements and comfort help • to raise awareness of the true benefit of the ESIE implementation • to increase awareness and improvement of energy saving behaviour • to influence them to want to be a part of something that benefits the environment • improve workers motivation through green-euro rewards

Table 20 Persona 7 – Demo 1

USER	USER CONTEXT
Renovation company	The Renovation/Technical Company is a company with high experience in maintenance and renovations of buildings and green performance improvement materials and solutions. is aware about the benefits that the new renovation technologies can provide to its business, in terms of efficient, sustainable, inclusive energy use (ESIE) for the relevant facilities. They are looking for ways to penetrate/open the market and increase their business in this domain, while addressing the challenges that limit this scope.
PAIN POINTS	**GOALS**
• difficulty to convince the owners about the benefits that the energy efficiency visualization provides. • hesitation of owners to invest restrict market penetration. • evidence and knowhow in ESIE activities needs enhancement to support large scale renovation and digitisation activities. • synergies to promote services in ESIE (renovation services and EPC smart contracts) with other suppliers and ESCOs for fast market penetration	• to implement and test new renovation technologies (sustainable materials/ renewable sources) • to enlarge their business and knowhow on renovation technology • to reduce the maintenance costs of the facilities. • to promote their work and benefits and existing success stories • to increase their knowledge on new renovation technologies and to get integrated, validated packages for each target group • to optimise the packages in terms of cost, time and investment options for large scale market adoption. • to adopt waste management practices where possible

Table 21 Persona 8 – Demo 1

USER	USER CONTEXT
ESCO	The ESCO is a company with high experience in the energy sector, promoting ESIE implementation and providing smart contracts based on achieved performance improvements
PAIN POINTS	**GOALS**
• services and contracts are not optimised to be widely and easily adopted by the market (too expensive, too lengthy, unclear impact, etc.) • difficulties in convincing the owners to invest in ESIE measures and increasing their trust in ESIE potential. • hesitation of owners to invest restrict market penetration. • evidence and knowhow in ESIE activities needs enhancement to support large scale renovation and digitisation activities. • synergies to promote services in ESIE with other suppliers and ESCOs for fast market penetration	• to implement ESIE measures in different facilities and demonstrate them as well as gather relevant evidence • to optimise the ESIE analysis tools for the facilities. • to implement and test new renovation technologies (sustainable materials/ renewable sources) • to enlarge their business and knowhow on renovation technology • to reduce the maintenance costs of the facilities they are serving. • to promote their work and benefits and existing success stories • to increase their knowledge on new renovation technologies and to get integrated, validated packages for each target group • to optimise the packages in terms of cost, time and investment options for large scale market adoption. • to adopt smart contracts and tools to ease the savings verification procedure

Table 22 Persona 9 – Demo 1

USER	USER CONTEXT
Provider of Digital Solutions	The Provider of Digital Solutions is a company with high experience in the ICT sector. It is aware about the benefits that the new digitisation and automation technologies can provide to its business, so it fosters the implementations for efficient, sustainble, inclusive energy use (ESIE) for the relevant facilities.
PAIN POINTS	**GOALS**
• difficulty to convince the owners of the facilities about the benefits that the energy efficiency visualization provides. • hesitation of owners to invest restrict market penetration • evidence and knowhow in ESIE activities needs enhancement to support large scale renovation and digitisation activities. • synergies to promote services in ESIE with other suppliers and ESCOs for fast market penetration	• to implement and test new digitisation and automation technologies (gather data, document in blockchain, user applications, mobile applications for user engagement and interaction • to integrate this services with complementary services of other suppliers • to enlarge the commercial activites in the area of building renovation and performance improvement • to increase their knowledge and services on new digitisation and automation technologies • to gain visibility out of the implemented pilots

5.3.3 User stories

Table 23 User stories for Persona 1 (Motivated Museum owner)

User Story 1.1
As a motivated Museum owner, I want to implement renovation measures, so that the ESIE measurements of these facilities are ameliorated, reducing costs and GHG emissions.
User Story 1.2
As a motivated Museum owner, I want to increase the trust of the visitors, so that it is easier to convince them to be engaged to improve ESIE measurements.
User Story 1.3
As a motivated Museum owner, I want to adopt standardised M&V tools, so that the M&V is unambiguously calculated and shared with relevant stakeholders (e.g. ESCO).
User Story 1.4
As a motivated Museum owner, I want to motivate visitors and employees to be engaged in increasing building performance, so that the cost savings are maximised.
User Story 1.5
As a Motivated Museum owner, I want to convince other museums about the benefits of the ESIE investments, so that these become motivated about the implementation of ESIE measures too.
User Story 1.6
As a motivated Museum owner, I want to implement novel renovation measures so that the conditions for storing and exhibiting the collection are improved.

Table 24 User stories for Persona 2 (Demotivated Museum owner)

User Story 2.1
As a Demotivated Museum owner, I want to learn about the real benefits of ESIE and renovation technologies, so that I decide to invest on them for my building.
User Story 2.2
As a Demotivated Museum owner, I want to be ensured about costs and savings related to all service providers so that I can benefit from an Energy Performance Contract.
User Story 2.3
As a Demotivated Museum owner, I want to understand the real benefits of ESIE measures, so that I foster the implementation of these measures.

User Story 2.4
As a Demotivated Museum owner, I want to continuously monitor and control the internal conditions (air quality , humidity/ CO_2 levels/ human comfort) of the museum so that the art and humans obtain the optimal conditions of comfort and operation.

Table 25 User stories for Persona 3 (Motivated visitor)

User Story 3.1
As a motivated visitor, I want to know how I can contribute to the museum greener operations so that I become more environmentally aware citizen.
User Story 3.2
As a motivated visitor, I want to know the results of my greener operations so that I can be rewarded.
User Story 3.3
As a motivated visitor, I want to experience the Green Euro concept so that I can be motivated and further adopt it.

Table 26 User stories for Persona 4 (Demotivated visitor)

User Story 4.1
As a Demotivated visitor, I want to understand the real benefits of ESIE measures so that I can also contribute to these activities in the museum and in general.
User Story 4.2
As a Demotivated visitor, I want to be motivated and rewarded for my green actions so that I can take more green initiatives with them.

Table 27 User stories for Persona 5 (Motivated employee)

User Story 5.1
As a Motivated employee, I want to learn how I can contribute to improve museum's overall performance, so that it becomes a green museum with related benefits, related to comfort of workign conditions, rewards and overall contribution to the fight against the environment.
User Story 5.2
As a Motivated employee, I want to monitor and control the building performance parameters so that I can take and promote relevant actions (opr example to issue a poll for visitors to reduce the temperature when energy consumption increases, or to switch on the ventilation when the air quality drops).

User Story 5.3
As a Motivated employee, I want to be motivated and rewarded for my green actions so that I can take more green initiatives with them.

Table 28 User stories for Persona 6 (Demotivated employee)

User Story 6.1
As a Demotivated employee, I want to get motivated to help the museum improve its overall performance, so that it becomes a green museum with related benefits related to comfort of working conditions, rewards and overall contribution to the fight against the climate change.
User Story 6.2
As a Demotivated employee, I want to be involved in the decision about the environmental conditions of my workspace, so that my well-being and comfort at work is ensured.
User Story 6.3
As a Demotivated employee, I want to be motivated and rewarded for my green actions so that I can take more green initiatives.

Table 29 User stories for Persona 7 (Renovation company)

User Story 7.1
As a Renovation Company, I want to test and deploy state of the art renovation technologies so that I can offer better, cheaper and faster relevant services.
User Story 7.2
As a Renovation Company, I want to test M&V so that I can know the impact of renovation packages in each target group which is calculated in standardised way.

Table 30 User stories for Persona 8 (ESCO)

User Story 8.1
As an ESCO, I want to implement ESIE measures in different building facilities, so that ESCO knowledge is increased.
User Story 8.2
As an ESCO, I want to measure the impact of ESIE and building performance improvements in standardised way, so that I can build customer trust and it is easier to convince them.
User Story 8.3
As an ESCO, I want to adopt ESIE and building performance improvements, so that their overall sustainability is enhanced and their life is extended.
User Story 8.4
As an ESCO, I want to gather and promote evidence, so that market penetration is facilitated.

User Story 8.5
As an ESCO, I want to adopt the green Euro as a behaviour change and financing facilitator so that customers are further motivated to invest.
User Story 8.6
As an ESCO, I want to create synergies with other complementary service providers so that we provide more value and ease market penetration.
User Story 8.7
As an ESCO, I want to optimise the packages in terms of time, cost, and investment options, so that customers investment decisions are easier.

Table 31 User stories for Persona 9 (Provider of Digital Solutions)

User Story 9.1
As a Provider of Digital Solutions, I want to demonstrate end to end M&V and energy performance contracting technologies, so that it is easier to penetrate the market.
User Story 9.2
As a Provider of Digital Solutions, I want to integrate, test and deploy state of the art digitisation services with renovation technologies so that to enlarge commercial activities.
User Story 9.3
As a Provider of Digital Solutions, I want to integrate and test M&V so that the impact of renovation and ESIE activities in each target group is calculated in standardised way.
User Story 9.4
As a Provider of Digital Solutions, I want to create synergies with other complementary service providers so that we provide more value and ease market penetration.

6 The pilots – Demo 2 (VEO)

6.1 Description of the pilot sites

6.1.1 Description of the building

Characteristics of building

VEO will have of Demo 2 a residential district of 20 blocks of buildings. This district is called FASA. It is located in the South-East of Valladolid (Spain), so it is in an urban area. It was constructed During the 50's and 60's decades and its main materials are brick, cement and metal. It is terrace-detached.

The main physical characteristics are the following:

- District area: 29,000 m^2
- Constructed area: 36,5000 m^2
- Conditioned area (dwellings): 24,7000 m^2

This district consists of 20 blocks, a tower, a building for the central boilers, a park, some sports facilities and 2 car parks. Some of the buildings have their main façades oriented to east and west direction and the rest to north-east and south-west.

Figure 8 FASA District overview

Figure 9 Demo 2 details

Characteristics of renovation

In this Demo, apart from the tower, there are 18 blocks that were renovated in 2018 and 1 block that was not renovated (with the main physical characteristics of the rest).

This district has been renovated in 2018 within the REMOURBAN project incorporating the following elements:

- New biomass boilers and new DH network.
- New 20 substations.
- New DEMS, BEMS and HEMS.
- Roof and façade buildings retrofitting (except one)
- LED lighting in the common areas

The main reason for the renovation was to increase energy efficiency in the district by reducing heat losses and contributing to the decarbonisation and sustainability plan.

The buildings are located in a Mediterranean climate, which is temperate with dry, hot summer [Winter (min, max) 0oC – 8oC, summer (min, max) 15ºC – 32ºC].

In relation to the energy source, it is based on biomass and gas backup and the energy use is heat supply from oil and gas-fired boilers.

There are regional incentives active in the pilot region to improve the quality of life of the city and with the aim of accelerating its transformation.

6.1.2 Target groups

The buildings of VEO are residential buildings, they are considered an owners's community (condominium). They have 1,181 inhabitants with a population density 340 inhab/ha. The distribution of the inhabitants according to age is the following:

- People > 65 years – 22, 50%
- People >=18 years and <=65 years – 66,5
- People < 18 years – 11%

The inhabitants are the main stakeholders in this Demo but in the buildings there are also business premises.

6.1.3 The external stakeholders

The buildings from VEO have the following primary stakeholders related to the building and their core interest:

- Citizens and owners- to improve their contracts.
- Investors- to link the energy savings to the economic benefit.
- Suppliers- to expand their business activities improving their ITC solutions.

6.2 Analysis of current situation

Some of the main aspects to be considered are the following:

- Temperature and climate situation
  - Warm summers and cold winters (Continental climate)
  - Winter (min, max) 0ºC – 8ºC, summer (min, max) 15ºC – 32ºC
  - In 2022, the annual average heating degree days (HDD) was 2262.
- Energy use situation
  - The neighbourhood was completely remodelled in 2019, changing the network, renovating the hall, insulating facades and roofs. In addition, a photovoltaic system was installed.
  - One of the main objectives at present is to achieve the optimisation of the installation.

6.2.1 Existing measuring systems and data

Currently, a total of 700 variables are monitored. These include: boiler energy production and building demand.

Monitoring data has been collected for more than 3 full years.

The current technologies used for heating are based boilers. In the boiler room there are 3 boilers.

- Boiler 1, biomass boiler (499 kW), covers most of the demands.
- Boiler 2, biomass boiler (499 kW), works as secondary, supporting the main boiler in the periods of time when Boiler 1 is not enough to cover demand.
- Boiler 3, gas boiler (3,750 kW).

This distribution system provides thermal energy (DHW+heating) to the 20 buildings through 20 heat exchange substations.

Currently, 768 variables are measured and collected, such as:

- Energy production (MWh)
- Gas consumption (MWh - HHV)
- Energy demand (MWh) (District, building & dwelling)
- Flow and return temperature (ºC)

Table 32 Existing measuring systems and data – Demo 2 (VEO)

System	Details	Current estimated data
Energy consuming equipment and overall consumption	Pumps/ for heating and domestic hot water	Electricity meter1: 1516.31 kWh Electricity meter 2: 1642.1 kWh Electricity meter 3: 1190.29 kWh Electricity meter 4: 1531.28 kWh Electricity meter 5: 1303.1 kWh Electricity meter 6: 1342.64 kWh Electricity meter 7: 1224.21 kWh Electricity meter 8; 1424.63 kWh Electricity meter9: 1326.22 kWh Electricity meter 10: 1393.18 kWh Electricity meter 11: 1334kWh Electricity meter 12: 1370 kWh Electricity meter 13: 1372kWh Electricity meter 14: 1294 kWh Electricity meter 15: 1446 kWh Electricity meter 16: 1501 kWh Electricity meter 17: 1228 kWh Electricity meter 18: 1521 kWh Electricity meter 19: 1401 kWh
Energy generating equipment	Photovoltaic plant 3 boilers (2 biomass, 1 gas-fired)	Photovoltaic plant: 5.2 MWh Biomass: 1178.36 MWh and 1209.66 MWh Gas fired: 177.37 MW
Climate control	Thermostatic valves	N/A
Air and humidity control	NO	N/A
Rooftop	NO	N/A
Energy monitoring and other sensors	BEMS/DEMS & Smart meters	N/A

6.3 Analysis of end users and stakeholders requirements

6.3.1 Use cases

Table 33 Use Case Card for Demo 2 (VEO)

Name	Goal
DEMO 2 (ES): Green, comfortable, and sustainable homes **Use Case 1: Energy Performance Contract and the Measurement and Verification (M&V) of Energy Savings method (based on**	**Overall goal: To improve the current EPCs by a verification system to increase the consumer trust.** • To develop a method to calculate the energy savings, based on IPMVP.

IPMVP) supported by Blockchain and Smart Contract Technology (B&SCT)in a residential district [ESCO: VEO]	• To deploy advance analytics for Measurement and Verification (M&V) calculations. • To create a tool that shows the energy savings for the ESCO. • To deploy Blockchain and Smart Contract Technology (B&SCT) to certificate compliance of the contract. • To increase consumer trust on EPCs by using Blockchain and Smart Contract Technology (B&SCT). • To gather and promote evidence for other buildings to adopt EPCs. • To increase the comfort of the home and the daily life of the user. • To motivate commitment to the environment by setting an example.

Metrics	**Target group**	
	Target group	**Personas**
Energy consumption Verifying the EPC is well controlled with the new tool User awareness of further saving measures User confidence in assessment methods Higher customer trust	**ESCOs**	ESCO ESCOs developer market
	Citizens and Owners	Motivated owner Careless owner Disbelieving owner
	Investors	Benefit-oriented bank Sustainability supporter bank
	Suppliers	Provider of digital solutions

6.3.2 Personas

Table 34 Persona 1 – Demo 2 (VEO)

USER	**USER CONTEXT**
ESCOs: **ESCO**	The ESCO is a company with high experience in the energy sector. It is aware about the benefits that the energy efficiency can provide to its business, so it fosters the implementations of energy efficiency measures in the facilities it manages.
PAIN POINTS	**GOALS**
The knowledge the ESCO about some of the facilities it manages is limited, which hinders the optimal operation of those. The ESCO finds difficult to convince the owners of the facilities about the benefits that the energy efficiency measures provide. This issue will be eased by increasing the trust of the owners in these measures.	The Pilot services can help them: • to implement energy efficiency measures in different facilities. • to make it easier to convince the owners to carry out the interventions to improve the efficiency. • to improve the analysis of the energy performance of the facilities. • to promote their work and benefits and existing success stories. • to have a way to certificate the energy savings verification procedure. • to increase the knowledge that the ESCO has about the facility it manages.

Table 35 Persona 2 – Demo 2 (VEO)

USER	USER CONTEXT
ESCOs: **ESCOs developer market**	ESCOs provides the expertise to help the building manager successfully implement an EPC project. They work with building owners to help them enter into an energy performance contract.
PAIN POINTS	**GOALS**
The ESCOs developer market deals with homeowners who are not aware of the benefits of energy efficiency. The ESCOs developer market will therefore have to try to convince them to obtain an EPC contract.	The pilot services can help them: • to exemplify how energy performance contracting works. • to demonstrate the benefits of good energy efficiency practices in buildings. • to provide the data needed to compare installations before and after the changes are made

Table 36 Persona 3 – Demo 2 (VEO)

USER	USER CONTEXT
Citizens and Owners: **Motivated owners**	Motivated owners are people who own and/or live in a building. They know and are aware of the need to reduce emissions through energy consumption analysis. They are willing to actively participate in the dissemination of the benefits that this analysis would provide in terms of consumption, comfort, and emissions.
PAIN POINTS	**GOALS**
Lack of tools to prove to other disbelieving owners the savings they will be getting. • Reluctance to make the initial investment without a concrete forecast of the savings they will make. • Mild mistrust in the forecasted savings specified by the ESCO".	Pilot services can help them: • Upgrading the value of housing through the use of energy efficiency. • Encourage other homeowners to benefit from these services. • Improve their contracts thanks to energy performance contracts.

Table 37 Persona 4 – Demo 2 (VEO)

USER	USER CONTEXT
Citizens and Owners: **Careless owners**	The careless owner is the owner and inhabitant of one or more dwellings in the building, and does not care about consumption, emissions or comfort. He/she ignores existing upgrades in the contracts to save and pays the bills without concern. They do not participate in decision-making in the building and do not have a good or close relationship with other neighbours.
PAIN POINTS	**GOALS**
• Lack of tools to be convinced of the savings he/she will be getting. • Reluctance to make the initial investment without a concrete	Pilot services can help them: • to get awareness about the real benefits behind the implementation of energy efficiency measures and about

forecast of the savings he/she will make. • Lack of interest in the forecasted savings specified by the ESCO. • Easily convinced by other neighbours (both by motivated or disbelieving).	the impact of these measures, making them more in favour of the changes.

Table 38 Persona 5 – Demo 2 (VEO)

USER	USER CONTEXT
Citizens and Owners: **Disbelieving owners**	The disbelieving owner is an owner and inhabitant of one or more flats in the building. He is a person who pays his bills, does not cause any problems, but he is not committed to ESCO. He thinks that ESCO uses energy efficiency proposals as a marketing ploy to make money, as he sees no need to implement energy saving measures and tries to get the other neighbours on his side.
PAIN POINTS	**GOALS**
• Lack of tools to be convinced of the savings to be gained. • Severe reluctance to make the initial investment without a concrete forecast of the savings he/she will make. • Severe mistrust in the forecasted savings specified by the ESCO.	• Tools to help convince about the savings they will be getting. • Evidence and financial tools to help minimise risks and initial costs and concrete forecast of the savings he/she will make. • Green Euro rewards and behaviour change recommendations tailored to individual profiles and consumption patterns to train about the possible actions to do.

Table 39 Persona 6 – Demo 2 (VEO)

USER	USER CONTEXT
Investors: **Benefit-oriented bank**	The benefit-oriented bank is a private international company whose main interest is to make profit from its operations. Analysing the opportunities of ESIE in the market, could consider entering, even if it is not specialised in this field. It has some doubts about the type of credits it can grant in this sector for measures of this type.
PAIN POINTS	**GOALS**
• the fear Benefit-oriented bank has of not profiting from the energy efficiency sector. • the lack of specialisation and information that bank has.	Pilot services can help them: • Exploit the potential of the energy contracts and offer new tailored services. • Predict the benefit to be gained from making this type of investment. • Link the energy savings to the economic benefit, helping them to capture the advantages."

Table 40 Persona 7 – Demo 2 (VEO)

USER	USER CONTEXT
Investors: **Sustainability supporter bank**	The Sustainability Supporter Bank is a socially approved bank for its work in social and sustainable actions. From experience, it is aware of the many environmental benefits of energy efficiency projects.
PAIN POINTS	**GOALS**
• to not compromise its decisions by taking care of its image. • doubt of whether all projects it finances are good for the environment and beneficial.	Pilot services can help them: • to understand the potential economic and environmental benefits of the project. • to improve their ROI, by promoting this kind of interventions/investments.

Table 41 Persona 8 – Demo 2 (VEO)

USER	USER CONTEXT
Provider of Digital Solutions	The Provider of Digital Solutions is a company with extensive experience in the ICT sector, able to develop a solution based on ICT that meets the needs from the ESCO.
PAIN POINTS	**GOALS**
• difficulty to convince the owners of the facilities about the benefits that the energy efficiency visualization provides. • the lack of confidence of facility owners in digital solutions • synergies to promote services in ESIE with other suppliers and ESCOs for fast market penetration	• to make use of innovative ICT solutions for the energy efficiency field. • to make itself known through existing pilots. • expand business activities in the field of building performance improvement.

6.3.3 User stories

Table 42 User stories for Persona 1 (ESCO)

User Story 1.1
As an ESCO, I want to implement ESIE measures in different facilities, so that the efficiency of these facilities increases, reducing costs and GHG emissions.
User Story 1.2
As an ESCO, I want to increase the trust of the owners, so that it is easier to convince them to carry out interventions to improve the efficiency.
User Story 1.3
As an ESCO, I want to improve the analysis means of the facilities, so that the M&V activities are easier.
User Story 1.4
As an ESCO, I want to make the energy savings verification procedure easier, so that trust of owners can increase and overall offering is more credible.

Table 43 User stories for Persona 2 (EPC facilitator)

User Story 2.1
As an EPC facilitator, I want to adopt and present Energy Performance Contracts offerings, so that they realise the benefits this tool provides to both the owners and the ESCO.
User Story 2.2
As an EPC facilitator, I want to prove the upsides of the implementation of energy efficiency measures in the buildings, so that owners foster the renovation of their buildings.
User Story 2.3
As an EPC facilitator, I want to provide accurate information about the facility's behaviour before and after and intervention so that owners realise the benefits provided by energy efficiency measures.

Table 44 User stories for Persona 3 (Motivated owner)

User Story 3.1
As a Motivated owner, I want to convince other owners about the benefits of energy efficiency interventions, so that these become motivated about the implementation of energy efficiency measures too.
User Story 3.2
As a Motivated owner, I want to benefit from financial support tools to face the upfront costs of the interventions using Energy Performance Contracts, so that the energy efficiency intervention can be carried out even if I am not able to pay for it.
User Story 3.3
As a Motivated owner, I want to implement energy efficiency measures to my building, so that the value of the dwelling I own increases.

Table 45 User stories for Persona 4 (Careless owner)

User Story 4.1
As a Careless owner, I want to realise that there is a real benefit behind the application of energy efficiency measures, so that I can promote its implementation in my building.
User Story 4.2
As a Careless owner, I need evidence to trust the ESCO, so that I can benefit from an Energy Performance Contract.

Table 46 User stories for Persona 5 (Disbelieving owner)

User Story 5.1
As a Disbelieving owner, I want to understand the real benefits of energy efficiency measures, so that I foster the implementation of these measures.
User Story 5.2
As a Disbelieving owner, I want to realise how the energy performance contracts work, so that I can benefit from those.

Table 47 User stories for Persona 6 (Benefit-oriented bank)

User Story 6.1
As a Benefit-oriented bank, I want to reduce the risk in the investment on energy efficiency measures, so that I can invest in more facilities with confidence and obtain economic benefit.
User Story 6.2
As a Benefit-oriented bank, I want to precisely foresee the benefit to obtain when making this kind of investment, so that I can make better predictions about my investment plan.
User Story 6.3
As a Benefit-oriented bank, I want to link energy savings to economic benefit, so that I can quantify the benefits of a certain investment.

Table 48 User stories for Persona 7 (Sustainability supporter bank)

User Story 7.1
As a Sustainability supporter bank, I want to foresee both economic and environmental impact of the different energy efficiency measures, so that I can understand the benefits of a certain intervention, helping me to take a decision.
User Story 7.2
As a Sustainability supporter bank, I want to improve the ROI of my investment, so that I can promote more energy efficiency interventions.

Table 49 User stories for Persona 8 (Provider of digital solutions)

User Story 8.1
As a Provider of Digital Solutions, I want to demonstrate end to end M&V and energy performance contracting technologies, so that it is easier to penetrate the market.
User Story 8.2
As a Provider of Digital Solutions, I want to integrate, test and deploy state of the art digitisation services in the field of energy efficiency so that to enlarge commercial activities.

7 The pilots – Demo 2 (GAR)

7.1 Description of the pilot sites

7.1.1 Description of the building

Currently, GAR proposes the following building to be part of the FORTESIE project, but it has to be noted that depending on different factors it may change for another with similar characteristics, as GAR is doing several renovations a year.

Characteristics of building

The proposed building (in an urban environment) is located Gijón, in Campo Sagrado Street, 59. It is in the process of being rehabilitated, with 4 floors and 8 homes. It was built in 1962.

Figure 10 Location of the building in Gijón

Figure 11 External aspect of the building

Characteristics of renovation need

The building needs a façade renovation due to:

- Large energy losses due to poor insulation of the building and the existence of thermal bridges, most of them on open terraces. These cause heat leaks and pathologies such as condensation and others. The apartments also have obsolete windows with considerable energy losses.
- A reduction in energy demand is required, so GAR proposes the renovation of the building by incorporating insulation in all facades of the thermal envelope. Moreover, the replacement of windows and the closing of the open terraces also with high-performance windows.
- Overall ESIE monitoring is proposed and to enable among other things, a most efficient use and, consequently, a decrease in energy use and CO_2 emissions.

Below there is a schema of the different types of façades proposed by GAR to accomplish the renovation process.

Figure 12 Schema of the types of façades

- Front façade: EFIVENTO SYSTEM: ventilated facade with PIR (polyisocyanurate insulation 60mm R:2,72 m^2/wk)
- Back and REAR façade: EFIMETA SYSTEM: pre-industrialized facade with PIR insulation (polyisocyanurate insulation 50mm+20mm chamber R:2,40 m^2/wk)
- Inner and side façade: ETICs: (EPS Neopor 80 mm R:2,5 m^2/wk)

(To obtain the final transmittance of the action, the resistance of the current walls would also have to be added)

7.1.2 Target groups

The target groups are the owners of the homes (there are 8 homes).

7.2 Analysis of current situation

7.2.1 Existing measuring systems and data

The main characteristics related to energy consumption at the building are the following:

- Connected to the general electrical network.
- It does not have a connection to the piped gas distribution network.
- 6 homes with DHW electric accumulators.
- 2 homes with DHW through butane gas (LPG).

- None has air conditioning.
- Individual meters per dwelling.
- 8 houses with electric heating (electric radiators).

7.3 Analysis of end users and stakeholders' requirements

7.3.1 Use cases

Table 50 Use Case Card for Demo 2 (GAR)

<table>
<tr><th>Name</th><th colspan="3">Goal</th></tr>
<tr><td>DEMO 2 (ES): Green, comfortable, and sustainable homes
Use Case 2: Building Renovation Company will apply and demonstrate an energy performance assessment and certification in one building renovation project
[Building Renovation Company: GAR]</td><td colspan="3">• Cost-effective assessment and certification of building energy performance:
• To refurbish a building by installing a new façade with thermal insulation in its envelope to reduce energy costs and improve ESIE.
• To learn and document the individual energy consumption by installing monitoring and measurements systems inside the homes.
• To capture and analyse the behaviour of the users in energy aspects, so they can be advised on the most appropriate way to manage their energy consumption to reduce it.
• To demonstrate the results of the intervention by comparing them in relation to what was estimated and what was finally obtained.
• To increase the comfort of the home and the daily life of the user.
• To motivate commitment to the environment through the provided recommendations.</td></tr>
<tr><th colspan="2">Metrics</th><th colspan="2">Target group</th></tr>
<tr><td colspan="2" rowspan="4">• Effective execution of façade renovation of at least one building with 8 homes, including monitoring of energy consumption through sensors and meters.
• cost of monitoring system
• measurements for individual energy consumption: energy consumption, air quality and CO_2 level, average internal temperature, humidity, (UV), external conditions (temperature, humidity, wind, rain).
Accurate of building energy demand estimator
User acceptance and trust and comfort metrics
DEMO KPIs:
- Number of houses included in the renovation (at least 8)
- Number of homes with indoor monitoring (at least 4)
- % Estimated demand reduction according to national certification systems (at least 30%)
- % Reduction of CO_2 emissions according to national certification systems (at least 30%)
- Customer satisfaction with the performance (at least 6 particate to surveys in the project)</td><th>Target group</th><th>Personas</th></tr>
<tr><td>Building renovation company</td><td>Project designer
Sales department</td></tr>
<tr><td>Citizens and Owners</td><td>- Owners involved in the renovation (motivated owners)
- Owners involved in the renovation (disbelieving owners)
- Other citizens and owners</td></tr>
<tr><td>Suppliers</td><td>- Providers of Building Renovation
- Digital solutions provider</td></tr>
</table>

7.3.2 Personas

Table 51 Persona 1 – Demo 2 (GAR)

USER	USER CONTEXT
Building renovation company: **Project Designer**	The project designer is responsible for deciding the combination of systems and materials that are most suitable for the building and proposing an intervention that resolves pathologies and at the same time improves energy performance.
PAIN POINTS	**GOALS**
Difficulty to design a new project based on different features of a building, as to date, the results of the renovation actions are estimates, based on standardized calculations through programs approved by the government and that are based on general experiences on a laboratory scale. Thus, the project designer does not have specific data to efficiently design new projects in new buildings with different characteristics.	• to know the effectiveness of the interventions, comparing the reality achieved vs the projected interventions. • to use the cost-effective assessment and certification of building energy performance to design new projects in an effective way. • to install innovative systems and materials in the façade of a building. • to enlarge their business and knowhow on renovation technology. • to reduce the maintenance costs of the facilities. • to promote their work and benefits and existing success stories. • to adopt waste management practices where possible.

Table 52 Persona 2 – Demo 2 (GAR)

USER	USER CONTEXT
Building renovation company: **Sales Department**	The Sales Department is responsible for conveying to customers the suitability of the proposed intervention.
PAIN POINTS	**GOALS**
Difficulty to convince the owners about the benefits of getting a façade renovation project, as to date, the results of the renovation actions are estimates. Thus, the sales department does not have specific data to show the homeowners about their future savings, so they have a hard time convincing the most distrustful or reticent customers.	• to know the effectiveness of the interventions, comparing the reality achieved vs the projected interventions. • to use the cost-effective assessment and certification of building energy performance to show the clients what they are consuming and savings, so they could be more informed to get decisions. • to promote benefits from existing success stories.

Table 53 Persona 3 – Demo 2 (GAR)

USER	USER CONTEXT
Citizens & owners: **Owners involved in the renovation [Motivated owners]**	They are the owners who have decided to undertake a renovation work because they want to reduce their energy consumption, reduce CO_2 emissions and the potential reduction of their energy bill. They are also interested in the improvement of their buildings.

	They are convinced that the renovation will have the promised results.
PAIN POINTS	**GOALS**
Lack of tools to really know savings they will be getting. Mild mistrust in the forecasted savings specified by the renovation company.	• To verify the promised results by the renovation company. • To upgrade the value of housing through the use of energy efficiency. • To encourage other homeowners to benefit from these services.

Table 54 Persona 4 – Demo 2 (GAR)

USER	**USER CONTEXT**
Citizens & owners: **Owners involved in the renovation [Disbelieving owners]**	They are the owners who have decided to undertake a renovation work because they want to reduce their energy consumption, reduce CO_2 emissions and the potential reduction of their energy bill. They are also interested in the improvement of their buildings. They have accepted the renovation for the sake of the building, but they think that their energy consumption will not really be reduced.
PAIN POINTS	**GOALS**
• Lack of tools to really know savings they will be getting. • Severe mistrust in the forecasted savings specified by the renovation company.	• To verify the promised results by the renovation company. • To upgrade the value of housing through the use of energy efficiency.

Table 55 Persona 5 – Demo 2 (GAR)

USER	**USER CONTEXT**
Citizens & owners: **Other citizens and owners**	They are citizens or homeowners who have not yet made the decision to rehabilitate their buildings. They would like to reduce their energy consumption, but they are hesitant due to the cost of the renovation, which they are not sure that they will get back with the energy bill reduction.
PAIN POINTS	**GOALS**
• Lack of tools to be convinced of the savings he/she will be getting. • Reluctance to make the initial investment without a concrete forecast of the savings he/she will make.	• To learn about advantages of renovation in real buildings thanks to the dissemination activities of the project. • to see that there is a real benefit behind the implementation of energy efficiency measures. • to become more aware of the impact of these measures, making them more in favour of the changes.

Table 56 Persona 6 – Demo 2 (GAR)

USER	USER CONTEXT
Suppliers: **Providers of Building Renovation**	They are the manufacturers and suppliers of materials and systems that will be integrated into the solutions projected by the designers of the project.
PAIN POINTS	**GOALS**
Lack of tools to know the performance of the materials or equipment they develop, as they have been measured on a laboratory scale or in artificial environments individually but not in a real demonstrator and in an integrated manner with the rest of the components.	to analyse the solutions comparatively and detect deviations from the expected results that will allow manufacturers to improve their products.

Table 57 Persona 7 – Demo 2 (GAR)

USER	USER CONTEXT
Suppliers: **Providers of Digital Solutions**	The Provider of Digital Solutions is a company with extensive experience in the ICT sector. This provider is able to develop ICT solutions that meets the needs from the renovation company.
PAIN POINTS	**GOALS**
• difficulty to convince the owners of the facilities about the benefits that the energy efficiency visualization provides. • the lack of confidence of facility owners in digital solutions. • synergies to promote services in ESIE with other suppliers and ESCOs for fast market penetration.	• to make use of innovative ICT solutions for the energy efficiency field. • to make itself known through existing pilots. • expand business activities in the field of building performance improvement.

7.3.3 User stories

Table 58 User stories for Persona 1 (Project Designer)

User Story 1.1
As a project designer, I want to implement ESIE measures in buildings, so that the efficiency of these buildings increases, reducing costs and GHG emissions.
User Story 1.2
As a project designer, I want to know the effectiveness of the interventions, comparing the reality achieved vs the projected interventions so that I know the real results of my projects.
User Story 1.3
As a project designer I want to use the cost-effective assessment and certification of building energy performance so that I am able to design new projects in an effective way.
User Story 1.4
As a project designer, I want to install innovative systems and materials in the façade of a building so that I profit from the last technical advances.

Table 59 User stories for Persona 2 (Sales Department)

User Story 2.1
As Sales Department, I want to know the effectiveness of the interventions, comparing the reality achieved vs the projected interventions so that I gain the trust of customers.
User Story 2.2
As Sales Department, I want to use the cost-effective assessment and certification of building energy performance to show the clients what they are consuming and savings, so that they could be more informed to get decisions.
User Story 2.3
As Sales Department, I want to promote benefits from existing success stories so that I can generate more business opportunities.

Table 60 User stories for Persona 3 (Owners involved in the renovation - Motivated owners)

User Story 3.1
As an owner involved in the renovation (Motivated owner), I want to verify the promised results by the renovation company so that I know if I have invested my money well.
User Story 3.2
As an owner involved in the renovation (Motivated owner), I want to implement ESIE measures to my building, so that the value of the dwelling I own increases.
User Story 3.3
As an owner involved in the renovation (Motivated owner), I want to encourage other homeowners to benefit from these services, so that more people can contribute to emissions reduction.

Table 61 User stories for Persona 4 (Owners involved in renovation - Disbelieving owners)

User Story 4.1
As an owner involved in the renovation (Disbelieving owner), I want to verify the promised results by the renovation company, so that I know if I have invested my money well.
User Story 4.2
As an owner involved in the renovation (Disbelieving owner), I want to implement energy efficiency measures to my building, so that the value of the dwelling I own increases.

Table 62 User stories for Persona 5 (Other citizens and owners)

User Story 5.1
As an Other citizen and owner, I want to know the real results of other buildings, so that I am able to decide whether or not to act on mine.

Table 63 User stories for Persona 6 (Providers of Building Renovation)

User Story 6.1
As a Provider of Building Renovation solutions, I want to give more accurate information based on real results, so that I am able to gain the trust of customers.
User Story 6.2
As a Provider of Building Renovation solutions, I want to know the real results of the solutions I develop, so that I am able to improve them.

Table 64 User stories for Persona 7 (Providers of digital solutions)

User Story 7.1
As a Provider of digital solutions, I want to demonstrate technologies in the field of assessment and certification of building energy performance, so that it is easier to penetrate the market.
User Story 7.2
As a Provider of digital solutions, I want to integrate, test and deploy state of the art digitisation services in the field of energy efficiency so that it is possible to enlarge commercial activities.

8 The pilots – Demo 2 (ENE)

8.1 Description of the pilot sites

The activity of Demo2 is complemented by the inclusion of ENE as a one-stop shop. Thus, ENE role in Demo 2 will focus on providing information for renovations but not achieving a renovation.

Below, the main aspects of ENE are described:

ENE is an organization that manages the efficient use of energy and whose activity is oriented towards improving the environment, reducing CO_2 emissions and sustainable development, promoting energy efficiency, the use and knowledge of renewable energies and optimization of the quality of services related to this sector.

Its main objective is to contribute to making the council of Langreo in particular, and Asturias in general, a benchmark area at the national level in the energy sector, promoting a new energy culture among citizens, industry and public bodies.

As an energy agency, its role is key to achieving local and global energy, economic and environmental objectives, as well as monitoring initiatives, projects and subsidies from the European Commission.

ENE's lines of action are:

- TECHNICAL POINT: Information and advice to companies.
- INSTITUTIONAL LINE: Technical support at the municipal level.
- DISCLOSE ENERGY: Attention and training to citizens and educational centres.

8.1.1 Langreo Municipality

Langreo is part of the Metropolitan Area of central Asturias (one of the largest in Spain), together with the urban and peri-urban space of Oviedo, Gijón, Avilés, Siero and Mieres, an interconnected territory of more than 850.000 inhabitants.

Figure 13 View of Langreo (Asturias)

The municipality of Langreo, with nearly 40,000 inhabitants and an area of 82,46 km2, includes the urban districts of Ciañu, Sama, La Felguera, Lada, Barros, Riañu and Tuilla, which are articulated in a linear city model which follows the course of the Nalón river and its tributaries, urban areas surrounded by a valuable rural and natural environment of mid-mountain valleys.

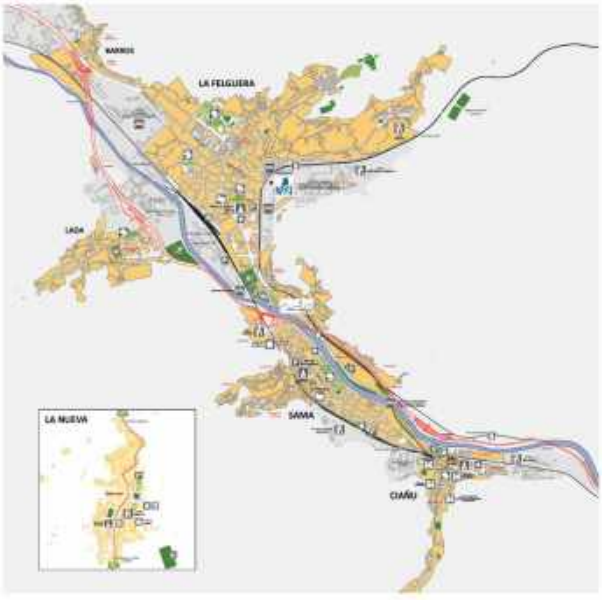


Figure 14 Langreo map

8.2 Analysis of end users and stakeholders requirements

8.2.1 Use cases

Table 65 Use Case Card for Demo 2 (ENE)

Name	Goal
DEMO 2 (ES): Green, comfortable, and sustainable homes **Use Case 1: One-Stop-Shop for information on renovation services**	**Overall goal: To support the FORTESIE marketplace as a one-stop-shop.** The renovation processes in the building industry are very complex as they imply a lot of different entities and actors. In addition, the cost of any action is very high, so even taking a decision about carrying out a renovation process can be difficult. A one-stop-shop is either physical or online place where people can find all the information and services they need for a certain action. In this context, FORTESIE will implement an online marketplace for sustainable service provisioning and value chain networking acting as a One-Stop-Shop for building renovation for ESIE, networking and empowering local actors. This marketplace intends to facilitate the networking between involved stakeholders and providing all the necessary info to carry out an efficient renovation of a building, from the techniques to be used or the companies to contact, to the new financing possibilities that will be promoted in FORTESIE (e.g. innovative and alternative schemes such as crowd funding and green euro rewards, a potential Central Bank Digital Currency (CBDC), etc). ENE will support this marketplace, being one of the two entities working as a one-stop-shop. ENE will combine their online attention in the marketplace with presential attention in Spain, in both cases informing about the different possibilities that FORTESIE offers.

Metrics	Target group	
	Target group	**Personas**
The number of people who are going to request help or information is estimated to be around one hundred.	Community of owners (condominium)	Motivated owners Disbelieving owners
	Owner of individual home	Owner of individual home
	Regional / National administration	Responsible for Green Deal policies
	Funding entities	Motivated funding entity to support Green Deal
	Renovation company	Renovation company
	Provider of digital solutions	Provider of digital solutions

8.2.2 Personas

Table 66 Persona 1 – Demo 2 (ENE)

USER	USER CONTEXT
Community of owners (condominium): **Motivated owners**	The community of owners is a group of owners of homes that live in the same building. Their building has been built some decades ago. They are aware that the façade materials are degrading: they have had some recent problems with water leaks that they have been solving one by one. These problems are becoming more and more frequent and cost them a lot of money. Therefore, they believe that it is time for a complete renovation of the building's façade. They believe that a complete renovation can help prevent future serious problems. In addition, they believe that nowadays there will be more modern materials to incorporate in the façade, which will allow them to better insulate the building and thus reduce their electricity consumption in the long run. They know that other buildings have been renovated thanks to some public subsidies, but they do not know how to apply for them or the steps to follow. In addition, all the owners need to agree to begin this kind of renovation. In this context, the Motivated owners are the ones that really hope that this renovation will help them to reduce their energy bill in the long run.
PAIN POINTS	**GOALS**
• Lack of knowledge of the renovation technologies and measurement tools to adopt. • Lack of knowledge of experts and about renovation technologies. • Lack of guidance where to start and what are the first steps. • Lack of knowledge about public subsidies and other financial tools. • Lack of tools to convince the other owners about the positive results they should be getting. • Mild reluctance to make the initial investment without a concrete forecast of	To have a place (online marketplace and presential office in Spain) in which they can solve all their doubts about a façade renovation process: • To learn about façade renovation technologies. • To get information about innovative services for the renovation (e.g., smart contracts). • To learn about the advantages of a façade renovation process that increases ESIE performance. • To get information about the different available "traditional" grants (regional, national or European) for a renovation process.

the savings they will make (as the initial investment is a big amount of money).	• To get information about attractive and innovative financing schemes for renovation processes (e.g., green euro). • To get information about different technical means of verification of the savings that he/she will achieve.

Table 67 Persona 2 – Demo 2 (ENE)

USER	USER CONTEXT
Community of owners (condominium): **Disbelieving owners**	The community of owners is a group of owners of several homes that live in the same building. Their building has been built some decades ago. They are aware that the façade materials are degrading: they have had some recent problems with water leaks that they have been solving one by one. These problems are becoming more and more frequent and are costing them a lot of money. Therefore, they believe that it is time for a complete renovation of the building's façade. They are not sure that a complete renovation can help prevent future serious problems. In addition, they do not trust the modern materials to incorporate in the façade, and they do not know how big will the advantage be to better insulate the building and thus reduce their electricity consumption in the long run. They know that other buildings have been renovated thanks to some public subsidies but they do not know how to apply for them or the steps to follow. In addition, all the owners need to agree to begin this kind of renovation. In this context, the Disbelieving owners are not convinced to carry out the renovation, mainly due to the high cost they expect it to entail. They also don't trust that the final energy savings will so large that they compensate the cost of the renovation process.
PAIN POINTS	**GOALS**
• Lack of knowledge of the renovation technologies and measurement tools to adopt. • Lack of knowledge of experts and renovation technologies potential. • Lack of guidance where to start and what are the first steps. • Lack of knowledge about public subsidies. • Lack of tools to be convinced about the positive results they should be getting. • Severe reluctance to make the initial investment without a concrete forecast of the savings they will make (as the initial investment is a big amount of money).	To have a place (online marketplace and presential office in Spain) in which they can solve all their doubts about a façade renovation process: • To learn about façade renovation technologies • To learn about innovative services for the renovation (e.g., smart contracts). • To get information about the advantages of a façade renovation process that increases ESIE performance. • To get information about the different “traditional" available grants (regional, national or European) for a renovation process. • To learn about attractive and innovative financing schemes for renovation processes (e.g., green euro). • To get information about different technical means of verification of the savings that he/she will achieve.

Table 68 Persona 3 – Demo 2 (ENE)

USER	USER CONTEXT
Owner of individual house	An owner of an individual home that has been built some decades ago would like to renovate his/her façade in order to be more efficient to reduce the energy bill. This owner knows that other buildings in the area have been renovated thanks to some public subsidies, but he/she does not know if there are some equivalent subsidies for individual homes and where to ask for this information. Although he/she would like to renovate the façade of the house, he/she does not know if it would be feasible, as the cost of the renovation may be very high for a single home and he/she would not be able to afford it. In addition, he/she would like to have some way to know the reduction of the bill he/she would be getting.
PAIN POINTS	**GOALS**
• Lack of knowledge of the renovation technologies and measurement tools to adopt. • Lack of knowledge of experts and renovation technologies potential. • Lack of guidance where to start and what are the first steps. • Lack of knowledge about public subsidies. • Lack of tools to really know the savings he/she will be getting. • Mild reluctance to make the initial investment without a concrete forecast of the savings he/she will make (as the initial investment is a big amount of money).	To have a place (online marketplace and presential office in Spain) in which he/she can solve all the doubts about a façade renovation process: • To learn about façade renovation technologies. • To learn about innovative services for the renovation (e.g., smart contracts). • To get information about the advantages of a façade renovation process that increases ESIE performance. • To get information about the different "traditional" available grants (regional, national or European) for a renovation process. • To get information about attractive and innovative financing schemes for renovation processes (e.g., green euro). • To get information about different technical means of verification of the savings that he/she will achieve.

Table 69 Persona 4 – Demo 2 (ENE)

USER	USER CONTEXT
Regional/National Administration: **Responsible for Green Deal issues**	Those responsible for the administration in charge of Green Deal issues (climate change, environmental aspects...) should encourage actions from the public sector to promote environmentally beneficial actions. Household energy consumption has a direct impact on the environment, so the administration should encourage the granting of aid in this context. However, they need to know in more detail what kind of actions can exist and that this information is provided by a trustworthy and neutral entity.
PAIN POINTS	**GOALS**
• Lack of knowledge of the potential of the renovation technologies in the context of buildings or individual homes	To have a place (online marketplace and presential office in Spain) in which he/she can solve all the doubts about a façade renovation process: • To get information about façade renovation technologies.

• Lack of a neutral entity that can provide the information needed. This information is only found throughout a company that would be indirectly benefited (i.e., consultancy entity, renovation companies, architects, constructors...)	• To get information about innovative services for the renovation (e.g., smart contracts). • To get information about the advantages of a façade renovation process that increases ESIE performance. • To get information about how these aspects are managed in other public administrations. • To get information about attractive and innovative financing schemes for renovation processes (e.g., green euro).

Table 70 Persona 5 – Demo 2 (ENE)

USER	USER CONTEXT
Funding entities: **Motivated funding entity**	There are financing entities that may be interested in offering new products related to the respect for the environment. The type of entities can be very varied: from banks to crowdfunding type entities. They believe that offering this type of innovative financial products will be very good to stand out commercially as an environmentally friendly entity. They need to know in detail how these initiatives would work and would be interested in learning about other similar experiences in Europe.
PAIN POINTS	**GOALS**
• Lack of information of the possibilities of implementing new financing models (technical requirements, viability...). • Lack of knowledge of similar initiatives that have been already tested.	• To have a place (online marketplace and presential office in Spain) in which the entity can solve all the doubts about attractive and innovative financing schemes for renovation processes: • To understand new financial concepts such as green euro. • To do networking activities with other stakeholders. • To broaden the entity's business models reaching new activities.

Table 71 Persona 6 – Demo 2 (ENE)

USER	USER CONTEXT
Renovation company	The Renovation/Technical Company is a company with high experience in maintenance and renovations of buildings and green performance improvement materials and solutions. It is aware about the benefits that the new renovation technologies can provide to its business, in terms of efficient, sustainable, inclusive energy use (ESIE) for the relevant facilities. They are looking for ways to penetrate/open the market and increase their business in this domain, while addressing the challenges that limit this scope.
PAIN POINTS	**GOALS**
• Difficulty in communicating the advantages of their innovative services.	• To have a place (online marketplace and presential office in Spain) in which the entity can promote themselves as suppliers for a façade renovation, explaining their innovative services.

Table 72 Persona 7 – Demo 2 (ENE)

USER	USER CONTEXT
Provider of digital solutions	The Provider of Digital Solutions is a company with high experience in the ICT sector. It is aware about the benefits that the new digitisation and automation technologies can provide to its business, so it fosters the implementations for efficient, sustainable, inclusive energy use (ESIE) for the relevant facilities.
PAIN POINTS	**GOALS**
• Difficulty in communicating the advantages of their innovative services.	• To have a place (online marketplace and presential office in Spain) in which the entity can promote themselves as suppliers of digital solutions for a façade renovation, explaining their innovative services.

8.2.3 User stories

Table 73 User stories for Persona 1 (Motivated owner)

User Story 1.1
As a motivated owner, I want to have a place (online marketplace or presential place) in which I can solve all my doubts about a façade renovation process so that me and the other owners can agree to begin this project and get in contact with professionals that will carry out the work.
User Story 1.2
As a motivated owner, I want to have a place (online marketplace or presential place) in which I can solve all my doubts regarding the public grants that are possible for my building so that the renovations have a lower cost.
User Story 1.3
As a motivated owner, I want to have a place (online marketplace or presential place) in which I can solve all my doubts regarding attractive and innovative financing schemes for renovation processes so that the renovation is affordable to me.
User Story 1.4
As a motivated owner, I want to have a place (online marketplace or presential place) that informs me if there are technical services that are able to verify the savings that I will potentially obtain, so that I can convince the disbelieving owners to approve the renovation process of my building.

Table 74 User stories for Persona 2 (Disbelieving owner)

User Story 2.1
As a disbelieving owner, I want to have a place (online marketplace or presential place) in which I can solve all my doubts about a façade renovation process so that I can better understand what the other owners are proposing to carry out.
User Story 2.2
As a disbelieving owner, I want to have a place (online marketplace or presential place) in which I can solve all my doubts regarding the public grants that are possible for my building so that the renovations have a lower cost.

User Story 2.3
As a disbelieving owner, I want to have a place (online marketplace or presential place) in which I can solve all my doubts regarding attractive and innovative financing schemes for renovation processes so that the renovation is affordable to me.
User Story 2.4
As a disbelieving owner, I want to have a place (online marketplace or presential place) that informs me if there are technical services that can verify the savings that I will potentially obtain, so that I can be convinced that the renovation process with guarantee me some savings.

Table 75 User stories for Persona 3 (Owner of an individual house)

User Story 3.1
As an owner of an individual house, I want to have a place (online marketplace or presential place) in which I can solve all my doubts about a façade renovation process so that I am able to begin this project and get in contact with professionals that will carry out the work.
User Story 3.2
As a owner of an individual house, I want to have a place (online marketplace or presential place) in which I can solve all my doubts regarding the public grants that are possible for my house so that the renovations have a lower cost.
User Story 3.3
As an owner of an individual house, I want to have a place (online marketplace or presential place) in which I can solve all my doubts regarding attractive and innovative financing schemes for renovation processes so that the renovation is affordable to me.
User Story 3.4
As an owner of an individual house, I want to have a place (online marketplace or presential place) that informs me if there are technical services that can verify the savings that I will potentially obtain, so that I know the savings that are guaranteed with the renovation.

Table 76 User stories for Persona 4 (Responsible for Green Deal issues)

User Story 4.1
As a responsible for Green Deal issues, I want to have a place (online marketplace or presential place) in which I can solve all my doubts about a façade renovation process so that I can define the requirements for new public grants for these activities.
User Story 4.2
As a responsible for Green Deal issues, I want to have a place to be informed about attractive and innovative financing schemes for renovation processes, so that I can apply these new schemes in Public Administration.
User Story 4.3
As a responsible for Green Deal issues, I want that the entity that provides me with the needed information is neutral, so that the public administration is not accused of trying to provide grants to certain services.

User Story 4.4
As a responsible for Green Deal issues, I want to have a place (online marketplace or presential place) to know if there are granted actions in this context in other regions/nations so that we can align our public policies according to the rest.

Table 77 User stories for Persona 5 (Motivated funding entity)

User Story 5.1
As a motivated funding entity, I want to have a place (online marketplace or presential place) in which I learn about attractive and financing schemes for renovation processes, so that I can incorporate these kinds of services to our portfolio, improving our current business models.
User Story 5.2
As a motivated funding entity, I want to have a place (online marketplace or presential place) in which I learn about façade renovation processes that improve ESIE so that my entity is considered environmentally friendly, thus being better considered for potential clients.
User Story 5.3
As a motivated funding entity, I want to have a place (online marketplace or presential place) in which I can communicate our portfolio of services so that we can reach new potential clients.
User Story 5.4
As a motivated funding entity, I want to have a place (online marketplace or presential place) which allows me to do networking activities with other stakeholders so that I can get new potential clients.

Table 78 User stories for Persona 6 (Renovation company)

User Story 6.1
As a renovation company, I want to have an online marketplace in which I can promote my company as suppliers for a façade renovation so that I can reach new potential clients.
User Story 6.2
As a renovation company, I want to have an online marketplace in which I can do networking activities with other stakeholders, so that new business opportunities arise.

Table 79 User stories for Persona 7 (Provider of digital solutions)

User Story 7.1
As a provider of digital solutions, I want to have an online marketplace in which I can promote my company as suppliers of digital solutions for a façade renovation so that I can reach new potential clients.
User Story 7.2
As a provider of digital solutions, I want to have an online marketplace in which I can do networking activities with other stakeholders, so that new business opportunities arise.

9 The pilots – Demo 2 (OKT)

9.1 Description of the pilot sites

9.1.1 Description of the building

Characteristics of building

The specific houses in which the renovations will take place in this Demo are not yet selected. OKT currently participates in around two hundred home renovation projects a year. Within these 200 projects/year, OKT will choose the 50 that most fit the FORTESIE needs and that will demonstrate how high performance and low energy renovations can be deployed at scale using FORTESIE methodology, tools and financing opportunities.

However, it is possible to describe the usual characteristics of the buildings OKT usually works with:

- Type of building: single family house

- Size of building: in average around 120m^2

- Address / location of building: in the Grand Est Region in France

- Composition of building: generally, the houses are made of red bricks (1900's), occasionally traditional sandstone(1800's), or more recently concrete (after 1948)

- Year of dwelling / construction: from 1800's until 1980's

- Location specification: both city centre and rural.

- Type of building and length of ownership/occupation: variable

Characteristics of renovation need

Usually, the homeowner comes to OKT for technical, administrative and financial assistance when he/she wants to start a renovation process. The need of the renovation is mostly related with energy saving and home maintenance. In most cases, heating and ventilation are needed. Usually, fuel oil is the main energy and it is common to replace it with a heat pump. In France there are numerous incentives and subsidies, see section 2.2.3.2.

9.1.2 Target groups

The main type of user is the homeowner and the other inhabitants: usually in the houses live a family of 2 parents plus 2 or 3 kids. Each family usually has a mean income of over 50000€/year, having an expense of heating bills of generally over 3000€/year in fuel oil. In this case the primary decision makers related to renovation are the homeowners.

9.1.3 The external stakeholders

External stakeholders are various, they might include:

- the companies that do the renovation job;
- local authorities, that might be interested in showing how innovative and ambitious their Region/Town is;
- the energy company, that might be interested to manage energy demand;
- Workers syndicate (CAPEB/FFB), might be interested to follow renovation prices within FORTESIE, and could create specific home energy renovation training for workers;
- Resource centers (envirobat grand est) might be interested with the innovative methodologies and KPI, specifically the carbon footprint of FORTESIE project.

- Financial organization that may invest based on FORTESIE economic and environmental benefits.

9.2 Analysis of current situation

The current situation of a house that needs renovation is that it is an uncomfortable house, expensive to heat and cool. Occasionally, in energy poverty situation, a house can have mould and sanitary issues. The energy source is very variable, generally fuel oil for boiler, with storage in fuel tank.

In addition, it must be noted that a home renovation project usually takes about 12-18 months from the first home audit until renovation is completed.

9.2.1 Existing measuring systems and data

Regarding the existing monitoring systems and data of the houses OKT usually works with, the following data can be described:

- OKT will have access to energy bills to know energy consumption of a whole year.
- Generally, the houses have no insulation, an old fuel boiler, no ventilation, maybe 30–40-year-old double-glazed windows or single-glazed, and old roofing insulation between 10-20cm.
- OKT usually has plans, or an official surface measurement before the renovation starts.
- OKT uses the blowerdoor test for most of their renovation projects.

9.3 Analysis of end users and stakeholders' requirements

9.3.1 Use cases

Table 80 Use Case Card 1 for Demo 2 (OKT)

<table>
<tr><th>Name</th><th colspan="2">Goal</th></tr>
<tr><td>DEMO 2 (FR): Green, comfortable, and sustainable homes

Use Case 1: OKT will coordinate the renovation up to 12 single family homes</td><td colspan="2">• confirm energy simulation and savings
• prepare smart contract requirements for EPC
• prepare financing options for CO_2 and other financing means (GOP)</td></tr>
<tr><th>Metrics</th><th colspan="2">Target group</th></tr>
<tr><td rowspan="4">• Home deep renovation: including all or most of façade, roof, basement, windows, heating and ventilation, hot water.
• Accurate of building demand estimator.
• Higher customer trust.
• Reduced energy costs.
• Standardised and automated calculation of M&V for energy consumption, air quality and CO_2 level, average internal temperature, humidity, (UV), water management.</td><th>Target group</th><th>Personas</th></tr>
<tr><td>Citizens and Owners</td><td>Homeowner</td></tr>
<tr><td>Renovation Consulting Company</td><td>Designer</td></tr>
<tr><td>Renovation company</td><td>Renovation company</td></tr>
<tr><td></td><td>Labour syndicate</td><td>Labour syndicate</td></tr>
</table>

Table 81 Use Case Card 2 for Demo 4 (OKT)

<table>
<tr><th>Name</th><th colspan="2">Goal</th></tr>
<tr><td>DEMO 2 (FR): Green, comfortable, and sustainable homes
Use Case 2: OKT will assist homeowners to renovate their home and install an energy monitoring device</td><td colspan="2">• After a deep home renovation:
• To know the individual energy consumption by installing monitoring and measurements systems inside the homes.
• To know about the behaviour of the users in energy aspects, so they can be advised on the most appropriate way to manage their energy consumption to reduce it.
• To demonstrate the results of the intervention by comparing them in relation to what was estimated and what was finally obtained.
• To increase the comfort of the home and the daily life of the user.
• To motivate commitment to the environment by setting an example</td></tr>
<tr><th>Metrics</th><th colspan="2">Target group</th></tr>
<tr><td rowspan="3">• At least 50 homes deep renovation, including monitoring of energy consumption through sensors and meters.
• measurements for individual energy consumption: energy consumption, average internal temperature, humidity, external temperature, humidity.
DEMO KPIs:
• Number of homes with indoor monitoring: at least 25%
• % Estimated demand reduction according to national certification systems: at least 50%
• Customer satisfaction with the performance</td><td>Target group</td><td>Personas</td></tr>
<tr><td>Citizens and Owners</td><td>Homeowner</td></tr>
<tr><td>Renovation Consulting Company</td><td>Designer</td></tr>
</table>

9.3.2 Personas

Table 82 Persona 1 – Demo 2 (OKT)

USER	USER CONTEXT
Citizens & Owners: **Homeowners involved in renovation**	• They are the owners who have decided to undertake a renovation work because they want to reduce their energy consumption, reduce CO_2 emissions and the potential reduction of their energy bill. • They are interested in the improvement/ maintenance of their home. • Ultimately, they are interested in giving more value to their home on the market in the future.
PAIN POINTS	**GOALS**
• Today, homeowners spend many hours to understand how the National subsidies work, and they must fight with renovation companies to fit the administrative criteria. It is a long process that has no guarantee. • The CBDC and the associated financial services, linked to National subsidies and White certificates, can make payments and administrative validation much more efficient and quicker.	• To verify the promised results by the renovation company. • To upgrade the value of housing through the use of energy efficiency. • To simplify the administrative validation process, and fluidify payment.

Table 83 Persona 2 – Demo 2 (OKT)

USER	USER CONTEXT
Oktave Renovation Consulting Company: **Designer**	The organisation: • audits homes, propose renovation work, estimates costs and simulates energy savings. • chooses renovation companies, gets quotes and puts together all administrative documents so the homeowners get the maximum subsidies from the renovation. • coordinates the job site for the homeowner. • controls renovation quality on site during renovation, and with a blowerdoor test. • manages subsidy demands until complete payments. • No performance control is done over time.

PAIN POINTS	GOALS
• The CBDC and the associated financial services, linked to National subsidies and White certificates, can make payments and administrative validation much more efficient and quicker. • No data is gathered over time, to prove the real savings. • Subsidy is paid based on forecasted and not real savings/performance	• To simplify the administrative validation process, and fluidify payment. • To have real energy data after renovation. • To reward performance and real achievements over time.

Table 84 Persona 3 – Demo 2 (OKT)

USER	USER CONTEXT
Renovation company	The renovation company follows these phases in a renovation process: • Give estimates, • program the job needed, • do the job, in time and on budget, • the quality of the job gets tested with blowerdoor, OKT fixes what is unsatisfying, • bill the work done, as the only legal document to validate the subsidies, • No performance control is done over time.
PAIN POINTS	**GOALS**
• Getting subsidies require extra administrative work with no extra value for the company. So, they overcharge to compensate. • Many trust problems with the energy savings claim, homeowners doubt they can save 70-80% of their energy. • -time lost with work quality control, mainly around the blowerdoor test.	• To simplify the administrative validation process, and fluidify payment. • To gain in credibility towards clients. • To gain in work quality, speed and performance, make more money. • To improve customer satisfaction.

Table 85 Persona 4 – Demo 2 (OKT)

USER	USER CONTEXT
Labour syndicate	• Political activity of lobbing, defending the interests of all construction companies in France. • They are a powerful organisation to raise awareness about renovation wave.
PAIN POINTS	**GOALS**
• National trust issue from homeowners with renovation company, many media stories of shady companies, and outright criminal renovation subsidy fraud. • Costly quality controls.	• To defend the interest of companies in the construction sector. • To raise awareness about renovation wave.

9.3.3 User stories

Table 86 User stories for Persona 1 (Homeowner)

User Story 1.1
As an owner involved in the renovation (homeowner), I want to verify the promised results by the renovation company so that I know if I have invested my money well.
User Story 1.2
As an owner involved in the renovation (homeowner), I want to implement ESIE measures to my house, so that the value of the dwelling I own increases.
User Story 1.3
As an owner involved in the renovation (homeowner), I want to learn about the best financial options , so that the cost of the renovation is more affordable.

User Story 1.4
As an owner involved in the renovation (homeowner), I want to implement efficiency measures to my house, so that my energy bill decreases but my comfort is maintained.

Table 87 User stories for Persona 2 (OKT designer)

User Story 2.1
As a project designer, I want to implement measures in houses, so that the efficiency of these houses increases, reducing costs and GHG emissions.
User Story 2.2
As a project designer, I want to know the effectiveness of the interventions, comparing the reality achieved vs the projected interventions so that I can show this information to the clients as a way of verification.
User Story 2.3
As a project designer, I want to know state-of-the-art systems and materials for the façades so that I can improve my future projects.
User Story 2.4
As project designer, I want to use the existing success stories of past projects so that I can reach and convince more clients to do renovations.

Table 88 User stories for Persona 3 (Renovation company)

User Story 3.1
As a renovation company, I want to adopt state-of-the-art renovation systems and materials so that I can offer my customers the best solutions.
User Story 3.2
As a renovation company, I want solid evidence to better convince my prospects that they can trust me, so that they accept my estimate quickly and more often.
User Story 3.3
As a renovation company, I want to do better work, so I have less corrections to do because I get it right the first time, so that I don't lose time and money.
User Story 3.4
As a renovation company, I want my customers to be satisfied, so that my good reputation grows, and customers come naturally.

Table 89 User stories for Persona 4 (Labour syndicate)

User Story 4.1
As a labour syndicate, I want to help my members to have information about financing mechanisms, to inform their customers, so that they continue paying for their membership.
User Story 4.2
As a labour syndicate, I want to provide my members with training with start-of-the-art technologies and systems for façade renovations, so that they improve their skills and continue paying for their membership.

10 The pilots – Demo 3

10.1 Description of the pilot sites

10.1.1 Description of the building

Characteristics of building

Living in housing deprivation means living in a house where many of the basic needs are missing, jeopardizing a dignified daily life. These are homes which cannot protect the inhabitants from cold and rain due to the lack of solid structures; where the absence of piped water makes it impossible to go to the bathroom or take shower (particularly a hot shower); where the lighting and ventilation are so inadequate that they inhibit reading, learning, or breathing proper clean air. These homes aren't safe to live in, let alone provide shelter, promote wellness and comfort. Those who live in such houses can't enjoy their homes as they lack a place that meets their emotional, learning and development needs. According to the Portuguese National Institute of Statistics (INE), 3,9% of the population lived under these conditions in 2020.

Housing deprivation is also the first cause of Energy Poverty in Portugal. This means not having access to the appropriate amount of energy to meet daily needs. Deficient building structures lead to energy inefficiencies, requiring an excessive amount of energy to light, clean, cook and heat the house. High energetic needs combined with a weak economic situation throws many families into Energy Poverty. In 2019, 18,9% of the Portuguese population couldn't keep their house properly heated.

JUST works both in in rural contexts and large metropolitan areas. Metropolitan areas (of Lisbon and Porto) have seen in the past few years steep increase in housing costs. Additionally, social exclusion and high unemployment rates are higher than the national average (6,5% in Portugal and 7,1% in LMA). The desertification of rural areas means there are very isolated communities, with many elderly people with no support network, living off low-paying pension.

A typical house renovated by Just a Change is an independent house, in a Rural location, under 100m^2. These are old buildings, owned by our beneficiaries as family heirlooms, most of them have ancient structures, of 50+ years. The houses are typically built in masonry, with wooden floors and tiled roofs. However, they have several deficiencies: leaky roofs, rotten floors, inadequately insulated walls, etc.

JUST has acted in several locations throughout Portugal, as it can be seen in the interactive map published on their website.

Funded by the European Union

Figure 15 Locations in which JUST has acted

A typical before and after full intervention will look like this:

Figure 16 Typical before and after full intervention

Characteristics of renovation need

As previously mentioned, the houses JUST acts on have many structural deficiencies. Their renovation works will provide basic structures such as roofs, flooring, insulation, doors, and windows, but also

other basic needs such as piped water and electricity. Each renovation has specificities, and sometimes there is no need for such a deep intervention. As an example, in 2021, JUST renovated 56 houses in which they made:

- 20 full new roofs
- 18 bathrooms from scratch
- 32 homes got new doors and windows
- 25 new thermal insulation
- 25 new piping and sanitation networks
- 25 painted façades
- 47 painted inside
- 12 photovoltaic panels installed

JUST believes the needs of future houses will fall mainly into these categories, and the main renovations made will focus on improving thermal comfort and modernizing energetic equipment.
Most of these houses use wooden fireplaces to heat their dwelling, or old gas equipment. Sometimes, they are not even connected to the electric grid. Our focus here is to provide a better insulated structure that will reduce their energetic needs and provide modern equipment to ensure efficiency.

10.1.2 Target groups

JUST beneficiaries are families or individuals who suffer from housing deprivation and energy poverty. In Portugal, according to the National Statistics Institute (I.N.E.), 5% of the population lives in severe housing deprivation. Also, over 160 thousand people cannot shower at home, and 50 thousand don't even have piped water or sanitation at home. The Excess Winter Mortality rate in Portugal is 28%, contrasting to the 15% rate of the EU (Energy Poverty Handbook, EU, 2016). The problem is spread all over the territory and the existent solutions are neither enough nor effective. The affected population is very diverse, from elder people living isolated in rural Portugal, to low-income families living in large urban cities.
The root causes the Housing deprivation are many:
(1) Long term unemployment (vicious cycle of poverty – these inhabitants are poor and cannot access other existing solutions available);
(2) Low literacy rate;
(3) Mental Health Problems;
(4) Landlords without money to renovate homes.
Just a Change acts together with local authorities to identify the homes to act on. Once the beneficiaries are identified, the houses are visited, and the renovation plan and budget made. All these steps are made by Just a Change. They engage the beneficiary to understand what house features are most valuable to the person, and how JUST can include it in the renovation. JUST also engages with local institutions/social responses to ensure that the beneficiary receives support in other areas. Housing deprivation and energetic poverty are key issues; however, they are commonly accompanied by other situations that need to be attended (unemployment, addiction, mental disease, etc.). These underlying conditions should also be addressed, and JUST counts on local social support to ensure this.

10.1.3 The external stakeholders

Eradicating housing poverty will always depend on the joint effort of many sectors; therefore, JUST engages many partners:

- Municipalities and local authorities help to fund operations and help Just a Change to boost local economies by employing local contractors. They are also critical in screening the intervention cases, providing local warehouses and accommodation.
- Private companies help JUST achieve its goal, whether by supporting JUST on the housing and energy poverty topic, or by in-kind donations of construction material.
- NGO's and institutions help us identify and map cases of housing poverty and provide post-renovation support to the beneficiary when needed.

10.2 Analysis of current situation

As the final houses in which the renovations will take place are not yet decided, a detailed description is not possible at this point. A thorough description of each house will be possible closer to date.
JUST visits each beneficiary before and after the intervention to conduct interviews that help them assess the impact of the interventions, in the many areas of life they support. resulted 3 different levels of impact indicators.

- OUTPUT INDICATORS (Numbers directly representing the work of Just a Change during the year):
  - Number of renovated homes
  - Number of beneficiaries supported
  - Number of volunteers
- OUTCOME INDICATORS (Numbers that intend to show the direct consequences of Just a Change's intervention):
  - State of conservation of the house
  - Living Conditions
  - Energetic efficiency
  - Health and safety risks reduction
- IMPACT INDICATORS (Change recorded in the life of the beneficiaries one year after the intervention in the following areas):
  - Health and hygiene
  - Comfort and well-being
  - Security and protection
  - Social integration
  - Autonomy and education

10.2.1 Existing measuring systems and data

As the final houses in which the renovations will take place are not yet decided, a detailed description is not possible at this point. A thorough description of each house will be possible closer to date.

10.3 Analysis of end users and stakeholders requirements

10.3.1 Use cases

Table 90 Use Case Card for Demo 3

<table>
<tr><th>Name</th><th colspan="2">Goal</th></tr>
<tr><td>DEMO 3 (PT): Green, comfortable, and sustainable energy poverty homes
Use Case 1: Renovations, Energetic Efficiency and Energy Savings methods in low income homes
[NGO: JUST A CHANGE]</td><td colspan="2">• Renovate 10 poverty households.
• Improve Energetic Efficiency: thermal insulation, reduce/optimize energy consumption, replace outdated equipment.
• Improve living conditions, state of conservation of the house, property valuation.
• Improve Health and Hygiene conditions, Comfort and Well-being and Social inclusion.
• Test the crowd-lending model with GOP.
• Create a new financing model for the renovation of poverty homes.</td></tr>
<tr><th>Metrics</th><th colspan="2">Target group</th></tr>
<tr><td rowspan="6">• Energetic Certificate before and after the intervention.
• Impact assessment on the improvement of the other variables:
○ Health and hygiene
○ Comfort and well-being
○ Security and protection
○ Social integration
○ Autonomy and education</td><td>Target group</td><td>Personas</td></tr>
<tr><td>NGOs in the Housing Sector</td><td>NGO</td></tr>
<tr><td>Crowdlending Organisation</td><td>Crowdlending Organisation</td></tr>
<tr><td>Low-income Citizens and Owners</td><td>- Uninformed Low-income Citizens and Owners
- Informed Low-income Citizens and Owners</td></tr>
<tr><td>Municipalities</td><td>Municipality Social and Housing Offices</td></tr>
<tr><td>Crowd-lending participants</td><td>- Investors profit-first
- Investors impact-first</td></tr>
</table>

10.3.2 Personas

Table 91 Persona 1 – Demo 3

USER	USER CONTEXT
NGO	The NGO is an organization with high experience in the social sector. It is aware about the benefits that a renewed home has on the beneficiary, and how it affects different aspects of their life. Specifically, how the improvements on the housing infrastructure can impact the energetic comfort, consumption and efficiency.
PAIN POINTS	**GOALS**
Measure and improve energetic efficiency in each renovation.	- New/Better equipment to install in each household. - Sharing best Practices - Better impact assessment.

Table 92 Persona 2 – Demo 3

USER	USER CONTEXT
Crowdlending Organisation	The money lending platform provides impactful investment opportunities for individuals and organisations and, through that,

	provides financing to organisations to implement activities that can generate a positive impact on the environment and on people.
PAIN POINTS	**GOALS**
Efficient financing for projects of lower financial returns and high impact.	• Innovative financing model for high impact needs. • Access to broader community of investors and of projects to be financed. • Insights on impact assessment of energy efficiency projects.

Table 93 Persona 3 – Demo 3

USER	**USER CONTEXT**
Low-income Citizens and Owners: **Uninformed Low-income Citizens and Owners**	People living in housing deprivation and energy poverty, with no means to renovate/improve their dwelling. They are often socially excluded and isolated people, with an underlying condition (addiction, mental disease, etc).
PAIN POINTS	**GOALS**
Undignified living conditions. Leaky roofs, no piped water, no sanitations, sometimes no electricity, etc.	Have a dignified home, living conditions, access to piped water, energetic efficiency means and appliances.

Table 94 Persona 4 – Demo 3

USER	**USER CONTEXT**
Low-income Citizens and Owners: **Informed Low-income Citizens and Owners**	People living in housing deprivation and energy poverty, with no means to renovate/improve their dwelling. They are often families with low incomes, but have some knowledge energy efficiency about modern technology, they are able to use modern equipment.
PAIN POINTS	**GOALS**
Undignified living conditions. Leaky roofs, no piped water, no sanitations, sometimes no electricity, overspending on electric bills.	Have a dignified home, living conditions, access to piped water, energetic efficiency means and appliances.

Table 95 Persona 5 – Demo 3

USER	**USER CONTEXT**
Crowd-lending participants: **Investors profit-first**	Individuals and organisations that wish to get return on their invested money.
PAIN POINTS	**GOALS**
- Limited offer of profitable and risk-transparent investment opportunities. - Limited transparency regarding risk of investment opportunities.	A profitable and risk-sound opportunity for return on investment.

Table 96 Persona 6 – Demo 3

USER	USER CONTEXT
Crowd-lending participants: **Investors impact-first**	Individuals and organisations that have a social and environmental conscience that wish to personally contribute to create impact.
PAIN POINTS	**GOALS**
• Reliability of impact assessment of interventions. • Limited transparency regarding impact logic, indicators and metrics. • Limited access to impact stories of the intervention's beneficiaries. • Limited investment opportunities for high impact interventions.	• Offer financing opportunities with measured social and environmental impact implementation. • Contribute to demonstrate sound and transparent impact logic, indicators and metrics. • Close the gap to reach to the end beneficiaries of interventions.

Table 97 Persona 7 – Demo 3

USER	USER CONTEXT
Municipality Social and Housing Offices	Municipalities (urban or rural) know the housing conditions of their local population. There are usually housing and shelter programs, but they are very bureaucratic and do not cover many cases. They need another strategy to deliver appropriate living conditions to their people.
PAIN POINTS	**GOALS**
Lack of funding, lack of specific knowledge about housing/energetic efficiency etc, they have to resort to third parties, unable to have a large scale intervention in a short period of time.	Better financing possibilities to promote programs and protocols like Just a Change, ESIE improvements in the houses, better informed leads to better decision making.

10.3.3 User stories

Table 98 User stories for Persona 1 (NGO)

User Story 1.1
As an NGO, I want to implement energy efficiency measures in each home, so that all beneficiaries live in a more comfortable and efficient dwelling.
User Story 1.2
As an NGO, we want to improve the analysis on the impact of the intervention, so that they validate our work.

Table 99 User stories for Persona 2 (Crowdlending Organisation)

User Story 2.1
As a crowdlending organisation, I want to reach more investors, so that more projects can get funding.

User Story 2.2
As a crowdlending organisation, I want to reach more project promoters, so that I can promote more impact.
User Story 2.3
As a crowdlending organisation, I want to improve impact assessment, so that I can increase the realiability for investors.

Table 100 User stories for Persona 3 (Uninformed Low-income citizens and owners)

User Story 3.1
As an uninformed low-income citizen and owner, I want to have a better place to live so that my comfort improves.
User Story 3.2
As an uninformed low-income citizen and owner, I want to have a smaller energetic bill so that the cost is lower.

Table 101 User stories for Persona 4 (Informed Low-income citizens and owners)

User Story 4.1
As an informed low-income citizen and owner, I want to improve my home so that I have a better place to live.
User Story 4.2
As an informed low-income citizen and owner, I want to have a smaller energetic bill, so that I can take advantage of modern equipment and technology.

Table 102 User stories for Persona 5 (Investors profit-first)

User Story 5.1
As an investor, I want to find investments that secure the return on my investments so that I increase my financial earnings

Table 103 User stories for Persona 6 (Investors impact-first)

User Story 6.1
As an investor, I want to enable impact on the environment and on people, so that I contribute to my personal values.

Table 104 User stories for Persona 7 (Municipality Social and Housing Offices)

User Story 7.1
As a Municipality, I want to ensure better living conditions to the population so that people can live in a dignified manner.
User Story 7.2
As a Municipality, I want to ensure the best equipment possible so that the renovations have enough quality.

11 The pilots – Demo 4

11.1 Description of the pilot sites

11.1.1 Description of the building

Characteristics of building

In Demo 4, single-family houses with reduced area whose owners are prosumer members of Coopérnico will be selected. The houses are in different regions of Portugal (north, center, south, coast and interior) and two cities: Lisbon and Oporto. The selected houses are aged 15 years or more and preferably that have not benefited from energy efficiency renovations.

Characteristics of renovation need

Portugal has 10 million people. Until 1990, buildings were built without minimum requirements.

Most of the Portuguese residential buildings are mostly built in reinforced concrete structure (slabs, pillars and beams) and walls in masonry of ceramic brick, solid or hollowed, laid with cement mortar and plastered with cement. It is also very likely to find houses built in carved or ordinary stone masonry with an interior structure in wood and partitioned wood, plastered and stuccoed.

Also, there is a high percentage of buildings that were built before 1960 which were not renovated. This fact is more aggravated in densely populated areas, like high and low Alentejo.

In terms of heating devices in the houses, it is mostly divided between mobile or fixed appliances. In the fixed ones, the most used are fireplaces and recovering heat appliances, representing 26,6% and 10,7% each of the houses that have fixe appliances. In the interior areas of the country it is more likely to find houses with fireplaces, while in coastal areas like Lisbon and Oporto have more mobile appliances. By 2011, most of the residential houses used electricity as heating source, while the other 50%, 34% used wood and coal. The remaining percentage used gaseous or liquid fuel.

Portugal has an extensive coastline, which brings a lot of humility to the houses. This is even worse as there is lack of adequate ventilation system in the houses, and creates the surge of mould. This brings a lot of health problems to the residents of the houses.

There was a period between 1990 and 2005 when there were requirements to prevent pathologies and then in 2006 the law of requirements for energy efficiency and energy certificates came into force. Of the 2,100,000 energy certificates issued, 67% of the buildings have an energy class C or lower.

The Recovery and Resilience Plan includes financing to improve the energy efficiency of residential buildings, through the Casas+Eficientes Program. 82,000 applications have been submitted so far and of these more than 22,000 have already received the money. For example, 35% of renovations involved replacing windows and 25% installing heat pumps.

11.1.2 Target groups

The target groups are made up of prosumer members of Coopérnico, living in a single-family building, prevailing to be a Coopérnico customer. Only people who allow the monitoring of energy consumption, before and after the renovation of their homes, will be accepted.

11.2 Analysis of current situation

As houses for renovation have not yet been selected, no info can be provided at the current moment.

11.2.1 Existing measuring systems and data

The beneficiaries of the DEMO4 renovation works, if they are Coopérnico customers, access to their consumption data is facilitated to determine their profile, subject to consent. Not being a Coopérnico customer, we will have access to consented data if they have a smart meter.

The outside and inside temperature of the house, as well as the humidity will be monitored. Every 6 months beneficiaries fill in a questionnaire where qualitative data will be collected.

11.3 Analysis of end users and stakeholders requirements

11.3.1 Use cases

Table 105 Use Case Card for Demo 4

<table>
<tr><th>Name</th><th colspan="2">Goal</th></tr>
<tr><td>DEMO 4(Portugal): Green, comfortable and sustainable energy prosumers
Use Case 1: Both energy efficiency and savings increase for Coopernico prosumer's household</td><td colspan="2">• Overall goal: Renovate 10 Coop members' homes:
• Raise environmental awareness
• Increase thermal comfort
• Participate in the new energy system paradigm
• Reduce energy consumption
• Property valuation</td></tr>
<tr><th>Metrics</th><th colspan="2">Target group</th></tr>
<tr><td rowspan="6">• Energy bills before and after the intervention
• Room temperature and humidity monitoring before and after the renovation work
• Access to smart meter record
• Filling in a survey every 6 months</td><th>Target group</th><th>Personas</th></tr>
<tr><td>Prosumers living in a single-family household</td><td>- Informed prosumers
- Uninformed prosumers</td></tr>
<tr><td>Renewable energy cooperative</td><td>Renewable energy cooperative</td></tr>
<tr><td>Crowdlending organisation</td><td>Crowdlending organisation</td></tr>
<tr><td>Renovation NGO's</td><td>Renovation NGO's</td></tr>
<tr><td>Investors</td><td>- Investors profit-first
- Investors impact-first</td></tr>
</table>

11.3.2 Personas

Table 106 Persona 1 – Demo 4

USER	USER CONTEXT
Informed prosumers	Prosumers that have a certain level of energy saving knowledge and are interested in increasing the performance of self-generated production. This large group includes prosumers that have conscience of the values generated by self-production and try to optimise the self-consumption, whether by reducing the energy necessities of the house, or by finding when to heat the home when the energy cost is lower.

PAIN POINTS	GOALS
- Lack of knowledge or financial capacity to invest in energy renovation techniques. - Lack of knowledge regarding when to heat the house. - Lack of access to the best energy efficiency renovation methods. - Distrust to acquire alternative financing schemes.	- Improve self-generated saving by reducing the house consumption. - Increase thermal comfort and living conditions in the households. - Improve knowledge regarding energy efficiency measures in the households. - Gain knowledge regarding which renovation techniques and financial ways should invest.

Table 107 Persona 2 – Demo 4

USER	USER CONTEXT
Uninformed prosumers	Prosumers that have no knowledge regarding the energy they produce and only know that their photovoltaic systems can be optimised for the energy savings. Most of these prosumers live in houses that are very energy inefficient.
PAIN POINTS	**GOALS**
- They have no knowledge when it comes to combining their photovoltaic installation with the comfort of their home. - Don't have the financial capacity to invest in energy renovation techniques. - Don't have access to the best energy efficiency renovation methods.	- Improve self-generated savings by reducing the house consumption. - Increase thermal comfort and living conditions in the households. - Improve knowledge regarding energy efficiency measures in the households.

Table 108 Persona 3 – Demo 4

USER	USER CONTEXT
Renewable energy cooperative	Non-profit organisations with prosumers and people interested in decentralized production and energy democratization. The cooperative aims to increase their service options that can bring ESIE solutions to its members.
PAIN POINTS	**GOALS**
- Lack of knowledge regarding household energy renovation. - Innovative financial schemes and smart contracts. - Measure and improve energetic efficiency in targeted houses.	-Adopt solutions that brings the improvement of energy savings and thermal comfort to the prosumers. -Develop construction techniques more suitable to the target households, given the location and climate conditions. -Testing models which bring investment with transparency and sustainability for investors and end-users.

Table 109 Persona 4 – Demo 4

USER	USER CONTEXT
Crowdlending Organisation	The money lending platform provides impactful investment opportunities for individuals and organisations and, through

	that, provides financing to organisations to implement activities that can generate a positive impact on the environment and on people.
PAIN POINTS	**GOALS**
- Raising funds efficiently for projects of lower financial returns (even with high impact). - Limited resources to assess, measure and monitor impact indicators and metrics related to energy efficiency projects' implementation. - Limited experience with selecting criteria to finance energy efficiency and renovations projects. - Limited reach to direct beneficiaries of financed interventions.	- Creation of innovative financing models for energy efficiency and buildings renovations. - Access to a broader community of investors and of projects to be financed. - Access to new geographies and impact potential. - Gather know-how and experience with impact assessment, criteria, indicators and metrics for energy efficiency projects.

Table 110 Persona 5 – Demo 4

USER	**USER CONTEXT**
NGO in the Housing Sector	The NGO is an organization with high experience in the social sector. It is aware about the benefits that a renewed home for the beneficiaries, and how it affects different aspects of their life. Specifically, how improvements of housing infrastructure impact the energetic comfort, consumption and efficiency.
PAIN POINTS	**GOALS**
Measure and improve energetic efficiency in each renovation.	The Pilot services can help them: - Get new equipment to install in each household and measure and document the ESIE performance. - Sharing best Practices. - Better impact assessment.

Table 111 Persona 6 – Demo 4

USER	**USER CONTEXT**
Investors profit-first	Individuals and organisations that wish to get return on their invested money.
PAIN POINTS	**GOALS**
- Limited offer of profitable and risk-transparent investment opportunities. - Limited transparency regarding risk of investment opportunities.	A profitable and risk-sound opportunity for return on investment.

Table 112 Persona 7 – Demo 4

USER	USER CONTEXT
Investors impact-first	Individuals and organisations that have a social and environmental conscience that wish to personally contribute to create impact.
PAIN POINTS	**GOALS**
- Reliability of impact assessment of interventions. - Limited transparency regarding impact logic, indicators and metrics. - Limited access to impact stories of the intervention's beneficiaries. - Limited investment opportunities for high impact interventions.	- Offer financing opportunities with measured social and environmental impact implementation. - Contribute to demonstrate sound and transparent impact logic, indicators and metrics. - Close the gap to reach to the end beneficiaries of interventions.

11.3.3 User stories

Table 113 User stories for Persona 1 (Informed prosumer)

User Story 1.1
As an informed prosumer, I want to improve the energy efficiency of my house, to improve ESIE and consequently the energy bill.
User Story 1.2
As an informed prosumer, I want to increase my knowledge on ESIE measures, so that I can know when I should heat my house.
User Story 1.3
As an informed prosumer, I want to know about financial models regarding energy efficiency interventions, so that I can know how to invest in future renovations.

Table 114 User stories for Persona 2 (Uninformed prosumer)

User Story 2.1
As an uninformed prosumer, I want to improve the ESIE of my house, to reduce energy consumption and consequently the energy bill.
User Story 2.2
As an uninformed prosumer, I want to increase my knowledge on ESIE measures, so that I can improve my PV system performance.

Table 115 User stories for Persona 3 (Renewable energy cooperative)

User Story 3.1
As a renewable energy cooperative, I want to develop innovative renovation techniques, so that my members can improve the energy savings from the PV system.

User Story 3.2
As a renewable energy cooperative, I want to develop innovative financial schemes and smart contracts for members, so that we can promote investment with transparency and sustainability to end-users.

Table 116 User stories for Persona 4 (Crowdlending platform)

User Story 4.1
As a crowdlending organisation, I want to reach more investors, so that more projects can get funding.
User Story 4.2
As a crowdlending organisation, I want to reach more project promoters, so that I can promote more impact.
User Story 4.3
As a crowdlending organisation, I want to improve impact assessment of funded projects, so that I can increase the reliability of the projects' impact creation for investors.

Table 117 User stories for Persona 5 (NGOs)

User Story 5.1
As an NGO, I want to implement energy efficiency measures in each home, so that all beneficiaries live in a more efficient and comfortable dwelling.
User Story 5.2
As an NGO, I want to improve the analysis on the impact of the intervention, so that they validate my work.

Table 118 User stories for Persona 6 (Investors profit-first)

User Story 6.1
As a profit-first investor, I want to get return on my investments so that I increase my financial earnings.

Table 119 User stories for Persona 7 (Investors impact-first)

User Story 7.1
As an impact-first investor, I want to enable positive impact on the environment and on people, so that I contribute to my personal values.

12 The pilots – Demo 5

12.1 Description of the pilot sites

12.1.1 Description of the building

The DEMO 5 is located in Athens (Central Greece) with a subtropical Mediterranean climate. The main characteristic of climate of Athens is the alternation of long hot and dry summers and mild wet winters.

The General Secretariat of Information Systems for Public Administration (G.S.I.S.P.A.), of the Ministry of Digital Governance, is a strong technological pillar with the mission of optimal utilization of Information and Communication Technologies (ICT) in the Public Administration, with the aim of the digital transformation of the State and the provision of secure and efficient electronic services to citizens and businesses.

The headquarters of the Service is in Chandri street 1, in Moscato Attica (close to the city centre of Athens) and is housed in a building of special specifications, consisting of two basements and five floors. The total area of the building is approximately 30,000 m^2. Mainly, used for commercial purposes (offices). It occupies approximately 930 people who work daily in the building with opening hours from 07:00 to 20:00.

Figure 17 Offices for Demo 5

The composition of the building is mainly cement, but inside the building, there are some gypsum boards (space divisions) and ceiling panels. It was built for industrial use, but in 1995-1999, it was reconstructed into an office space.

The current energy source of situation is the electric power supply, the oil is used only for heating purposes and the operation of the stand-by generators.

The basic electromechanical equipment of the building consists of:

- Cooling System: Air Cooled Chillers, FCU's and VRV's.
- Heating system: Oil burners – Boilers.
- Ventilation System: Central Air Conditioning Units.
- Uninterrupted power supply: Diesel Generators.
- Monitoring-management of electromechanical equipment: BMS.

Public buildings' energy bills have not improved despite several efforts from EU to impose Energy Efficiency practices. This is due to important barriers which apply especially for public buildings, mostly related to:

a) lack of expertise that leads to blind energy consumption (electricity, heating/cooling),
b) lack of time and interest of public sector building owners and public sector employees to take actions for energy savings at their working environment,
c) lack of incentives to take actions for reducing the energy bill they do not really pay,
d) hesitation to introduce smart metering devices due to issues related to costs, maintenance and unknown contribution to energy efficient action.

The Greek Government's special plan envisages an immediate reduction in consumption **by 10 %** in 2022, with a target of **30 %** in 2030 for public buildings and the application of a digital system for monitoring energy consumption.

The suggested applications aim at: better monitoring of "building behavior" (digitalization) and energy optimization (**15 %** estimated energy consumption decrease), better indoor environmental conditions, CO_2 emissions reduction, wasted energy minimization and savings creation.

12.1.2 Target groups

The main target group of the building is its daily users (employees). Owners and users' contribution are mandatory so they should be well informed for the benefits not only for them (financial, better indoor conditions, better monitoring, immediate corrections) but also for the environment. For that reason, we have to attract them with a proposal in which they will feel familiar and safe. Analytically, they should:

- learn the benefits of the application of the new technologies not only the financial but also the environmental,
- learn and follow the procedure for the optimization of the building performance and to be ensured that those systems contribute also to their well- being,
- be motivated to be involved in the building performance improvements activities and to change their daily routine,
- be informed for their social responsibility.

12.1.3 The external stakeholders

The external stakeholders for Demo 5 are identified and are the following: ESCO companies, investors such as banks, digital solutions providers and Facility Management (FM) companies. Their needs and challenges depend on the existing market as well as the organization-company size, but the most common are presented at the following table.

Table 120 External stakeholders for Demo 5

Stakeholder	Needs	Challenges	Data needed
ESCO company	• to support large scale renovation and digitization activities, • to make synergies to promote services in ESIE with other suppliers and ESCOs for fast market penetration	To overtake: • difficulties in convincing the owners to invest, • the lack of owners' trust or hesitation in these measures' implementations, gathering and documented evidence of performance improvements, • the hesitation of owners to invest restrict market penetration, • evidence and knowhow in ESIE activities needs enhancement.	To ensure the effectiveness of the case study
Investors	• To understand deeper the procedure of energy performance contracting (EPC), • to learn the benefits of the application of the new technologies not only the financial but also the environmental, • to understand that is almost a standard procedure and their investment is "secure".	To solve: • the fear that their investment is not "secure", • the lack of expertise.	To ensure the effectiveness of the case study
Digital Solutions Supplier	• To cooperate with other ESCO companies to promote those services and technologies. • to demonstrate new integrated digital solutions and services, • to integrate this service with complementary services of other suppliers, • to increase their knowledge about the new technologies and their benefits (energy savings, cost saving, less CO_2, better indoor environmental conditions etc.) and motivate other clients in the market.	• To solve: • Owner's lack of knowledge of economic incentives to invest in such projects, • difficulty to convince building owners about the benefits of the implementations of new technologies, • lack of confidence in the development of new digitization and automation technologies, • hesitation to cooperate with other ESCO companies to promote those services and technologies.	To ensure the effectiveness of the case study
Facility Management Company (FM)	• to clarify and present how energy performance contracting and new technologies works, • to demonstrate the benefits of good energy efficiency practices in buildings, • to provide the data needed to compare installations before and after the changes are made.	• to deal with owners who are not aware of the benefits of energy efficiency. The facilitator will therefore have to try to convince them to obtain an EPC contract or to apply new technologies.	To ensure the effectiveness of the case study

12.2 Analysis of current situation

12.2.1 Existing measuring systems and data

Systems and data about energy current situation (e.g., building designs, energy bills of a whole year), the current technologies and the available measurements (if any) are recorded and described in this section.

Table 121 Current Systems of G.S.I.S.P.A

System	Details	Current estimated data
Energy consuming equipment and overall consumption	1. Lamps (not led) 2. Cooling/heating 3. Electric boilers for domestic hot water 4. Data centers (servers, Closed control units etc.) 5. Elevators (8 Pcs)	950 KW/per month Total energy consumption 2022: 6810 MWh (all building, including data center) Total energy consumption 2021: 7110 MWh (all building, including data center)
Energy generating equipment	1. Four electric power generators	1. One of 500KVa, one of 1000 KVa and two of 2500 Ka
	2. Photovoltaics	2. 25,8 m^2
Climate control	1. Three Central Cooling Units/Petrol Boilers for air conditioning/heating with FCU	468 Fcu's
	2. VRV systems	19 (pieces)
	3. Ceiling fans	200 (pieces)
Air and humidity control	1. Central AC Units	26 (pieces)
	2. Ventilation units	16 (pieces)
Rooftop	Ceiling Panel	No data
Energy monitoring and other sensors	1. No energy monitoring	No data
	2. BMS	No data

12.3 Analysis of end users and stakeholders requirements

12.3.1 Use cases

Table 122 Use Case Card 1 for Demo 5

Name	Goal
DEMO 5 (GR): Office and commercial building in Greece **Use Case 1: Energy Performance Contract and the Measurement and Verification (M&V) of Energy Savings method (based on IPMVP) supported by**	• To follow Europe's Renovation Wave, by adopting novel and relevant renovation technologies, • to deploy digital solutions that allows to control energy and indoor environmental data and to improve the comfort levels of indoor environmental conditions and the occupant's well-being,

<table>
<tr><td>Blockchain and Smart Contract Technology (B&SCT) in Office and Commercial building
[ESCO: CORDIA]</td><td colspan="2">• to improve the energy efficiency and the energy savings through energy consumption and monitoring from real data and energy profiles,
• to motivate other ESCO companies and buildings owners to promote and apply those smart energy solutions and EPC contracts,
• to improve overall building performance and its environmental footprint through the reduction of the energy consumption.</td></tr>
<tr><td>Metrics</td><td colspan="2">Target group</td></tr>
<tr><td rowspan="5">• Energy savings due to the reduction of the energy consumption and lower energy costs due to PV installation.
• Standardized, automated calculation and online monitoring of energy consumption and energy savings from real time data and energy profile.
• Criteria and metrics for the evaluation of EPCs.</td><td>Target group</td><td>Personas</td></tr>
<tr><td>Office and Commercial building Owner</td><td>Motivated owner
Demotivated owner</td></tr>
<tr><td>Employees</td><td>Motivated employees
Demotivated employees</td></tr>
<tr><td>Company</td><td>ESCO company
FM company</td></tr>
<tr><td>Investors</td><td>Banks</td></tr>
<tr><td></td><td>Suppliers</td><td>Provider of digital solutions and technology developers.</td></tr>
</table>

Table 123 Use Case Card 2 for Demo 5

<table>
<tr><th>Name</th><th colspan="2">Goal</th></tr>
<tr><td>DEMO 5 (GR) :Office and commercial building in Greece
Use Case 2: ESCO company will apply and demonstrate an energy performance assessment, energy cost reduction and comfort level improvement at General Secretariat of Information Systems for Public Administrations' building.
[Public Buildings Owners: GSIS]</td><td colspan="2">• cost-effective assessment and certification of building energy performance,
• deploy digital solutions and renovation technologies,
• measure deployment costs and time and adopt approaches for optimising large scale deployment,
• prepare smart contract requirements for EPC.</td></tr>
<tr><td>Metrics</td><td colspan="2">Target group</td></tr>
<tr><td rowspan="5">• Energy savings due to the reduction of the energy consumption and lower energy costs due to PV installation.
• Standardized, automated calculation and online monitoring of energy consumption and energy savings from real time data and energy profile.
• Criteria and metrics for the evaluation of EPCs.</td><td>Target group</td><td>Personas</td></tr>
<tr><td>Office and Commercial building Owner</td><td>Motivated owner
Demotivated owner</td></tr>
<tr><td>Suppliers</td><td>Provider of digital solutions and technology developers.</td></tr>
<tr><td>Company</td><td>ESCO company
FM company</td></tr>
<tr><td>Investors</td><td>Banks</td></tr>
</table>

12.3.2 Personas

Table 124 Persona 1 – Demo 5

USER	USER CONTEXT
Company: **ESCO Company**	The ESCO is a company with high experience in the energy sector, promoting ESIE implementation and providing smart contracts based on achieved performance improvements. It is aware about the benefits that the energy efficiency can provide to its business, so it fosters the implementations of energy efficiency measures in the facilities it manages.
PAIN POINTS	**GOALS**
• Services and contracts are not optimised to be widely and easily adopted by the market (too expensive, too lengthy, unclear impact, etc.), • difficulties in convincing the owners to invest in ESIE measures, • lack of owners' trust or hesitation in these measures implementations, gathering and documented evidence of performance improvements, • hesitation of owners to invest restrict market penetration, • evidence and knowhow in ESIE activities needs enhancement to support large scale renovation and digitisation activities, • synergies to promote services in ESIE with other suppliers and ESCOs for fast market penetration.	• to implement ESIE measures in different facilities and demonstrate them as well as gather relevant evidence, • to implement and test new renovation technologies (sustainable materials / renewable sources), • to enlarge their business and knowhow on renovation technology, • to reduce the maintenance costs of the facilities, • to promote their work and benefits and existing success stories, • to increase their knowledge on new renovation technologies and get integrated, validated packages for each target group, • to optimise the packages in terms of cost, time and investment options for large scale market adoption, • to adopt smart contracts and tools to ease the savings verification procedure,

Table 125 Persona 2 – Demo 5

USER	USER CONTEXT
Company: **Facility Management (FM) Company**	Provides the expertise to help the building manager successfully implement an EPC project or digital solutions. Facility Management company is responsible to integrate people, place and process within the built environment with the purpose of improving the quality of life of people, the performance of the facility- building and the productivity of the core business.
PAIN POINTS	**GOALS**
The FM company will usually have to deal with owners who are not aware of the benefits of energy efficiency. The facilitator will therefore have to try to convince them to obtain an EPC contract or to apply new technologies.	• To clarify and present how energy performance contracting and new technologies works, • to demonstrate the benefits of good energy efficiency practices in buildings, • to provide the data needed to compare installations before and after the changes are made.

Table 126 Persona 3 – Demo 5

USER	USER CONTEXT
Office Building Owner: **Motivated owner**	Office and commercial building owners may be aware of the need to improve overall building performance through ESIE analysis. They are interesting not only for cost reduction but also for the improvement of the building energy performance and they will try to support the effort and the benefits from the application of the new technologies.
PAIN POINTS	**GOALS**
• Lack of knowledge of economic incentives and theoretical background to invest in such projects, • lack of knowledge of the process-procedure and the measurement "tools" for the EPCs, cost and energy savings, payback period etc., • lack of expertise and knowhow for fast deployment of novel technologies, • lack of trust in technology providers innovation, • lack of knowledge of the new technologies and their benefits, • pressure from the increasing energy costs and uncertain policies, • in the public sector, almost all of the procedures demand long-term and demanding efforts and it is not an “easy task” to review existing legislation or public.	• To understand deeper the process of energy performance contracting (EPC), • to learn the benefits of the application of the new technologies not only the financial but also the environmental and to inform relatively the users of the facility and other owners, • To follow and respect the procedure for the optimization of the building performance and to ensure the best comfort levels for the users, • To involve and motivate employees- users of the building to support the building performance improvements activities, • To increase the sense of social responsibility.

Table 127 Persona 4 – Demo 5

USER	USER CONTEXT
Office Building Owner: **Demotivated owner**	Office and commercial owners may not be aware of the need to improve overall building performance through ESIE analysis. They may hesitate or not trust the application of the new technologies and their benefits neither financial nor environmental.
PAIN POINTS	**GOALS**
• Lack of knowledge of economic incentives and theoretical background to invest in such projects, • lack of knowledge of the process-procedure and the measurement "tools" for the EPCs, cost and energy savings, payback period etc., • lack of expertise and knowhow for fast deployment of novel renovation technologies, • lack of trust in technology providers innovation, • lack of knowledge of the new technologies and their benefits,	• To understand the process of energy performance contracting (EPC), • to learn the benefits of the application of the new technologies not only the financial but also the environmental, • to understand the principles of the operation of the new technologies and their contribution to the optimization of the overall building performance and indoor environmental conditions (well-being),

• pressure from the increasing energy costs and uncertain policies.	• to understand that there is a real and guarantee benefit behind the implementation of energy efficiency measures.

Table 128 Persona 5 – Demo 5

USER	USER CONTEXT
Users: **Motivated users**	Motivated users, who work in the building, respect the need for energy, cost and emissions reductions and they are willed to contribute the goals to be achieved. They want to participate in the dissemination of the benefits that this analysis would provide in terms of consumption, comfort and CO_2 emissions.
PAIN POINTS	**GOALS**
• Limited knowledge of the new technologies and their benefits, • "pressure" from the demotivated employees, • lack of knowledge how to support the new systems.	• to learn the benefits of the application of new technologies not only the financial but also the environmental and to inform relatively their colleagues, • to learn and follow the procedure for the optimization of the building performance and to be ensured that those systems contribute also to their well- being, • to increase the sense of social responsibility.

Table 129 Persona 6 – Demo 5

USER	USER CONTEXT
Users: **Demotivated users**	The demotivated users are not interested for the benefits from the application of the new technologies. They ignore existing digital tools in their company and they are uninterested to participate in that process and to follow specific - new procedures.
PAIN POINTS	**GOALS**
• Lack of knowledge of the new technologies and their benefits, • lack of interest to support the new technologies and to change their daily routine, • lack of social responsibility.	• To understand that there is a real benefit behind the implementation of energy efficiency measures, • to raise awareness and "pushing" them to implement of the measures, thinking more the changes and its results, • to communicate the changes and results to the others, • To raise the sense of social responsibility.

Table 130 Persona 7 – Demo 5

USER	USER CONTEXT
Investors: **Financial organization**	The Financial Organization is a private organisation where people and businesses can keep, invest, or borrow money, exchange currencies, etc. More specific the lending process in any banking institutions is based on some core principles such as safety, liquidity, diversity, stability and profitability, so to invest in the energy efficiency sector means that all the above aspects are covered.
PAIN POINTS	**GOALS**
• the fear that their investment is not "secure", • the lack of expertise.	• To understand deeper the procedure of energy performance contracting (EPC), • to learn the benefits of the application of the new technologies not only the financial but also the environmental, • to understand that is almost a standard procedure and their investment is "secure".

Table 131 Persona 8 – Demo 5

USER	USER CONTEXT
Suppliers: **Provider of Digital Solutions**	The Provider of Digital Solutions is a company which has expertise in digital solutions in energy saving for work environmental and the digitalization of buildings. It is aware for new technologies; their operational benefits and how new technologies can be applied in its clients' business. The purpose is to apply digital solutions for a better work comfort level and energy performance of each building.
PAIN POINTS	**GOALS**
• Owner's lack of knowledge of economic incentives to invest in such projects, • difficulty to convince building owners about the benefits of the implementations of new technologies, • lack of confidence in the development of new digitization and automation technologies, • hesitation to cooperate with other ESCO companies to promote those services and technologies.	• To demonstrate new integrated digital solutions and services, • to integrate this service with complementary services of other suppliers, • to increase their knowledge about the new technologies and their benefits (energy savings, cost saving, less CO_2, better indoor environmental conditions etc) and motivate other clients in the market.

Table 132 Persona 9 – Demo 5

USER	USER CONTEXT
Suppliers: **Renovation company**	The Renovation Company is a company that renovates existing buildings in order to extend the usable lifespan, improve living and working conditions and reduce operational energy costs. It

	has high experience in technical maintenance and renovation of buildings and it's aware about the new renovation technologies and the benefits that can provide to its business.
PAIN POINTS	**GOALS**
• hesitation of owners to invest restrict market penetration, • difficulty to convince the owners about the benefits that the energy efficiency measurements provide. • synergies to promote services in ESIE with other suppliers and ESCOs for fast market penetration. • lack of confidence in the development of new renovation technologies.	• to implement and test new renovation technologies (sustainable materials / renewable sources), • to enlarge their business and knowhow on renovation technology, • to reduce the maintenance costs of the facilities, • to increase their knowledge on new renovation technologies and get integrated, validated packages for each target group, • to enlarge their business and knowhow on renovation technology.

12.3.3 User stories

Table 133 User stories for Persona 1 (ESCO)

User Story 1.1
As an ESCO, I want to implement energy efficiency measures in the building, so that the energy consumption, the energy costs and CO_2 emissions will be reduced.
User Story 1.2
As an ESCO, I want users to trust me and to be convinced of the effectiveness of these measures, so that interventions inside the building become easier and supportive.

Table 134 User stories for Persona 2 (FM Company)

User Story 2.1
As a facilitator developing new market, I want to provide real data of the building, before and after the installation and the changes have been made, so that they will understand better the benefits of the new technologies and the operation of an EP contract (comparison of the building performance before and after the changes).
User Story 2.2
As a facilitator developing new market, I want to achieve energy savings, so that owners will be convinced and they will want to obtain an EPC contract.

Table 135 User stories for Persona 3 (Motivated owner)

User Story 3.1
As a Motivated owner, I want to convince other users/employees of the effectiveness of the system, to be awarded and motivated to change their behaviour in the building, so that the energy consumption will be reduced.

User Story 3.2
As a motivated owner, I want to trust the ESCO, so that I can obtain suitable knowledge about that and maybe obtain more EP Contracts in the future.

Table 136 User stories for Persona 4 (Demotivated owner)

User Story 4.1
As a Demotivated owner, I want to understand the real benefits of energy efficiency measures, so that I can promote and encourage the implementation of these measures.
User Story 4.2
As a Demotivated owner, I want to understand the operation of energy performance contracting (EPC), so that I can benefit financially by one of those.

Table 137 User stories for Persona 5 (Motivated users)

User Story 5.1
As a Motivated user, I want to implement energy efficiency measures, so that the comfort level will be improved in the workplace.
User Story 5.2
As a Motivated user, I want to become more aware and motivated to change the way of thinking, so that I will support any effort for lower energy consumption.

Table 138 User stories for Persona 6 (Demotivated users)

User Story 6.1
As a Demotivated user, I want to realise that there is a real benefit behind the implementation of ESIE measures, so that I can promote and support any change to others.
User Story 6.2
As a Demotivated user, I want to have an incentive/benefit to support the effort of ESIE improvement of the building, so that I am thinking more about the changes and the results.
User Story 6.3
As a Demotivated user, I want to be rewarded in green euros, so that the green actions will be more and more effective.

Table 139 User stories for Persona 7 (Financial Organization)

User Story 7.1
As a Financial Organization, I want to "secure" the investment on ESIE measures, so that I can invest in more facilities with confidence and obtain economic benefit.
User Story 7.2
As a Financial Organization, I want to understand the operation of energy performance contracting (EPC) and the benefits of the new technologies implementation, so that I can benefit financially by one of those and a lot of others.

Table 140 User stories for Persona 8 (Provider of Digital Solutions)

User Story 8.1
As a provider of digital solutions, I want to demonstrate the operation of energy Performance Contract and the Measurement and Verification (M&V) of Energy Savings method (based on IPMVP) in Office and Commercial building, so that the service will be known in the market.
User Story 8.2
As a provider of digital solutions, I want to deploy new technologies and provide smart solutions with the aim of the inclusive, sustainable, efficient use of energy in a building, so that our green activities become more familiar in the energy sector.

Table 141 User stories for Persona 9 (Renovation Company)

User Story 9.1
As a renovation company, I want to develop new renovation technologies (sustainable materials / renewable sources), provide smart and competitive renovation solutions, so that the services will be known and affordable in the market.
User Story 9.2
As a renovation company, I want to demonstrate the benefits of the renovation services, so that prospective clients can trust us and benefit from our services.

13 The pilots – Demo 6

13.1 Description of the pilot sites

13.1.1 Description of the building

Characteristics of building: Current Situation

The mission of the Sports and Recreation Center (pol. Ośrodek Sportu i Rekreacji w Górze Kalwarii) managed by the Municipality of Góra Kalwaria is to provide the residents of the municipality with sports, recreation and cultural space. Relevant building is a Public pool, located in Góra Kalwaria (urban area) in Masovian Voivodship. Exact address of the building is Pijarska 119 Street, 05-530 Góra Kalwaria (51°59'17.8"N 21°12'00.6"E)., Building is located in the center of the town of Góra Kalwaria, surrounded by single-family houses. The swimming pool facility with a total usable area of 4,052.60 m^2 was built in 1999 (while drawing on mid-80's project and technical design), by the municipal office and the owner did not change. Around 20 people work daily in the building with opening hours from 06:00 am to 9:45 pm.

The building (main materials) is constructed by concrete, glass, timber. It has a compact form with a single-pitched roof above the hall with a swimming pool. Roof structure in the technology of beams made of glued timber.

The swimming pool is equipped with a sports and recreation area, which has numerous attractions such as a slide, a wild spring, a jacuzzi, etc. In addition, the building has a restaurant, gym and commercial space for rent. On the underground floor there is a ventilation room, a heating substation room and a sub-basin with technological facilities - a swimming pool water filtration system, pumping systems, heating installation, etc.

In the existing state, the external partitions of the building are as follows:

External walls/ basements: solid brick walls, partly reinforced concrete.

Above-ground: brick walls made of ceramic hollow bricks, 25 cm thick, insulated with 8 cm a layer of polystyrene finished with a pressure layer of checkered brick 12 cm thick.

Above-ground walls after thermal modernization: brick walls made of ceramic hollow bricks, 25 cm thick, insulated with a total of 14 cm layer of polystyrene.

Ceiling above the cellar made of reinforced concrete, 25 cm thick, insulated with an 8 cm layer of polystyrene.

Roof of the swimming pool hall: made of galvanized trapezoidal sheet fastened to wooden girders. It has been insulated with an 18 cm layer of mineral wool and is covered with thermally weldable roofing felt.

Remaining roof: reinforced concrete slab above some rooms; above the service part on lattice steel girders. The whole is insulated with an 18 cm layer of mineral wool.

Figure 18 Swimming pool for Demo 6

Characteristics of renovation need

The building requires renovation due to obsolete technological solutions and the wear of the existing building elements. With rising maintenance costs, the building consumes too much energy according to current standards. The biggest problems of the existing building are the ventilation devices and the glazed southern façade.

The current ventilation system serving part of the recreational swimming pool hall is not powerful enough for removing moisture gains, and therefore there are frequent exceedances of relative humidity above 80%. Such high humidity is dangerous for the structure of the swimming pool hall, its effects can be observed e.g., on girders.

Some of the windows of the swimming pool hall remain unprotected, i.e., no supply of fresh, warm air to their surface to protect it against condensation of moisture. The area around the slide tower is practically not protected against moisture accumulation in any way, there is no supply of fresh air in the right amount, here the relative humidity exceeds 90% at times. When analysing the operation of swimming pool air handling unit, it was noticed that currently the pressure loss on the heat recovery exchanger in the air supply duct is over 600 Pa at approx. 30% share of fresh air. This condition results from the incorrectly selected cross-section of the exchanger by-pass and the poor technical condition of the exchanger itself (dirty and corroded fins), which qualifies the air handling unit not for repair, but for reconstruction or replacement.

Currently, when operating in recirculation with a small share of outside air, the air supply fan capacity in the Air handling unit NW2 is about 8,000 m^3/h. When trying to increase the share of external air in relation to the recirculating air, too high resistance of the exchanger and by-pass reduce the efficiency of the air supply system to about 5,000 m^3/ h. air flow through the components of the air handling units enable full regulation. For both operating NW and NW2 systems, the change in the share of external air takes place in the range between 4,926 m^3/h (when dehumidification is not needed and the AHU should

operate in 100% recirculation) and 12,540 m³/h (when the AHU is required to operate with 100 % share of outside air - without recirculation).

The total efficiency of the supplied air NW1 and NW2 in the entire regulation range changes slightly in the range from 18,864 to 19,814 m3/h. In addition, there is air infiltration of approx. 1,900 m3 / h, which is confirmed by measurements of the supply and exhaust air efficiency.

13.1.2 Target groups

Type of user /occupant, internal users (e.g. inhabitants) / external users (e.g. visitors)

Monthly number of total tickets sold, approx. 110.000, incl.: regular tickets – 41224; reduced tickets – 24408; pensioners – 3114; seniors - 2409; people with disabilities- 2637; people with a family card (Gora Kalwaria commune) – 2340; family tickets - 2577; holiday/holiday tickets – 1747; Swimming classes for infants – 1787; Number of people in Physical Education classes- 2709; Groups from outside the Gora Kalwaria commune – 4227; non-swimming sports clubs: 1741 users; Swimming clubs training regularly - 4298; School groups- 2470.

Maximum capacity of swimming pool users per hour is 212 users. Pool has most customers in the months: February, March, July, October; and least during: September, December.

Most customers (during weekdays) are on Tuesday, Thursday, Friday at 17-21 pm: approx. 170-180 people; and during whole days during the weekends; the least number of customers (on weekdays) between 6-8 am: approx. 30 people.

Besides the operator of the pool and its users, there are 22 stakeholders renting either usable space or advertising space in the building.

Situation characteristics

The swimming pool hall is served by two central units responsible for ventilation, heating and cooling.

N1 / W1 ventilation unit part of the sports swimming pool hall / circulating air volume: 15000 m3/h

The N2 / W2 ventilation complex, part of the recreational swimming pool hall: the amount of circulating air: 9800 m3/h.

The temperature of the air supplied in winter is 38°C.

The teams are tasked with maintaining constant parameters (temperature, humidity and negative pressure) in the swimming pool hall throughout the year, regardless of the weather conditions.

In the swimming pool hall, a constant temperature should be maintained two degrees lower than the air temperature, which according to the regulations should be in the range of 29-31 C.

Types and amount of energy used, place of energy use Annual costs (PLN): Electricity: Lighting, mechanical ventilation, heating installation, cooling installation, office equipment, DHW); 768 [MWh/year].

Network heat (Central heating, Technological heat (ventilation): 1301 [MWh/year].

The four largest areas of heat consumption are Swimming Pool Water Installation (30%), Central Heating without N1W1 and N2W2 Air Handling Units (28%), N1W1 and N2W2 Air Handling Units (25%) and Domestic Hot Water (13%).

The heat source in the building is a district heating station located in the basement part of the building, supplied from the municipal district heating network. Central heating in the building is carried out in two ways: in the swimming pool hall, by air (air prepared in ventilation units) through diffusers located in the floor; in the rest of the building, water, pump, double-pipe heating with steel and panel radiators. Domestic hot water is prepared centrally in the heating substation and distributed to individual draw-off points. Swimming pool water is also heated from heat exchangers located in the heating substation.

13.2 Analysis of current situation

Temperature and climate situation (heating/cooling/venting needs)

According to the regulations of the document "Sanitary and Hygienic Requirements for Indoor Swimming Pools", the air temperature in the swimming pool room should be 1 to 2°C higher than the water temperature but should not exceed 32°C. Air humidity should be between 55 and 60%. However, the temperature and humidity of the air must be selected in a way that ensures optimal conditions for thermal comfort. Too high humidity and air temperature will cause the feeling of suffocation in people staying in the room. Too low humidity or air temperature will increase the evaporation of water from the pool (the need to oversize the air conditioning system to effectively dry the air).

The swimming pool hall is served by two central units responsible for ventilation, heating and cooling.

N1 / W1 ventilation unit part of the sports swimming pool hall / circulating air volume 15000 m^3/h.

The N2 / W2 ventilation complex, part of the recreational swimming pool hall: the amount of circulating air 9800 m^3/h.

The teams are tasked with maintaining constant parameters (temperature, humidity and negative pressure) in the swimming pool hall throughout the year, regardless of the weather conditions.

In the swimming pool hall, a constant temperature should be maintained two degrees lower than the air temperature, which according to the regulations should be in the range of 29-31 C.

Annual budget / household budget

Budget of expenses for 2022 of the Sports and Recreation Center: 3,534,557.68 PLN (763,210.53 EUR)

- income budget for 2022 of the Swimming Pool Complex: 1,722,891.86 PLN (372,020.86 EUR)

- operating costs without electricity and heat: a) materials (pool chemicals, cleaning agents, materials for maintenance and repairs) - 170,377.69 PLN (36,789.34 EUR); b) technological services, repairs, economic and technical services - 236,316.00 PLN (51,027.28 EUR)

- costs of heating energy for 2022: 770,728.19 PLN (166,421.92 EUR)

- electricity costs for 2022: 641,184.30 PLN (138,449.74 EUR)

13.3 Analysis of end users and stakeholders requirements

13.3.1 Use cases

Table 142 Use Case Card 1 for Demo 6

Name	Goal
DEMO 6 (Poland): Comfortable and sustainable (Public) Pools **Use Case 1: Creation and development of a tool for energy consumption management and monitoring of the pool user's satisfaction**	**Overall: To test integrated user-scoped public pool energy management tools advancing European Green New Deal and New European Bauhaus objectives** • To reduce energy consumption of the pool and increase its energy efficiency. • To monitor and aggregate the data on satisfaction of the pool users. • To deploy and mainstream tool for management, testing and validation of the pool conditions (water temperature, air temperature, humidity). • To generate energy management messages for the pool users. • To monitor the energy consumption of energy appliances and systems deployed.

Metrics	Target group	
	Target group	**Personas**
• Reduction of the energy use • Calculation of the energy consumption, based on the temperature of air and water as well as air quality, humidity level • User satisfaction, acceptance and trust metrics	Pool operators	- Motivated operator - Demotivated operator
	Citizens	- Motivated citizens - Disbelieving/careless citizens - Demotivated citizens
	Users	- Incentivised, eager users - Careless/ indifferent users
	Municipality	- Motivated Municipality - Disbelieving/careless Municipality
	Suppliers	- Provider of Digital Solutions: Software developer
	Investors	- Convinced Investors - Unconvinced Investors

Table 143 Use Case Card 2 for Demo 6

Name	Goal	
DEMO 6 (Poland): Comfortable and sustainable (Public) Pools **Use Case 2: Design and deploy relevant renovation activities to improve the overall public infrastructure performance and increase its energy efficiency.** [Renovation Company: Contractor]	**Goal: To design and implement modernised integrated user-scoped public pool infrastructure advancing European Green New Deal and New European Bauhaus objectives** • To curb energy consumption of the pool, increase its energy efficiency and reduce its operating costs. • To deploy and test optimal matching of ventilation and pool temperature. • To synergise with the designed tool for management, testing and validation of the pool conditions (water temperature, air temperature, humidity).	
Metrics	**Target group**	
	Target group	**Personas**
• Reduction of the energy costs. • Reduction of the energy use. • Calculation of the energy consumption, based on the temperature of air, and water as well as humidity level. • User satisfaction, acceptance and trust metrics.	Pool operators	- Motivated operator - Demotivated operator
	Citizens	- Motivated citizens - Disbelieving/careless citizens - Demotivated citizens
	Users	- Incentivised, eager users - Careless/ indifferent users
	Municipality	- Motivated Municipality - Disbelieving/careless Municipality
	Suppliers	- Renovation company / Contractor

Table 144 Use Case Card 3 for Demo 6

<table>
<tr><th>Name</th><th colspan="2">Goal</th></tr>
<tr><td>DEMO 6 (Poland): Comfortable and sustainable (Public) Pools
Use Case 3: One-Stop-Shop for information on renovation services</td><td colspan="2">Overall goal: To support the FORTESIE marketplace as a one-stop-shop.
The renovation processes in the building industry are very complex as they imply a lot of different entities and actors. In addition, the cost of any action is very high, so even taking a decision about carrying out a renovation process can be difficult.
A one-stop-shop is a physical or online place where people can find all the information and services they need for a certain action.
In this context, FORTESIE will implement an online marketplace for sustainable service provisioning and value chain networking acting as a One-Stop-Shop for building renovation for ESIE, networking and empowering local actors. This marketplace intends to facilitate the networking between involved stakeholders and providing all the necessary info to carry out an efficient renovation of a building, from the techniques to be used or the companies to contact, to the new financing possibilities that will be promoted in FORTESIE (e.g. innovative and alternative schemes such as crowd funding and green euro rewards, a potential Central Bank Digital Currency (CBDC), etc).
GKW will support this marketplace, being one of the two entities working as a one-stop-shop. GKW will combine their online attention in the marketplace with presential attention in Poland, in both cases informing about the different possibilities that FORTESIE offers.</td></tr>
<tr><th>Metrics</th><th colspan="2">Target group</th></tr>
<tr><td rowspan="4">Number of people who are going to request help or information in the OSS.</td><td>Target group</td><td>Personas</td></tr>
<tr><td>Citizens</td><td>- Motivated citizens
- Disbelieving/careless citizens
- Demotivated citizens</td></tr>
<tr><td>Municipality</td><td>- Motivated Municipality</td></tr>
<tr><td>Suppliers</td><td>- Renovation company / Contractor
- Provider of Digital Solutions: Software developer</td></tr>
</table>

13.3.2 Personas

Table 145 Persona 1 – Demo 6

USER	USER CONTEXT
Pool operator: **Motivated pool operator**	The operator is concerned about the poor energy efficiency of the pool building. The operator is motivated to reduce the energy costs by optimizing the use of the ventilation and heating system. The operator believes that beside replacing the inefficient appliances, the way of using them can be improved too. The operator is convinced that the improvements can influence the environmental impact of the building in a positive way. The operator trusts that the project benefits can enable the implementation of the improvements in a wider scale.

PAIN POINTS	GOALS
• inefficiency of the heating and ventilation system. • inconsistency of the pool workers to achieve the best possible results of the heating and ventilation system. • lack of adaptability of the heating and ventilation system to the predictable occupancy of the pool. • lack of flexibility of the system to adapt towards the pool operator needs. • lack of knowledge on how to improve the efficiency of the system. • unmodernised systems and lack of tools.	• to create a tool to manage and monitor the energy consumption in the pool building. • to develop a tool to measure the satisfaction of the pool users. • to involve and motivate users to support the programmes of the energy consumption reduction. • to educate the pool operators about their important role in the process. • to increase the building sustainability by improving the heating and ventilation system. • to introduce innovative ways of heating the air and water inside the pool.

Table 146 Persona 2 – Demo 6

USER	USER CONTEXT
Pool operator: **Demotivated pool operator**	The operator might not be aware of the poor energetic efficiency of the pool building. The operator might not be motivated to introduce any changes towards the reduction of the energy costs and optimisation of the ventilation and heating system. The operator might not believe that the way appliances are used can be improved. The operator might not see the possible environmental impact of the changes proposed in the building. The operator's trust in the project and its wider impact might be limited.
PAIN POINTS	**GOALS**
• inefficiency of the heating and ventilation system. • inconsistency of the pool workers to achieve the best possible results of the heating and ventilation system. • lack of adaptability of the heating and ventilation system to the predictable occupancy of the pool. • lack of flexibility of the system to adapt towards the pool operator needs. • lack of knowledge on how to improve the efficiency of the system. • unmodernised systems and lack of tools.	• to educate the pool operator about their important role in the process. • to educate about solutions that can help reduce the energy consumption in the building. • to provide the best possible way of data collection. • to introduce a system of management and monitoring of the energy use in the building.

Table 147 Persona 3 – Demo 6

USER	USER CONTEXT
Pool facility users: **Motivated users**	Motivated users of the pool are aware that the energy efficiency of the pool building needs improvements. They acknowledge that the change of their behaviours might help improve the overall performance of the pool building. They are motivated to participate in the events and actions organised by the pool operator. They are

	willing to adapt to the new temperature and ventilation conditions inside the pool. They are promoting the actions of the pool operator among other users and local citizens. They are open to contribute to the process, control it and be willing to provide feedback to the operator. They believe that their actions may have impact on a wider scale.
PAIN POINTS	**GOALS**
• limited knowledge about the green solutions for buildings. • lack of knowledge on how the users/citizens can contribute to the reduction of energy in the pool building. • limited knowledge on how the ventilation and heating system of the building works. • lack of knowledge on people's ability to adapt to different water temperature.	• to educate on how the citizens can contribute to the decrease in energy use. • to further motivate and guide actions and behaviours of the users. • to educate on how the ventilation and temperature system of the building works. • to help users to adapt to changes in the thermal conditions of the building. • to promote contribution to the green actions by rewarding them. • to educate on how the green solutions can be implemented on a wider scale.

Table 148 Persona 4 – Demo 6

USER	**USER CONTEXT**
Pool facility users: **Disbelieving/careless users**	Disbelieving or careless users are not concerned about the energy use inside a public building. They believe that the energy savings strategies are marketing tools created for money making. They are not willing to adapt their habits to help improve the efficiency of the building and are not motivated to give feedback to pool operator.
PAIN POINTS	**GOALS**
• limited knowledge about the green solutions for buildings. • lack of knowledge on how the users/citizens can contribute to the reduction of energy in the pool building. • limited knowledge on how the ventilation and heating system of the building works. • lack of knowledge on people's ability to adapt to different water temperature. • limited trust for the actions of the municipality • lack of knowledge on the importance of the introduction of green solutions. • lack of desire to introduce any change.	• to educate on the importance of the citizens contribution to the green actions. • to explain how the citizens can contribute to the decrease in energy use. • to educate on how the ventilation and temperature system of the building works. • to help users to adapt to changes in the thermal conditions of the building. • to promote contribution to the green actions by rewarding them. • to convince that the reduction of the energy consumption is beneficial for the whole community.

Table 149 Persona 5 – Demo 6

USER	**USER CONTEXT**
Citizens: **Motivated citizens**	Motivated citizens of Municipality are aware that the energy efficiency of the public facilities in Municipality (like public pool building) needs improvements. They

	acknowledge that the change of their behaviours might help improve the overall performance of the public infrastructure, like pool building. They are satisfied that Municipality puts effort to be more energy efficient in their actions towards public infrastructure. They are motivated to spread the word about Municipality actions, promoting the actions of the pool operator among other citizens, and participate in the events and actions organised by the pool operator. They control the process and are willing to provide feedback to the operator. They believe that their actions may have impact on a wider scale, and also can benefit them in long term. In addition, they would like to know more about what kind of renovations can be done for public facilities that improve ESIE measures.
PAIN POINTS	**GOALS**
• limited knowledge about the green solutions for buildings. • lack of knowledge on how the users/citizens can contribute to the reduction of energy in the pool building. • limited knowledge on how the ventilation and heating system of the building works. • lack of knowledge on people's ability to adapt to different water temperature.	• to educate on how the citizens can contribute to the decrease in energy use. • to educate on how the ventilation and temperature system of the building works. • to make citizens also become the users of building; willing to adapt to changes in the thermal conditions of the building. • to promote contribution to the green actions by rewarding them. • to educate on how the green solutions can be implemented on a wider scale. • to have a place (online marketplace and presential office in Poland) in which they can solve all their doubts about a renovation process.

Table 150 Persona 6 – Demo 6

USER	USER CONTEXT
Citizens: **Disbelieving/careless citizens**	Disbelieving or careless citizens are not concerned about the energy use regarding public facilities. They believe that the energy savings strategies are marketing tools created for money making. They do not feel that saving costs and energy by Municipality will affect them, thus they are not interested in promoting Municipality actions. In addition, they would like to know more about what kind of renovations can be done for public facilities that improve ESIE measures.
PAIN POINTS	**GOALS**
• limited knowledge about the green solutions for buildings. • lack of knowledge on how the users/citizens can contribute to the reduction of energy in the pool building. • limited knowledge on how the ventilation and heating system of the building works. • lack of knowledge on people's ability to adapt to different water temperature.	• to educate on the importance of the citizens contribution to the green actions. • to explain how the citizens can contribute to the decrease in energy use. • to educate on how the ventilation and temperature system of the building works. • to encourage to become user of the building/facilities.

• limited trust for the actions of the municipality • lack of knowledge on the importance of the introduction of green solutions. • lack of desire to introduce any change.	• to promote contribution to the green actions by rewarding them. • to convince that the reduction of the energy consumption is beneficial for the whole community. • to have a place (online marketplace and presential office in Poland) in which they can solve all their doubts about a renovation process.

Table 151 Persona 7 – Demo 6

USER	USER CONTEXT
Citizens: **Demotivated citizens**	Demotivated citizens do not feel that saving costs and energy by Municipality will affect them, thus they are not interested in participating in Municipality actions or promoting them. In addition, they would like to know more about what kind of renovations can be done for public facilities that improve ESIE measures.
PAIN POINTS	**GOALS**
• limited knowledge about the green solutions for buildings. • lack of knowledge on how the users/citizens can contribute to the reduction of energy in the pool building. • limited knowledge on how the ventilation and heating system of the building works. • lack of knowledge on people's ability to adapt to different water temperature. • limited trust for the actions of the municipality. • lack of knowledge on the importance of the introduction of green solutions. • lack of desire to introduce any change.	• to educate on the importance of the citizens contribution to the green actions. • to explain how the citizens can contribute to the decrease in energy use. • to educate on how the ventilation and temperature system of the building works. • to encourage to become user of the building/facilities. • to promote contribution to the green actions by rewarding them. • to convince that the reduction of the energy consumption is beneficial for the whole community. • to have a place (online marketplace and presential office in Poland) in which they can solve all their doubts about a renovation process.

Table 152 Persona 8 – Demo 6

USER	USER CONTEXT
Municipality: **Motivated municipality**	Members of the local authorities are motivated to improve the energetic efficiency of the pool building. They are aware that the ventilation and heating system in the building requires renovation. They are determined to find the best possible solution to improve the energetic performance of the building. They are eager to learn about the possible actions from the specialists. Motivated municipality believes that the pool improvements can have a positive environmental impact. They regard creation of the analytical tool as an opportunity and believe that the results of the analysis can influence the municipality in a wider context.

	In addition, they would like to host the OSS to offer information regarding what kind of renovations can be done for public facilities that improve ESIE measures.
PAIN POINTS	**GOALS**
• inefficiency of the heating and ventilation system resulting in high energy costs. • lack of tool on how to measure the energetic efficiency of the pool building. • lack of knowledge on how to improve the efficiency of the system. • lack of knowledge on how to convince the citizens of the benefits of green actions. • hesitation if the changes in the water temperature will not result in the drop of satisfaction among the users.	• to lower the energy costs of the pool by monitoring the energy consumption in the building. • to save the costs of energy that can be used in other sectors in the municipality. • to improve the communication between the municipality and the citizens. • to have a tool for more aware and reasonable management of the building. • to be able to replicate the solution in other venues of the municipality. • to improve the visual perception of the facility. • to increase the engagement of the citizens. • to promote green actions among the citizens. • to improve Municipality' good image and publicity; as modern Local Authority, following the up-to date sustainable solutions; and promoting good practices. • to have a place (online marketplace and presential office in Poland) in which they can solve all their doubts about a renovation process.

Table 153 Persona 9 – Demo 6

USER	**USER CONTEXT**
Municipality: **Disbelieving/careless municipality**	Disbelieving or careless members of the local authorities are neither willing to organise nor participate in the events promoting the aware use of the energy in the municipality. They do not believe that citizens/visitors will be willing to change their habits. They do not want to engage in a long term process, but would rather expect the benefit of the short term actions.
PAIN POINTS	**GOALS**
• inefficiency of the heating and ventilation system resulting in high energy costs. • lack of tool on how to measure the energetic efficiency of the pool building. • lack of knowledge on how to improve the efficiency of the system. • lack of knowledge on how to convince the citizens of the benefits of green actions. • hesitation if the changes in the water temperature will not result in the drop of satisfaction among the users.	• to lower the energy costs of the pool by monitoring the energy consumption in the building. • to convince that saving the costs of energy at the pool can improve other sectors of the municipality. • to educate about the benefits of improvement of the communication between the municipality and the citizens. • to have a tool for more aware and reasonable management of the building. • to be able to replicate the solution in other venues of the municipality. • to improve the visual perception of the facility. • to educate about the benefits of green actions for the municipality.

Table 154 Persona 10 – Demo 6

USER	USER CONTEXT
Provider of Digital Solutions: Software developer	Software Developer is a digital solution provider with high experience in the ICT sector. It is aware about the benefits that the new digitisation and automation technologies can provide to its business, so it fosters the implementations for efficient, sustainable, inclusive energy use for the relevant facilities.
PAIN POINTS	**GOALS**
• difficulty to convince the owners about the benefits that the energy efficiency visualization provides. • hesitation of owners to invest restrict market penetration. • evidence and knowhow in efficient, sustainable and inclusive energy use activities need enhancement to support large scale renovation and digitisation activities. • synergies to promote services with other suppliers.	• to implement and test new digitisation and automation technologies (data gathering, user applications, mobile applications for user engagement, interaction and satisfaction measurement). • to integrate these services with complementary services of other suppliers. • to gain visibility out of the implemented pilots. • to enlarge the commercial activities in the area of building renovation and performance improvement. • to increase their knowledge and services on new digitisation and automation technologies pilot showcase on public facility, with possibility to inspire other for its replication. • to have a place (online marketplace and presential office in Poland) in which the entity can promote themselves as suppliers of digital solutions for a renovation, explaining their innovative services.

Table 155 Persona 11 – Demo 6

USER	USER CONTEXT
Contractor: Renovation Company	Contractor being renovation company with high experience in maintenance and renovations of buildings and green performance improvement materials and solutions. Company is aware about the benefits that the new renovation technologies can provide to its business, in terms of efficient, sustainable, inclusive energy use for the relevant facilities. They are looking for ways to explore the market and increase their business in this domain.
PAIN POINTS	**GOALS**
• difficulty to convince the owners about the benefits that the energy efficiency visualization provides. • hesitation of owners to invest restrict market penetration. • evidence and knowhow in efficient, sustainable and inclusive energy use activities needs enhancement to support large scale renovation and digitisation activities. • synergies to promote services with other suppliers	• to implement and test new renovation technologies (sustainable materials/ renewable sources). • to enlarge their business and knowhow on renovation technology. • to reduce the maintenance costs of the facilities. • to promote their work and benefits and existing success stories. • to increase their knowledge on new renovation technologies and to get integrated, validated packages for each target group. • to optimise the packages in terms of cost, time and investment options for large scale market adoption. • to promote green practices by pilot showcase on public facility, with possibility to inspire other for replication. • to have a place (online marketplace and presential office in Poland) in which the entity can promote themselves as suppliers for a renovation, explaining their innovative services.

Table 156 Persona 12 – Demo 6

USER	USER CONTEXT
Convinced Investors	Companies or organisations confident to get return on invested money, additionally being driven by will of creating positive impact. They can invest in pilot software for measurement, optimization and energy efficiency in other Municipalities (replication effect); later becoming the owners; and finally sell/ trade the software to other municipalities/ public institutions.
PAIN POINTS	**GOALS**
• Reliability of impact assessment of interventions on non-commercial markets. • Limited transparency regarding impact logic, indicators and metrics. • Limited investment opportunities for high impact interventions. • Limited access to impact stories of the intervention's beneficiaries and lack of the investments of that sort regarding public infrastructure.	• Offer investment opportunities with measured social and environmental impact. • Contribute to demonstrate transparent impact logic, indicators and metrics regarding public facilities/infrastructure. • Close the gap to reach to the end beneficiaries of interventions. • A promising, profitable opportunity for return on investment in software/tools beneficial for communities.

Table 157 Persona 13 – Demo 6

USER	USER CONTEXT
Unconvinced Investors	Companies or organisations being concerned that software will not bring expected impact, return of investment and will not be interesting product for future potential buyers and users on non-commercial market (Municipalities/ public facilities).
PAIN POINTS	**GOALS**
• Reliability of impact assessment of interventions on non-commercial markets. • Limited transparency regarding impact logic, indicators and metrics. • Limited investment opportunities for high impact interventions. • Limited access to impact stories of the intervention's beneficiaries and lack of the investments of that sort regarding public infrastructure.	• Offer investment opportunities with measured social and environmental impact. • Contribute to demonstrate transparent impact logic, indicators and metrics regarding public facilities/infrastructure. • Close the gap to reach to the end beneficiaries of interventions. • A promising, profitable opportunity for return on investment in software/tools beneficial for communities.

13.3.3 User stories

Table 158 User stories for Persona 1 (Motivated pool operator)

User Story 1.1
As a pool operator, I want to reduce the costs of its operation, so that is why I need to improve the management of the temperature and ventilation system.

User Story 1.2
As a motivated pool operator, I want to encourage users to visit the pool, so that is why I need to improve the internal air conditions and promote my business.
User Story 1.3
As a motivated pool operator, I want to promote sport activity among the citizens, so that I need to increase attendance.
User Story 1.4
As a motivated pool operator, I want to monitor the end results of my actions, so that I need to receive the reports about the use of the energy combined with the users' satisfaction reports.

Table 159 User stories for Persona 2 (Demotivated pool operator)

User Story 2.1
As a pool operator, I want to make sure that the programme that is being introduced will not result in the decrease of satisfaction, as a result of the water temperature reduction, so that attendance does not drop.
User Story 2.2
As a pool operator, I want to make sure that the energy savings will surpass the increased spendings so that I benefit from the project financially.
User Story 2.3
As a pool operator, I want to find out if the programme is understandable for the users so that I need a clear communication system.
User Story 2.4
As a pool operator, I want to learn if manipulating the temperature of the pool will disappoint the users and more complaints received, so that my position in front of the municipality is weakened.

Table 160 User stories for Persona 3 (Motivated users)

User Story 3.1
As a motivated user, I want to make sure that the pool operator is doing whatever they can, so that the least energy is wasted.
User Story 3.2
As a motivated user, I want to be well informed about the events organised by the operator, so that I can attend them and motivate my friends to join me.
User Story 3.3
As a motivated user, I want to know the results of the measurements and events organised by the operator, so that I can become more aware of my environmental impact.
User Story 3.4
As a motivated user, I want to become a part of the Green Euro programme, so that I can be awarded for my environmental actions.

Table 161 User stories for Persona 4 (Disbelieving/careless users)

User Story 4.1
As a disbelieving/careless user, I want to realise that there is a real profit for the municipality behind the implementation of the green solutions, so that I contribute to something important.
User Story 4.2
As a disbelieving/careless user, I want to understand the ventilation and temperature management system of the pool so that I become convinced to take part in the programme.
User Story 4.3
As a disbelieving/careless user I want to be rewarded for my green actions so that I benefit from them personally.

Table 162 User stories for Persona 5 (Motivated citizens)

User Story 5.1
As a motivated citizen, I want to make sure that the pool operator of public facility is doing whatever they can, so that the least energy is wasted.
User Story 5.2
As a motivated citizen, I want to be well informed about the events organised by the operator, so that I will attend them and motivate other citizens to join me.
User Story 5.3
As a motivated citizen, I want to know the results of the Municipality efforts, as results of the measurements and events organised by the operator, so that I can become more aware of my environmental impact.
User Story 5.4
As a motivated citizen, I want to become a part of the Green Euro programme, so that I can be awarded for my environmental actions, benefiting Municipality and whole community.
User Story 5.5
As a motivated citizen, I want to have a place (online marketplace or presential place) in which I can solve all my doubts about a renovation process so that I am more informed.

Table 163 User stories for Persona 6 (Disbelieving/careless citizens)

User Story 6.1
As a disbelieving/careless citizen, I want to realise that there is a real profit for the municipality behind the implementation of the green solutions, so that I contribute to something important.
User Story 6.2
As a disbelieving/careless citizen, I want to understand the ventilation and temperature management system of the pool so that I become convinced to take part in the programme.
User Story 6.3
As a disbelieving/careless citizen, I want to be rewarded for my green actions so that I benefit from them personally.

User Story 6.4
As a disbelieving/careless citizen, I want to have a place (online marketplace or presential place) in which I can solve all my doubts about a renovation process so that I am more informed.

Table 164 User stories for Persona 7 (Demotivated citizens)

User Story 7.1
As a demotivated citizen, I want to understand the benefits of the green initiatives so that I can also contribute to them at the pool and in the municipality.
User Story 7.2
As a demotivated citizen, I am not incentivised to use public infrastructure and I want to be rewarded for my green actions so that I benefit from them personally.
User Story 6.4
As a demotivated citizen, I want to have a place (online marketplace or presential place) in which I can solve all my doubts about a renovation process so that I am more informed.

Table 165 User stories for Persona 8 (Motivated municipality)

User Story 8.1
As a motivated member of the municipality, I want to improve the energetic efficiency of the building, so that the costs of the operation of the pool are lower.
User Story 8.2
As a motivated member of the municipality, I want to obtain a tool for heating and ventilation measurements so that I can better manage the use of energy in the pool building.
User Story 8.3
As a motivated member of the municipality, I want to be able to monitor the heating and ventilation energy consumption so that I understand how I can reduce the carbon footprint of the municipality.
User Story 8.4
As a motivated member of the municipality, I want to better understand the possible benefits of green actions so that I can introduce more of them in my municipality.
User Story 8.5
As a motivated member of the municipality, I want to lower the energy use in public buildings so that my municipality appear as an environmentally friendly community.
User Story 8.6
As a motivated member of the municipality, I want to provide a place (online marketplace or presential place) in which the citizens can solve all their doubts about a renovation process so that the buildings in my town become more efficient.

Table 166 User stories for Persona 9 (Disbelieving/careless municipality)

User Story 9.1
As a disbelieving/careless member of the municipality, I want to see the real reduction of the energy use of the building so that the municipality benefits from these actions financially.
User Story 9.2

As a disbelieving/careless member of the municipality, I want to prevent a drop in satisfaction so that the citizens are not disappointed with me as a local leader.
User Story 9.3
As a disbelieving/careless member of the municipality, I want to see the increase in the attendance at the pool so that I am convinced that the introduction of the programme had a positive impact on the community.

Table 167 User stories for Persona 10 (Provider of Digital solutions)

User Story 10.1
As a Provider of Digital Solutions, I want to demonstrate end to end energy performance and verification technologies, so that it is easier to penetrate the market.
User Story 10.2
As a Provider of Digital Solutions, I want to integrate, test and deploy state of the digitisation service with renovation technologies so that to enlarge commercial activities.
User Story 10.3
As a Provider of Digital Solutions, I want to create synergies with other complementary service providers (ex. renovation services contractor) so that we provide more value and ease market penetration.
User Story 10.4
As a Provider of Digital Solutions, I want to promote our services and used solutions to showcase sustainable tools used in demo, to disseminate its results and possibly to replicate in the future in other facilities.
User Story 10.5
As a Provider of Digital Solutions, I want to have an online marketplace in which I can promote my company as suppliers of digital solutions for a renovation so that I can reach new potential clients.

Table 168 User stories for Persona 11 (Renovation company)

User Story 11.1
As a Renovation Company, I want to test and deploy state of the renovation technologies so that I can offer better, cheaper and faster relevant services aiming curbing energy consumption of the building, increasing its energy efficiency and reducing its operating costs.
User Story 11.2
As a Renovation Company, I want to create synergies with other complementary service providers (ex. digital solutions) so that we provide more value and ease market penetration.
User Story 11.3
As a Renovation Company, I want to promote our services as competent, solid and reliable service providers.
User Story 11.4
As a Renovation Company, I want to have an online marketplace in which I can promote my company as suppliers for a renovation so that I can reach new potential clients.

Table 169 User stories for Persona 12 (Convinced Investors)

User Story 12.1
As a convinced investor, I want to get return on my investments, so that I can continue believing on the market potential as well as the positive impact for environment and community of that investment.

Table 170 User stories for Persona 13 (Unconvinced Investors)

User Story 13.1
As an unconvinced investor, I want to make sure that opportunity to invest has positive impact, as well as the potential to get returned from non-commercial market so that I get a return on my investment.

14 The pilots – Demo 7

14.1 Description of the pilot sites

14.1.1 Description of the building

Characteristics of building

The building for Demo 7 is a school located in the following address: Stamerienas Street 8, Riga, Latvia

The building is located in the Vidzeme suburb of Riga City, a medium-populated district and was constructed on 1972. The use of the building is an educational institution, Riga 9th Secondary School (School, class groups from 1st to 12th grade).

The main characteristics of the building are the following:

- Area - 5258 m^2
- Foundations of the building - reinforced concrete blocks, ribbon-shaped
- Walls of the building - bricks
- Cladding - reinforced concrete
- Roof - ruberoid
- Source of thermal energy - centralized supply of thermal energy from AS "Rigas Siltums"
- Facade and roof thermal insulation was done in 2022. Stone wool (150 mm thick) and decorative plaster were applied to the walls. Thermal insulation (200 mm wide) and roll material were used for the roof. The foundation of the building was insulated, doors replaced, window boxes and doors processed, etc.

Figure 19 Riga 9th Secondary School

Characteristics of renovation need

Thermal insulation in 2022 did not include the reconstruction of engineering networks.

The old heating system, built in 1972, is currently being operated in the building. No forced ventilation was planned during the construction of the building. A natural ventilation system was built, which is now primarily inoperative.

Today's requirements set out much broader options and conditions for exploiting buildings.

Regarding heating, energy prices require the broadest possible implementation of saving solutions, providing optimum heat in the building (not overheating), according to the building's load schedule (nights, weekends), and segmenting the building's rooms (rooms that require a higher/lower temperature).

Regarding ventilation, limiting the spread of various viruses is currently relevant. According to proven evidence, the prevalence of viruses is significantly reduced by maintaining high-quality ventilated facilities. Labor productivity in well-ventilated spaces is also considerably higher.

As mentioned above, the reconstruction works of the engineering networks were not included in the thermal insulation works. Consequently, engineering networks currently being operated in the building need updated technology, which does not allow high-quality and contemporary regulation of the building's microclimate.

14.1.2 Target groups

The owner of the building is Riga City Council. The building is an educational institution – Riga 9th Secondary School.

Secondary School is attended by 315 pupils. The educational process is provided by 38 teachers and 23 members of the technical staff.

All occupants of the building need to ensure comfortable working and educational conditions, including terms of air temperature and indoor air quality. To ensure these conditions, representatives of the owner of the building and users of the building follow these conditions daily. In addition, the parents of pupils carry out supervision – using publicly available data, parents can see the air temperature and air quality metrics in institutions remotely. When assessing these parameters in different institutions, parents also emphasize the need to take measures to improve air temperature and quality in this facility.

The facility staff is interested in ensuring and maintaining air parameters in the building at an appropriate, economic level. The management at a facility is competent in adjusting the system settings to ensure the optimum operation of the equipment and systems.

There have been several discussions with the owner of the building (Stamerienas Street 8) about the need to perform improvement works in the building, and a conceptual agreement has been reached.

14.1.3 The external stakeholders

The owner of the building is responsible for the facilities' rational, economic, and regulatory operation. The owners' intention is to be confident that the investments will achieve the expected results - whether the planned thermal energy savings will be achieved through heat adjustment measures or whether the installed ventilation system will provide the required air quality. As part of this project, a heating adjustment system will be installed, giving maximum possibilities for regulating heat in the building. The new equipment will be installed for ventilation to ensure the air quality in specific rooms. The project results will be complementary to confirming the efficiency of investments and will allow building owners to use such solutions more. Latvia has many public buildings in which such solutions will ensure savings of funds without lowering (even increasing) working conditions.

14.2 Analysis of current situation

The building is a school with a primary workload during the educational process – primarily throughout the year, except for the summer months. Given the specificity of this workload, it is not essential to provide cooling solutions in the building, as the usage of the building is small during the summer months. The geographical location of Latvia determines that heating costs are an essential component of the total costs. It is, therefore, vital to take measures to control and regulate heating costs, similar to

ventilation - during the heating season, the coordinated operation of ventilation and heating systems allows the appropriate air parameters to be achieved using a reasonable amount of energy.

The building has a centralized supply of thermal energy from AS "Rigas Siltums". Energy efficiency solutions reduce the amount of thermal energy used, thus reducing the institution's costs without lowering working and learning conditions.

14.2.1 Existing measuring systems and data

An energy audit was done in the building in 2022. According to energy audit calculations, the total thermal energy consumption of the building for heating was 119 kWh/m², for the preparation of hot water – 3 kWh/m², and for lighting (electricity) – 14 kWh/m². Heat and electricity meters are installed in the building. Since April 2022, 8 CO_2 sensors have been installed in the building rooms, providing measurements of the following parameters: CO_2 levels, temperature, and humidity.

Table 171 Existing measuring systems and data for Demo 7

System	Details	Current estimated data
Energy consuming equipment and overall consumption	Heating system, lighting	According to the energy audit – thermal energy – 122 kWh/m²/year, electronic energy – 14 kWh/m²/year
Energy generating equipment	none	none
Climate control	none	none
Air and humidity control	CO_2 sensors for measuring CO_2, temperature and air humidity	8 pcs
Rooftop	Horizontal insulation (200 mm), covered with roll material	2381 m²
Energy monitoring and other sensors	Thermal meter, electricity meter	-

14.3 Analysis of end users and stakeholders requirements

14.3.1 Use cases

Table 172 Use Case Card 1 for Demo 7

<table>
<tr><th colspan="2">Name</th><th colspan="2">Goal</th></tr>
<tr><td colspan="2">DEMO 7(Latvia): Comfortable, inclusive and sustainable green Schools
Use Case 1: Deploy solutions to improve air quality metrics for the building to fulfil the set of defined requirements for environment of public buildings (CO_2 levels, temperature, humidity)</td><td colspan="2">To demonstrate the most efficient way to improve air quality</td></tr>
<tr><th colspan="2">Metrics</th><th colspan="2">Target group</th></tr>
<tr><td colspan="2" rowspan="2">• Energy consumption (heating/electric)
• CO_2 levels in classrooms
• Room temperature in the building</td><th>Target group</th><th>Personas</th></tr>
<tr><td>The users of the building</td><td>Students, teachers, parent of the students</td></tr>
</table>

• Humidity level in the building	Building owner	Municipality, School director

Table 173 Use Case Card 2 for Demo 7

Name	Goal	
DEMO 7(Latvia): Comfortable, inclusive and sustainable green Schools **Use Case 2: Design and demonstrate digitalization technologies which will include IOT and energy management systems to enable synchronization of heating and ventilation.**	To show how digitalization can be used in BMS-less building's HVAC management	
Metrics	**Target group**	
• Possibility to automate air exchange in classrooms • Possibility to automate air heating in classrooms • Replicability of the system in the future • User acceptance (testing via questionary, how the system is working, how it is used etc.)	**Target group**	**Personas**
	Building owner	Facility Managers

Table 174 Use Case Card 3 for Demo 7

Name	Goal	
DEMO 7(Latvia): Comfortable, inclusive and sustainable green Schools **Use Case 3: Implement control of HVAC resources usage in order to operate building in the "on demand" manner.**	To demonstrate how energy efficient building can be if resources are allocated on demand without waste.	
Metrics	**Target group**	
• Energy consumption (heating/electric) • CO_2 levels in classrooms • Room temperature in the building • Humidity level in the building • Occupancy schedules as vertical comparison	**Target group**	**Personas**
	Building owner	- Finance department that works in the municipality and is responsible for the financial management of the schools. - Development department that have responsibility to reach efficiency goals in EU funded projects
	Policy makers	Informed policy maker, who is responsible for overall energy efficiency actions in the municipality (E.g., SEAP actions realization) and/or policy maker who is responsible for the overall policy of school building management, and in the future could create GREEN EUROS program.
	Funding authority	Financing manager, who evaluates the potential financial support for the particular building and particular ventilation system renovation project
	User of the building	Students and teachers, who could be involved in the process of the savings and qualitative maintenance of the building.

Table 175 Use Case Card 4 for Demo 7

Name	Goal	
DEMO 7(Latvia): Comfortable, inclusive and sustainable green Schools **Use Case 4: Use available data to improve decisions on building maintenance**	To demonstrate how much subjective decisions are in the building maintenance process and make future recommendations on critical data analysis in order to avoid it.	
Metrics	**Target group**	
	Target group	**Personas**
Accuracy of the recommendations	Building owner	- Finance department that works in the municipality and is responsible for the financial management of the schools. - Development department that have responsibility to reach efficiency goals in EU funded projects - Facility Managers
	Policy makers	Informed policy maker, who is responsible for overall energy efficiency actions in the municipality (E.g., SEAP actions realization) and/or policy maker who is responsible for the overall policy of school building management. and in the future could create GREEN EUROS programme.
	The owner of digital solutions	Qualified digital solution owner that could improve the existing platforms, services

14.3.2 Personas

Table 176 Persona 1 – Demo 7

USER	USER CONTEXT
Building owner: **Facility managers**	Responsible facility manager takes lead on managing a business's property and buildings, ensuring that facilities meet compliance standards and government regulations. Responsible facilities manager is planning for the future by forecasting the facility's upcoming needs and requirements. He's also overseeing any renovations, refurbishments and building projects.
PAIN POINTS	**GOALS**
The responsible manager does not have data of how HVAC systems are working and therefore any problem solving has to begin with onsite time-consuming visits (to fill the act of defection). When municipalities request for a list of priorities for improvement, they rely on claim history not on the financial benefits and other objective statistics.	• to know which is the best ventilation renovation solution for each building. • to demonstrate how digitalized buildings can provide online performance data that allows to take justified proposals. • to know with predictions what will be the energy savings. • to translate these energy savings into economic ones and establish the investment terms and their recovery

Table 177 Persona 2 – Demo 7

USER	USER CONTEXT
Building owner: **Finance department (Director of Finance)**	The Director of Finance is responsible for the financial health of the company (municipality who is the owner of public buildings). By combining strategic and operational goals, the Director of Finance manages the accounting and economic aspects of a company by enforcing a financial strategy aimed toward profitable long-term growth. Additional duties include overseeing the ongoing project department, conducting their financial assessments and conduct risk assessments on business initiatives.
PAIN POINTS	**GOALS**
The Director of Finance in charge is not sure which investments in ventilation system and energy efficiency will be the most efficient or most needed. Lack of prediction leads to high risk to not meet the goals and get financial corrections.	• to translate these energy savings into economic ones and establish the investment terms and their recovery.

Table 178 Persona 3 – Demo 7

USER	USER CONTEXT
Building owner: **Development department**	Development department arranges development of building portfolio, its main responsibility is related on planning new renovations and relocating building users. Typical drivers are open funding programmes from ministries and EU.
PAIN POINTS	**GOALS**
Decisions are usually made on limited information and wrong assumptions.	• Data and prediction will highly improve decision quality. • Data can be used to explain and act in monitoring period after project implementation.

Table 179 Persona 4 – Demo 7

USER	USER CONTEXT
Building owner: **Municipality, School director**	Municipality and director have responsibility to provide environmentally safe facilities to users with well-known and regulated requirements for temperature, humidity and air quality.
PAIN POINTS	**GOALS**
Users will make claims in case of bad environment that could badly impact on municipalities sustainability. Facility quality and environment quality is difficult to control.	• Demonstrate on how environment quality can be improved with usage of potential energy savings. • Provide methods for improving monitoring solutions and better handling on unfounded claims with history data.

Table 180 Persona 5 – Demo 7

USER	USER CONTEXT
The users of the building: **Students, teachers, parent of the students**	Students and teachers are the user of the building daily. The indoor air quality affects their productivity and comfort. They are involved in the maintenance actions of the building and give feedback about it.
PAIN POINTS	**GOALS**
Students are not aware about building maintenance issues. They are willing to take the part in it, if they see the benefit of it (earned Green Euros, energy savings etc.). Teachers see the possibility via building maintenance activities to teach students practical knowledges and improve the teaching process. Students' parents are concerned about indoor air quality in terms of diseases (COVID 19 etc.) thus they want to make sure the building is maintained according to the highest standards.	Participate in building maintenance activities. Improve the learning process. Ensure high standard for indoor climate.

Table 181 Persona 6 – Demo 7

USER	USER CONTEXT
The owner of digital solution: **Qualified digital solution owner**	Owners of digital solutions have different platforms, which do the data analyses, thus the data from the ventilation renovation projects are new material for further researches.
PAIN POINTS	**GOALS**
Owners of digital solutions platforms are not aware/ do not have access to indoor building data.	Learn about data coming from ventilation renovation projects. Find out how the data can be analysed/ stored via different digital platforms. Offer new services for the market.

Table 182 Persona 7 – Demo 7

USER	USER CONTEXT
Ministries/Municipalities: **Informed policy makers**	The policy maker is making policies to avoid excessive and unnecessary use of energy through regulation (e.g. building codes and minimal standards) and policies that stimulate behavioural changes.
PAIN POINTS	**GOALS**
The policy maker does not have a sufficient understanding or lacks supporting information of the energy efficiency situation in the state or local government.	• to know which building are the priority for investments. • to know with predictions what will be the energy savings and ventilation system improvements. • to translate these energy savings and ventilation system improvements into economic ones and establish the investment terms.

Table 183 Persona 8 – Demo 7

USER	USER CONTEXT
Funding authority: **Financing manager**	Financing manager evaluates the payback period for each fundable project and the investment efficiency.
PAIN POINTS	**GOALS**
Financial manager is not aware of ventilation project details and needs to have clear understanding, if such kind of project could be a good investment project. Financial manager is not aware if ventilation system recovery projects are the ones where private funding authority could create the business model.	• Learn about the ventilation system renovation project specific investment and results to be achieved. • Find out how ventilation system renovation project can affect the building energy efficiency, thereby energy costs.

14.3.3 User stories

Table 184 User stories for Persona 1 (Facility Managers)

User Story 1.1
As a facility manager managing a governmental building, I want to get live data from buildings, so that I can make decision with right resources to act on problems proactively.
User Story 1.2
As a facility manager managing a governmental building, I want to get historical data from building, so that I can understand a reason for issues/address right resources on resolving them.
User Story 1.3
As a facility manager managing a governmental building, I want to be sure which investments in ventilation will be the most efficient or most needed, so that I can know which is the best refurbishment solution for each building.
User Story 1.4
As a facility manager managing a governmental building, I want to be sure which investments in ventilation will be the most efficient or most needed, so that I can know which is the best refurbishment solution for each building.

Table 185 User stories for Persona 2 (Finance department)

User Story 2.1
As a finance department I want to predict potential savings in HVAC investments, so that I can calculate payback and future cashflow.
User Story 2.2
As a finance department I want to know all potential running costs so that I can align budget with new developments.
User Story 2.3
As a finance department I want to be informed on all planned support fundings for particular activity so that I can plan right time for investment and priorities.

Table 186 User stories for Persona 3 (Development department)

User Story 3.1
As a development department I want to be informed on all planned support fundings for particular activity so that I can plan right time for investment and priorities.
User Story 3.2
AS a development department I want to secure tools for monitoring buildings so that project goals keep persistent afterwards and penalty risks are as low as possible.

Table 187 User stories for Persona 4 (Municipality, School director)

User Story 4.1
As a municipality I want to have best building indoor environment so that society supports municipality and vote for particular politicians in next election.
User Story 4.2
As a school director I want to have an appropriate building indoor environment so that school ranking could get a gain.
User Story 4.3
As a school director I want to minimize maintenance costs for a building so that money can be spent on students, teachers and future development of the school.

Table 188 User stories for Persona 5 (Building user: Students, teachers, parents of the students)

User Story 5.1
As a building user, I want to be involved in building maintenance, so the school can earn digital euros.
User Story 5.2
As a building user, I want to feel safe in the building , so I don't feel threaten by different diseases.
User Story 5.3
As a building user, I want to have qualitative indoor climate, so I can achieve the best results of teaching and learning process.

Table 189 User stories for Persona 6 (Qualified digital solution owner)

User Story 6.1
As qualified digital solution owner, I want to learn about data from ventilation projects, so I can offer a new service in the market.
User Story 6.2
As qualified digital solution owner, I want to learn about data from ventilation projects, so I can improve my platforms.

Table 190 User stories for Persona 7 (Informed policy makers)

User Story 7.1
As a policy maker working for a government institution, I want to have a sufficient understanding or supporting information of the ventilation system situation in the state or local government, so that I can translate these ventilation system improvements into economic ones and establish the investment terms and their recovery and I know which building is the priority for investments.
User Story 7.2
As a policy maker working for a government institution, I want to have a sufficient understanding or supporting information of the ventilation system situation in the state or local government, so that I can know which building is the priority for investments.
User Story 7.3
As a policy maker working for a government institution, I want to have a sufficient understanding or supporting information of the ventilation system situation in the state or local government, so that I can know with predictions what will be the energy savings and indoor climate improvements.

Table 191 User stories for Persona 8 (Financing manager of a Funding authority)

User Story 8.1
As a financing manager, I want to learn about the ventilation system renovation project specific, so that I can see what results are planned to be achieved and if the investments are feasible.
User Story 8.2
As a financing manager, I want to learn how a ventilation system renovation project can affect the building energy efficiency thereby energy costs, so I can evaluate the project financing rules.
User Story 8.3
As a financing manager, I want to learn the payback period of ventilation system renovation project, so I can say is it a business case for funding organization.

15 Requirements

Considering the aforementioned methodology to transform user stories into requirements, all the user stories from all the demos have been analysed. As a result, the following functional and non-functional requirements have been identified.

15.1 Functional requirements

The following table describes FORTESIE's functional requirements.

Table 192 Functional requirements

ID	Description	Associated Demos	Personas
F1	The FORTESIE solution shall be able to allow the definition of a smart Energy Performance Contract based on ESIE measures.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner Persona 4: Careless owner Persona 5: Disbelieving owner Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	-
		Demo 2 (ENE)	-
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 3: Motivated owner Persona 4: Demotivated owner Persona 8: Provider of Digital Solutions
		Demo 6	-
		Demo 7	-
F2	The FORTESIE solution shall be able to store the relevant data needed for the Energy Performance Contract.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner

			Persona 4: Careless owner Persona 5: Disbelieving owner Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	-
		Demo 2 (ENE)	-
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 3: Motivated owner Persona 4: Demotivated owner Persona 8: Provider of Digital Solutions
		Demo 6	-
		Demo 7	-
F3	The FORTESIE solution shall be able to provide a trusted method for guaranteeing that the information stored (which is needed for the calculation of the Energy Performance Contract) is not altered.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner Persona 4: Careless owner Persona 5: Disbelieving owner Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	-
		Demo 2 (ENE)	-
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 3: Motivated owner Persona 4: Demotivated owner Persona 8: Provider of Digital Solutions
		Demo 6	-

		Demo 7	-
F4	The FORTESIE solution shall be able to provide a means for the final user to consult the information related to the Energy Performance Contract stored and calculated in it (only the relevant information for that user).	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 3: Motivated owner Persona 4: Careless owner Persona 5: Disbelieving owner Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	-
		Demo 2 (ENE)	-
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	Persona 3: Motivated owner Persona 4: Demotivated owner Persona 8: Provider of Digital Solutions
		Demo 6	-
		Demo 7	-
F5	The FORTESIE solution shall be able to provide a means for the relevant stakeholders (e.g ESCOs, renovation companies, potential investors) to consult the information related to the Energy Performance Contract stored and calculated in it.	Demo 1	Persona 7: Renovation company Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 6: Benefit-oriented bank Persona 7: Sustainability supporter bank Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	-
		Demo 2 (ENE)	-
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 7: Financial Organization Persona 8: Provider of Digital Solutions Persona 9: Renovation Company

		Demo 6	-
		Demo 7	-
F6	The FORTESIE solution shall be able to compare the before and after energy consumption or demand of the building.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner Persona 4: Careless owner Persona 5: Disbelieving owner Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	Persona 1: Project Designer Persona 2: Sales Department Persona 3: Owners involved in the renovation - Motivated owners Persona 4: Owners involved in the renovation - Disbelieving owners Persona 7: Providers of digital solutions
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner Persona 2: OKT designer
		Demo 3	Persona 1: NGO Persona 3: Uninformed Low-income citizens and owners Persona 4: Informed Low-income citizens and owners
		Demo 4	Persona 1: Informed prosumer Persona 2: Uninformed prosumer Persona 3: Renewable energy cooperative Persona 5: NGOs
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 3: Motivated owner Persona 4: Demotivated owner Persona 8: Provider of Digital Solutions
		Demo 6	Persona 1: Motivated pool operator Persona 2: Demotivated pool operator Persona 8: Motivated municipality Persona 9: Disbelieving/careless municipality Persona 10: Provider of Digital solutions
		Demo 7	Persona 1: Facility Managers Persona 3: Development department Persona 6: Qualified digital solution owner

F7	The FORTESIE solution shall be able to provide a comparative of performance of buildings from an energy and sustainability perspective.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 7: Renovation company Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner Persona 4: Careless owner Persona 5: Disbelieving owner Persona 6: Benefit-oriented bank Persona 7: Sustainability supporter bank Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	Persona 1: Project Designer Persona 2: Sales Department Persona 3: Owners involved in the renovation - Motivated owners Persona 4: Owners involved in the renovation - Disbelieving owners Persona 6: Providers of Building Renovation Persona 7: Providers of digital solutions
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner Persona 2: OKT designer Persona 3: Renovation company
		Demo 3	Persona 1: NGO Persona 3: Uninformed Low-income citizens and owners Persona 4: Informed Low-income citizens and owners Persona 5: Investors profit-first Persona 6: Investors impact-first
		Demo 4	Persona 1: Informed prosumer Persona 2: Uninformed prosumer Persona 3: Renewable energy cooperative Persona 5: NGOs Persona 6: Investors profit-first Persona 7: Investors impact-first
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 3: Motivated owner Persona 4: Demotivated owner Persona 7: Financial Organization Persona 8: Provider of Digital Solutions Persona 9: Renovation Company

		Demo 6	Persona 1: Motivated pool operator Persona 2: Demotivated pool operator Persona 8: Motivated municipality Persona 9: Disbelieving/careless municipality Persona 10: Provider of Digital Solutions Persona 11: Renovation company Persona 12: Convinced Investors Persona 13: Unconvinced Investors
		Demo 7	Persona 1: Facility Managers Persona 3: Development department Persona 6: Qualified digital solution owner Persona 7: Informed policy makers Persona 8: Financing manager of a Funding authority
F8	The FORTESIE solution shall be able to provide personalised feedback to consumers regarding their progress in achieving energy savings.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 3: Motivated visitor Persona 4: Demotivated visitor Persona 5: Motivated employee Persona 6: Demotivated employee Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	-
		Demo 2 (GAR)	Persona 3: Owners involved in the renovation - Motivated owners Persona 4: Owners involved in the renovation - Disbelieving owners Persona 7: Providers of digital solutions
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner
		Demo 3	-
		Demo 4	Persona 1: Informed prosumer Persona 2: Uninformed prosumer
		Demo 5	Persona 3: Motivated owner Persona 4: Demotivated owner Persona 5: Motivated users Persona 6: Demotivated users Persona 8: Provider of Digital Solutions
		Demo 6	Persona 1: Motivated pool operator Persona 2: Demotivated pool operator Persona 3: Motivated users Persona 4: Disbelieving/careless users Persona 5: Motivated citizens

			Persona 6: Disbelieving/careless citizens Persona 7: Demotivated citizens Persona 10: Provider of Digital Solutions
		Demo 7	Persona 4: Municipality, School director Persona 5: Building user: Students, teachers, parents of the students Persona 6: Qualified digital solution owner
F9	The FORTESIE solution shall be able to offer personalised challenges to the consumers related to their energy consumption.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 3: Motivated visitor Persona 4: Demotivated visitor Persona 5: Motivated employee Persona 6: Demotivated employee Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	-
		Demo 2 (GAR)	Persona 3: Owners involved in the renovation - Motivated owners Persona 4: Owners involved in the renovation - Disbelieving owners Persona 7: Providers of digital solutions
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner
		Demo 3	-
		Demo 4	Persona 1: Informed prosumer Persona 2: Uninformed prosumer
		Demo 5	Persona 3: Motivated owner Persona 4: Demotivated owner Persona 5: Motivated users Persona 6: Demotivated users Persona 8: Provider of Digital Solutions
		Demo 6	Persona 1: Motivated pool operator Persona 2: Demotivated pool operator Persona 3: Motivated users Persona 4: Disbelieving/careless users Persona 5: Motivated citizens Persona 6: Disbelieving/careless citizens Persona 7: Demotivated citizens Persona 10: Provider of Digital Solutions
		Demo 7	Persona 4: Municipality, School director Persona 5: Building user: Students, teachers, parents of the students

			Persona 6: Qualified digital solution owner
F10	The FORTESIE solution shall be able to generate personalised recommendations and rewards to guide the consumers towards a more energy efficient behaviour.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 3: Motivated visitor Persona 4: Demotivated visitor Persona 5: Motivated employee Persona 6: Demotivated employee Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	-
		Demo 2 (GAR)	Persona 3: Owners involved in the renovation - Motivated owners Persona 4: Owners involved in the renovation - Disbelieving owners Persona 7: Providers of digital solutions
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner
		Demo 3	-
		Demo 4	Persona 1: Informed prosumer Persona 2: Uninformed prosumer
		Demo 5	Persona 3: Motivated owner Persona 4: Demotivated owner Persona 5: Motivated users Persona 6: Demotivated users Persona 8: Provider of Digital Solutions
		Demo 6	Persona 1: Motivated pool operator Persona 2: Demotivated pool operator Persona 3: Motivated users Persona 4: Disbelieving/careless users Persona 5: Motivated citizens Persona 6: Disbelieving/careless citizens Persona 7: Demotivated citizens Persona 10: Provider of Digital Solutions
		Demo 7	Persona 4: Municipality, School director Persona 5: Building user: Students, teachers, parents of the students Persona 6: Qualified digital solution owner
F11	The FORTESIE solution may be able to integrate non-economical rewards (e.g., badges) and/or	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 3: Motivated visitor Persona 4: Demotivated visitor Persona 5: Motivated employee

	economical rewards (e.g., Green euro).		Persona 6: Demotivated employee Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	-
		Demo 2 (GAR)	Persona 3: Owners involved in the renovation - Motivated owners Persona 4: Owners involved in the renovation - Disbelieving owners Persona 7: Providers of digital solutions
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner
		Demo 3	-
		Demo 4	Persona 1: Informed prosumer Persona 2: Uninformed prosumer
		Demo 5	Persona 3: Motivated owner Persona 4: Demotivated owner Persona 5: Motivated users Persona 6: Demotivated users Persona 8: Provider of Digital Solutions
		Demo 6	Persona 1: Motivated pool operator Persona 2: Demotivated pool operator Persona 3: Motivated users Persona 4: Disbelieving/careless users Persona 5: Motivated citizens Persona 6: Disbelieving/careless citizens Persona 7: Demotivated citizens Persona 10: Provider of Digital Solutions
		Demo 7	Persona 4: Municipality, School director Persona 5: Building user: Students, teachers, parents of the students Persona 6: Qualified digital solution owner
F12	The FORTESIE solution shall be able to offer a OSS that provides presential and online services, via a marketplace.	Demo 1	-
		Demo 2 (VEO)	-
		Demo 2 (GAR)	-
		Demo 2 (ENE)	Persona 1: Motivated owner Persona 2: Disbelieving owner Persona 3: Owner of an individual house Persona 4: Responsible for Green Deal issues Persona 5: Motivated funding entity Persona 6: Renovation company

			Persona 7: Provider of digital solutions
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	-
		Demo 6	Persona 5: Motivated citizens Persona 6: Disbelieving/careless citizens Persona 7: Demotivated citizens Persona 8: Motivated municipality Persona 10: Provider of Digital Solutions Persona 11: Renovation company
		Demo 7	-

15.2 Non-functional requirements

The following table describes FORTESIE's non-functional requirements.

Table 193 Non-functional requirements

ID	Description	Associated Demos	Personas
NF1	The FORTESIE solution must be able to have accurate calculations in order to increase trust of stakeholders.	Demo 1	Persona 7: Renovation company Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 6: Benefit-oriented bank Persona 7: Sustainability supporter bank Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	Persona 1: Project Designer Persona 2: Sales Department Persona 6: Providers of Building Renovation Persona 7: Providers of digital solutions
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 2: OKT designer Persona 3: Renovation company
		Demo 3	Persona 1: NGO Persona 5: Investors profit-first Persona 6: Investors impact-first
		Demo 4	Persona 3: Renewable energy cooperative Persona 5: NGOs Persona 6: Investors profit-first Persona 7: Investors impact-first

		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 7: Financial Organization Persona 8: Provider of Digital Solutions
		Demo 6	Persona 8: Motivated municipality Persona 9: Disbelieving/careless municipality Persona 10: Provider of Digital Solutions Persona 11: Renovation company Persona 12: Convinced Investors Persona 13: Unconvinced Investors
		Demo 7	Persona 1: Facility Managers Persona 3: Development department Persona 6: Qualified digital solution owner Persona 7: Informed policy makers Persona 8: Financing manager of a Funding authority
NF2	The FORTESIE solution shall be able to incorporate a new type of currency based on ESIE performance improvements (Green euro).	Demo 1	Persona 3: Motivated visitor Persona 5: Motivated employee Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	-
		Demo 2 (GAR)	-
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner Persona 2: OKT designer
		Demo 3	-
		Demo 4	Persona 1: Informed prosumer Persona 3: Renewable energy cooperative
		Demo 5	Persona 1: ESCO Persona 5: Motivated users Persona 6: Demotivated users Persona 8: Provider of Digital Solutions
		Demo 6	Persona 3: Motivated users Persona 4: Disbelieving/careless users Persona 5: Motivated citizens Persona 6: Disbelieving/careless citizens Persona 10: Provider of Digital Solutions
		Demo 7	Persona 5: Building user: Students, teachers, parents of the students Persona 6: Qualified digital solution owner
NF3	The FORTESIE solution may use green euros to	Demo 1	Persona 3: Motivated visitor Persona 5: Motivated employee Persona 8: ESCO

	finance green achievements.		Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	-
		Demo 2 (GAR)	-
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner Persona 2: OKT designer
		Demo 3	-
		Demo 4	Persona 1: Informed prosumer Persona 3: Renewable energy cooperative
		Demo 5	Persona 1: ESCO Persona 5: Motivated users Persona 6: Demotivated users Persona 8: Provider of Digital Solutions
		Demo 6	Persona 3: Motivated users Persona 4: Disbelieving/careless users Persona 5: Motivated citizens Persona 6: Disbelieving/careless citizens Persona 10: Provider of Digital Solutions
		Demo 7	Persona 5: Building user: Students, teachers, parents of the students Persona 6: Qualified digital solution owner
NF4	The FORTESIE approach shall be able to guide the stakeholders to design and implement innovative financing models based on ESIE measures to improve comfort and living conditions.	Demo 1	Persona 8: ESCO
		Demo 2 (VEO)	Persona 6: Benefit-oriented bank Persona 7: Sustainability supporter bank
		Demo 2 (GAR)	-
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 2: OKT designer
		Demo 3	Persona 2: Crowdlending Organisation Persona 5: Investors profit-first Persona 6: Investors impact-first
		Demo 4	Persona 3: Renewable energy cooperative Persona 4: Crowdlending platform Persona 6: Investors profit-first Persona 7: Investors impact-first
		Demo 5	Persona 1: ESCO Persona 7: Financial Organization
		Demo 6	Persona 3: Motivated users Persona 4: Disbelieving/careless users Persona 5: Motivated citizens Persona 6: Disbelieving/careless citizens Persona 8: Motivated municipality

			Persona 9: Disbelieving/careless municipality Persona 10: Provider of Digital Solutions Persona 12: Convinced Investors Persona 13: Unconvinced Investors
		Demo 7	Persona 2: Finance department Persona 7: Informed policy makers Persona 8: Financing manager of a Funding authority
NF5	The FORTESIE approach shall be able to guide the stakeholders to design and implement building renovations using innovative state-of-the-art materials.	Demo 1	Persona 7: Renovation company
		Demo 2 (VEO)	-
		Demo 2 (GAR)	Persona 1: Project Designer Persona 6: Providers of Building Renovation
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 2: OKT designer Persona 3: Renovation company Persona 4: Labour syndicate
		Demo 3	Persona 1: NGO
		Demo 4	Persona 3: Renewable energy cooperative
		Demo 5	Persona 9: Renovation Company
		Demo 6	Persona 11: Renovation company
		Demo 7	Persona 1: Facility Managers Persona 3: Development department
NF6	The FORTESIE approach shall be able to guide the stakeholders to design and implement building renovations that improve ESIE measurements and comfort.	Demo 1	Persona 1: Motivated Museum owner Persona 2: Demotivated Museum owner Persona 7: Renovation company Persona 8: ESCO
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner Persona 4: Careless owner Persona 5: Disbelieving owner
		Demo 2 (GAR)	Persona 1: Project Designer Persona 3: Owners involved in the renovation - Motivated owners Persona 4: Owners involved in the renovation - Disbelieving owners Persona 6: Providers of Building Renovation
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner Persona 2: OKT designer Persona 3: Renovation company Persona 4: Labour syndicate
		Demo 3	Persona 1: NGO

			Persona 3: Uninformed Low-income citizens and owners Persona 4: Informed Low-income citizens and owners Persona 7: Municipality Social and Housing Offices
		Demo 4	Persona 1: Informed prosumer Persona 2: Uninformed prosumer Persona 3: Renewable energy cooperative Persona 5: NGOs
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 3: Motivated owner Persona 4: Demotivated owner Persona 9: Renovation Company
		Demo 6	Persona 1: Motivated pool operator Persona 2: Demotivated pool operator Persona 8: Motivated municipality Persona 9: Disbelieving/careless municipality Persona 11: Renovation company
		Demo 7	Persona 1: Facility Managers Persona 3: Development department Persona 4: Municipality, School director Persona 5: Building user: Students, teachers, parents of the students
NF7	The FORTESIE approach shall be able to guide the stakeholders to design and implement dissemination strategies focusing on **informative** aspects related to ESIE concepts to generate **trust**.	Demo 1	Persona 1: Motivated Museum owner Persona 8: ESCO
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner
		Demo 2 (GAR)	Persona 1: Project Designer Persona 2: Sales Department Persona 3: Owners involved in the renovation - Motivated owners
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner Persona 2: OKT designer
		Demo 3	Persona 1: NGO Persona 2: Crowdlending Organisation Persona 3: Uninformed Low-income citizens and owners Persona 4: Informed Low-income citizens and owners Persona 5: Investors profit-first Persona 6: Investors impact-first Persona 7: Municipality Social and Housing Offices
		Demo 4	Persona 1: Informed prosumer

			Persona 2: Uninformed prosumer Persona 3: Renewable energy cooperative Persona 4: Crowdlending platform Persona 5: NGOs Persona 6: Investors profit-first Persona 7: Investors impact-first
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 3: Motivated owner Persona 5: Motivated users Persona 7: Financial Organization
		Demo 6	Persona 1: Motivated pool operator Persona 3: Motivated users Persona 5: Motivated citizens Persona 7: Demotivated citizens Persona 8: Motivated municipality Persona 12: Convinced Investors Persona 13: Unconvinced Investors
		Demo 7	Persona 1: Facility Managers Persona 2: Finance department Persona 3: Development department Persona 4: Municipality, School director Persona 5: Building user: Students, teachers, parents of the students Persona 7: Informed policy makers Persona 8: Financing manager of a Funding authority
NF8	The FORTESIE approach shall be able to guide the stakeholders to design and implement dissemination strategies focusing on the **green / environmental** impact of ESIE concepts.	Demo 1	Persona 3: Motivated visitor Persona 5: Motivated employee Persona 8: ESCO
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner
		Demo 2 (GAR)	Persona 3: Owners involved in the renovation - Motivated owners
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 2: OKT designer Persona 3: Renovation company Persona 4: Labour syndicate
		Demo 3	Persona 6: Investors impact-first
		Demo 4	Persona 3: Renewable energy cooperative Persona 7: Investors impact-first
		Demo 5	Persona 5: Motivated users
		Demo 6	Persona 1: Motivated pool operator

			Persona 3: Motivated users Persona 5: Motivated citizens Persona 8: Motivated municipality Persona 12: Convinced Investors
		Demo 7	-
NF9	The FORTESIE approach shall be able to guide the stakeholders to design and implement dissemination strategies focusing on **economical** benefits related to ESIE concepts.	Demo 1	Persona 3: Motivated visitor Persona 5: Motivated employee Persona 8: ESCO
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 3: Motivated owner
		Demo 2 (GAR)	Persona 1: Project Designer Persona 2: Sales Department Persona 3: Owners involved in the renovation - Motivated owners Persona 6: Providers of Building Renovation
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 1: Homeowner Persona 2: OKT designer Persona 3: Renovation company Persona 4: Labour syndicate
		Demo 3	Persona 2: Crowdlending Organisation Persona 5: Investors profit-first
		Demo 4	Persona 1: Informed prosumer Persona 2: Uninformed prosumer Persona 3: Renewable energy cooperative Persona 4: Crowdlending platform Persona 6: Investors profit-first
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 3: Motivated owner Persona 7: Financial Organization
		Demo 6	Persona 1: Motivated pool operator Persona 3: Motivated users Persona 5: Motivated citizens Persona 8: Motivated municipality Persona 12: Convinced Investors
		Demo 7	Persona 1: Facility Managers Persona 2: Finance department Persona 3: Development department Persona 4: Municipality, School director Persona 7: Informed policy makers Persona 8: Financing manager of a Funding authority

NF10	The FORTESIE approach shall be able to guide the stakeholders to design and implement dissemination strategies focusing on **new business opportunities** related to ESIE concepts.	Demo 1	Persona 7: Renovation company Persona 8: ESCO Persona 9: Provider of Digital solutions
		Demo 2 (VEO)	Persona 1: ESCO Persona 2: EPC facilitator Persona 8: Provider of Digital solutions
		Demo 2 (GAR)	Persona 2: Sales Department Persona 6: Providers of Building Renovation Persona 7: Providers of digital solutions
		Demo 2 (ENE)	-
		Demo 2 (OKT)	Persona 2: OKT designer Persona 3: Renovation company Persona 4: Labour syndicate
		Demo 3	Persona 2: Crowdlending Organisation
		Demo 4	Persona 3: Renewable energy cooperative Persona 4: Crowdlending platform
		Demo 5	Persona 1: ESCO Persona 2: FM Company Persona 7: Financial Organization Persona 8: Provider of Digital Solutions Persona 9: Renovation Company
		Demo 6	Persona 10: Provider of Digital Solutions Persona 11: Renovation company
		Demo 7	Persona 6: Qualified digital solution owner
NF11	The FORTESIE approach shall be able to guide the stakeholders to design and implement **motivation** strategies focusing on **informative** aspects related to ESIE concepts to generate **trust**.	Demo 1	Persona 2: Demotivated Museum owner Persona 4: Demotivated visitor Persona 6: Demotivated employee
		Demo 2 (VEO)	Persona 4: Careless owner Persona 5: Disbelieving owner Persona 6: Benefit-oriented bank Persona 7: Sustainability supporter bank
		Demo 2 (GAR)	Persona 4: Owners involved in the renovation - Disbelieving owners Persona 5: Other citizens and owners
		Demo 2 (ENE)	-
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	Persona 4: Demotivated owner Persona 6: Demotivated users
		Demo 6	Persona 2: Demotivated pool operator

			Persona 4: Disbelieving/careless users Persona 6: Disbelieving/careless citizens Persona 7: Demotivated citizens Persona 9: Disbelieving/careless municipality
		Demo 7	-
NF12	The FORTESIE approach shall be able to guide the stakeholders to design and implement **motivation** strategies focusing on the **green / environmental** impact of ESIE concepts.	Demo 1	Persona 2: Demotivated Museum owner Persona 4: Demotivated visitor Persona 6: Demotivated employee
		Demo 2 (VEO)	Persona 4: Careless owner Persona 5: Disbelieving owner Persona 7: Sustainability supporter bank
		Demo 2 (GAR)	Persona 4: Owners involved in the renovation - Disbelieving owners Persona 5: Other citizens and owners
		Demo 2 (ENE)	-
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	Persona 6: Demotivated users
		Demo 6	Persona 2: Demotivated pool operator Persona 4: Disbelieving/careless users Persona 6: Disbelieving/careless citizens Persona 7: Demotivated citizens Persona 9: Disbelieving/careless municipality
		Demo 7	-
NF13	The FORTESIE approach shall be able to guide the stakeholders to design and implement **motivation** strategies focusing on **economical** benefits related to ESIE concepts.	Demo 1	Persona 2: Demotivated Museum owner
		Demo 2 (VEO)	Persona 4: Careless owner Persona 5: Disbelieving owner Persona 6: Benefit-oriented bank Persona 7: Sustainability supporter bank
		Demo 2 (GAR)	Persona 4: Owners involved in the renovation - Disbelieving owners Persona 5: Other citizens and owners
		Demo 2 (ENE)	-
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	Persona 4: Demotivated owner
		Demo 6	Persona 2: Demotivated pool operator Persona 4: Disbelieving/careless users Persona 6: Disbelieving/careless citizens

			Persona 7: Demotivated citizens Persona 9: Disbelieving/careless municipality Persona 13: Unconvinced Investors
		Demo 7	-
NF14	The FORTESIE approach shall be able to guide the stakeholders to offer a OSS that provides information regarding façade renovation technologies, innovative digital services for a renovation and attractive and innovative financing schemes for renovation processes.	Demo 1	-
		Demo 2 (VEO)	-
		Demo 2 (GAR)	-
		Demo 2 (ENE)	Persona 1: Motivated owner Persona 2: Disbelieving owner Persona 3: Owner of an individual house Persona 4: Responsible for Green Deal issues Persona 5: Motivated funding entity Persona 6: Renovation company Persona 7: Provider of digital solutions
		Demo 2 (OKT)	-
		Demo 3	-
		Demo 4	-
		Demo 5	-
		Demo 6	Persona 5: Motivated citizens Persona 6: Disbelieving/careless citizens Persona 7: Demotivated citizens Persona 8: Motivated municipality Persona 10: Provider of Digital Solutions Persona 11: Renovation company
		Demo 7	-
NF15	The FORTESIE solution shall be able to guarantee GDPR compliance.	All	All
NF16	The FORTESIE solution shall be able to provide a user-friendly and easy-to-use interface for the parts that the final user needs to interact with it.	All	All

16 Assessing the saving potential and cost-effectiveness of the ESIEs in the pilots using the DREEM model

16.1 The DREEM model

The "Dynamic high-Resolution dEmand-sidE Management" (**DREEM**) model is a fully integrated dynamic **bottom-up** high-resolution model that can embody key features towards the simulation of renewable, energy efficiency, and demand-response actions in buildings [31]. It builds on the concept of **modularity**, as its structure is decomposed into individual modules characterised by the main principles of component- and modular-based system modelling approach, namely "*the interdependence of decisions within modules; the independence of decisions between modules; and the hierarchical dependence of modules on components embodying standards and design rules*" (Figure **20**). In this way, it allows for more flexibility in terms of possible system configurations and computational efficiency towards a wide range of scenarios regarding different aspects of end-use.

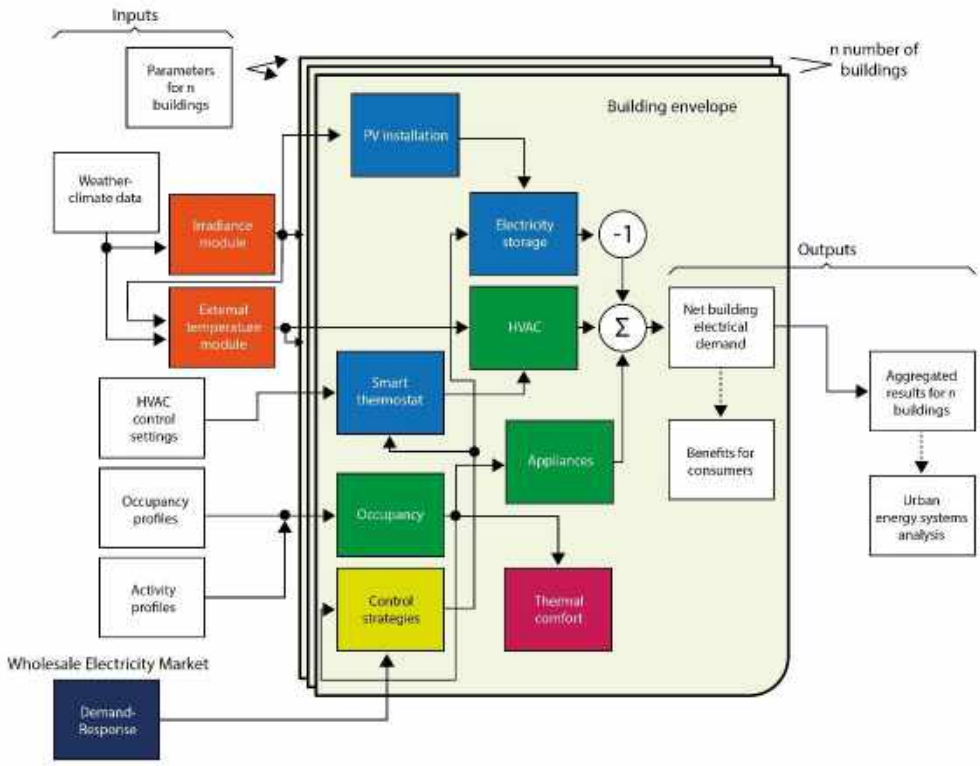


Figure 20 The overall architecture of the DREEM model

DREEM also provides the ability to incorporate future technological breakthroughs in a detailed manner, such as the inclusion of **heat pumps**, or **electric vehicles (EVs)**, while it supports the capability of producing **outputs for a group of buildings and/or different building structures** (e.g., neighbourhood, energy hub, energy community, eco-village, etc.). In this respect, it can serve as a basis

for modelling domestic energy demand within the broader field of the energy transition of urban (local), regional, and national energy systems in different geographical (climate) and socioeconomic contexts.

16.2 Premise and Applicability of the model

The main premise behind the DREEM model and the range of applications in which it can be used is that, for **end-users** (**consumers**/**citizens**) to have more **active participation** in the energy transition, they first need to become more aware of the benefits from investing in new products/services. While technological infrastructure is often available, **business models** and **regulatory innovations** are needed to find ways to maximise the value of these products/services, as well as to **monetise** them, to compensate end-users.

In this context, thus, DREEM is used to simulate different aspects towards the development of "**game changer**" business models, in terms of different configurations of innovative **product-service offerings**, which could **incentivise** end-users to invest.

The model can also be used to evaluate **market-oriented** regulatory **designs**, which **eliminate** aspects of **subsidisation** and implement more advanced market rules that could affect the **behaviour**, **lifestyle**, and **consumption patterns** of end-users (e.g., engaging citizens, incentivising household- and community-level changes, etc.).

Lessons learnt can be then **scaled up** to larger projects, technological infrastructures, communities, etc., used as models for testing, demonstrating, and **developing** new ones, and/or the **improvement** of existing ones, supporting **efficient** decision-making with concrete recommendations on how developed societies could substantially reduce their environmental impact.

16.3 Pilots/Demos to be modelled

Within the context of the FOrTESIE project, the DREEM model will analyse the **cost-effectiveness of different portfolios** of ESIE improvement measures and financing schemes for the project's pilots/demos, aiming to support the decision-making process towards the optimal financing of energy-efficiency interventions.

As indicated in , DREEM will model the "**prior**" (before) and "**to be**" (after) situations of the project's residential pilots (i.e., Demo 2: *Green, comfortable, and sustainable homes in Spain & France*, Demo 3: *Green, comfortable and sustainable homes in Portugal*, Demo 4: *Green and comfortable households through prosumer engagement in Cooperatives in Portugal*), as well as the museum and public building pilots in Greece (i.e., Demo 1 and Demo 5, respectively)

Below the parameterisation and the capabilities of the individual components/modules of the DREEM model are presented, along with the main data inputs needed to explore the energy performance of the five demo pilots in the "prior" and "to be" situations.

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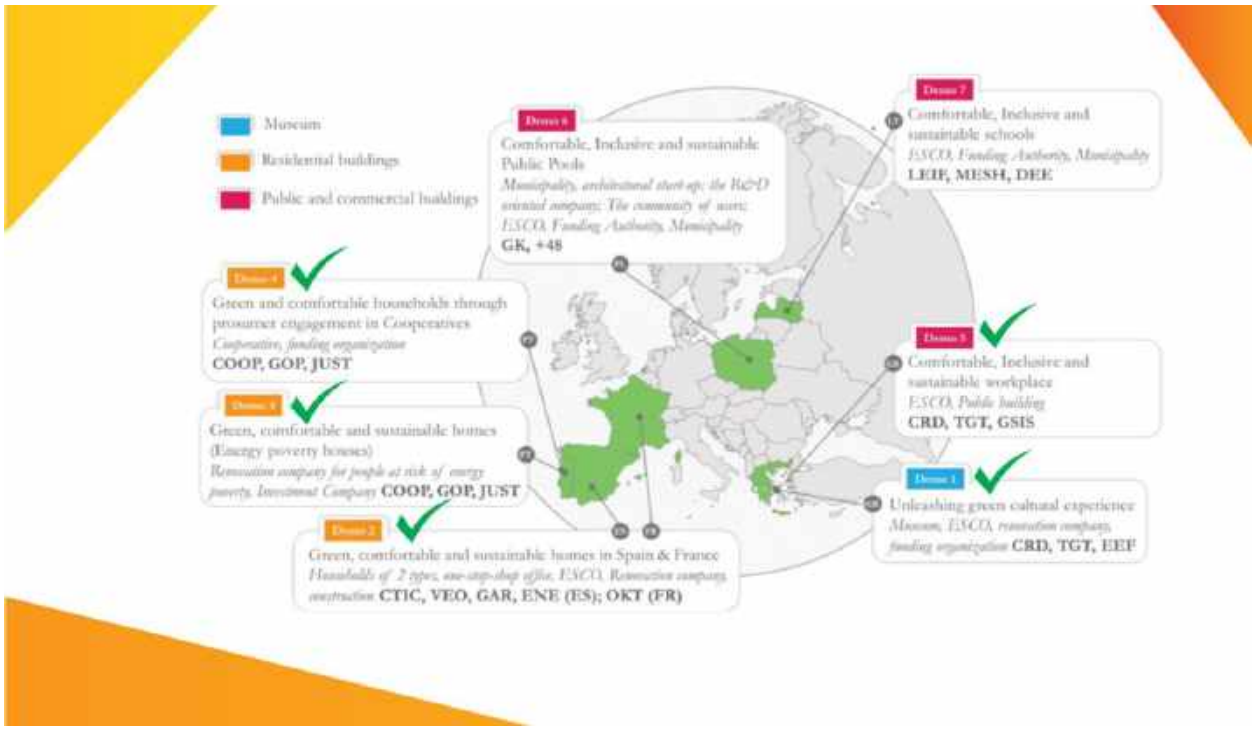

Figure 21 FORTESIE demos that will be modelled and simulated using the DREEM model.

The "prior" (before) situation: Baseline scenarios

The basic inputs for this process are:

Weather-climate data: To reflect the changing demand according to the climatic conditions DREEM uses weather data in a Typical Meteorological Year (TMY) format. The model is configured appropriately to provide a common set of irradiance and temperature data for the geography under study, with the respective profiles having appropriate time diversity to enable higher resolutions. To do so, data from the World Meteorological Organisation are used as derived from several platforms [15,16,17], according to the needs.

Building envelope parameters: DREEM can simulate all the main thermal masses of different building typologies. Indicative parameters for this process are the building's construction year and type, the number of floors, total floor/roof/wall area, height, heat transfer coefficients, and thermal resistances and capacities. To determine them, historical data, and standards (e.g., TABULA webtool[18], ENTRANZE project,[19] etc.), as well as relevant national documents are used depending on the geographical context of interest.

Occupancy & activity profiles: DREEM aims at the generation of accurate and realistic energy demand profiles, avoiding unnecessary complexity. To this end, it uses a bottom-up approach with many simplified assumptions to simulate the various aspects of energy demand focusing on a minimal set of easily obtainable parameters and statistics. Occupancy and activity profiles are some of the most important parameters in this process, which are derived from national standards or statistical data.

[15] https://climate.onebuilding.org
[16] https://www.copernicus.eu/en
[17] https://www.renewables.ninja
[18] https://webtool.building-typology.eu/#bm
[19] https://www.entranze.eu

More specifically, DREEM describes states of occupancy and activity in terms of a combined state variable which consists of a first digit describing the occupancy state (1= "at building", 0= "not at building") and a second digit describing the activity state (1 = "active", 0 = "not active").

Heating, Ventilation, and Air-conditioning (HVAC) systems & Appliance ownership/use: The next step concerns linking the occupancy and activity to the use of HVAC systems and appliances. The latter ensures that HVAC systems and appliances are activated at appropriate times of the day without the need for detailed usage statistics. For example, in the case of households, an active heating system requires occupants to be "at-home", while an active oven requires occupants both "at-home" and "active". The type of HVAC systems, and the chosen appliances are configured according to available statistical data in the region under study (e.g., national household budget surveys (HBS), surveys on energy consumption in households (SECH), etc.) that describes their mean total daily energy demand and associated power use characteristics, including steady-state consumption, or typical use cycles as appropriate, along with ownership levels.

The "to be" (after) situation

Following the baseline estimations, and **after considering user requirements for each pilot/demo under study** as specified in this deliverable, DREEM will examine how different energy-efficiency measures, business models, and regulatory frameworks affect the baseline estimations.

More specifically, DREEM will:

- Evaluate the performance and replicability of **conventional** ``Energy-Efficiency Measures (EEMs) (e.g., wall and roof insulation, double-glazed windows, etc.), as well as the change of heating technology, i.e., the substitution of fossil-fuel boilers with more efficient and environmentally friend technologies (e.g., heat pumps, etc.). The model will evaluate the long-term energy savings, sustainability, risks, and return on investment of each intervention, assessing the benefits of each measure at a disaggregated level, providing investors, consumers, and other relevant stakeholders with useful insights.
- Evaluate the performance and replicability of **smart** EEMs (smart meters and thermostats, building energy management systems, etc.), evaluating their long-term energy savings, sustainability, risks, and return on investment, also considering prosuming and storage issues (e.g., simulation of roof solar panels, EV charging, interaction with the grid, etc.). By doing so, DREEM supports moving towards the smart-grid paradigm and the incentivisation of innovative energy policy and financial frameworks.
- Bring together all the important aspects of end-use with a **demand-response (DR) modelling framework** that builds on the concept of time-based methods, which are considered the most effective demand-side management strategies. DREEM simulates DR mechanisms using machine learning to illustrate the decision-making framework and solve the dynamic pricing problem in a hierarchical electricity market that considers both the service providers' profit and consumers' costs (Figure **22**).

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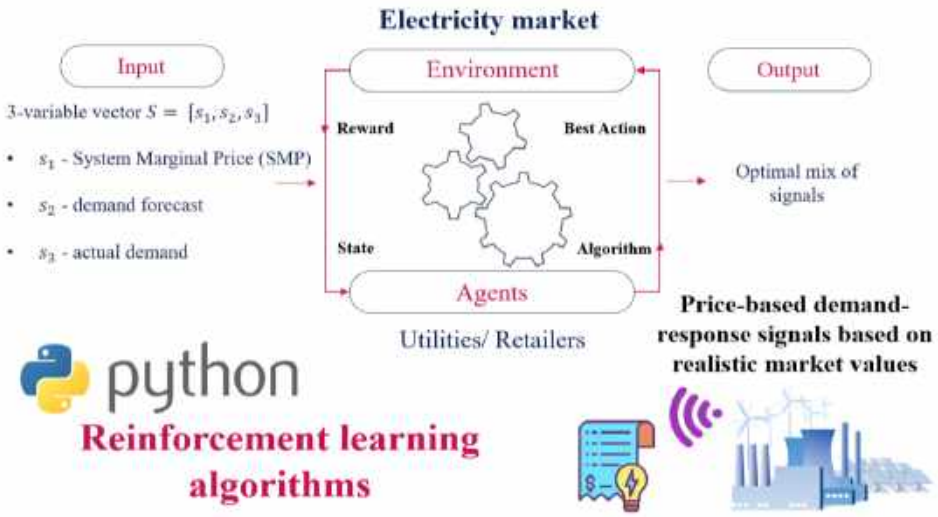

Figure 22 Conceptual framework of the demand-response component in DREEM

- Determine **appropriate indoor thermal conditions** and **temperature ranges** that result in **thermal satisfaction** of the occupants based on the "DIN EN ISO 7730," "ASHRAE 55", and "EN 15251" **international standards**. The model uses the characteristic numbers "Predicted Mean Vote (PMV)" and "Predicted Percentage of Dissatisfied (PPD)" to compute the thermal comfort of occupants.

Overall, DREEM will support the FOrTESIE pilot/demo activities by **(i).** demonstrating the cost-effectiveness and economic viability of the proposed "to-be" solutions/user requirements and the underlying business models for both consumers/end-users and the economic actors involved, **(ii).** assessing the contribution of proposed "to-be" solutions to the sustainability of the buildings as rated from the LEED standard, and **(iii).** investigating how the proposed "to-be" solutions will minimise potential negative impacts, either on the satisfaction of building users (i.e., in relation to comfort, or accessibility), or on the potential of circular material flows during the building's lifecycle, and maximise potential benefits (e.g., energy cost savings and health, etc.). Based on these contributions integrated renovation packages/services, including different portfolios of targeted measures and financing options, will be developed for each pilot under study.

17 Conclusions

The main objective of this deliverable was to identify the current state of each Demo and to define what are the expectations for each Demo in the FORTESIE project. In order to do this, several aspects were taken into consideration.

First of all, FORTESIE has Demos from 6 different countries (Greece, Spain, France, Portugal, Poland and Latvia) and in the last phase of the project (Phase 3: Product Assessment & market uptake), Slovakia will be used as a proof test of the solutions, so FORTESIE will have direct impact in 7 different countries. As a result, the starting point for the partners was to look for the legal aspects that may affect their countries in relation to building renovation policies: the existent laws, initiatives, programmes, or similar concepts that promote building renovation. To do this, national legislation (and even regional legislation when applicable) was reviewed, as well as the European legislation in this scope, as the European programmes usually set the general aspects that the different countries should comply with. In addition, as FORTESIE intends to define alternative financing schemes, a search was also done in each country for this kind of initiatives. Special focus was put on the Green-euro, based on the transformation of carbon credits into this new currency, which is one of the main aspects that will be tested during the project.

Then, trying to extract knowledge from such a wide variety of Demos will not be possible without a methodology. In this case, the partners used the CIM methodology to understand their strategic needs and limitations of existing ESIE and renovation technologies, which supports the definition of other specific methodologies for capturing the current situation (before doing the renovation) and for capturing the stakeholders' requirements.

Once the methodologies were set, the different partners from the same Demo worked together to define the aspects that were needed. After this, a workshop with each Demo was organised, for the Demo partners to present their findings and work jointly with a set of partners that have helped them to solve their doubts and to better define their needs and expectations. This process was very helpful for all the partners in several aspects: it has helped all the parties to know the needed details of the starting point of all the Demos and to better understand what the FORTESIE approach can improve in each Demo.

FORTESIE has a set of Demos with a wide variety of typology: public buildings vs private buildings, buildings for work vs buildings for leisure, dwellings that need a renovation to be more efficient vs dwellings that need a renovation to have basic things like a roof. In this context, individual analysis for each Demo was required as they have very different characteristics. All the Demos provided information for:

- The description of the pilot site, detailing the characteristics of the building and why the renovation was needed.
- The analysis of the current situation, focusing on the existing measuring systems and data.
- The analysis of the end users and stakeholders' requirements, which was described using the following elements:
  - Use cases: they were useful to set the goals of the Demo and to define the main target groups (the potential users in each Demo).
  - Personas: each target group has defined a set of Personas, which are a fictional character created to represent the needs, wants and behaviours of the target groups to ensure that we are thinking from their perspective.
  - User stories: each Persona has defined one or more user stories, which are the description of a service feature, written in a natural language, from the user's perspective.

After this analysis was complete, all the information gathered in each of the Demos was joined to extract the requirements for FORTESIE, resulting in a total of 13 functional and 16 non-functional requirements, that will serve as a baseline for both the implementation within the project, as well as the short-term future improvement of the system.

In a parallel way to the requirements definition, the "Dynamic high-Resolution dEmand-sidE Management" (DREEM) model was proposed to assess the saving potential and cost-effectiveness of the ESIEs in the pilots. After studying the specific use cases proposed by the Demos, it was concluded that the DREEM model will be useful to model and simulate different scenarios in 5 of the 7 Demos.

Finally, it has to be noted that the findings gathered in this deliverable will serve as the basis for:

- Task 2.2 "Value-added services design and specification based on SSH-approach (co-creation)", Task 2.3 "Reference architecture tailored to renovation technologies for increased performance" and WP3 "Components Development and Integration", where these requirements will be transformed and linked to technical decisions and implemented.
- Task 2.4 "Novel market structures and business models for renovation services", as to understand the possible market potential it was very important to know the different target groups and their expectations regarding innovative business models.
- Task 4.1 "Pilots preparation, evaluation framework and baseline analysis", contributing to the pilots definition.
- Task 4.2 "Engagement of citizens, stakeholder and community", as several personas with different levels of engagement have been already identified.

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