



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

D2.4 Novel market structures and business models for renovation services

Report Identifier:	D2.4		
Work-package:	WP2	Task:	T2.4
Responsible Partner:	450 (CC02)	Version Number:	1.0
Due Date	M9	Document Date	13/11/2023
Distribution Security:	PU	Deliverable Type:	R
Keywords:	Business models, European market, Planning		
Project website: http://www.fortesie.eu/			



Quality Control

	Name	Organisation	Date
Editor	Jean-Luc Baradat	CCO2	19/10/2023
Peer review 1	Konstantinos Alexakis	NTUA	24/10/2023
Peer review 2	Marcel Lauko	ECN	26/10/2023
Authorised by (Technical Coordinator)	Alkiviadis Giannakoulis	ED	07/11/2023
Authorised by (Quality Manager)	Kostas Panagopoulos	ED	07/11/2023
Submitted by (Project Coordinator)	Anastasia Garbi	ED	13/11/2023

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FORTESIE is an EU project funded by the Horizon Europe (HORIZON) research and innovation programme under grant agreement No. 101080029. The information and views set out in this deliverable are those of the author(s) and do not necessarily reflect the official opinion of the European Union. The information in this document is provided “as is”, and no guarantee or warranty is given that the information is fit for any specific purpose. Neither the European Union institutions and bodies nor any person acting on their behalf may be held responsible for the use which may be made of the information contained therein. The FORTESIE Consortium members shall have no liability for damages of any kind including without limitation direct, special, indirect, or consequential damages that may result from the use of these materials subject to any liability which is mandatory due to applicable law.

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Abbreviations

AMI	Advanced Metering Infrastructure
AML	Antimoney laundering
APR	Annual Percentage Rate
BIPV	Building Integrated Photovoltaics
bn	billion
BPIE	Buildings Performance Institute Europe
CAGR	Compound Annual Growth Rate
CBDC	Central Bank Digital Currency
CO ₂	Carbon Dioxide
D€	Digital Euro
DSO	Distribution System Operator
EBITDA	Earnings Before Interest, Taxes, Depreciation, and Amortization
EBRD	European Bank for Construction and Development
ECB	European Central Bank
EE	Energy Efficiency
EED	Energy Efficiency Directive
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contracts
ESCO	Energy Service Company
ESG	Environmental, Social, and Governance considerations
ESIE	Efficient, Sustainable and Inclusive Energy
EU	European Union
EU GDP	European Union Gross Domestic Product
EUR	Euro

G€	Green Euro
GDP	Gross Domestic Product
GEFFs	Green Energy Finance Facilities
GET	Green Economy Transition
GHG	Greenhouse Gas
GWP	Global Warming Potential
IEA	International Energy Agency
IT	Information Technology
JRC	European Commission's Joint Research Centre
KYC	Know Your Customer
LEED	Leadership in Energy and Environmental Design
m	million
MEES	Minimum energy efficiency standard
MFJ	Multiannual Financial Framework
NGEU	NextGenerationEU
nZEB	Nearly zero-energy building
OSS	One Stop Shop
POC	Proof Of Concept
PFI	Partner Financial Institutions
PV	Photovoltaic
RES	Renewable Energy Sources
ROI	Return on Investment
RPI	Responsible property investing
RRPs	Recovery and Resilience Plans
SSH	Social Sciences and Humanities
UK	United Kingdom

UNEP	United Nations Environment Programme
WP	Work Package
ZEB	Zero-Emission Building

Executive Summary

FORTESIE's overarching vision is to design, demonstrate, validate, and replicate innovative renovation packages within the building industry, featuring Smart Performance-Based guarantees and financing. The primary objective is to promote Efficient, Sustainable, and Inclusive Energy (ESIE) usage, with the aim of expediting the Renovation Wave throughout Europe.

This deliverable provides the position of the FORTESIE results in the market based on the updated analysis of the market trends, needs and gaps and potential stakeholders that the FORTESIE ecosystem addresses. On the other hand, this deliverable aims to present the early expected exploitable results of FORTESIE project. The business models proposed in the initial proposal for each pilot have been further refined and scrutinized using a systematic approach known as BASE/X, which is further elaborated upon in this report. New business models, involving various players taking on alternative roles, have been collaboratively developed by members of each value chain and are presented here to illustrate how the €G can be used in different contexts and scenarios. Subsequent phases will provide further elaboration, and some of these models will be transformed into actionable strategies to engage a broader audience.

This document positions FORTESIE as a demonstrator of new potential innovative payment system solution. The document explains how €G used in smart EPC could be further extended and experimented as a retail Central Bank Digital Currency (CBDC), for example during the work conducted by ECB on the "Digital euro" (D€). €G could become an example of retail currency to be adopted by ECB as the concept of the Digital Euro, which beyond the general operations also supports the green economy and promotes green initiatives, at individual and/or organization level.

In the tense climate and energy context, Jacques Attali, a well-established economist, has developed the concept of Economy of Life versus Economy of Death, the economy based on fossil energies. He believes it is still possible to make the great shift and avoid catastrophe by "moving from the economy of death to the economy of life". FORTESIE is thus a demonstrator of the digital-euro, as the euro of the economy of life, where green initiatives are taken by masses, compared to the current euro, associated with the fossil economy of death. FORTESIE is actively paving the way for a significant large-scale experiment involving D€s. It delivers a clear and compelling message to a large audience, i.e. all EU citizens Embrace D€s as a means of payment over traditional euros to enter the economy of life.

1 Introduction

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, CO₂ 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.

Complementary to the renovation packages, ESIE performance will be recorded on a blockchain, and will power smart contracts (i.e. automated execution) that could open to new energy services business models presented in this document.

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 and smart EPC will illustrate a new use case for new payments methods and new currency that could position 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

This deliverable provides the position of the FORTESIE results in the market based on the updated analysis of the market trends, needs and gaps and potential stakeholders that the FORTESIE ecosystem addresses. On the other hand, this deliverable aims to present the expected exploitable results and concrete plans of FORTESIE project. During the second period of the project, the market has significantly changed as well as the perspective of end users and the needs of the stakeholders, the system – and the use cases and pilot business models - have revealed the FORTESIE potential exploitable outcomes. This deliverable is considered complementary to all deliverables in WP5 which outline the business plans and policy recommendations and market development activities.

Finally, this document presents FORTESIE as a demonstrator of an innovative payment system solution, using a new currency so-called green-euro or €Gs). The document explains how €G could be further extended and experimented as a retail CBDC, for example during the work conducted by ECB on the “Digital euro”.

2 Current Situation and Trends

The objective of the FORTESIE is to change the behaviour of final residential consumers with an innovative approach of empowerment and monetary incentives/rewards as motivation, with the target of contributing to the objectives set by the European Commission in terms of energy reduction in households and increased energy efficiency (EE).

2.1 Current situation

2.1.1 ESIE

Efficient, Sustainable and Inclusive Energy use (ESIE) is key to achieve the challenge of the 21st century, Climate Change: life is at stake on earth.

ESIE is a term used to describe energy that is produced and used in a way that is efficient, sustainable, and inclusive. The European Commission has launched a new call for project proposals to support research and innovation under efficient, sustainable and inclusive energy use. The total indicative budget available is EUR 44 million

2.1.2 Key principles for building renovation towards 2030 and 2050

The EU must adopt an encompassing and integrated strategy involving a wide range of sectors and actors on the basis of the following key principles:

- 'Energy efficiency first'¹ as a horizontal guiding principle of European climate and energy governance and beyond, as outlined in the European Green Deal² and the EU strategy on Energy System Integration³, to make sure we only produce the energy we really need;
- Affordability, making energy-performing and sustainable buildings widely available, in particular for medium and lower-income households and vulnerable people and area
- Decarbonisation and integration of renewables⁴. Building renovation should speed up the integration of renewables in particular from local sources, and promote broader use of waste heat. It should integrate energy systems at local and regional levels helping to decarbonise transport as well as heating and cooling;
- Life-cycle thinking and circularity. Minimising the footprint of buildings requires resource efficiency and circularity combined with turning parts of the construction sector into a carbon sink, for example through the promotion of green infrastructure and the use of organic building materials that can store carbon, such as sustainably-sourced wood;
- High health and environmental standards. Ensuring high air quality, good water management, disaster prevention and protection against climate-related hazards⁵, removal of and protection against harmful substances such as asbestos and radon, fire and seismic safety. Furthermore,

¹ See Article 2(18) Governance Regulation (EU) 2018/1999: “energy efficiency first’ means taking utmost account in energy planning, and in policy and investment decisions, of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient, in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission and distribution of energy, whilst still achieving the objectives of those decisions”.

² The European Green Deal, COM(2019) 640 final.

³ Powering a climate-neutral economy: An EU Strategy for Energy System Integration, COM(2020) 299 final.

⁴ This refers to energy from renewable sources produced on-site or nearby.

⁵ Climate resilient buildings means that the buildings are renovated to be resilient against acute and chronic climate related hazards relating to temperature, wind, water and solid mass, as appropriate. A complete list of such hazards is included in Table 1 of Annex I of Commission Implementing Regulation (EU) 2020/1208.

accessibility should be ensured to achieve equal access for Europe's population, including persons with disabilities and senior citizens.

- Tackling the twin challenges of the green and digital transitions together. Smart buildings can enable efficient production and use of renewables at house, district or city level. Combined with smart energy distribution systems, they will enable highly efficient and zero-emission buildings.
- Respect for aesthetics and architectural quality⁶. Renovation must respect design, craftsmanship, heritage and public space conservation principles.

2.1.3 The renovation activity in Europe.

In today's world, buildings are not just a physical structure that provides shelter but are considered a major contributor to the world's environmental footprint. The built environment is responsible for a significant share of our consumption of energy and resources: 50% of all extracted materials, 30% of water consumption, 40% of energy consumption, and 36% of CO₂ emissions are associated with the building industry.⁷ In addition buildings are responsible for 12% and 40% of the global greenhouse gas (GHG) emissions and energy use, respectively⁸ ⁹. Studies reveal that more than 80% of the life-cycle energy use in buildings happens during the operational phase¹⁰. This emphasizes the need to reduce energy consumption in buildings.

However, the European renovation wave does not only affect new constructions but also the existing building stock. With the buildings ageing, there is an urgent need for renovation to achieve multidimensional European and international goals. The built-up area in Europe covers 25 billion square meters, 10 billion of which were constructed before 1960 and 20 billion before 1990. Until the 1970s buildings were designed without optimised energy performance in terms of energy demands and consumption, and newly built energy-efficient buildings now make up a small share of the existing building stock, which means that the EU cannot reach its goals by relying solely on the new buildings.. According to some estimates, at least 75% of EU buildings need to be made more energy efficient¹¹. Around 75% of the total building stock in Europe comprises residential building, of which 36% are multi-apartment housing blocks, and more than half (57%) were built in the period before 1970¹². As they typically rely on low-cost technologies, most of these multifamily housing blocks are characterized by poor energy performance¹³. It is estimated that approximately 85% of the 160 million buildings within the EU are energy-inefficient¹⁴ and more than 85% of today's buildings are likely to still be in use in 2050.¹⁵ New construction accounts for only 1% of the annual addition to the

⁶ In line with the Davos Declaration "Towards a High-quality Baukultur in Europe" adopted by European Ministers of Culture and stakeholders in 2018, "quality architecture" is not only defined by aesthetics and functionality but also by its contribution to people's quality of life and to the sustainable development of our cities and rural areas.

⁷ M. Panagiotidou and R. J. Fuller, "Progress in ZEBs - A review of definitions, policies and construction activity," Energy Policy, no. 62, pp. 196-206, 2013.

⁸ Environment and Climate Change Canada. Overview of 2015 Reported Emissions; Environment and Climate Change Canada: Gatineau, QC, USA, 2017.

⁹ Friess, W.A.; Rakhshan, K. A review of passive envelope measures for improved building energy efficiency in the UAE. Renew. Sustain. Energy Rev. 2017, 72, 485-496.

¹⁰ KTH Royal institute of technologies, Sustainable Buildings - Concept, Design, Construction and Operation, Stockholm, 2021.

¹¹ Economidou, M.; Atanasiu, B.; Despret, C.; Maio, J.; Nolte, I.; Rapf, O. Europe's Buildings under the Microscope: A Country-ByCountry Review of the Energy Performance of Buildings; Building Performance Institute Europe (BPIE): Brussels, Belgium, 2011; p. 43, ISBN 9789491143014

¹² Kamari, A.; Corrao, R.; Kirkegaard, P.H. Sustainability focused decision-making in building renovation. Int. J. Sustain. Built Environ. 2017, 6, 330-350.

¹³ Missimer, M.; Robèrt, K.-H.; Broman, G. A strategic approach to social sustainability—Part 1: Exploring the social system. J. Clean. Prod. 2017, 140, 32-41.

¹⁴ Pombo, O.; Rivela, B.; Neila, J. The challenge of sustainable building renovation: Assessment of current criteria and future outlook. J. Clean. Prod. 2016, 123, 88-100.

¹⁵ [Building renovation: where circular economy and climate meet — European Environment Agency \(europa.eu\)](https://www.euro.observatory.org/article/building-renovation-where-circular-economy-and-climate-meet/)

total gross floor area in the EU, and in most industrialised countries by 2050 new buildings will only contribute 10%–20% to additional energy consumption, whereas more than 80% will continue to be consumed by the existing building stock¹⁶.

Today, only 11% of the current EU building stock undergoes some level of renovation each year. However, very rarely, renovation works address energy performance of buildings. Buildings are renovated for many reasons, largely cosmetic, and the “background” renovation rate for micro-upgrades at 9% is reasonably high. The weighted annual energy renovation rate is currently low at around 1%. Across the EU, deep renovations that reduce energy consumption by at least 60% are carried out only in 0.2% of the building stock per year and in some regions, energy renovation rates are virtually non-existent. At this pace, cutting carbon emissions from the building sector to net-zero would require centuries.

In December 2018, the European Parliament and the Council adopted Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action¹⁷. The aim was to set common rules for planning, reporting and monitoring the track towards reaching the goals of the Paris Agreement. Furthermore, the EE first principle is introduced: “energy efficiency first’ means taking utmost account in energy planning, and in policy and investment decisions, of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient, in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission and distribution of energy, whilst still achieving the objectives of those decisions”. A year later, in December 2019, the European Commission launched the European Green Deal. It is a set of policy initiatives to transform the EU to carbon neutrality until 2050. In the European Green Deal presentation, the Commission already made clear that “energy efficiency must be prioritised”. Specifically for the building sector, accounting for around 40% of energy consumption, the announced ‘renovation wave’ and a recast of the Energy Performance of Buildings Directive (EPBD) aim to at least double the current renovation rates of 0.4–1.2% per year¹⁸. The latest version of the EPBD published in 2018 (Directive 2018/844/EU) stated that “Member States should seek a cost-efficient equilibrium between decarbonising energy supplies and reducing final energy consumption¹⁹”.

The United Nations Environment Programme (UNEP) emphasised the imperative for all nations to pursue efforts to drastically reduce GHG emissions (UNEP 2021). It also called for a green Covid-19 pandemic recovery with more ambitious net-zero commitments. The pre-COP26 measures agreed during the 2015 Paris Agreement on climate change (IPCC 2018) would have only reduced predicted 2030 emissions by 7.5%; whereas reductions of 30% are needed to stay on the least-cost pathway for 2 °C and 55% for 1.5 °C²⁰. **There is a pressing need for every sector in the industry, including the entire building and construction supply chain, to decarbonise by 2050.** In this context, the construction/ renovation industry is faced with the challenge and opportunity to reduce energy demand, improve process efficiency, and reduce carbon emissions²¹.

¹⁶ Sierra, L.A.; Yepes, V.; García-Segura, T.; Pellicer, E. Bayesian network method for decision-making about the social sustainability of infrastructure projects. *J. Clean. Prod.* 2018, 176, 521–534.

¹⁷ 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. European Parliament.

¹⁸ Communication from the Commission to the European Parliament, The European Council, The Council, the European Economic and Social Committee and the Committee of the Regions - The European Green Deal (No. COM(2019) 640 final). Brussels: European Commission (COM).

¹⁹ Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency

²⁰ IPCC 2021; Cohen et al. 2021

²¹ Rezgui and Miles 2010; Alreshidi et al. 2018; Li et al. 2019

The European Commission's REPowerEU Initiative called for an increased roll out of solar energy in buildings, underlined the role of citizen led energy communities, and an expansion of heat pumps as a means of increasing EU energy sovereignty. The REPowerEU Initiative mandates solar energy installations in buildings. The Rapporteur proposes to expand the provision to include the installation of heat pumps in line with the Commission proposal to roll out 10 million heat pumps in the next five years. This will improve energy security for households, combat their dependence on increasingly volatile fossil fuel prices, and empower them to play an active part in the energy transition.

Despite the plethora of supporting measures, the current level of energy renovations in EU is still far from the optimal one²². Building owners are typically depicted as being motivated to renovate to save energy and money, but they are often refrained from doing so due to hurdles such as capital constraints and behavioural failures²³. However, the decision to renovate is far more complex than this. Renovation decisions are not only influenced by financial and informational barriers, but also by factors that affect decision-making as well as by the conditions of everyday domestic life²⁴. Whilst new financial models are tested in the European market, a successful energy transition in the building sector depends also on factors beyond financing²⁵.

As we move forward in our efforts to achieve EU sustainability goals, it has become increasingly clear that **deep renovations of existing buildings must be prioritised**. Energy renovations of the building envelope and its technical systems aimed at EE improvements, together with renewable energy technology installations, have been recognised as a key vehicle for achieving the EU EE target for 2030 and the transition towards climate-neutral Europe by 2050²⁶. The EU must become a resource-efficient economy with no GHG emissions by 2050.

The importance of energy renovations is particularly pronounced given that the vast majority of buildings in the EU were built before EE regulations were put in place. Existing buildings must be renovated with a high-energy performance. An essential point is the introduction of the Net Zero building.²⁷ Therefore, **renovation is considered to be the primary factor in achieving the EU sustainability goals** of becoming climate neutral by 2050²⁸ and the Renovation Wave set the objective to double the current renovation rate (at maximum 1% in EU) by 2030.

The building industry requires significant amounts of energy and mineral resources such as sand, gravel, or cement. It is extremely energy consuming, and more than 50 million consumers suffer from energy precariousness. In 2019, the annual renovation rate of the building stock was between 0,4% and 1,2% in the different Member States. The goal is to at least double this rate in order to reach the climate objectives. This target is called the "**renovation wave**" and applies to residential, non-residential, public and private buildings. To ensure the proper unning of this renovation wave, the commission published the EPBD where all the requirements are

²² Schleich, Joachim, et al. "Making the implicit explicit: A look inside the implicit discount rate." *Energy Policy* 97 (2016): 321-331. [10.1016/j.enpol.2016.07.044](https://doi.org/10.1016/j.enpol.2016.07.044)

²³ K. Gillingham, R.G. Newell, K. Palmer, *Energy efficiency economics and policy*, *Annu. Rev. Resour. Econ.* 1 (1) (2009) 597–620, <https://doi.org/10.1146/annurev.resource.102308.124234>.

²⁴ C. Wilson, L. Crane, G. Chrysochoidis, *Why do homeowners renovate energy efficiently? Contrasting perspectives and implications for policy*, *Energy Research & Social Science* 7 (2015) 12–22, <https://doi.org/10.1016/j.erss.2015.03.002>.

²⁵ P. Bertoldi, M. Economidou, V. Palermo, B. Boza-Kiss, V. Todeschi, *How to finance energy renovation of residential buildings: Review of current and emerging financing instruments in the EU*. *Wiley Interdisciplinary Reviews, Energy and Environment* e384 (2021), <https://doi.org/10.1002/wene.384>.

²⁶ Economidou, M.; Todeschi, V.; Bertoldi, P. *Accelerating Energy Renovation Investments in Buildings—Financial and Fiscal Instruments across the EU*, JRC Science for Policy Report; Publications Office of the European Union: Luxembourg, 2019; ISBN 978-92-76-12195-4.

²⁷ European Commission, "directive of the European parliament and of the council on the energy performance of buildings," Brussel, Belgium, 2019.

²⁸ Fetting, C. *The European Green Deal; ESDN Report; ESDN Office: Vienna, Austria, 2020.*

listed and explained **Error! Bookmark not defined.** As a revision of the EPBD the Commission proposed on 15 December 2021 the new European 'Fit for 55'²⁹ legislative package that aims to reduce the EU's GHG emissions by 55% by 2030, compared to 1990 levels. This sets the vision and outlines the tools for achieving a zero-emission building stock by 2050, introducing a new definition of zero-emission building and refining existing definitions such as 'nearly-zero energy building' (nZEB) and 'deep renovation'. Long term renovation strategies in the EPBD would be replaced by national building renovation plans that are more operational with a stronger monitoring framework, with the first draft plans submitted by 30 June 2024.

According to the Commission's proposal existing provisions on renovation will be complemented by the introduction of minimum EU-level efficiency standards, triggering an increase in the renovation rate of the worst-performing buildings. Non-residential buildings with a class G (lowest) energy performance label will need to be renovated and improved to at least class F by 2027 and class E by 2030. **The worst-performing residential buildings will need to reach at least class F by 2030 and class E by 2033.** To ensure comparable national standards, all energy performance labels must be based on a harmonised scale of energy performance by 2025 and subject to future rescaling with a view to reaching a zero-emission building stock by 2050. Class G labels will cover at least 15 % of buildings in each Member State, while the validity of labels in the lower classes (D-G) will be reduced from 10 to 5 years. To help building owners plan renovations, voluntary renovation passports and a Smart Readiness Indicator will be introduced by 2024 and 2026 respectively.

The concepts of nZEB and ZEB (Zero Emission Building) are addressed below:³⁰

NZEB concept

The EPBD states that nZEBs means a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby²⁷. According to Article 9 of the directive, every member state has to develop a national plan to adapt the directive to its economical and geographical context.

ZEB concept

In the field of sustainable buildings, the EPBD has been guiding the efforts of policymakers and stakeholders towards more energy-efficient and environmentally friendly buildings.

One of the primary challenges in defining ZEB is its variable and context-dependent nature. Many definitions can be given depending on the project goals, design principles, and owners; The building owner is interested in reducing his/her energy costs, governmental organizations are interested in source energy, environmental organisations are more concerned about CO₂ emissions, etc.

²⁹ [05 2023 | A European Green Deal | Revision of the Energy Performance of Buildings Directive \(europa.eu\)](#)

³⁰ European commission, „Directive of the European parliament and of the council on the energy performance of buildings (recast),“ Brussel, Belgium, 2021.

Moreover, most definitions imply that the building is connected to the grids, weather electrical grid, district heating, and cooling systems, or biomass distribution network. With these connections, the building can import and export energy. However, a ZEB can also use on-site storage and be independent of the grids.

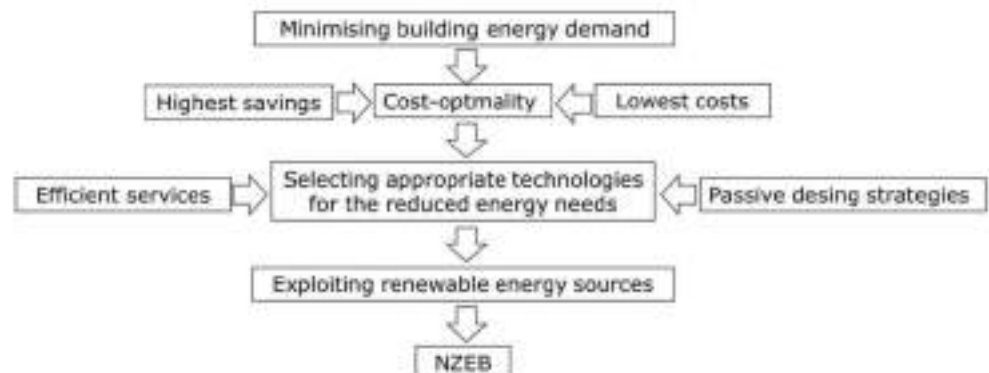


Figure 1 The NZEB concept, linked to cost optimality illustrated by d'Agostino and Mazzarella

EPBD recast requirements

As previously mentioned, the European Commission introduced a recast of the EPBD in 2021, where ZEB became the new requirement for both new constructions and building renovations. It is intriguing to examine the definition applied by the Commission, as stated in the document: "The enhanced climate and energy ambition of the Union requires a new vision for buildings: the zero-emission building, the very low energy demand of which is fully covered by energy from renewable sources where technically feasible. All new buildings should be zero-emission buildings, and all existing buildings should be transformed into zero-emission buildings by 2050".

ZEB primarily stands for a zero-emission building, emphasizing the need for a minimal energy demand that is entirely met by renewable sources, whenever technically feasible. However, it is worth noting that the emphasis is placed on energy demand rather than CO₂ emissions. Nonetheless, CO₂ emissions are also addressed as a requirement by the EPBD, specifically for new buildings: "Member States shall ensure that the life-cycle Global Warming Potential (GWP) is calculated in accordance with Annex III and disclosed through the energy performance label of the building"³⁰.

ZEB necessitates that the total primary energy usage remains below a specified threshold, which varies depending on the climate type and building typology. Furthermore, the total annual primary energy consumption should be entirely offset, on a net annual basis, through one of the following means:

- On-site renewables
- Renewable energy community energy
- Renewable and waste heat sourced from a district heating system

Ultimately, a zero-emission building should not produce any on-site carbon emissions resulting from fossil fuel usage.

EU climatic zone	Residential building	Office building	other non-residential buildings
mediterranean	<60 kWh/(m2.y)	<70 kWh/(m2.y)	<NZEB primary energy use defined at national level
oceanic	<60 kWh/(m2.y)	<85 kWh/(m2.y)	<NZEB primary energy use defined at national level
continental	<65 kWh/(m2.y)	<85 kWh/(m2.y)	<NZEB primary energy use defined at national level
nordic	<75 kWh/(m2.y)	<90 kWh/(m2.y)	<NZEB primary energy use defined at national level

Figure 2 ZEB requirements in EPBD

The definition of ZEB remains blurry at certain points. First, concerning the primary energy use, the recast defines it as the “energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting”. According to professor’s J. Kurnitski analysis on nZEBs, all components of energy use are mandatory except the energy use of appliances (households, elevators/escalators, and outlets) which may or may not be included. With the inclusion of appliances, the energy use in the buildings includes energy used for heating, cooling, ventilation, hot water, lighting, and appliances.³¹

Another issue is the same as in the previous version of the EPBD, meaning that every Member State is free to adapt the definition. For instance, for non-residential buildings that are not offices, the primary energy demand should be smaller than the threshold, nationally fixed for the primary energy demand for NZEB (non-residential)³⁰. The cost optimality is also determined by every country³⁰. As a conclusion of this state-of-the-art, our Net Zero approach must be clearly defined, as there is, nowadays, no crystal-clear, universal definition. The type of ZEB should be specified (energy or emissions), as well as the boundaries of the system.

2.1.4 The metering system in Europe.

2020 was a key year for several targets in European energy and climate policy, including the requirement for European countries to deploy smart metering for at least 80% of electricity consumers. This target was set to ease the transition towards a consumer-centred and digitalised energy system. Smart meters are useful **not only for automatic readings** by the energy provider, but also for **empowering the consumer** to be aware of their own consumption. In addition, smart meters can be the means of communication between the consumer and the energy provider, thus enabling the shifting of electricity consumption after having received price incentives or on the other hand providing electricity generated at home, e.g., through Renewable Energy Sources—RES—to the market. Smart meters also have an important function in facilitating an efficient retail market functioning, allowing end-users to change providers, and thus achieving fair competition among

³¹ J. Kurnitski, „Technical definition for nearly zero energy buildings,” REHVA, 2013

energy retailers. A new legislation, the “Clean Energy for all Europeans”³² was approved in June 2019, shaping the smart metering roll-out in the coming years for those countries which had not completed the roll-out yet.

In homes and buildings, smart meters will contribute to a 25% CO₂ saving by 2035³³ (from 2015 levels) by helping households reduce their energy demands, enabling dynamic pricing tariffs to support low carbon electric heating, promoting improved measurement of EE performance to drive increasing standards and supporting new business models for buying low carbon heating.

Member States are now committed to proceeding with (or have already completed) the roll-out of smart metering. There are close to 45 million smart meters already installed in three Member States (Finland, Italy and Sweden), representing 23% of envisaged installation in the EU by 2020. The rollout commitments amount to an investment of around EUR 45 billion for the installation by 2020 of close to 200 million smart meters for electricity (representing approximately 72% of all European consumers) and 45 million meters (around 40% of consumers) for gas. These figures are encouraging. They demonstrate that where roll-out of smart metering is positively assessed, the expected penetration rate for electricity in these Member States exceeds the Third Energy Package target of 80% but falls short of an EU-wide penetration rate of 80%

- More than half of the Member States have reached a 10% installation rate for electricity smart meters, meaning a first important step in their large-scale roll-out programmes.
- More than 56% of the electricity customers in European Union and the United Kingdom (the so-called EU27+3) had a smart meter at the end of 2022 and the installation rate for electricity smart meters in the European Union is expected to reach almost 77% by 2024
- Eight countries have already reached 80%, like Denmark, or even finished their large-scale electricity smart metering roll-out like Estonia (>98% in 2017), Finland (100% 2013), Italy (95% by 2011), Malta ([80-85]% by 2014), Spain (100% end of 2018), Sweden (100% by 2009) and France (>90% by end of 2022). Some of them are already proceeding with the second-generation rollout, like Italy, or planning this (for instance, Finland and Sweden).
- About 49% of the electricity customers in EU27+3 had a smart meter at the end of 2020 and the penetration rate is expected to reach 72% in 2026³⁴.
- Nevertheless, only a few of those remaining Member States that had committed to do so are still on track to reach the 80% deployment rate target by 2020; some of them are now setting this target as late as 2030. One of the reasons for these deployment delays relates to consumer acceptance.

The EU smart meter roll-out is in the final stage and progresses with very different operational frameworks in each member state. Italy was the first and Sweden the second to fully rollout since years.

Some countries have a clear mandatory regulatory framework according to national plans (Denmark, Finland, France, Ireland, Norway, the Netherlands, Slovenia, Spain and the UK). Some other countries with a more neutral cost-benefit or weak support have a clear way but they are progressing slower (Austria, Germany or Poland). The other countries are facing delays for different reasons, but the overall progress in the EU is positive. Most of the rollouts are based on clear regulatory norms and made by Distribution System Operators (DSO) based also on improving operational efficiency.

³² (<https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans>)

³³ [smart-meter-benefits-climate-change.pdf \(smartenergygb.org\)](#)

³⁴ [Brochure Long.indd \(berginsight.com\)](#)

2.1.4.1 Worldwide

The worldwide status of the smart meters markets is growing according to the regulatory conditions in different countries. Smart meters are helping to improve grid management and are the main focus areas for smart grid projects. Asia Pacific is the fastest growing region by revenue but the growth rate by volume is moderate, which portrays a high growth potential in the region over the forecast period. China is gearing towards sustainable energy management with substantial reserves for smart grid implementation in its 13th Five Year Plan (2016 to 2020), a delay was planned to the end of 2025. The deployment of smart electricity meters enables domestic customers to utilize varied significant features, such as enabling the reduction of peak purchases, demand response, and direct load control, thereby applying downward pressure on energy prices in spot markets, potentially lowering carbon emissions through the integration of cleaner distributed generation, offsetting the need for new generation through Transmission & Distribution (T&D) capacity, and reducing the domestic energy consumption. But despite the high number of smart meters rollouts in EU countries, the challenge is to make them work for utilities' and consumers' benefit and help to reduce the EU Energy consumption and CO₂ emissions.

This is a very good opportunity for FORTESIE as it provides additional value to the meters that are planned to be installed.

2.1.4.2 The existing end user metering devices market

There are several Smart meter systems in EU market with and without real-time information available to the end users, with such a smart meters installed. In some cases, they could be part of the FORTESIE ecosystem, with reduced extra cost from their side as the main installation is already made. The specific win-win offering must be drafted, once their compatibility to FORTESIE services is studied in detail.

Table 1 Smart meter systems in Market

Company	Website
BEN Energy	https://www.ben-energy.com/de/smart-meter-toolbox
Circutor	http://circutor.es/en
*Currentcost	http://www.currentcost.com/products.html
Dwelo	http://dwelo.com
*Ecoisme	https://www.ecoisme.com/
*Efergy	http://efergy.com
Egreen	http://www.egreen.fr/
Enel	https://www.enel.com/
Factor Energia	http://www.factorsmarthome.com
Fifth Play	http://www.fifthplay.com
Green Choice	https://www.greenchoice.nl/app
Green Pocket	http://www.greenpocket.de/en
Greenely	https://greenely.com
Ijenko	http://www.ijenko.com
Intelen	http://intelen.com/us
Mirubee	http://www.mirubee.com
MyEnergy	http://www.myenergy.com

Navetas	http://www.navetas.com
*Neurio	http://neur.io
Onzo	http://www.onzo.com
Plugwise	https://www.plugwise.com
Rocket home	http://www.rokethome.de/en
Simple Energy	http://simpleenergy.com
*Smappee	http://www.smappee.com/be_en/energy-monitor
SolarCity	http://www.solarcity.com/residential/mysolarcity
Tendril	https://www.tendrilinc.com
Toon	https://www.eneco.nl/toon-thermostaat
Wattio	https://wattio.com/en
Watty	http://watty.io

There are more sensors coming to the market in the future as Global market investment in smart metering ramps up. The global smart meters market size is expected to grow from estimated revenue of USD 20.7 billion in 2020 to USD 28.6 billion by 2025, at a compound annual growth rate (CAGR) of 6.7%. This growth is attributed to the government mandate and support policies for smart meter installation across end-users sectors such as residential, commercial, and industrial.

Despite the high number of smart meters rollouts in EU countries, the challenge is to make them work for utilities' and consumers' benefit and help to reduce the EU Energy consumption and CO₂ emissions. FORTESIE studied the different units of deployment of intelligent meters, so that in some countries the intelligent meter DSO can be the energy measurement solution associated with the solution without the need to incorporate the cost associated with the equipment for the end consumer and would be a faster and simpler technical solution when it comes to exploiting results more in line with market requirements (need to implement meter vs. associated cost). Once the existing situation in Europe has been defined, the benefits for the two specific targets can be summarised as follows:

- **Customers benefits:** The consumers will be better informed on their energy consumption patterns. Online and in-home displays help manage their consumption and costs and realize energy/cost savings bill by having access to the price rates. The customer can receive a better and tailored advice, recommendation and challenges, as the utility company is able to better profile the behaviour of its customers.
- **Suppliers' benefits:** Estimated and manual read-outs will be avoided; utility companies will obtain (nearly) real time readings and a perceptible cost reduction to obtain the required data. Customer service will be improved and value-added services will be offered to the consumers (in line with EC and national policies). The energy bill is reduced, and the Green Euros are a new source of revenue for the households which supported by the green euro loan provides alternative financing options for procuring green appliances.

Collaterally, due to the AMI³⁵(Advanced Metering Infrastructure) implementation the electrical system will be more efficient, and reliable, bringing a losses and costs reduction. Also, a rapid outage or system faults detection and quick fix of the problem helps reducing interruptions and improve service. In a more open perspective, new business will arise mainly in the IT and data analysis fields due to the large amount of data generated.

³⁵ Advanced metering infrastructure (AMI) is a group of technologies combined together from an architecture that permits a two-way communication between the consumer and the utility (EPRI, 2015).

2.2 Challenges to Green Deal and Renovation

The implementation of the renovation wave is faced with numerous challenges, all of which are effectively addressed by FORTESIE. These challenges hinder the ability of homeowners, building owners, public authorities, and businesses to carry out renovation projects in an efficient manner, ultimately impacting the overall success of the initiative.



Figure 3 Categories of good practice examples

One of the key obstacles is the prevalence of existing patterns of energy decision-making and practices, which often do not prioritize EE. The **lack of standardisation** in the industry encompasses a range of issues such as the absence of standardised methods for measuring real ex-post energy performance. Energy performance labelling in line with EPBD and relevant technical standards presents EU wide standard for evaluation of ex-ante energy performance of buildings, which are often far from real consumption or ex-post measures. This creates confusion and hesitation for people seeking to carry out renovation projects, making it challenging to assess the effectiveness of renovation measures and to determine which materials and technologies are most suitable for a particular building. Moreover, a **lack of coordination and collaboration** among stakeholders exacerbates the problem, making it difficult to implement effective renovation strategies. The complexity of renovation projects makes them difficult to effectively plan and execute. It requires to orchestrate a variety of professionals and purchase expensive equipment and material which are not clearly documented in terms of their expected benefits to the renovation objectives and overall building performance. Kivimaa and Martiskainen of the University of Sussex conducted research and discovered³⁶ that in many countries the building sector consists of a multitude of actors and requires structural coordinated activities by the municipality. Coordination and collaboration are difficult when partners have diverse interests, goals and motivations but a way to overcome this challenge is through shared understanding and mutuality. Howells³⁷ defines intermediaries broadly as “organisations that provide a supportive role for collaboration between two or more parties during various stages of the innovation process” but at the same time acknowledges that intermediaries are also individual actors. The role of intermediation is required for coordination of knowledge from

³⁶ [Innovation, low energy buildings and intermediaries in Europe: systematic case study review | Energy Efficiency \(springer.com\)](https://www.springer.com)

³⁷ [Intermediation and the role of intermediaries in innovation - ScienceDirect](https://www.sciencedirect.com)

planning to implementation, however, such roles are often not formalised and ill-defined and actors who perform the intermediary role often arise from projects rather than actively found³⁸.

Further, social and multi-family housing in desperate need of renovations face the barrier of the complex decision-making process. With nearly 34 million Europeans unable to afford keeping their home adequately warm³⁹, tackling energy poverty is an urgent task for the EU and its Member States. Each year, 800.000 social homes need renovation, requiring an estimated € 57 billion of additional funding per year⁴⁰.

Inefficient buildings are often synonymous with energy poverty and social problems⁴¹. This often means that people with low incomes have little control over their energy expenditure, causing a vicious circle of high energy bills, arrears⁴² and problems with wellbeing and health. People in inefficient buildings are more exposed to cold spells, heatwaves and other impacts of climate change⁴³. Inadequate comfort and sanitary conditions in housing and work environments, such as inadequate indoor temperatures, deficient air quality and exposure to harmful chemicals and materials, contribute to lower productivity, health problems and higher mortality and morbidity.

Poorly performing buildings have a large potential for improvement, but their renovation faces persistent barriers ranging from regulatory obstacles to structural factors. Addressing these barriers call for an integrated approach that also accounts for the social setting and affordability of housing. Minimum energy performance standards coupled with financing that would limit the monthly net expenditure of the inhabitants can significantly accelerate renovation. Accompanying services and technical assistance are essential for the worst-performing buildings.

Another significant challenge is the **lack of trust and uncertainty** surrounding the potential benefits of energy performance improvements. Many stakeholders are skeptical about the actual impact of renovations on energy consumption and are uncertain about the return on investment. This skepticism can hinder progress and discourage stakeholders from taking action. The world is still facing a major barrier against the uptake of ESIE measures that results by uncertainty around the level of savings achieved⁴⁴ with a consequent lack of trust and reliability to providers⁴⁵, but most importantly energy performance improvements resulting from certain technologies are not defined; hence investments do not materialise. The current approach of energy performance contracting, which binds the building owner to a contractual obligation to remit a portion of the cost saving to the ESCO is hindered by lack of automation in performance improvements calculation and its verification. Such technologies have not yet been developed, adopted and deployed at a large scale. Several effects are the result of this, among which a slow pace of investments.

³⁸ Lindkvist, C., et al., 2019. Defining a niche for facilities management in smart cities. In: IOP Conference Series: Earth and Environmental Science.

³⁹ Data from 2018. Eurostat, SILC [ilc_mdcs01]].

⁴⁰ Report of the High-Level Task Force on Investing in Social Infrastructure in Europe, January 2018.

⁴¹ For example, the EFIG has identified studies showing that default rates of mortgages with good energy performance label energy ratings can be as low as 0.92%, compared to 1.18% for mortgages with poor energy performance label energy ratings (28% higher default rate).

⁴² In 2018 30.3 million people were unable to keep up with utility bills, including energy bills, and so were at risk of having their supply cut off.

⁴³ European Environment Agency, Report No 22/2018: Unequal exposure and unequal impacts: social vulnerability to air pollution, noise and extreme temperatures in Europe.

⁴⁴ [http://www.ey.com/Publication/vwLUAssets/Renewable_energy_country_attractiveness_indices_Issue_30/\\$FILE/EY_RECAI_issue_30.pdf](http://www.ey.com/Publication/vwLUAssets/Renewable_energy_country_attractiveness_indices_Issue_30/$FILE/EY_RECAI_issue_30.pdf)

⁴⁵ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/209325/9589-TSODECC_AR-2012

In addition to the lack of trust the lack of motivation also plays also an important role. Zavadskas et al. (2004)⁴⁶ categorised the factors affecting renovation/refurbishment decisions as micro level and macro level. The macro level includes environmental, social and economic factors, whereas indoor environmental quality, deterioration in buildings and lower fuel charges, as well as health benefits, are considered on the micro level. Energy saving measures are rarely the only motivation for renovating a residence but come when there is a need for updating and modernising other functions. According to Risholt and Berker⁴⁸ every year new statistics show a considerable rate of home improvement among Norwegians. In this Norwegian survey findings showed that approximately 32% of the participants voted for aesthetic aspects as their main renovation motivation. This was followed by improving comfort in their dwellings (29%), reducing electricity cost (23%), and finally saving the environment (16%)⁴⁷. Upgrades include redecorations such as new floors/wall coverings, aesthetical upgrades, as well as renovations including repairs and replacement of components and improvement of the qualities of the dwelling⁴⁸. Such measures do not have direct energy saving potentials; however, they may indirectly influence the building energy use⁴⁸. For instance, incremental renovation such as improvements of the building envelope can lead to 37% of the stabilisation of the energy consumption in Norwegian household since the 1990⁴⁹. As agreed in several studies, the motivation of being involved in sustainable building renovation requires consciousness and special, personal beliefs, situational aspects, social engagement, the facilitation and access to expertise^{50,51,52,53}.

The absence of motivation for green and sustainable renovations is often linked to its **high cost**^{54,55,56}, long-term payback period, lack of information about its economic and social benefits, knowledge of how to engage and get involved as well as personal benefits, in terms of better indoor quality or reduced energy costs^{51,52,57,58}. Involving expertise and giving best practice examples to the residents in order to communicate the benefits of green and sustainable renovation projects is recommended by Baumhof et al.⁵¹. Renovating buildings to improve energy performance often requires significant financial investments, which can deter many homeowners and building owners from pursuing such projects. Energy-efficient buildings are often characterised by higher construction costs and there is a large cost variance, especially in retrofit projects. This is seen as a barrier for the adoption of energy retrofit practices. At the same time projects in the renovation sector appear to be more complex, especially in terms of design, causing cost overruns. The more cyclical nature of new construction, however, equalises “Earnings Before Interest Tax Depreciation and Amortization” (EBITDA)

⁴⁶ Zavadskas, E.K., Kaklauskas, A., and Gulbinas, A., 2004. Multiple criteria decision support web based system for building refurbishment.

⁴⁷ [Sustainable building renovation in residential buildings: barriers and potential motivations in Norwegian culture \(tandfonline.com\)](https://doi.org/10.1016/j.enpol.2013.06.011)

⁴⁸ Risholt, B. and Berker, T., 2013. Success for energy efficient renovation of dwellings—learning from private homeowners. Energy policy, 61, 1022–1030. doi: <https://doi.org/10.1016/j.enpol.2013.06.011>.

⁴⁹ Hille, J., Simonsen, M., and Aall, C., 2011. Trends and drivers for energy use in Norwegian households (Trendere Og Drivere for Energibruk i Norske Husholdninger).

⁵⁰ Ferreira, J., Duarte Pinheiro, M., and de Brito, J., 2013. Refurbishment decision support tools review-energy and life cycle as key aspects to sustainable refurbishment projects. Energy policy.

⁵¹ Baumhof, R., et al., 2018. Which factors determine the extent of house owners’ energy-related refurbishment projects? A motivation-opportunity-ability approach. Sustainable cities and society.

⁵² Paiho, S., et al., 2019. A new procedure for assessing the energy-efficient refurbishment of buildings on district scale. Sustainable cities and society.

⁵³ Støre-Valen, M. and Buser, M., 2019. implementing sustainable facility management: challenges and barriers encountered by Scandinavian FM practitioners.

⁵⁴ Bruce, T., et al., 2015. Factors influencing the retrofitting of existing office buildings using Adelaide, South Australia as a case study.

⁵⁵ Miller, E. and Buys, L., 2008. Retrofitting commercial office buildings for sustainability: tenants’ perspectives. Journal of property investment & finance,

⁵⁶ Shah, S., 2012. Sustainable refurbishment. Oxford: John Wiley & Sons.

⁵⁷ Gohardani, N., Af Klintberg, T., and Björk, F., 2015. Turning building renovation measures into energy saving opportunities.

⁵⁸ Temeljotov Salaj, A. and Lindkvist, C., 2021. Urban facility management.

differences over time⁵⁹. In addition, the low prices of energy, generate very long return on investment (ROI) time of those high upfront costs, which are not incentivising for immediate action. Huge increase in energy prices (10 x in electricity prices in 2022), as we currently see with the Russian/Ukrainian war seems to have more effect to stimulate people towards action. However, huge increase in energy prices generates inflation rates largely above the 2% target set by the ECB and put people in poverty or in angry demonstrations. Due to a century of low energy prices, there is no social acceptance of high energy prices.

Furthermore, the **lack of financing schemes** adapted to the existing building stock, whether public, commercial or residential for EE renovation projects can further exacerbate this issue. Currently, building owners and investors tend to focus on measures with short to medium payback periods (less than 10 years), which usually generate less than 30% savings. However, ambitious energy and climate policies require saving up to 80% energy in buildings, which can only be reached through structural interventions: insulation of facades, replacement of windows, and in some cases ventilation systems. This is referred to as “deep renovation”, and has payback times between 15 and 40 years at current energy prices, not in line with the time horizon of most property owners. Moreover, collecting the “low hanging fruits” with short payback times has a lock-in effect, in that it increases even more the payback time for the remaining structural interventions, which can never be reimbursed through the savings. Most communities lack the financial solutions to address the large-scale renovation of the building stock on their territory. Alternative financing schemes are therefore needed to unlock the potential for deep renovation and increase the yearly renovation rate.

Massive and ambitious energy renovation in the building sector cannot be reached solely through the public subsidies:

- Direct and indirect subsidies are limited resources and not sustainable by nature (they depend on public priorities, budgetary margins, etc), and in fact better adapted for supporting demonstration projects than massive market uptake programs, which require large and constant investments;
- Public subsidies constitute only a partial answer to the needs of project developers, which range from technical assistance to the financial structuring of the project;
- Considering awarding procedures, subsidies are not always targeted to the projects for which they are most justified and may cause unjustified windfall profits;
- Public subsidies do not solve (or very partially solve) the issue of financial credibility and solidity of projects promoters in front of financial operators (banks in particular). The leverage effect of public support remains therefore limited and the financial closure of some viable projects remains problematic.

On top of traditional public subsidies (necessarily limited), there **need** to be **other sources of financing**, and **technical expertise** to support the development of projects.

Furthermore, a major cause for the low achievements is found to be the classical economic problem of **free riding** in respect to fighting climate change. Free riding occurs when those who benefit from consumption of certain goods or services do not take the full cost and consume these goods or services excessively. A classic example of free riding often appears in public buildings where there is lack of accountability for excessive consumption. Free riding critically undermines the Paris Climate Conference Agreement and EC policies⁶⁰, which seek to limit global warming increase to 1.5°C. In addition, the theoretical ex-ante energy savings calculation is offset when users’ behaviour leads to higher consumption (the so-called rebound effect⁶¹). Money has been demonstrated by Thaler

⁵⁹ [Sustainable building renovation – strategies and processes \(tandfonline.com\)](https://www.tandfonline.com)

⁶⁰ https://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm

⁶¹ [https://en.wikipedia.org/wiki/Rebound_effect_\(conservation\)](https://en.wikipedia.org/wiki/Rebound_effect_(conservation))

(Economic Nobel prize 2017), to successfully implement policy and social objectives and affect human choices^{62,63}. A powerful economic policy based on monetary rewards, is capable of constructing a collective narrative⁶⁴ - to mobilise mass initiatives - on climate change, a key missing element so far to achieve ESIE. This helps the transition from policies which try to impose individual actions (top-down) to mass initiatives, where everyone - business or individual - takes action to change behaviour and invest in ESIE improvements (bottom-up). It supports the decentralisation of decisions, as they are no longer made by policy makers, but by the economic agents themselves. It supports social objectives and collective action that is attractive as opposed to economic policies (regulation, taxes, quotas, energy checks to poor households) which were ineffective and resulted in social protests. The green rewards based on ESIE measured and verified performance improvements, support the transition to green behaviours, and social coherence, and also demonstrates the design and distribution of a potential Central Bank Digital Currency (CBDC), a retail CBDC as means to “*enhance safety and neutrality in digital payments, financial inclusion and access, innovation and openness*”⁶⁵ while reducing dependency on cash.

EC’s building renovation wave policy⁶⁶, as of November 2020 (aiming to double the renovation rate from 1%), aims at reinforcing long-term renovation strategies towards nearly Zero Energy Buildings. Right after its publication, the International Energy Agency (IEA) announced in Dec 2020 that due to COVID management this rate regressed to its lowest value in the decade. “Studies indicate that reusing a building avoids 50-70% of the embodied carbon emissions that an identical new building would generate.”⁶⁷ ***Lack of large public awareness, eradicating scepticism and understanding stakeholder added value*** about real costs and investments, about why new approaches and systems are necessary, and how they enable everyone from her/his role (consumer, investor, owner, etc.) to play from her/his part against the “disaster, death and destruction” that results out of climate change. Awareness must be raised about the different solutions, their impact, and the priorities that must be set to embark on this journey. Clear benefits and incentives along the value chain for all involved stakeholders need to be gathered, evidenced and communicated in more targeted campaigns to each target group. “But unless such projects are brought to the wider public’s attention – unless people can see how they work and understand the benefits they can bring – many people will remain ambivalent about the need to embrace something similar for themselves. And, without the right kind of messaging the ambition will never be realised. If that happens the whole net zero drive could be blown off course.”⁶⁸

Large and attractive opportunities need to be explored in novel ways to achieve the target of 70% reduction⁶⁹ in the planet’s carbon footprint and ESIE and building renovation targets against the 2050 baseline, when analysed with this new perspective. Innovation and investments are needed in the entire value chain to achieve the transformative adaptation that renovation brings and associated climate, economic and societal benefits.

⁶² E. Shafir, P. Diamond, A. Tversky, “Money Illusion”, The Quarterly Journal of Economics, Vol. CXII, Issue 2, May 1997

⁶³ C.K. Hsee, F. Yu, J. Zhang, Y. Zhang, “Medium Maximization,” Journal of Consumer Research, 30, June 2003

⁶⁴ CAE, March 2019, « Pour le climat : une taxe juste, pas juste une taxe » Dominique Bureau, Fanny Henriet et Katheline Schubert

⁶⁵ <https://www.investopedia.com/terms/c/central-bank-digital-currency-cbdc.asp>

⁶⁶ https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en

⁶⁷ <https://www.greenbiz.com/article/combating-climate-change-study-embodied-carbon>

⁶⁸ <https://www.holyrood.com/inside-politics/view/building-for-the-future-the-challenge-of-decarbonising-scotlands-homes>

⁶⁹ International Energy Agency, “Energy Technology Perspectives 2016: Towards Sustainable Urban Energy Systems”, OECD/IEA, 2016

Lack of post-retrofit performance data and cost data related to existing and novel retrofit options is a challenge for developing comprehensive retrofit plans and predicting energy performance⁷⁰. These impacts reduce the investor confidence, community penetration potential of energy retrofits, and limit the creativity and innovation in energy retrofit projects⁷¹. Databases containing energy savings and cost data, including capital and operational costs, can greatly support successfully planning retrofits projects. Building Performance Database in the United States is a great example of such database⁷². Building stock data⁷³ collection is also a key challenge for many local authorities too. What data to collect, where to store the collected data and how to compare and validate various types of data are recurring issues encountered by local policymakers. Initiatives and programmes related to energy management systems, smart meter technology and EPC schemes can help authorities improve their understanding of the building stock in their jurisdiction.

Lastly the **lack of ownership** plays a big role in decision-making. Residents who rent their property are reluctant or unable to undertake sustainability retrofits because their lease may prevent them from doing work on the property and they may not be able to afford the measures as the payback period can exceed the duration of their lease⁷⁴. Ownership patterns in real estate markets vary significantly for different building types and between Member States, which leads to differentiated investment abilities. In larger residential buildings, heterogeneous ownership often inhibits investment decisions for deep renovation. In non-residential buildings, different usage types may result in varying investment cycles⁷⁵. In addition, the existing legislative requirements for purchasing and renovation of existing public buildings currently cover only public buildings owned and occupied by the central governments, which represent around 4.5% of all public buildings. As part of the revision of the EED, the Commission will examine the need to extend the renovation requirements to buildings at all public administration levels, including the Commission, and to increase the annual renovation rate.

Addressing these challenges requires a multifaceted approach, involving the development of standardised methods for measuring energy performance, the establishment of certification and accreditation processes. Additionally, the development of financing options, the training and certification of skilled labour, and public education campaigns to increase awareness about the benefits of energy-efficient renovation will be crucial for overcoming these challenges and creating a more accessible and streamlined EE renovation industry. Empowering households to put them at the centre of the renovation challenge (customer-centric renovation) is also a key factor to be addressed.

2.3 Opportunities for FORTESIE Project

As stated before the built-up area in Europe covers 25 billion square meters, 10 billion of which were constructed before 1960 and 20 billion before 1990. Europe's housing stock is as unique and

⁷⁰ Soratana, K.; Marriott, J. Increasing innovation in home energy efficiency: Monte Carlo simulation of potential improvements. *Energy Build.* 2010, 42, 828–833.

⁷¹ Dickerson, C.A.; Skumatz, L.A.; Bordner, R.D.; Landry, P. Working toward market transformation through residential and non-residential standard performance contract (SPC) programs—Lessons learned on delivery, design, participation, and needs. In *Proceedings ACEEE Summer Study on Energy Efficiency in Buildings*; ACEEE: Washington, DC, USA, 2000; Volume 5, pp. 527–539. Available online: https://www.aceee.org/files/proceedings/2000/data/papers/SS00_Panel5_Paper03.pdf (accessed on 21 October 2020)

⁷² US Department of Energy. Building Performance Database. Available online: <https://bpd.lbl.gov/#compare> (accessed on 24 July 2018).

⁷³ <https://www.bpie.eu/publication/our-buildings-templates/>

⁷⁴ Åstmarsson, B., Jensen, P.A., and Maslesa, E., 2013. Sustainable renovation of residential buildings and the landlord/tenant dilemma.

⁷⁵ [Minimum-standards-maximum-impact Final.pdf \(europa.eu\)](#)

heterogeneous as it is old. This age was addressed by renovation, but the pace at which this is taking place is very slow. Currently, 85% of the EU's building stock, i.e., more than 220 million buildings, are over 21 years old, of which up to 95% will still be standing in 2050⁷⁶, and virtually none of them is energy efficient. Additionally historic buildings are a distinctive feature of many cities, towns and villages in Europe, and represent a rich European cultural heritage and a living symbol of diversity.

Overall, buildings are responsible for 40% of the EU's total energy consumption as well as 36% of its GHG⁷⁷. Therefore, and taking into account the implications of the "Clean Energy for All Europeans" package, a 40% reduction in GHG emissions compared to 1990 levels, a 32% share of renewable energy consumption and 32.5% energy savings compared to 2005 levels⁷⁸, it is clear that the building construction sector is key to achieving the objectives set and that one of the best methods to achieve this will be through building renovation

Member States are increasingly recognising the high impact of the existing building stock and are starting to set targets and implement building renovation measures with the aim of reaching the minimum energy performance requirements, using some NZEB requirements, as the EPBD definition of NZEB does not differentiate between new and existing buildings⁷⁹.

The European Union has identified several renovation opportunities to improve the EE and sustainability of buildings, with a focus on reducing GHG emissions. One key opportunity is the renovation of public buildings, including schools, hospitals, and social housing. BPIE report states clearly: "To achieve at least 55% reduction in GHG by 2030... deep energy renovation rate should reach 3% per year, as soon as possible before 2030 and maintained up to 2050." To reach minimum targets defined in the Paris Agreement, rates of basic green renovations of existing buildings in these countries must reach 6 to 8% by 2040 (to exceed these standards and achieve nearly zero carbon performance, rates of advanced, deep renovations would need to reach 1.5% by 2025 and 2% by 2040)

At the same time, while the current rate of energy-renovation in the EU is 1% per year, only 0.2% of the overall rate represents deep renovation, which is far below what is necessary⁸⁰. Therefore, via the Renovation Wave, the European Commission has called for an increase in the deep renovation rate to 2% annually. Nevertheless, according to the Buildings Performance Institute Europe (BPIE), in order to meet the 2030 targets, a much more ambitious annual deep renovation rate of 3%, which accounts for 70% of all renovations, is necessary.⁸¹

⁷⁶ European Commission. Renovation Wave Communication. 2020. Available online: https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf (accessed on 25 November 2021).

⁷⁷ United Nations Environment Programme. Emissions Gap Report 2019; UNEP: Nairobi, Kenya, 2019.

⁷⁸ Navarro, J.; Filippidou, F. Achieving the Cost-Effective Energy Transformation of Europe's Buildings; Energy Renovations via Combinations of Insulation and Heating & Cooling Technologies Methods and Data; Publications Office of the European Union: Luxembourg, 2019.

⁷⁹ D'Agostino, D.; Zangheri, P. Development of the NZEBs concept in Member States Towards Nearly Zero Energy Buildings in Europe Title: Development of the NZEBs concept in Member States. 2016. Available online: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC104344/development%20of%20the%20nzrebs%20concept%20in%20member%20states_final.pdf (accessed on 2 December 2021).

⁸⁰ Buildings Performance Institute (BPIE), Deep renovation: Shifting from exception to standard practice in EU policy, 2021 https://www.bpie.eu/wp-content/uploads/2021/11/BPIE_Deep-Renovation-Briefing_Final.pdf

⁸¹ [rev6 SPIPA EU.pdf \(bpie.eu\)](#)

Annual Renovation Rate	Annual Deep Renovation Rate	Annual Investment (vol.)	Annual Investment (share)
<ul style="list-style-type: none"> • Current: 1% (EU level, small national, variation) • Needed for 2030 targets: Double the current rate to 2% (Renovation Wave) 	<ul style="list-style-type: none"> • Current: 0.2% (EU level, small national, variation) • Needed for 2030 targets: 3% overall (BPIE estimate) 	<ul style="list-style-type: none"> • Current: EUR 56 billion spent on medium and deep renovation • Needed for 2050 target: EUR 243 billion need annually to align building stock with climate neutrality 	<ul style="list-style-type: none"> • Current: EUR 127 billion with 66.3% light renovation, 28.3% medium, 5% deep • Needed for 2030 target: 70% of renovations to be deep* <p>*The European Commission does not have a set target for deep renovation.</p>

Figure 4 Status quo of building renovations, and the levels required to meet EU climate targets

There are around 131 million buildings in the EU. 90% of these buildings are residential, but by floor area the residential building stock accounts for three quarters of the 25 billion square metres of useful space (64% single family homes, and 36% apartments), with the remaining 25% being non-residential buildings (28% retail/commercial, 23% offices, 17% education, 11% hospitality, 7% healthcare, 4% sports and 11% other). Today, 75% of the typical buildings in Europe are currently energy inefficient, and just 1% of them are being renovated annually⁸². These numbers suggest that the current building stock in Europe will need more than five decades to be carbon-neutral, exceeding by a few decades EU's climate-neutral goal by 2050 and making the needed changes imperative. Yet, the interest in the climate crisis and sustainable development seems to have grown during the past few years^{83,84,85,86}. The renovation of existing buildings may be the ultimate solution for reducing carbon dioxide emissions and building energy demand^{87,88,89,90}. This, along with the European Green Deal, has sparked a rise in real estate developers' interest in environmentally friendly and sustainable buildings. All the above seem to have led to a growing interest in green buildings since future homeowners prioritise green buildings compared to other choices in the market⁹¹. Subsequently, green building technologies are being incorporated by real estate developers in order to gain strategic

⁸² Zancanella, P.; Bertoldi, P.; Boza-Kiss, B. Energy Efficiency, the Value of Buildings and the Payment Default Risk; EUR 29471 EN; Office of the European Union: Luxembourg, 2018.

⁸³ Skordoulis, M.; Ntanos, S.; Arabatzis, G. Socioeconomic evaluation of green energy investments: Analyzing citizens' willingness to invest in photovoltaics in Greece. *Int. J. Energy Sect. Manag.* 2020, 14, 871–890.

⁸⁴ Zhang, L.; Wu, J.; Liu, H. Turning green into gold: A review on the economics of green buildings. *J. Clean. Prod.* 2018, 172, 2234–2245.

⁸⁵ Vardopoulos, I. Multi-criteria decision-making approach for the sustainable autonomous energy generation through renewable sources. Studying Zakynthos Island in Greece. *Environ. Manag. Sustain. Dev.* 2018, 7, 52–84

⁸⁶ Vardopoulos, I. Multi-criteria analysis for energy independence from renewable energy sources case study Zakynthos Island, Greece. *Int. J. Environ. Sci. Dev.* 2017, 8, 460–465.

⁸⁷ Theokli, C.; Elia, C.; Markou, M.; Vassiliades, C. Energy renovation of an existing building in Nicosia Cyprus and investigation of the passive contribution of a BIPV/T double façade system: A case-study. *Energy Rep.* 2021, 7, 8522–8533.

⁸⁸ Tan, Y.; Lee, S. Building Energy Consumption Raw Data Forecasting Using Data Cleaning and Deep Recurrent Neural Networks. *Buildings* 2019, 9, 204

⁸⁹ Khan, J.S.; Zakaria, R.; Shamsudin, S.M.; Abidin, N.I.A.; Sahamir, S.R.; Abbas, D.N.; Aminudin, E. Evolution to Emergence of Green Buildings: A Review. *Adm. Sci.* 2019, 9, 6.

⁹⁰ Vardopoulos, I.; Stamopoulos, C.; Chatzithanasis, G.; Michalakelis, C.; Giannouli, P.; Pastrapa, E. Considering urban development paths and processes on account of adaptive reuse projects. *Buildings* 2020, 10, 73.

⁹¹ Sichali, M.; Banda, L.J. Awareness, Attitudes and Perception of Green Building Practices and Principles in the Zambian Construction Industry. *Int. J. Constr. Eng. Manag.* 2017, 6, 215–220

positioning in the housing market⁹²⁻⁹³. Additionally, the interest of some real estate investors who invest in green buildings is due to their higher returns. The increasing interest in green buildings led to responsible property investing (RPI), with which investors can demonstrate their commitment to sustainable and green development⁹⁴. RPI is a component of responsible investment established by the UN Environment Programme Finance Initiative⁹⁵, which has as a main purpose to minimise the impact of investment on society and the environment whilst guaranteeing financial profitability⁹⁶. The above notes are supported by the fact that any building that has a LEED certification in the housing market can be sold at a 30% higher price, according to the research by Saeed and Mullahwaish (2020)⁹⁷, who also proved how a property's green certification can improve its appeal in the real estate market and even raise its level of desirability, raising its market value. This is also supported by the fact that green residential buildings attract advanced market value in the housing market, according to the United States Green Building Council; the same report by this group connects green buildings to higher rents for real estate investors⁹⁸.

Current research^{99,100,101,102,103} and data from the private sector¹⁰⁴ have shown that green buildings can be considered as “premium” in the global market since sustainability practices are followed during the design and construction phases, with an additional 8% to 18% increase in sales prices and 3% to 13% increase in rental prices. Owning a green building or property has been shown to have advantages such as higher resale value, higher rental rates, higher occupancy rates, lower operating rates, higher net operating income, and lower capitalisation rates, making it appealing to an owner to renovate it.

Furthermore, some countries like UK have already implemented the MEES Regulations, which mandate a minimum EE standard (MEES). As of April 1, 2023, the MEES regulations will be updated to require a minimum energy performance label rating of D for new tenancies and renewals. This means that landlords must ensure their properties have a label rating of D or above before they can let them to new tenants or renewals. Furthermore, from April 1, 2025, the MEES regulations will be updated again to require a minimum label rating of C for new tenancies and renewals. These regulations apply to all privately rented properties in England and Wales, including domestic and non-

⁹² Zhang, X.; Shen, L.; Wu, Y. Green strategy for gaining competitive advantage in housing development: A China study. *J. Clean. Prod.* 2011, 19, 157–167.

⁹³ Chan, A.P.C.; Darko, A.; Ameyaw, E.E.; Owusu-Manu, D.-G. Barriers affecting the adoption of green building technologies. *J. Manag. Eng.* 2017, 33, 04016057

⁹⁴ Leskinen, N.; Vimpari, J.; Junnila, S. A Review of the Impact of Green Building Certification on the Cash Flows and Values of Commercial Properties. *Sustainability* 2020, 12, 2729.

⁹⁵ The UN-Convended Network of Banks, Insurers and Investors Accelerating Sustainable Development, UN Environ. Program. *Financ. Initiat.* 2023. Available online: <https://www.unepfi.org/> (

⁹⁶ Pivo, G.; McNamara, P. Responsible Property Investing. *Int. Real Estate Rev.* 2005, 8, 128–143.

⁹⁷ Saeed, A.A.; Mullahwaish, L.T. Effect of Green Areas Density on Real Estate Price in Ramadi City. *Int. J. Des. Nat. Ecodyn.* 2020, 15, 253–259.

⁹⁸ Diller, M. The 2020 Green SmartMarket Report Overview. 2020. Available online: <https://www.usgbc.org/education/sessions/2020-green-smartmarket-report-overview-12846735> (accessed on 9 April 2023).

⁹⁹ Chegut, A.; Eichholtz, P.; Kok, N. Supply, Demand and the Value of Green Buildings. *Urban Stud.* 2014, 51, 22–43.

¹⁰⁰ Ott, C.; Hahn, J. Green pay off in commercial real estate in Germany: Assessing the role of Super Trophy status. *J. Prop. Investig. Financ.* 2018, 36, 104–124.

¹⁰¹ Das, P.; Wiley, J.A. Determinants of premia for energy-efficient design in the office market. *J. Prop. Res.* 2014, 31, 64–86.

¹⁰² Fuerst, F.; McAllister, P. Eco-labeling in commercial office markets: Do LEED and Energy Star offices obtain multiple premiums? *Ecol. Econ.* 2011, 70, 1220–1230.

¹⁰³ Newell, G.; MacFarlane, J.; Walker, R. Assessing energy rating premiums in the performance of green office buildings in Australia. *J. Prop. Investig. Financ.* 2014, 32, 352–370.

¹⁰⁴ Brookes, N. Active Capital: Trends in Global Real Estate Investment; London, UK. 2021. Available online: <https://content.knightfrank.com/research/1801/documents/en/active-capital-the-report-2021-8447.pdf> (accessed on 9 April 2023).

domestic properties. There are some exemptions to the regulations, such as certain listed buildings or properties where it is not technically feasible to make the necessary improvements, but these exemptions are limited¹⁰⁵. MEES regulations are prone to be adopted in other European countries too. The EPBD, currently negotiated among the EU institutions and only likely to conclude in autumn, will provide a timely impetus to boost renovation. The minimum energy performance requirements will set out a clear trajectory for renovating the private building stock. For this analysis, a conservative assumption of the outcome of this legislation was taken. However, the benefits could be amplified in the case of a more progressive outcome, for instance some proposals on the table suggest the least performant building to be renovated quickly so all buildings have at least energy label D by 2030¹⁰⁶.

Renovating existing buildings offers several significant advantages over constructing new ones, particularly when considering the environmental impact and energy consumption. First of all, from a “green” perspective, retaining and reusing things that already exist is generally seen as requiring less energy than demolishing and building from scratch along with the reduced cost, even if a building is going to be changed radically, keeping the most basic fabric in place can work out cheaper than a complete rebuild with new footings, external walls, etc. Renovations allow us to preserve the historical and cultural significance of older buildings. Many structures have architectural value or historical importance that would be lost if they were torn down to make way for new greener buildings. Renovations can help maintain the unique character of a place and contribute to its cultural heritage.

The European Green Deal has the potential to improve the quality of life for millions of Europeans. Gas, coal, and oil prices are the driving force behind high inflation in Europe, lowering households' purchasing power while increasing energy poverty. Energy end-uses in Europe are overly reliant on fossil fuels, meaning citizens are paying high prices for heating and cooling. Before the energy crisis, Eurostat estimated that around 7% of the European population could not afford to heat their homes properly. That equates to 34 million people, which is expected to have risen in the context of the crisis. While 2022 inflation was an average of +6.2%, the EU climate laws on renewables and efficiency could help stabilise prices. The climate-friendly solutions, whether PVs, changing heating systems or renovating homes, can be an effective shield against high prices and protect Europeans' wallets. This would be supported by a high share of renewables providing cheap electricity in the mid-term.

Financing mechanisms are also available to support renovation projects. The European Investment Bank provides loans and guarantees for renovation projects, while the European Union Emissions Trading System provides funding for energy-efficient renovations in member states. The EU also provides grants and subsidies for renovation projects through programs such as the European Regional Development Fund and the European Social Fund.

Digitalisation is another area of opportunity for renovation projects. The EU encourages the use of digital tools to improve construction plan efficiency and reduce waste. Digital tools and digital journals can also help to improve communication among the various stakeholders involved in a renovation project. Novel modules can ensure that data sharing initiatives relevant to construction enable businesses to realize the full potential of data sharing for building operation while adhering to existing contractual agreements and privacy. Cross-open and secure data sharing should be incentivized, based on case-by-case voluntary agreements, and made available to all actors worldwide.

Lastly, the EU is investing in skills and training for workers in the construction industry to support the renovation of buildings. The European Skills Agenda aims to improve the skills of workers in the construction industry, including those involved in renovations. This includes training in areas such as

¹⁰⁵ [Minimum Energy Efficiency Standards Regulation Update 2023 - Synergy Creativ](#)

¹⁰⁶ [Strategic Perspectives Turning the European Green Deal into Reality May 2023-2.pdf](#)

EE, digitalization, and sustainability. Improving the skills of workers can improve the quality of renovation projects and ensure that they are carried out in a sustainable and energy-efficient way.

Combining FORTESIE's extensive expertise in green renovations with the offered smart energy contracts and innovative funding schemes, the project is positioned to seize a substantial market opportunity in Europe. With mandatory green renovation requirements in place for a significant percentage of buildings across the continent, FORTESIE's comprehensive and all-encompassing approach provides a distinct advantage. FORTESIE is at the forefront of transforming the industry by providing a holistic package that combines both digital and renovation technologies and addresses all aspects of building renovation (social, economic, and environmental). FORTESIE is paving the way for a greener and more energy-efficient future.

Strengths	Weaknesses
<ul style="list-style-type: none"> - Improved quality of life and thermal comfort - Energy savings - Large availability of old and inefficient buildings in need of renovation, as well as high-quality building insulation materials and competent building practices. - Requirement of energy efficiency certificates when renting or selling the house and availability of quality energy efficiency certified equipment. 	<ul style="list-style-type: none"> - High renovation costs due to high regulatory requirements. - Challenging tax and incentive policies. - Scarcity or total absence of specific loans for deep renovation of single-family houses. - Increased business interest in new building construction. - Poor coordination small and medium-sized entrepreneurs on deep renovation. - Both small and medium-sized entrepreneurs and owners lack much knowledge about deep renovation and owners also tend to have little confidence in contractors. - Inconveniences caused by the deep renovation.
Opportunities	Threats
<ul style="list-style-type: none"> - Positive public attitude and interest in climate change mitigation and sustainability. - Targeted loans/incentives and taxes for deep renovation. - Higher energy prices and higher taxes promote interest in saving. - Availability of information and advice on energy efficiency. - A systematic renovation plan together with regular major maintenance. - State-of-the-art building technologies and practices. 	<ul style="list-style-type: none"> - New construction is preferred over renovation by construction companies. - Few quality services in the renovation market. - Poorer behaviour of the owners regarding energy savings after renovation. - Negative perception of the quality of work due to lack of coordination between the different contractors. - Interest in renovation largely dependent on the price of energy. - Aesthetic renovation is more attractive than deep renovation.

Figure 5 SWOT elements for building renovation market.¹⁰⁷

Existing Budget and recovery initiatives

Multiannual Financial Framework (MFF) 2021-2027

The Multiannual Financial Framework (MFF) is the seven-year framework for the EU budget. The current MFF runs from 2021-2027 and includes provisions for short-term economic recovery, while supporting a green and digital future for the EU. An existing budget of EUR 1.211 trillion for this period

¹⁰⁷ Mainali, B.; Mahapatra, K.; Pardalis, G. Strategies for deep renovation market of detached houses. *Renew. Sustain. Energy Rev.* 2020, 138, 110659.

is combined with a further EUR 806.9 billion from the temporary recovery instrument, NextGenerationEU, for a total of EUR 2.018 trillion.¹⁰⁸ Given the importance of building renovation for the EU's climate targets, the planned budget includes dedicated funds for building EE measures, outlined below.

InvestEU

InvestEU¹⁰⁹ is an investment support mechanism under the MFF for the 2021-2027 period. This EUR 26.2 billion EU guarantee program is expected to mobilize another EUR 372 billion of investments. InvestEU supports four policy areas: i) Research, innovation and digitalization; ii) SMEs; iii) Social investments and skills; and iv) Sustainable infrastructure, which also includes EE, building renovation and the integration of buildings-connected energy sources.¹¹⁰

NextGenerationEU (NGEU)

NextGenerationEU is a temporary European recovery instrument with a budget of EUR 806.9 billion, intended to help fix the economic damage incurred during the coronavirus pandemic. The NextGenerationEU instrument will reinforce the EU MFF 2021-2027 budget by providing additional funds to be distributed to Member States across several programs through grants and loans, primarily focusing on the 2021-2023 period.¹¹¹

Recovery and Resilience Facility (RRF)

The Recovery and Resilience Facility is the main NextGenerationEU program, making 90% of its total budget, EUR 723.8 billion, available in loans and grants to Member States for buildings renovation.¹¹² This facility aims to support the achievement of climate targets, while ultimately promoting economic recovery. The aim is to mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient, and better prepared to meet the challenges and opportunities of the green and digital transitions. 'Renovation', one of the eight RRF flagships highlighted by the European Commission, leads to job creation and savings on energy bills, and is ultimately indispensable as a tool to support the economic recovery.

Recovery and Resilience Plans (RRPs)

To receive funding from the RRF, Member States must submit Recovery and Resilience Plans. These provide an overview of reforms and investments in line with RRF objectives that any Member State plans to undertake in the coming years. Additionally, RRFs are required to allocate at least 37% of RRF spending to climate-related investment and policy.

Bank- investments

As Europe is discussing the scale of an unparalleled recovery programme to mitigate the damage of the Covid-19 pandemic, it has become clear that renovation of the European building stock would create a triple benefit. It would lead to an increase in economic activity, retaining and creating employment; it would support the achievement of Europe's climate and energy targets, and it would provide Europeans with better and healthier buildings. The scale of the investment opportunity is enormous, and while large figures for the economic recovery are currently featuring high in the

¹⁰⁸ European Commission, The 2021-2027 EU budget – What's New? https://ec.europa.eu/info/strategy/eu-budget/long-term-eu-budget/2021-2027/whats-new_en (Accessed December 2021)

¹⁰⁹ https://europa.eu/investeu/home_en

¹¹⁰ https://europa.eu/investeu/about-investeu/what-investeu-programme_en

¹¹¹ European Commission, The 2021-2027 EU budget – What's New? https://ec.europa.eu/info/strategy/eu-budget/long-term-eu-budget/2021-2027/whats-new_en (Accessed December 2021)

¹¹² https://ec.europa.eu/info/strategy/recovery-plan-europe_en

political debate, the question remains what investment is needed to deeply renovate Europe's buildings. The total amount to trigger a significant scaling up of the renovation rate and depth is adding up to EUR 90 billion per year, allocated to support mostly deep renovation, advisory services for owners/investors and technical assistance in member states, as well as innovation in serial renovation solutions. This funding would support an annual investment in mostly deep renovation of EUR 243 billion in EU-27. Of this amount, EUR 179 billion¹¹³ is required for residential buildings, and EUR 64 billion for non-residential buildings renovation.

According to the European Commission's Joint Research Centre (JRC), EUR 127 billion per year was invested in energy renovations in the residential sector across the EU-28 between 2012 and 2016.¹¹⁴In the same period, the JRC estimated EUR 56.7 billion in non-residential sector¹¹⁵. To raise the renovation rate from 1% to 3%, there would be not only a significant increase in investment, but also new financing instruments and schemes, as well as a significant increase in private capital. The European Commission estimated in 2020 that an additional EUR 275 billion would be required annually to close the investment gap in order to meet the EU's 2030 target, with the majority of it going toward EE.¹¹⁶

How much investment is needed to renovate the European building stock?							
	Floor area	Floor area renovated medium	Floor area renovated deep	Cost assumption for medium renovation	Cost assumption for deep renovation	Investment opportunity 2023-2055	Investment opportunity each year
	million m ²	million m ²	million m ²	EUR/m ²	EUR/m ²	in EUR	in EUR
EU-27							
total	26,136	3,284	15,755	290	405	7,282	243
residential	19,570	4,403	10,274	280	401	5,374	179
non-residential	6,566	1,481	5,479	300	420	1,907	64
West and Northwest							
total	14,523	3,288	7,645	350	490	4,802	163
residential	10,090	2,710	5,297	350	490	3,592	133
non-residential	4,433	997	2,327	350	490	1,400	50
Northeast and Central							
total	3,061	688	1,608	170	215	521	17
residential	1,866	447	1,043	174	243	311	11
non-residential	1,195	242	565	174	243	210	6
South							
total	7,588	1,783	3,973	340	598	3,742	98
residential	6,670	1,580	3,503	340	598	3,558	91
non-residential	898	203	472	340	598	207	7
Southeast							
total	1,062	234	547	140	205	348	11
residential	831	185	432	140	205	336	11
non-residential	231	49	115	140	205	112	0

Figure 6 EU Renovation investment needed

Funding pledges have been made but must materialise as quickly as the emergency short-term measures that governments have deployed. Nearly EUR 40bn has been earmarked for renovations across 18 EU countries and it is important that this translates into actual progress. However EU countries differ in the amount of aid committed to managing the energy crisis. The same is true when it comes to climate and energy targets. For example, France, which wants to slash energy consumption in buildings in a series of milestones up to 2032, will require up to EUR 25bn per year for this. Aid

¹¹³ [Recovery-investments-in-deep-renovation BPIE 2020.pdf](#)

¹¹⁴ 6 EUR 84.4 billion for 'light' renovations, EUR 36 billion for 'medium' renovations and EUR 6.9 billion for 'deep' renovations. See: <https://publications.jrc.ec.europa.eu/repository/handle/JRC122347> page 11

¹¹⁵ EUR 22 billion for 'light' renovations, EUR 29.1 billion for 'medium' renovation and EUR 5.6 billion for 'deep' renovations. See: <https://publications.jrc.ec.europa.eu/repository/handle/JRC122347> page 12

¹¹⁶ EEFIG, Closing the gap on energy efficiency investment, European Commission, https://ec.europa.eu/info/news/closing-gap-energy-efficiency-investments-2020-dec-22_en (accessed January 2022)

packages have so far focused on managing power prices and have totaled more than EUR 70bn since September 2021. Now seems like the perfect moment to ensure funding for its building renovation strategy while protecting consumers and businesses. Similarly, in Greece, EUR 10.5bn or nearly 5.7% of GDP was pumped into energy bill subsidies and other measures between September 2021 and October 2022. But when it comes to renovations, the Greek government is coming up short. The main Greek renovation programme ('Saving at Home') had EUR 632m from November 2021 to November 2022 – it's now been extended to early 2023 – and foresees another 925m from early 2023. In addition, two new renovation programmes have recently been launched: EUR 350m for young people (to upgrade old ancestral homes) and EUR 450m for businesses. Croatia – the EU's newest member state – has allocated 4.2% of its GDP to the energy crisis, with more than EUR 2.4bn spent on relief measures, according to the Bruegel think tank.

Croatia aims equally big with its renovation strategy, since it aims to renovate 25% of buildings by 2030 and 100% by 2050. This will require more than EUR 30bn – in other words, more than EUR 1bn a year. Yet the money set aside for renovating residential buildings is just EUR 128m until 2026, while public buildings get EUR 671m with an additional EUR 40m for public heritage buildings.

According to the European Commission, Greece will need EUR 10bn every year by 2030 and double that in the period to 2050 to reduce energy demand in buildings by up to 40%.

In recent years, a big market for green renovations has been created in the EU, with banks and crowdfunding playing a significant role in supporting this initiative. The EU's push towards a sustainable built environment has created a growing demand for green renovation projects, which has attracted a diverse range of investors. Banks have responded to this demand by offering specialized loans and financing options tailored to support renovation projects, such as energy-efficient renovations. For instance, the German development bank KfW offers a variety of loan programs to support energy-efficient renovations, including low-interest loans and grants. In 2021, the KfW bank announced a EUR 8 billion financing program for energy-efficient renovation and construction projects. In France, the Caisse des Dépôts et Consignations offers a range of financing options for sustainable renovation projects, including loans and guarantees. Additionally, green bonds have emerged as a popular financing option for renovation projects, with numerous banks issuing bonds to finance energy-efficient renovations of buildings and infrastructure.

Sustainable finance refers to a growing field in the financial services industry integrating environmental, social, and governance (ESG) considerations into investment decisions (European Commission, 2020a). The increased focus on sustainable finance in recent years driven by political movements, investor demand, and regulatory changes has led to the development of a new green market offering sustainable debt that has marked a compound global growth of 61% in the years between 2013 and 2020 (Bloomberg, 2021). The green bond market is, up until now, the most popular and relatively mature one – in 2020, it marked a 13% growth compared to 2019. Green bonds accounted for 93.1% of total green finance globally between 2012 and 2021. In 2021, global green bond issuance stood at \$511.5 billion, compared with \$2.3 billion in 2012.¹¹⁷ The share of green finance in the total finance market was about 4% in 2021, compared with around 0.1% in 2012.

On the other side, green lending instruments, i.e., “green loans”, earmarked for green projects, and sustainability linked-loans, henceforth “sustainable loans”, bench-marked by ESG criteria, have recently become globally recognized. Green loans are similar to green bonds in the sense that their proceeds should be entirely used to finance green projects. To this extent, the Green Loan Principles, published by the Loan Market Association in March 2018, provide guidelines on which projects are eligible to be classified as “green” (Loan Market Association, 2018). For instance, in January 2020, the Swedish property company Wallenstam obtained a green loan of 258 million dollars to finance a

¹¹⁷ [Global green finance rises over 100 fold in the past decade -study | Reuters](#)

project on the creation of “nearly zero-energy buildings” (LoanlyPlanet, 2020). Green lending market in Europe has been growing tremendously in the last years. The total volume issued in each year have increased from 25.2 billion euros in 2014 to 93.8 billion euros in 2019, which implies a growth rate of 272%. The aggregate volume of sustainable loans issued by European firms is almost 128 billion euros whereas the green loans represent 100 billion euros.¹¹⁸

Financing investments are made to strengthen renovations and implement energy-efficient installations and other decarbonization measures in the building stock. Examples of innovative financial instruments – ranging from grants and subsidies to fiscal support that helps to overcome the challenge of high upfront investments – are highlighted, including large funds providing loans and innovative financing initiatives like the promotion of energy service company (ESCO) services. To implement financial instruments on the local level collaboration with regional banks and energy agencies is beneficial. For example, the Flemish ‘Energy Houses’ (Energiehuizen) are locally operated organisations linked to the Flemish Climate and Energy Agency that provide zero-interest loans to residential building owners investing in EE, as well as providing legal, technical and financial advice. In the Netherlands’ Natural-Gas Free Districts Programme (Programma Aardgasvrije Wijken), the national government is investing EUR 400 million in subsidies to municipalities to detach complete residential districts from the gas network. French municipalities, on the other hand, are allowed to provide exemptions from real estate tax for renovations of buildings constructed before 1989. Many financial instruments tailored specifically to the local level focus on public buildings. This is for example the case with the state and local government EE fund in Latvia, the green loans from the Kommuninvest bank owned by Swedish municipalities, and the Danish municipal renovation loans. ESCO services are also available to local governments, for instance in Latvia and Ireland, although uptake remains modest because of the impact of such services on balance sheets.

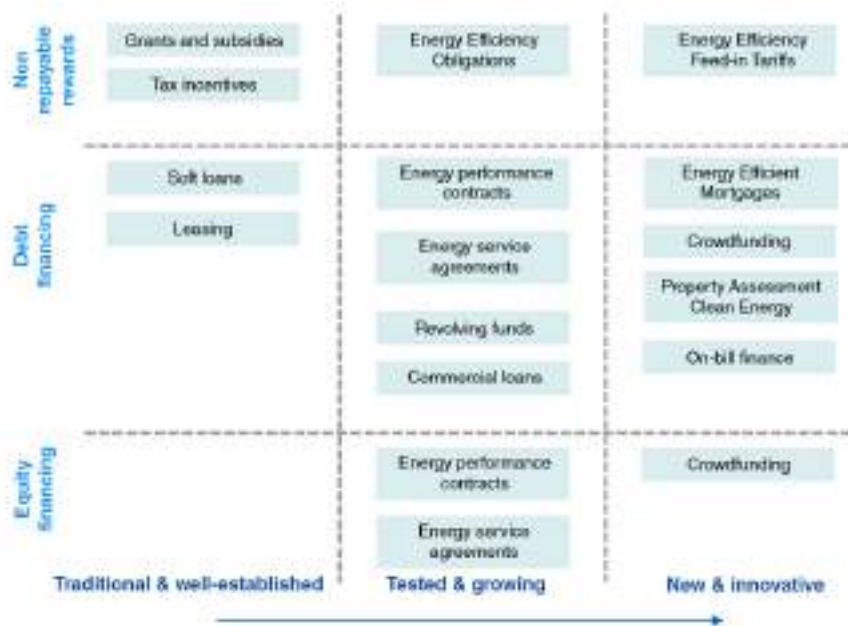


Figure 7 Overview of current financial instruments supporting energy renovations in the EU classified according to market saturation (traditional, growing and new) and type (non-repayable reward, debt financing, and equity financing)

¹¹⁸ Green versus sustainable loans: The impact on firms’ ESG performance * H. Ozlem Dursun-de Neef † Steven Ongena § Gergana Tsonkova/ This Draft: April 3, 2023

Green buildings represent a major global investment opportunity, with buildings making up the largest segment of the US\$ 231 billion EE market.¹¹⁹ In the U.S the value of investments in energy-efficient buildings worldwide reached its peak in 2022. However, to meet the net zero by 2050 goals, the value of those investments would need to amount to over half a trillion U.S. dollars annually between 2026 and 2030.¹²⁰ The level of investments would have to increase sharply for that scenario to occur. In 2015 the building renovation market in the EU-28 was valued at nearly EUR 109 billion and was responsible for 882,900 direct and indirect jobs. The installation of energy efficient technologies is labour-intensive, so green building investments help drive local employment growth in the European Bank for Construction and Development (EBRD) region. By 2020 investments in EE in the European green buildings sector are expected to deliver around 19 net jobs for each EUR 1 million invested. The creation of the Green Energy Finance Facilities (GEFFs) helped stimulate green economy growth by providing credit lines to local partner financial institutions (PFIs) for on-lending to small and medium-sized enterprises and homeowners wishing to undertake green building projects. Credit lines are complemented with technical assistance for PFI capacity-raising and project assessments, and occasionally with low-intensity grants to reward and offset the cost of adopting advanced technologies. The GEFF programme operates through a network of more than 120 local financial institutions across 24 countries, targeting the industrial, commercial, residential and municipal sectors. To date, GEFFs have facilitated the refurbishment of 60,832 buildings. Interestingly, the design of dedicated residential facilities allows the processing of tens of thousands of applications for recognised technologies that meet minimum energy performance requirements. Under the GET approach, the EBRD has financed more than 200 large-scale projects for the development, upgrade and refurbishment of more than 62,000 building assets, with the overall building area exceeding 25 million square metres. These investments enabled EUR 15 billion of green building investments, including EUR 2 billion from the EBRD. Investments in building assets under the GET approach vary from a few thousand euros to over EUR 100 million in larger, structured finance projects. The EBRD can fund 30 to 100 per cent of investment costs. The Bank's green building investments include commercial, public and residential buildings and yield aggregate lifetime (15-25 years) savings of 71,000 GWh of energy and 335 million tonnes of CO₂. Finance is available through different direct and intermediate channels.

Grants and subsidies, such as direct investment subsidies, are used by governments when optimal levels of investments cannot be fully provided by the market alone. They can partly contribute to overcoming the upfront cost barrier since they directly fill an immediate financial gap and, hence, enable a temporary shift in the market¹²¹. For EE, grants and subsidies can also raise awareness and trust in EE projects, improve cash flow, and increase investors' access to debt finance¹²². These forms of support are usually included in policy mixes covering further fiscal and financial instruments such as feed-in tariffs and tax breaks¹²³. Their main limitation, however, is budget restrictions as they are typically linked to public resources and can thus neither offer a sustainable solution nor support massive market uptake programs. Moreover, the effectiveness of a subsidy program can be difficult to assess i) because of rare monitoring processes of the share of free riders—beneficiaries that would have implemented their economically sound projects even without access to subsidies ¹²² ii) as

¹¹⁹ <https://www.ebrd.com/documents/climate-finance/>.

¹²⁰ [Global green buildings investment 2030 forecast | Statista](#)

¹²¹ Newell, R. G., Pizer, W. A., & Raimi, D. (2019). U.S. federal government subsidies for clean energy: Design choices and implications

¹²² Bertoldi, P., & Rezessy, S. (2010). Financing energy efficiency: Forging the link between financing and project implementation.

¹²³ Polzin, F., Egli, F., Steffen, B., & Schmidt, T. S. (2019). How do policies mobilize private finance for renewable energy?—A systematic review with an investor perspective.

subsidies are given on *ex-ante* savings estimates as opposed to real *ex-post* measured savings, with potentially large differences between the two measurements and little efficacy (*i.e.* little reduction in energy consumption) of the subsidy, and iii) installer and manufacturer tend to increase the price of the equipment and installation to capture in between 60% to 100% of the subsidies. Another barrier is that subsidies for small projects may hinder more ambitious projects achieving higher energy savings goals. Ideally, comprehensive packages are needed in cases where public grants are combined with other financing.

EPC is a guarantee-based agreement between the client and the ESCO, often with the participation of third-party, such as a bank, whereas the ESCO, according to literature, issues a performance guarantee, and their remuneration is directly linked to the savings achieved^{124,125}. In case of no or lower performance, the ESCO has to financially compensate the client^{126, 127}. In case of savings, those are used to pay for the cost of the renovation. Normally, an ESCO implements the agreed energy improvement measures using its technical and organizational know-how during the project. Often, the ESCO is also responsible for monitoring the energy savings. The financing for the investment may come from the client (e.g., in Denmark), the ESCOs own funds (in case of large ESCOs usually, typical for example, in Italy, France), or from a third-party using the EPC guarantee as a credit basis (as common in the Czech Republic and Germany)¹²⁸. In an EPC, the ESCO provides a performance guarantee which guarantees the flow of energy savings from a retrofit project. Alternatively, the guarantee ensures that the energy savings resulting from the investment will be sufficient to repay monthly debt service costs. ESCOs use various financing structures, such as limited recourse debt, usually with additional collateral or credit support needed, and an important role is played by the economic evaluation of the contract implementation¹²⁹. EPC can also be provided by Public-Private Partnerships to deliver EE projects in the public sector¹³⁰, where trust in these structures exists¹²⁸.

Crowdfunding platforms have also played a role in supporting green projects, including renovation. For example, the Swedish platform Trine has raised over EUR 21 million for solar energy projects in developing countries. In the UK, Abundance Investment has raised over £130 million for community-owned renewable energy projects, including solar panel installations on community buildings.

This new form of financing that, using internet-based platforms, connects investors directly with borrowers (without involving other traditional financial organizations) is **crowdfunding**^{133,131}. In the last few years, crowdfunding has become an alternative means of financing renewable energy

¹²⁴ Bertoldi, P., & Boza-Kiss, B. (2017). Analysis of barriers and drivers for the development of the ESCO markets in Europe.

¹²⁵ Pätäri, S., & Sinkkonen, K. (2014). Energy service companies and energy performance contracting: Is there a need to renew the business model? Insights from a Delphi study. *Journal of Cleaner Production*, 66, 264– 271.

¹²⁶ Bertoldi, P., Rezessy, S., & Vine, E. (2006). Energy service companies in European countries: Current status and a strategy to foster their development.

¹²⁷ Tsoutsos, T., Tournaki, S., Farmaki, E., Sonvilla, P., Lensing, P., Bartnicki, J., ... Biscan, M. (2017). Benchmarking framework to encourage energy efficiency Investments in South Europe. The trust EPC south approach. *Procedia Environmental Sciences*, 38, 413– 419. <https://doi.org/10.1016/j.proenv.2017.03.125>

¹²⁸ Boza-Kiss, B., Bertoldi, P., & Economidou, M. (2017). Energy Service Companies in the EU - Status review and recommendations for further market development with a focus on Energy Performance Contracting, EUR 28716 EN [JRC106624].

¹²⁹ Tupikina, A. A., & Rozhkova, M. V., Economic Evaluation of Energy Service Contract Implementation from the View of its Participants, 2018 14th International Scientific-Technical Conference on Actual Problems of Electronic Instrument Engineering, APEIE 2018, doi:<https://doi.org/10.1109/APEIE.2018.8545961>

¹³⁰ Carbonara, N., & Pellegrino, R. (2018). Public-private partnerships for energy efficiency projects: A win-win model to choose the energy performance contracting structure. *Journal of Cleaner Production*, 170, 1064– 1075.

¹³¹ Miller, L., & Carriveau, R. (2018). A review of energy storage financing-learning from and partnering with the renewable energy industry. *Journal of Energy Storage*, 19, 311– 319. <https://doi.org/10.1016/j.est.2018.08.007>

projects¹³², playing a key role to finance the early stages of projects (Lam & Law, 2016). Crowdfunding can be categorized in four types depending on the funding purpose and investment method: (a) donation-based, (b) reward-based, that can be collectively referred as “community crowdfunding”, (c) equity-based, or (d) lending-based, that can be defined as financial return crowdfunding or investment crowdfunding. The main benefits of this financing instrument are flexibility and reduction in transition costs, competing with traditional channels of financial intermediation¹³³. Potential problems with this type of instrument are for example the insufficiency of funds compared to the demand from entrepreneurs; or the high APRs for end users; or the possibility of online fraud due to the unproven technology¹³⁴. In general, the returns are not sufficient compared to the risks related to the technology adopted. In fact, projects offering better risk-adjusted returns attract relatively larger contributions. Tax reliefs could be an important element to improve crowdfunding model. For example, in the UK stakeholders can invest through a tax-efficient Individual Savings Account¹³⁵. In the European context, the CrowdFundRES project promotes the use of crowdfunding for financing the acceleration of renewable energy growth. The CrowdFundRES project involves three main actors: renewable energy project developers, public actors interested in investing in projects, and crowdfunding platforms to link public and project developers (facilitating the financial transaction). In Croatia, a crowdfunding platform project for EE has been put in place with the aim of funding public buildings and infrastructures benefitting the community. The projects have seen the collaboration of North-West Croatia Regional Energy Agency (REGEA), the Centre for Social Innovations and Sustainable Development (CEDIOR), and the University of Zagreb and the first pilot project focused on the complete renovation of a kindergarten, paving the way for future application of the funding scheme.

By creating a big market for green renovations, banks and crowdfunding platforms have helped to accelerate the transition to a sustainable built environment in the EU. The availability of specialized financing options and alternative funding sources has made it easier for renovation projects to be implemented and has increased community involvement in the decision-making process. This has led to a range of environmental, economic, and social benefits, such as reduced carbon emissions, increased EE, and improved quality of life for residents.

2.4 CBDC Requirements and Trends

The retail CBDC specifications towards the “Digital euro” are presented here. FORTESIE considers that the green-euro, could act as a potential use-case for a retail CBDC serving in parallel as a tool to accelerate EU renovation wave, which in the context of the EU Green Deal is a priority of EC.

2.4.1 Fierce competition in the monetary field

When in 2019 Facebook (now Meta) launched its project of a private currency called Libra (then DIEM) that would operate on a blockchain, it shook all institutions in the world: governments, banks, central banks, BIS, IMF, etc. In simple terms, all the reactions can be summarized by: “they were all afraid to run out of job”, i.e. could private companies (especially multinational digital company – Facebook holds c. 50% of the world population as customers) could take over financial sovereignty owned by public institutions?

¹³² Dilger, M. G., Jovanovi, T., & Voigt, K. I. (2017). Upcrowding energy co-operatives—Evaluating the potential of crowdfunding for business model innovation of energy co-operatives. *Journal of Environmental Management*,

¹³³ Oxera (2015). Crowd funding from an investor perspective. European Union. doi:<https://doi.org/10.2874/61896>.

¹³⁴ Bento, N., Gianfrate, G., & Groppo, S. V. (2019). Do crowdfunding returns reward risk? Evidences from clean-tech projects. *Technological Forecasting and Social Change*

¹³⁵ McInerney, C., & Bunn, D. W. (2019). Expansion of the investor base for the energy transition. *Energy Policy*, 129, 1240–1244. <https://doi.org/10.1016/j.enpol.2019.03.035>

The “digital euro” project was conceived to prepare competition against large international firms entering this field.

Competition is also coming from other States: China, Sweden and America are leading this field.

China: 4 cities are ready to propose a digital currency with support of 100 million users. The motive is to generate an international footprint for their currency (easy electronic access to Chinese electronic money for poor countries) but more details are not known. The Chinese CBDC is therefore pursuing a **political** objective of developing the **international role of their currency**.

Sweden: 1st country that launched the subject in 2017 because of the reduction of use of cash. The aim was to maintain access to CB currency for citizens: **this is a democratic issue**. Although Sweden started in 2017, the project has still not seen the light of day.

USA: consultation underway. In the USA, there is a debate about the role of public authorities and their involvement: Some believe that innovation should come from the market (the private sector) and that the digital \$ is too interventionist. Due to China's action means progress need to be accelerated.

The aim of the digital euro experiment is thus to increase the Eurosystem’s knowledge of digital currency technologies and be prepared to face fierce competition.

The ECB launched on July 14th 2021 the digital Euro project with a set of 5 prototypes was tested early 2023¹³⁶, of which the evaluation is expected by end 2023/early 2024. Should the digital euro be launched, it would take around 3 years. The digital euro should be thus effective in 2026. Depending on China’s activity, this schedule could be speeded-up.

The digital euro is clearly not aimed at addressing the green-deal priority of the EC but rather is a retail currency and does **not implement the greening of monetary policy**. The ECB focus is only to prepare to fight competition.

2.4.2 Antagonism and inconsistencies in the “digital euro” experiment

So far, the “digital euro” project is addressed to a large population, which needs to be convinced to use. As the French Governor of the French Central Bank (Banque de France) confessed in a public meeting¹³⁷, he is not able to explain the digital euro to his own family members.

Indeed, the definition of money is complex and not unanimously accepted, and so is the single monetary theory¹³⁸. Consequently, as of today, there is no simple use-case that could be offered to the European population.

Digital Euro was conceived as a political weapon and is thus not aligned with the long term “neutrality of money” of mainstream economic classes, nor is compliant with the separation of political power from monetary power, as described in the Treaty on the Functioning of the European Union¹³⁹. ECB mentions quite often an “**inclusion**” criterion as a feature for the digital euro, and to old/non-digital/excluded from financial services people, the same way cash is available to all. Central Banks suppressed all households accounts (in 2004 in France) and now pledge for financial inclusion. Can inclusion be done with digital tools and also preserve anonymity and EU General Data Protection Regulation (GDPR)?

¹³⁶ https://www.ecb.europa.eu/pub/pdf/other/ecb.prototype_summary20230526~71d0b26d55.en.pdf

¹³⁷ Conférence : L'euro numérique pour tous ! 21/6/2022

¹³⁸ See BENEFFICE report D7.3 Analysis of existing business models and drawbacks based on economic theory, 2022

¹³⁹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02016E%2FTXT-20200301>

Likewise in Northern Europe (Sweden) the usage of cash is disappearing, with great support from central banks and governments (also as a mean to fight money laundering)¹⁴⁰. However, technological advances, new actors and digitization of payments have brought up the question of the future role of the state in the payment market, whereby cash will not become irrelevant in countries if private persons no longer use it, and thus retailers do not accept it. If nothing is done to counteract this issue, it will probably lead to the general public no longer having access to generally-accepted central bank money, that is, cash. Similarly, ECB “digital euro” aims to maintain the contact of EU citizens, a major EU institution and avoid the cases that citizens disconnect from it, as cash is reduced.

In addition, there is confusion on means of payment (payment instruments and market) and currency. Payment systems are the pipe in which money (currency) flows. Cash is a means of payment and a form of the euro, complementary to the existing digital (scriptural) form of the euro. As euro is already digital, the concept of “digital euro” adds to the general confusion. The most user-friendly payment systems used by a majority of citizens is the card, which raises issues of sovereignty as three main card payment operators are US companies (Mastercard, Visa, and American Express). Public vs private, payment market/instrument vs currency, cashless society vs antimoney laundering (AML), independency of central banks vs role of states in financial markets, connection of EU citizens to central bank money vs private banking, sovereignty vs independence, inclusion vs anonymity.... these create an environment of confusion and disbelief, which leaves the opportunity for a new innovative scheme open.

2.5 A high level view of the FORTESIE innovation and competitive advantages

Jacques Attali, adviser to all French Presidents since François Mitterrand in 1981, presents in his latest book published in May 2023 (“Le Monde, modes d’emploi: Comprendre, prévoir, agir, protéger”) the concept of Economy of Life and Economy of Death, based on fossil energies. Attali believes it is still possible to make the great shift and avoid catastrophe” by “moving from the economy of death to the economy of life”.

To produce a simple message for a large audience, FORTESIE could speak of the **green-euro, the euro of economy of life** compared to the current brown euro, associated with the fossil economy of death.

FORTESIE is thus promoting, the economy of life, and uses currency as a vector of the identity of a community, used on a daily basis by allowing all economical agents to trade with this green form of the euro, has potential to build the required collective narrative on climate. The digital green-euro (€G) is a retail currency for all European economic agents.

Connected to the ECB digital euro project it could allow for the development of a strong green Europe and a European economy that works for people.

FORTESIE will create new energy contracts constructed around the principle of (Flat fee, kWh, Reductions) with blockchained automated measurements and payments.

¹⁴⁰ <https://www.ijcb.org/journal/ijcb22q4a3.htm>

3 Financing approaches

Citizens can fund a large part of the renovation packages thanks to all subsidies available. Depending on the renovation investment size, there is a cost born by the customer. This remaining financial burden can be borrowed at commercial banks with relatively high interest rates, around 3 to 6% depending on the country and the bank. In some cases commercial banks offer so called “green loans” to attract customers, i.e. loans at 1 or 2 % to fund the purchase of a carbon free equipment which adds up to the total investment. The difference in the APR is borne by sales and marketing expenses of the bank (customer acquisition/retention). Those operation are thus limited in quantity and time.

The section below illustrates how the valorisation of abated CO₂ (accounted in carbon credits) can be used to offer unbeatable APR on the market. The refinancing scheme described with consortium partner GOP, could also be developed at ECB or Member States level, in order to bring the APR to 0% or negative. This would be a strong signal on the renovation market to accelerate the renovation wave.

3.1 Proposed €G loans by CCO2 and Goparity for FORTESIE to replace fuel boilers by heat pumps

Carbon Hypothesis:

- Heating a house consumes annually **1500 litters of fuel** (average consumption in France ranges from 700 litters to 5000 litters, for a total cost around 1650 € per year (average of 1.1€/L).
- Prior to the installation of a heat pump, household is thus supporting a monthly “heating charge” of € 138 (1650€/12).
- 1500 litters of fuel produce around 14 000 kWh of heat.
- 1500 litters of fuel emit 4.02 tons of CO₂,
- The replacement of the fuel boiler by a heat pump avoids the emission of 4.02 tCO₂ annually, and generates **4 carbon credits**, annually. Emissions from electricity production are not considered or taken into account in this calculation, as CO₂ emissions from electricity production is already taken into account and managed under the EU Emissions Trading Scheme also known as the EU carbon market. The responsibility for those emissions are born by energy producers, and consequently, to avoid double counting of CO₂ emissions are not counted at the household level.

Financial Hypothesis:

- Carbon credits are purchased by CCO2 from the house owners at the price of **€ 44.60 per tCO₂**. This is the “green earning” for the customer, and the unique benefit of green euros. This price is set to equal the French carbon tax level to make all climate policies tools consistent.
- Carbon credits are then sold by CCO2 to companies or institution that voluntarily offset their emission. The price on the voluntary carbon market is at **€ 9 per tCO₂**.
- The house owner needs to borrow € 10k to install a heat pump assuming all other costs to install the heat pump are paid with various subsidies program.
- CCO2 borrows €10k from Goparity, at 1% interest rate (APR).
- CCO2 lends to the house owner € 10k at 4.8% APR (equivalent to market conditions).
- Carbon credit’s revenues pay back interest and reduce the total cost of the loan to make it a 1.7 % APR. In the table below, the monthly loan charges for the households now equal to €174.
- With the heat pump, the 14 000 kWh of heat can be produced with around 3 500 kWh of electricity (performance coefficient of the heat pump equal to 4). The monthly electricity cost of heating will thus be around € 60 (at 0.2€/kWh all tax included).

- Consequently, for renovation and heating the household pays € 174 + € 60 = €230, to be compared with the initial €138 monthly bill to pay fuel. The narrative “energy savings” does not translate into “euro savings”, and is a barrier to large renovation uptake. The aim of €G is too build a narrative on climate: By switching from fossil to electricity you fight climate change. Eventually you also gain on comfort. €Gs are there to help you fund this transition with low APRs. No mention on savings.

Financials are summarised in Figure 8, which presents in the long run, CCO2 to be needed to design an offer to operate profitably with the net revenue line.

	Borrowed at Goparity	Sold at customer	
Amount of Loan in € Green	10 000 €	10 000 €	10 000 €
Duration	60	60	60
Monthly rate	0.09%	0.39%	0.39%
APR	1.085%	4.782%	4.782%
Installment	171.28 €	187.25 €	187.25 €
Total amount paid	10 276.93 €	11 234.99 €	11 234.99 €
green earnings			795.00 €
Total cost of loan	276.93 €	1 234.99 €	439.99 €
Equivalent monthly instalment	171.28 €	187.25 €	174.00 €
Equivalent APR	1.085%	4.782%	1.721%
Revenues CO2 offset (CO2 sold)			160.43 €
Net gain for CCO2			323.49 €

Figure 8 CCO2 Financial Hypothesis

As a continuation of the business models developed in this deliverable, a concerted effort to commercially deploy the French business model will involve the following steps:

- Assuming FORTESIE is a success, scale up from 5 to 100 houses in France with OKT partner
- Working out the model with the other partners in co-creation workshops.
- Goparity will also scale up this new offering
- Contact with ECB and EC cabinets will take place in the context of CBDCs and the new EU plan to make EU competitive (response to the US IRA plan).

4 Stakeholders' analysis and description

Within this section the identified stakeholders related to FORTESIE, which are critical for the successful delivery of this FORTESIE green-euro vision, are described.

Table 2 FORTESIE value proposition

Stakeholders	Challenge	FORTESIE value proposition
Energy retailers & Suppliers, ESCO (Energy Service Company)	<ul style="list-style-type: none"> 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. (too long ROI). Owners' reluctance to invest limits market penetration. Limited evidence and knowhow in ESIE activities needs enhancement to support large scale renovation and digitisation activities. Difficulty in establishing synergies with other suppliers and ESCOs to promote services in ESIE for rapid market penetration Subsidy is paid based on forecasted and not on real savings/performance There is lack of data gathering and documented evidence to prove performance improvements and real savings. Differentiation from competitors in a fierce competitive Utility market is difficult. 	<ul style="list-style-type: none"> Opportunity for composing, validating and optimising innovative services for buildings based on smart performance contracts. Opportunity to create new types of contracts that would generate more revenue with less kWh sold. Competitive advantage of innovative business models. Leverage on new funding methods or improvements of existing ones to expand their business and be incentivized for further investments which help to address existing barriers. Novel partnerships and more attractive service offerings. New types of smart contracts to differentiate from competitors.
Consumers of all kinds	<ul style="list-style-type: none"> Lack of tools to be convinced and to really know of the savings they will be getting. Outdated systems. 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 desire to implement any change. Lack of knowledge or financial capacity to invest in energy renovation techniques. 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, 	<ul style="list-style-type: none"> Fair non-discriminatory access to renovation and ESIE solutions; Multi-dimensional financial and nonfinancial social incentive design for valuing participation in smart performance contracts; Enhanced levels of comfort, contribution to ESIE and climate change. Seamless access to innovative market solutions and consumption data in a secure way and with enhanced data protection & privacy; Increased motivation, reduced perceived risk of privacy breaches and increased perceived data sharing value due to consumer-centred service, incentive.

	<ul style="list-style-type: none"> • Lack of access and knowledge to the best energy efficiency renovation methods and to the new technologies and their benefits • Distrust to acquire alternative financing schemes. • 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. • National subsidies and White certificates, are complex to understand, generates fraud in some cases, generate administrative paper work (validation) and differed payments. The gain is for installers/equipment manufacturer more than for households. Reluctance to make the initial investment without a concrete forecast of the savings he/she will make. • Lack of interest in the forecasted savings specified by the ESCO. • In multi-family homes, homeowners are easily persuaded by disbelieving neighbours not to invest in energy-efficient renovations. • Mistrust in the forecasted savings specified by the renovation company. • Lack of knowledge of the experts, renovation technologies and measurement tools to adopt. • Lack of guidance where to start and what are the first steps. • Lack of knowledge about public subsidies and other financial tools. • 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 • Pressure from the increasing energy costs and uncertain policies • Lack of knowledge lead to wrong assumptions. Decisions are usually made on limited information and wrong assumptions. 	<ul style="list-style-type: none"> • Customer centric solution rewarding energy efficient behaviour. • Participation in a positive collective narrative on climate as opposed to the 50 years old “energy savings” campaigns.
<p>One Stop Shops</p>	<ul style="list-style-type: none"> • National trust issue from homeowners with renovation company, many media stories of shady companies, and outright criminal renovation subsidy fraud. • Costly quality controls. • Empty training programmes: millions € in training subsidies are available. 	<p>One Stop Shops network together, learn from each other, and promote the new packages to their local markets, together with validated results and best practices. They will be able to adopt novel services and combine them in additional packages for a variety of stakeholders. New financing schemes, innovative business models including all stakeholders.</p>

<p>Energy Cooperative</p>	<ul style="list-style-type: none"> • Lack of knowledge regarding household energy renovation. • Innovative financial schemes and smart contracts. • Measure and improve energetic efficiency in targeted houses. 	<p>The cooperative aims to increase their service options that can bring ESIE solutions to its members. Its goal is to a) adopt solutions that brings the improvement of energy savings and thermal comfort to the prosumers, b) develop construction techniques more suitable to the target households, given the location and climate conditions, c) testing models which bring investment with transparency and sustainability for investors and end-users.</p>
<p>Equipment manufacturers, including construction/renovation providers</p>	<ul style="list-style-type: none"> • 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 • Difficulty to convince the owners of the facilities about the benefits that the energy efficiency visualization provides and to in communicating the advantages of their innovative services. • Evidence and knowhow in ESIE activities needs enhancement to support large scale renovation and digitisation activities. • Limitation in synergies to promote services in ESIE (renovation services and EPC smart contracts) with other suppliers and ESCOs for fast market penetration • 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. • 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. • 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. • Lack of confidence in the development of new renovation technologies. 	<p>New tools, services that help them gain an insight in the contribution of their technologies to overall building performance. Opportunity to become game changers in terms of climate change and building renovation policies, and reach big market share. Discover new directions for business growth, innovation, diversification and visibility. They realise a business shift towards the provision of collaborative service offerings e.g. a a retailer selling EE heaters, in collaboration with IoT and analytics technologies can offer consumption information –facilitated by smart metering devices-, tailored consultancy for efficient usage –facilitated by decision support software- and access to a social interaction ecosystem, to increase their revenue and recover the loss for lower energy consumption. In other words, they will perform a shift from asset-based to service-based operation, taking advantage of the novel FORTESIE framework.</p>

	<ul style="list-style-type: none"> • Evidence and knowhow in efficient, sustainable and inclusive energy use activities need enhancement to support large scale renovation and digitisation activities. • Cooling systems, HVAC systems, insulation, solar panels, smart building controls, sensors, and other energy-efficient products, that are used in green renovation projects. 	
Technologies providers	<ul style="list-style-type: none"> • Difficulty to convince the owners of the facilities about the benefits that the energy efficiency visualization provides. • Hesitation of owners to invest in digital solutions restrict market penetration • Evidence and knowhow in ESIE activities needs enhancement to support large scale renovation and digitisation activities. • Hesitation in synergies to promote services in ESIE with other suppliers and ESCOs for fast market penetration • Lack of confidence in the development of new digitization and automation technologies • Owner's lack of knowledge of economic incentives to invest in such projects, • Evidence and knowhow in efficient, sustainable and inclusive energy use activities need enhancement to support large scale renovation and digitisation activities. • Owners of digital solutions platforms are not aware/ do not have access to indoor building data. 	
Financing organisations	<ul style="list-style-type: none"> • To set up the flow of cash (in-out) • To convince on the benefits of their service and gain trust of both investors and investments • The fear Benefit-oriented bank has of not profiting from the energy efficiency sector. • Doubt of whether all projects it finances are good for the environment and beneficial. • 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. • Inefficient financing for projects of lower financial returns and high impact. • Limited offer of profitable and risk-transparent investment opportunities. • Limited transparency regarding risk of investment opportunities • Limited offer of profitable and risk-transparent investment opportunities. 	<p>Identification of new business opportunities: Investment funds, fund specific actions to achieve policy targets, and request guaranteed ESIE which now they cannot be objectively measured. In addition, the concept of green banking and investments appeared to support these policy objectives and the green deal. Investors have realized this opportunity and are now seeking opportunities. The Green energy transition has become an unstoppable trend and FORTESIE demonstrates investment options and viable business models.</p>

	<ul style="list-style-type: none"> • 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. • Limited experience with selecting criteria to finance energy efficiency and renovations projects. • Limited resources to assess, measure and monitor impact indicators and metrics related to energy efficiency projects' implementation. • Limited reach to direct beneficiaries of financed interventions. • Private equity firms can invest in green renovation projects, often in exchange for a stake in the project. • Too much admin work with States to collect subsidies (case of the Zero APR loan in France). • No financial return for funding “green projects” 	
<p>Governments and policy makers</p>	<ul style="list-style-type: none"> • Lack of knowledge of the potential of the renovation technologies in the context of buildings or individual homes • The policy maker does not have a sufficient understanding or lacks supporting information of the energy efficiency situation in the state or local government. • Lack of funding (States finances are negatives), 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. • Lack of efficiency of public money spending due to ex-ante estimations and no ex-post controls; • 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...) • 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. 	<p>Opportunities for a system-level cross-energy and cross-sector energy and infrastructure are key actors to implement the community transformation towards the low-carbon society needs. Cities, municipalities, and regions can lead by setting up initiatives and drawing on other parties to those. They identify new ways, potentially more effective, to support the achievement of their goals and targets with respect to the EU and national regulations and directives.</p> <p>Ex-post vs ex-ante subsidies to guarantee efficiency of public spending.</p> <p>Offer new rewards with a new currency (€G) to reward saving behaviour in exchange for a high increase in electricity price.</p>

	<ul style="list-style-type: none"> • Certain environmental performance standards, which can increase the value and marketability of green renovation projects. • No social and political support to significantly increase energy prices 	
Social Science and Humanities activities /Dissemination and communication	A techno-centric approach that ignores personal, local, and community acceptance can impede the realisation of transformative projects and prevent successful uptake of innovative solutions. For example, people will not take up new solutions that they don't understand, trust, or perceive to fit their lifestyle.	<ul style="list-style-type: none"> • The community's and stakeholders' values, priorities, and practices are mapped and considered throughout the project to ensure that all solutions designed are compatible with them. • An engagement strategy based on social sciences and the community mapping facilitates acceptance of the solutions. It enables common goal tracking and motivational engagement of all stakeholders. The engagement strategy also facilitates feedback loop between the stakeholders, allowing iteration of solutions based on both meter data and user feedback. • Users are provided tailored content based on their motivation, capability, and opportunities.
Legal experts	<ul style="list-style-type: none"> • Potentially different legal situation on national level (e.g. different age limits for minors' consent) • Different types of data processed and different potential justifications/safeguards, e.g. for sensitive categories of data, needs to be considered. • Needing to ensure that any nudging mechanisms used remain non-exploitative and transparent 	<ul style="list-style-type: none"> • Guidelines for a lawful and ethical data processing to protect fundamental rights of participants. • Specific risk mitigation measures • Consent form and information sheet • Joint Controllers Agreement • Good practice guidelines and/or ethical oversight

FORTESIE aims to guarantee the relationships among the EPC contracts stakeholders. For this reason, the following analysis of the energy contracts took place, to understand the type of contracts, the guarantees and terms available, as of Today (2023)

Three types of contracts exist as of today and can be summarized as follows:

- 1) **Static (Flat fee, kWh).** The household pays a flat monthly fee, plus a price per kWh for each kWh consumed. The kWh price is constant during the period of the contract.
- 2) **Static (Flat fee, kWh, Green Energy).** The household pays a flat monthly fee, plus a price per kWh for each kWh consumed. The kWh price is constant during the period of the contract, higher than standard contracts, and guaranties that energy is produced by green sources.
- 3) **Dynamic: (Flat fee, kWh, Days).** The household pays a flat monthly fee, plus a price per kWh for each kWh consumed. The kWh price is NOT constant during the period of the contract and varies among days (in France for example, 3 types of days are proposed Red, White and Blue, together with night and day prices, thus a total of 6 different prices for one kWh).

How can this evolve?

Similar to the mobile phone industry, one can imagine that market opening and competition would favour and generate new competitive and innovative offers. Dynamic contracts could be enriched in following ways:

- 1) **Dynamic to cope with demand (Flat fee, kWh, Hour/minute?)** The household pays a flat monthly fee, plus a price per kWh for each kWh consumed. This kWh price could be set within a predefined price range, and vary depending on the time of day (avoidance of rush hours and pic consumption), and the day of the season (cold vs warm days).
- 2) **Contracts such as rewarding contracts (Flat fee, kWh, Reward);** even though fewer consumption (reduction in consumption) translate into cheaper invoices, new forms of contracts to favour more reductions could be designed. FORTESIE believes those type of contracts are antagonist with ESCO's financial objectives. Consequently, third parties need to be involved to generate rewards based on reduction or behaviour, such as OKT in the French pilot.

Those new types of contracts, in FORTESIE, face the following challenges:

1. Baseline calculation should be accurately calculated without any doubt from the two stakeholders of the contract, but despite several efforts, remains a challenge.
2. Rewards in €G to compensate with kWh price increase are transparently and automatically calculated and paid on a wallet thus, building trust between all parties.
3. Demonstrate the above to policy makers to trigger further actions and build:
 - i. Sustainable models in €Gs to be presented to ECB digital euro experiment.
 - ii. A climate narrative on climate change rather than on energy savings in order to favor social acceptance of huge energy price increases, that could be partly offsetted by €G rewards.

5 Identification of Key Exploitable Results

5.1 Overview

This is an updated and final list of the FORTESIE project exploitable results. The results of the FORTESIE project may be commercially exploited either by each partner individually, or by the consortium collectively, and at different levels. The highest exploitation level concerns the complete FORTESIE system, which includes all the offered FORTESIE solutions. At the next lower level, we find the major modules of the FORTESIE platform that the lead contributing partner can exploit each of them individually or in collaboration with other contributing partners. For each developed module, we can exploit at a lower level the corresponding accumulated lessons learnt and know-how.

The following table summarizes the Key Exploitable Outcomes (KEO) of the FORTESIE project; and the next subsections describe them in more details.

Table 3 Key Exploitable Outcomes of FORTESIE

Exploitable Outcome ID		Title	Lead Partner	Partners contributing	Potential exploitation form
<i>Integrated solution</i>	01	Reference architecture and blockchain digitisation suite which improves the automated and International Performance Measurement and Verification Protocol (IPMVP)	CTIC	All technical partners	Open Source
<i>Application/software products</i>	02	Integrated renovation packages solutions to raise the overall EPC value proposition	ED	All partners	Open Source, Selling services on top of them
	03	Data Analytics	NTUA		
	04	Gamification app	ED		
	05	Financing schemes for integrated renovation packages	CC02	GOP	Public offering For visibility
	06	Green-euro (€G) readiness for a Central Bank Digital Currency (CBDC) trial	CC02	CC02	Open Source/ Licencing
	07	A new Smart Electricity contract comprising of a fixed fee, various €G/kWh depending of the hour of the day, and rewards that offset kWh price increase.	CC02	All partners	Open publications/ Fee/ Licencing

<i>Business know-how</i>	08	Collaborative business models for immediate take up (adopting legal, regulatory and ethical aspects)	ED	All partners	Open Source, Selling services on top of them
	09	FORTESIE online OSS marketplace for sustainable service provisioning and value chain networking (One-Stop-Shop for building renovation for ESIE, networking and empowering local actors)	ED	IEECP, NTUA	Open Access maybe with selling specific services (studies, consulting)
	010	Technical/Legal and Business Know-how	Tech partners	Legal expert	Consulting services, development services

6 Presentation of BASE/X approach and its importance for FORTESIE

A first consideration regarding the business modelling that will be adopted is the shift from products to services and the collaborative composition of services. This is implemented with BASE/X, a business engineering framework for agile service-dominant business, i.e., service-oriented business that puts service management at the forefront. BASE/X has been developed since 2012 and has since been successfully applied in many cases in a spectrum of business domains, both in direct industrial practice and in research and development efforts (including several EU FP7 and H2020 projects: GET Service, BESTFACT, HORSE, C-MOBILE)

In FORTESIE, BASE/X is used as the core methodology for developing service-based business strategies and collaborative business models, as well as for the mapping of these business models to service orchestrations, EE support services, and information technology architectures that support the execution of these services (as detailed in the next section below). The fact that BASE/X is network-centric is essential in the EE domain, as true EE can only be obtained by collaboration of multiple stakeholders and explicitly balancing the costs and benefits for each of them. The fact that BASE/X is used to construct agile business models is of major importance too, as business models for ESIE should evolve (or even revolve) with new developments in the energy market, new technological possibilities and last – but certainly not least – newly conceived ways for collaboration between stakeholders. Agility and network-centricity are reflected in the main BASE/X design technique that will be used to develop business models in FORTESIE. The BASE/X business model radar models a network-based business collaboration to co-produce an explicitly defined value-in-use – the collaborating parties are pie slices in the radar. The radar identifies the actor value propositions (contributions to the central value-in-use), the actor co-production activities (business activities/services to produce the actor value propositions), and is the basis for a network-level design and analysis of costs and benefits of involved actors, covering both financial and non-financial costs and benefits. Explicitly handling non-financial costs and benefits is essential for business modelling in the energy domain to deal with factors like consumer awareness, quality of living, company image or required personal effort of consumers. The business model radar will be complemented with other proven BASE/X techniques.

The core facilitator behind BASE/X is the proposition that the value of a business offering is not based on the assets an organisation possesses, but on the combined services that these assets can provide. As such, agility and quick uptake of market trends and changes is ensured, since the evolution of a product is possible with the change of individual services instead of rigid assets, while different final products can be derived with different combinations of the services inventory, or with collaborations with a wide range of organisations offering services. As different services may be provided by different organisations, BASE/X also emphasizes the network of organisations which need to collaborate in order to provide the final business offering and allows the identification of the value and the benefits/costs of each organisation which participates. As such, the BASE/X methodology is considered highly appropriate for the FORTESIE business models design (both for the pilot phase and also for the exploitation of FORTESIE per partner after the end of the project), for two main reasons (amongst others):

1. At consortium level, it allows the design of different business offerings, and therefore exploitation opportunities, based on different combinations of the same core services.
2. At individual partner level, it emphasizes the value, costs and benefits for each organisation, allowing the further exploitation and identification of new opportunities that may be possible with different collaborations.

Table 4: Main differences between asset and service-oriented business approaches

	Asset-oriented approach	Service-oriented approach
Orientation	Business value comes from owning assets	Business value comes from the services offered by the assets
Agility	Business models are “constrained” by asset ownership of physical assets, which are not always so easy to acquire and relocate	It’s the use of an asset that is traded, allowing dynamic business models
Reaction to market developments	Providers may take years even to react	Reaction is reduced to months, weeks or even days
Complete integrated solutions to (evolving) complex problems	The problems become more and more complex and solutions cannot be provided by one provider only	Solutions are provided in an integrated way by multiple providers creating dynamic service networks

According to Table 4 above, that depicts the difference between an Asset and a Service oriented approach, the service-oriented approach as proposed by BASE/X methodology was decided to be adopted for the FORTESIE project, as it encompasses a wide range of different services and provides many opportunities for business exploitation:

- The FORTESIE complete system, which is comprised of different services, facilitated by software and hardware elements,
- The FORTESIE Modular platform that dynamically uses several different sensors’ types to collect and store energy related data,
- The Data Analytics, Green Energy scheduling, Recommendation Engine and Behavioural Model services
- The FORTESIE Mobile Application (combined with the green-euro credit management system), which also includes a number of different services
- Further potential services, such as consultancy, training, feasibility studies, adaptations of existing solutions over this new framework, etc.

BASE/X has two core principles¹⁴¹:

- Business services and their value-in-use are the primary building blocks of business design and execution,
- The final integrated business offering delivered to customer requires the orchestration of various basic services provided by a dynamic network of organisations.

BASE/X structures the business design in a conceptual pyramid consisting of business strategy, business models, and their operationalization in service compositions, and business services, all conceptually organized in a pyramid as seen in the Figure below.

¹⁴¹ GET Service project, “D8.3.1 - Exploitation model,” 7th Framework Programme (FP7), 2016

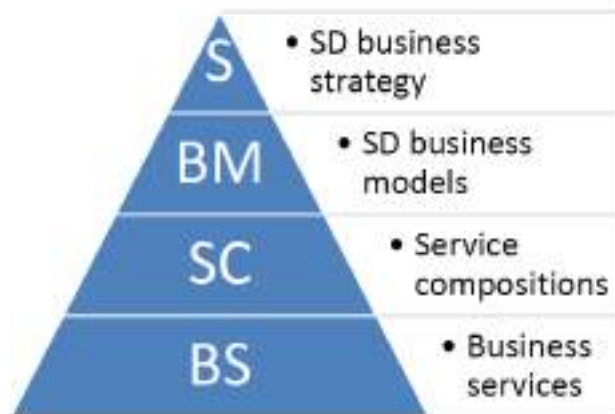


Figure 9 The conceptual BASE/X pyramid

The four layers of the pyramid represent different levels of business decision making:

- The service-dominant business strategy layer contains decision making with respect to the long-term business strategy.
- The service-dominant business models layer contains decision making with respect to medium-term business course.
- The service compositions layer contains the high-level services offered. A service composition is composed by a number of business services, while it represents the decision-making with respect to the implementation of the business models.
- The business services layer contains the elementary services that can be performed by the organization.

The building blocks used for FORTESIE are:

- Business strategy
- Business services
- Business model

The **business strategy canvas**, as presented in Figure 10 below, is designed in 3 steps:

1. Design the abstract value-in-use in terms of the generalized customer and high end interactions,
2. Determine the core and enriching services and partners required to co-create the abstract value-in-use, and
3. Determine the collaboration management in terms of high-level relationships with partners.

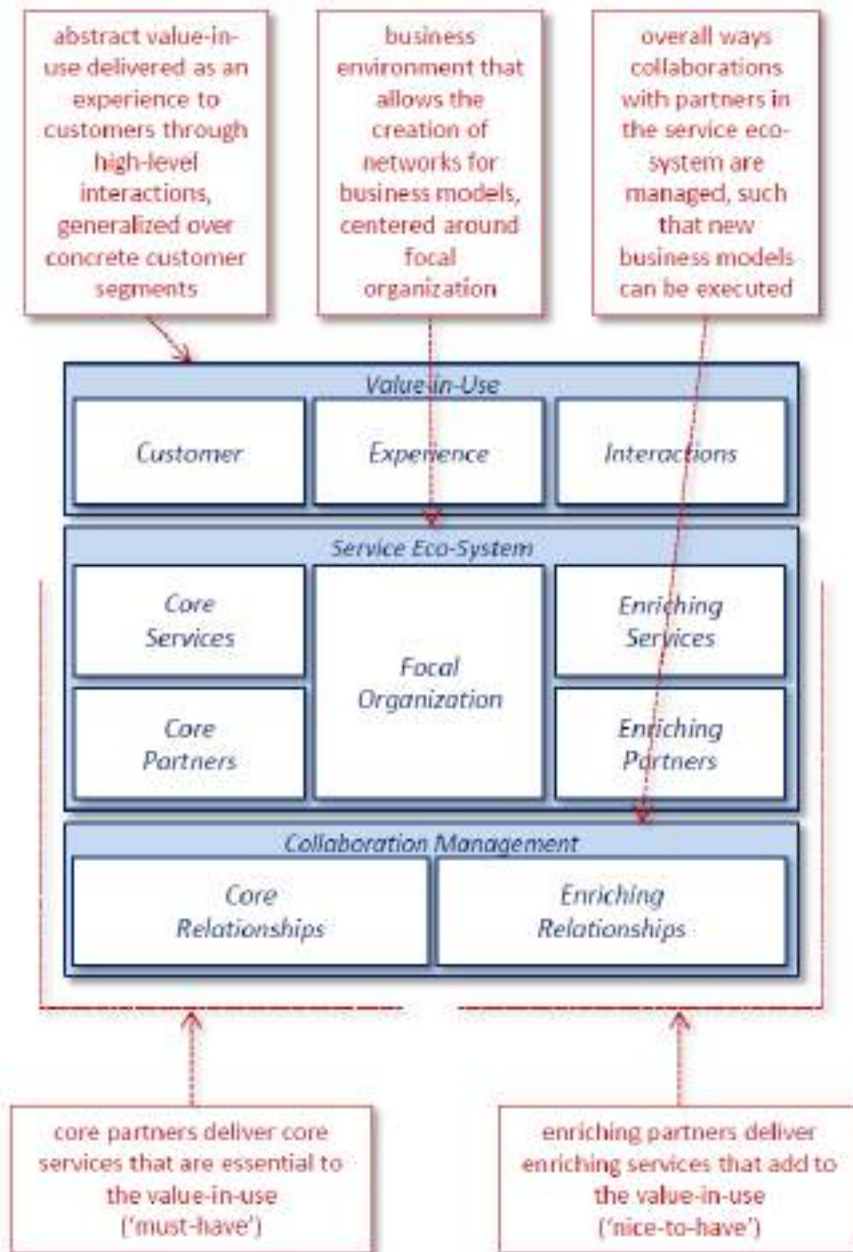


Figure 10 The BASE/X Business Strategy canvas

The service-dominant business model radar is the central tool in the **business model** design step. The service-dominant business radar contains 3 concentric circles that correspond to the service-based value proposition, the coproduction activity, and the costs or benefits for each actor. A business model can be related to the business model of another organization, creating a network.

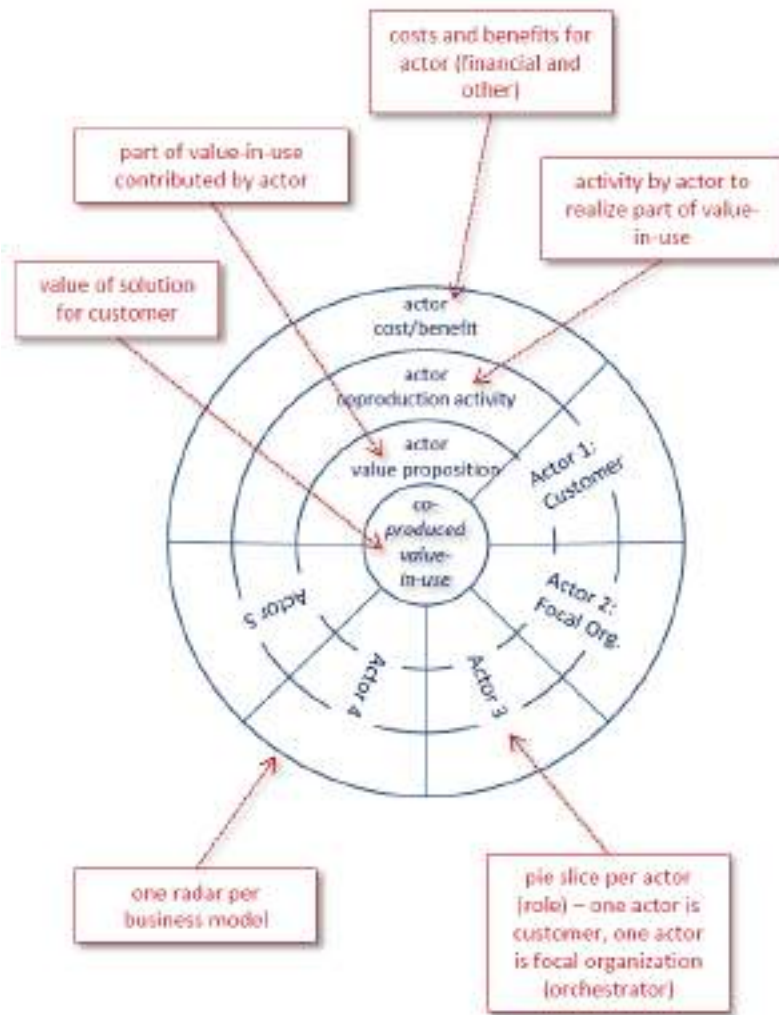


Figure 11 The BASE/X Business Model radar

The BASE/X model was used to develop early future business strategies of providers of the value chain, covering the entire range of networks, and business roles. The business strategy canvases per commercial partner are presented in Section 7.

The BASE/X framework was also used for the design of the business models for the pilots as described in Section 8.

7 Presentation of partners business strategies based on the BASE/X approach

7.1 ED's Business Strategy Canvas

This business strategy canvas highlights the view of FORTESIE product as seen from the viewpoint of partner ED as a Software provider (FORTESIE data sovereignty module, mobile application) and a Software/Hardware digital solution supplier for capturing and providing the measured data.

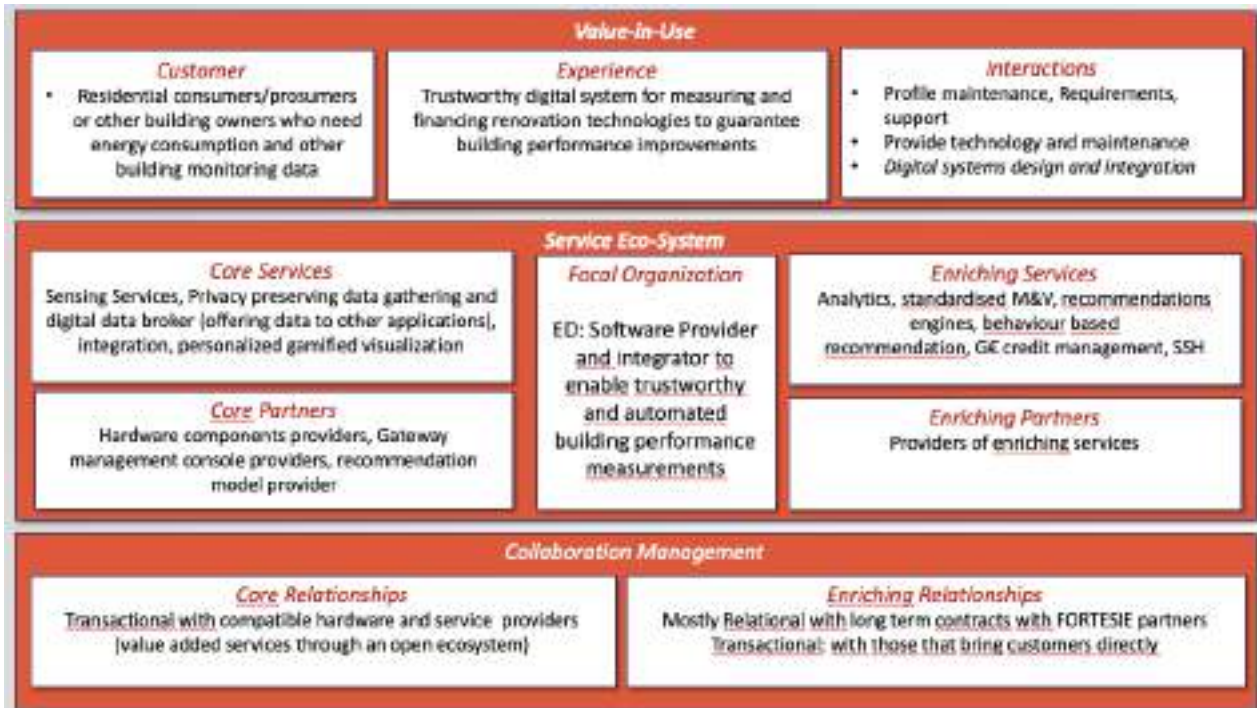


Figure 12 ED's business strategy canvas

ED's business strategy is summarised in the tables below:

Table 5 ED's value-in-use

Customer	Potential customers are residential consumers or prosumers or other building owners who wish to monitor their overall building performance and potentially invest in Green renovation technologies, and therefore save Euro on their energy bill by adopting a more energy efficient behaviour.
Experience	The experience offered is a trustworthy measurement and financing of renovation technologies to guarantee building performance improvements.
Interactions	Regarding the high-level interaction with the consumers, ED can offer technical support, consumer profile maintenance and requirements coverage.

Table 6 ED's eco-system

Core services	Sensing Services (data acquisition from installed sensors and meters), Cloud-based data broker service receives the data through the gateway device or other ways to be defined (stores/ provides access to data, manages/configures the gateways, stores user's input, displays outcomes to mobile application), and ensures the FAIR principles. Mobile application to interact with customer, software/hardware integration.
Core partners	Hardware components providers, Gateway management console providers are core partners needed for the integrated platform.
Enriching services	Analytics, standardised M&V, Recommendations Engine and behaviour based recommendations, G€ Credit Management System, SSH
Enriching partners	Enriching partners provide enriching services.

Table 7 ED's collaboration management

Core relationships	Transactional with compatible hardware and service providers. In this way, new added value services can be constantly added through an open ecosystem.
Enriching relationships	Mostly Relational based on long term contracts with FORTESIE partners. Transactional: with those who bring customers and want to adopt our solution for integrating it to their own offering.

7.2 TGT/ JUST/OKT’s Business Strategy Canvas

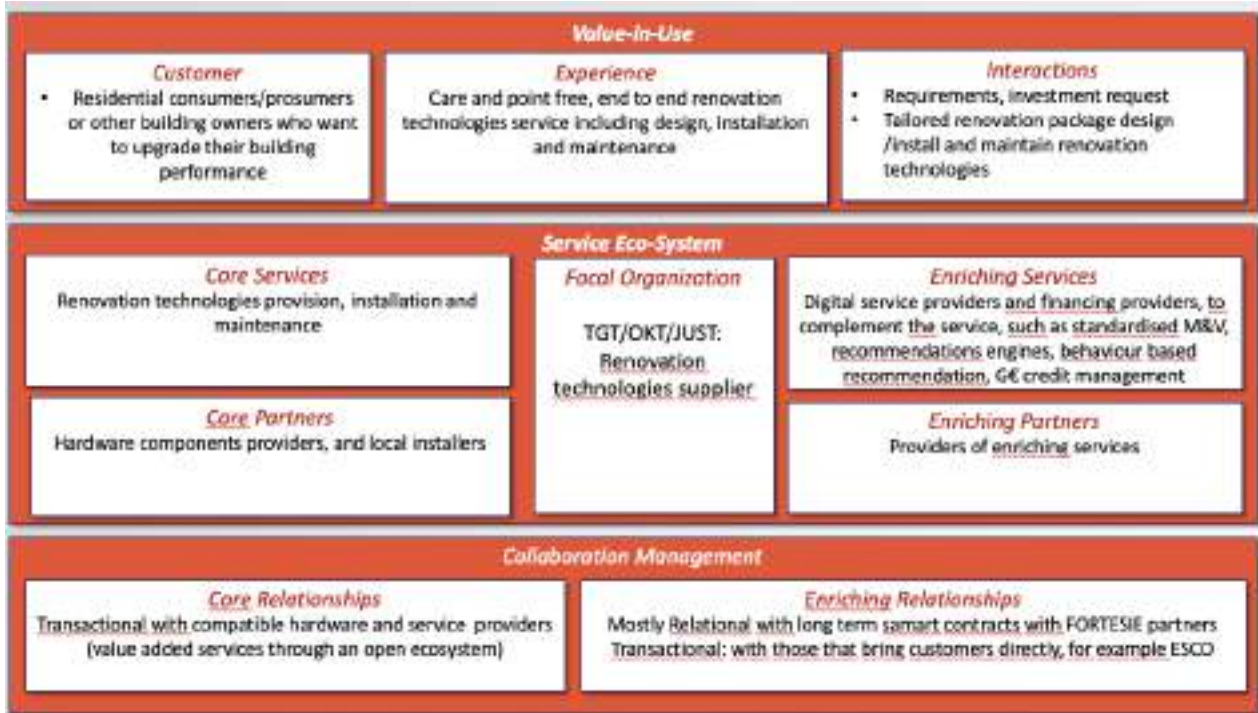


Figure 13 TGT/OKT/JUST's business strategy canvas

TGT/OKT/JUST’s business strategy is summarised in the tables below:

Table 8 TGT/OKT/JUST’s value-in-use

Customer	Potential customers are residential consumers or other building owners who wish to invest in renovating their home and enjoy care and pain free end to end renovation service with performance guarantees.
Experience	The experience they are offered is to enjoy care and pain free end to end renovation service with performance guarantees for the before-during and after processes of renovation.
Interactions	Regarding the high-level interaction with the consumers, TGT receives the requirements and investment request, and offers the complete tailored package offering technical support, consumer profile maintenance and requirements coverage.

Table 9 TGT/OKT/JUST's eco-system

Core services	End to end renovation starting from the analysis, tailored renovation package offered and installed and maintenance.
Core partners	Renovation components suppliers in case of third-party sourcing and installation/maintenance engineers.
Enriching services	Digitisation for M&V calculation and analytics and smart contracts execution, behavioural model, financing services and also ESCO to provide the smart contracts
Enriching partners	Enriching partners provide enriching services, such as software suppliers, financing suppliers, SSH, etc.

Table 10 TGT/OKT/JUST's collaboration management

Core relationships	Transactional with compatible suppliers, and digitization or financing partners, service providers.
Enriching relationships	Mostly Relational based on long term contracts with FORTESIE partners. Transactional: with those who bring customers and want to adopt our solution for integrating it to their own offering.

7.3 CC02 Business Strategy Canvas

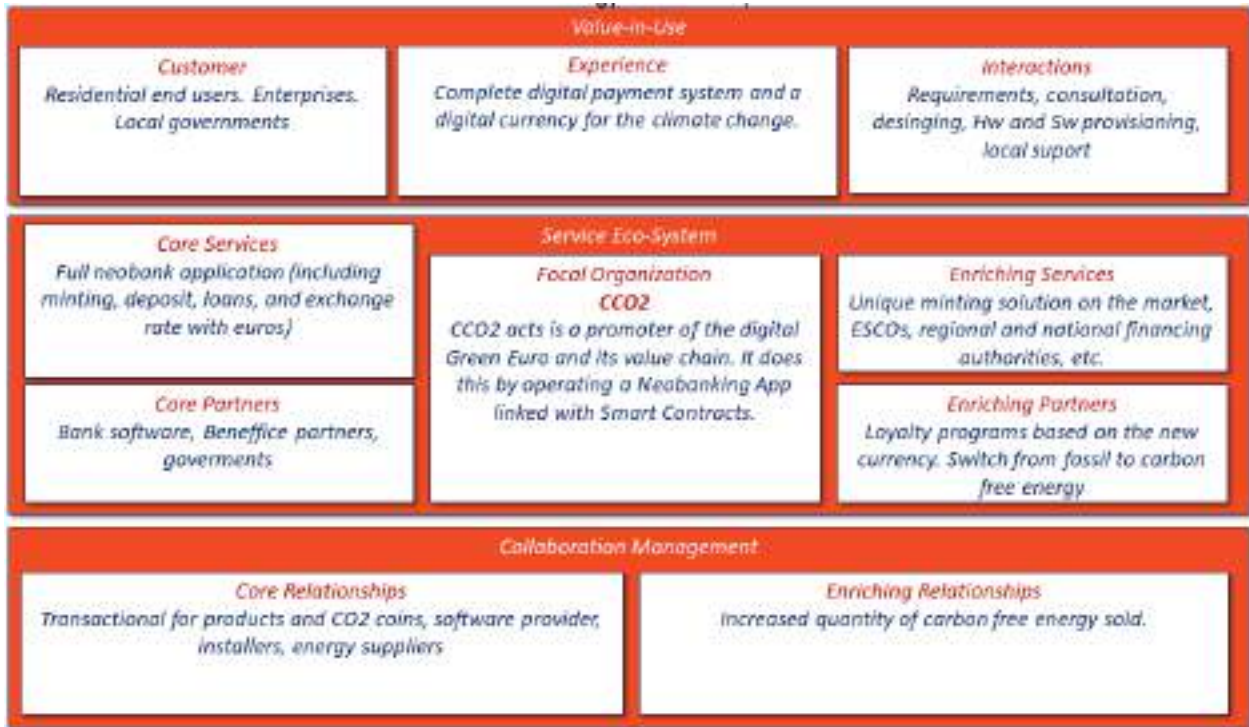


Figure 14 CC02 business strategy canvas

CC02 's business strategy is summarised in the tables below:

Table 11 CC02's value-in-use

Customer	Potential customers are residential consumers, other building owners (enterprises) who wish to invest in renovating their home and enjoy care and pain free end to end renovation service with performance guarantees. Enterprises seeking to enroll employees with attractive ESG policies?
Experience	The experience of a complete digital payment system and a digital currency for the climate change. New funding opportunities are also offered.
Interactions	Regarding the high-level interaction with the consumers, CC02 works with partners to recruit new users, and recruit on line using web marketing tools.

Table 12 CC02's eco-system

Core services	Rewarding neobank app promoting a new collective narrative on climate with €Gs, fully integrated in the renovation value chain, in terms of business offering and digital flow of smart contracts.
Core partners	ESCOs, Renovation/installers/equipment suppliers and digital service providers.
Enriching services	Smart contracts execution including payments, behavioural model, financing services and also ESCO to provide the smart contracts but also new customers.

Enriching partners	Enriching partners bring new customers and create traction for the new currency, such as ESCOs, cooperatives, regional and national financing authorities, etc.
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Table 13 CCO2's collaboration management

Core relationships	Transactional with compatible suppliers, and digitization or financing partners, service providers.
Enriching relationships	Mostly Relational based on long term contracts with FORTESIE partners. Transactional: with those who bring customers and want to offer a CCO2 account to their customers/employees have a dedicated financial agreement.

7.4 LEIF Business Strategy Canvas

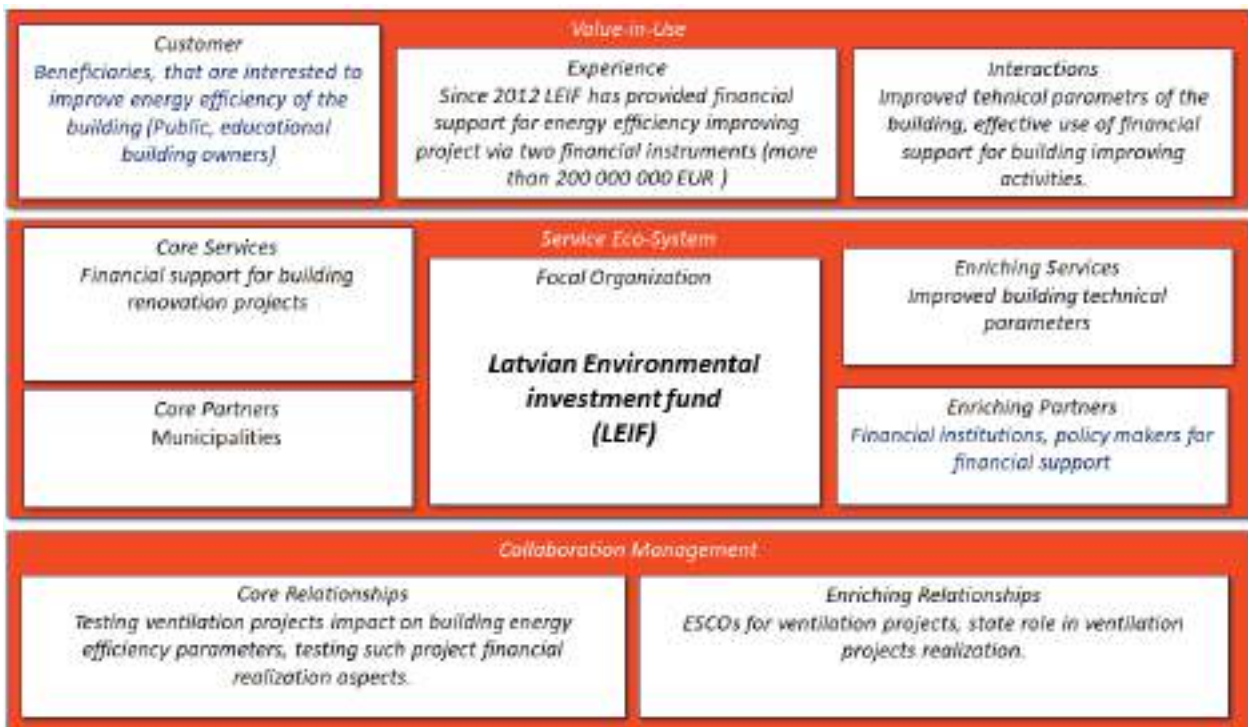


Figure 15 LEIF Business Strategy Canvas

Table 14 LEIF's value-in-use

Customer	Beneficiaries, that are interested to improve energy efficiency of the building (Public, educational building owners) and that are applying for financial support to realize the renovation projects.
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Experience	Since 2012 LEIF has provided financial support for energy efficiency improving project via two financial instrument: Climate change financial support and emission quota action instrument (more than 200 000 000 EUR).
Interactions	Via renovation project realization there will be done two main things: created ventilation system for the building and improved energy efficiency indicators of the building. Additionally effective use of financial support for future buildings renovation project will be set.

Table 15 LEIF's eco-system

Core services	Financial support for building renovation projects that has a need to improve energy efficiency and create ventilation system.
Core partners	Municipalities that are the owners of the public buildings and ensure the building maintenance service.
Enriching services	Via renovation project realization the building technical parameters will be improved. Building value will raise and maintenance costs will decrease.
Enriching partners	Financial institutions that provide financial support for renovation projects for the public buildings. Policy makers, who are creating the policy for financial support to reduce CO2 emissions.

Table 16 LEIF's collaboration management

Core relationships	Cooperation with technical partners, who are realizing the project, to learn the best ways of ventilation and energy efficiency improving projects realization, including both technical realization and financial terms.
Enriching relationships	Establishment of the dialogue between stakeholders in the public sector, to understand, how such projects can be realized in the future.

8 Early Business models for pilots based on BASE/X approach

In this section, an example on how the business models for the pilots can be evolved towards the exploitation of the FORTESIE solution by each partner is going to be presented. As already mentioned above, the business models for the pilots, that include the funding from the European Commission, will be adapted to fit the business strategy of each commercial partner and describe how the FORTESIE platform (or parts of the FORTESIE platform) can be exploited after the end of the project. Of course, this process is still ongoing as the early version of the integrated prototype is still under development. In addition further exploitation opportunities and the possible involvement of other stakeholders (industry, policy makers and market catalysts in general) are being currently explored.

8.1 OKT (Demo 2)

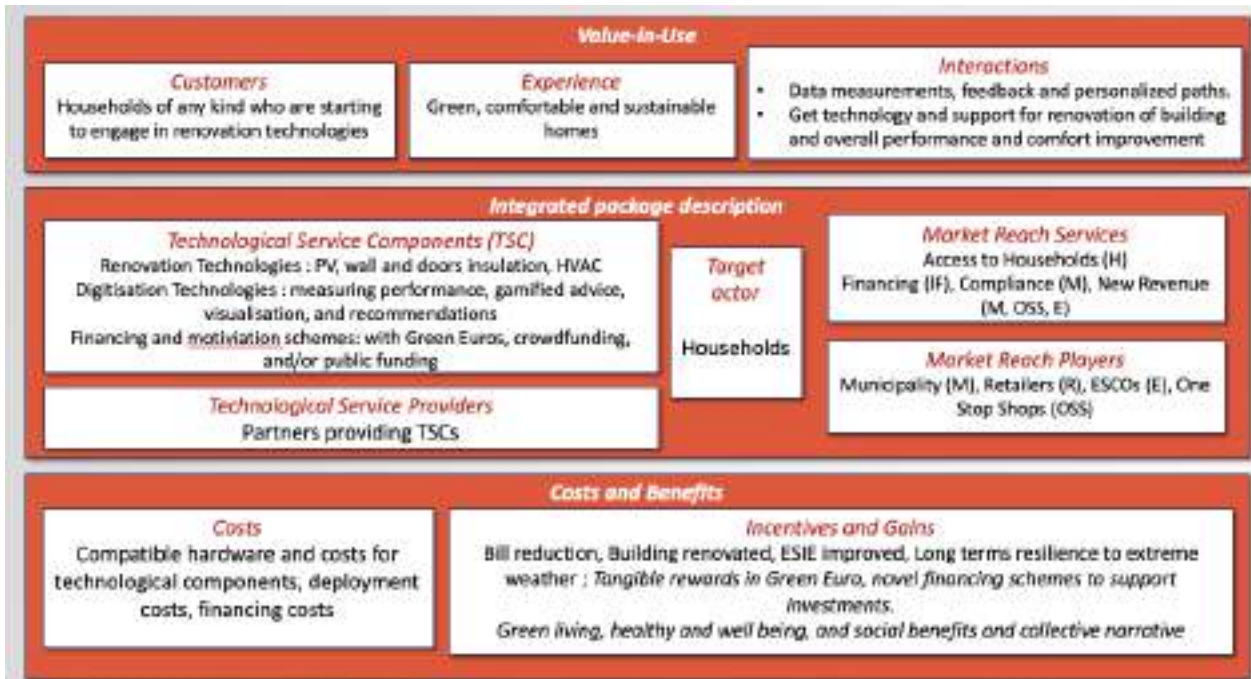


Figure 16 OKT's business strategy update for residential customers

The first approach of OKT's business model radar was created in a co-creation workshop that took place in Strasbourg in May 2022 with the cooperation of some key partners including TGT to function as an example for the other partners to develop their own offering:

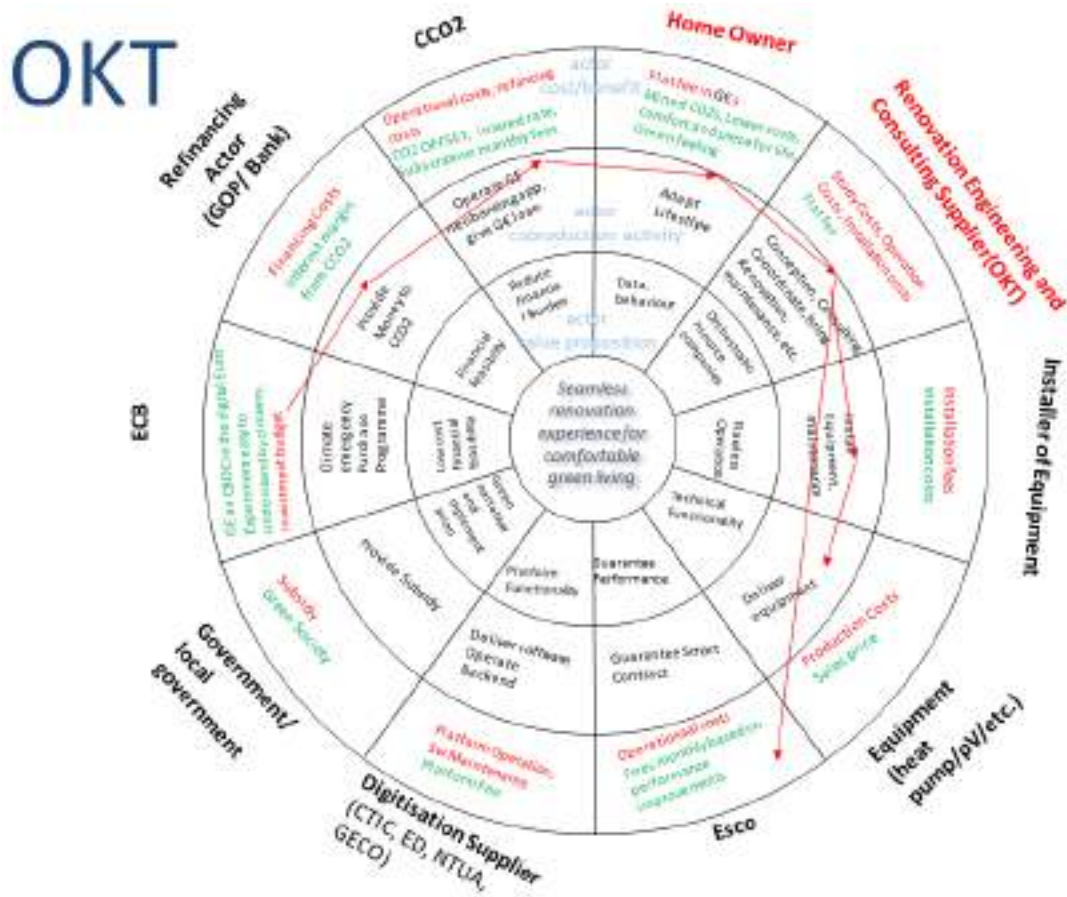


Figure 17 OKT's business model radar for exploitation (early version)

Table 17 Offered experience

Focal organisation	OKT has the link to the customer, will stay the contact point with the customer and offer the entire renovation and financing service.
Experience offered	Seamless renovation experience for comfortable green living: Renovation as-a-service, this means that when a customer goes to OKT they will get a complete end-to-end service, including, all the digital and renovation components, with guarantees, documented in smart contracts and financing.

Table 18 Customer: Home Owner

Value Proposition	Residential energy consumers offer their energy usage pattern and energy consumption measurements for further analysis. They are the target group where the service is offered.
Co-production activity	Residential energy consumers can adapt their lifestyle to achieve green efficiency, adopt a more energy efficient behaviour, save energy and money and earn CO2 coins and enjoy

	an increased level of comfort at their home. At the same time they enjoy care and pain free renovation services.
Cost / benefit	- Service fee, includes energy costs and FORTESIE service, paid in Green Euro + Continuous Minting of Green Euro and generated out of their investment for renovation and by adhering to proposed recommendations and/or challenges. + Save energy and money (reduced energy bills) and enjoy upgraded comfort (less humidity, tailored to their preferences heating (without wastages). + Adopt a more energy efficient behaviour and contribute to a green social community.

Table 19 Renovation Engineering and Consulting Supplier (OKT)

Value Proposition	The Renovation Engineer and Consulting Supplier orchestrates the entire renovation on behalf of the homeowner. They are the contact point for the customer and all the providers.
Co-production activity	The Renovation Engineer and Consulting Supplier will bring the renovation to the home owner as well as design the concept and renovation approach. They are in charge of consulting the homeowner on what is required, coordinating the entire renovation process, and overseeing maintenance. During the renovation, they also source companies.
Cost / benefit	-Study Costs -Operation Costs - Installation costs + Flat fee

Table 20 Installer of Equipment

Value Proposition	The installer of Equipment supplies and installs the equipment and ensures flawless operation throughout the renovation process and during maintenance.
Co-production activity	The Equipment Installer is responsible for installing all renovation equipment per the requests of the Renovation Engineering and Consulting Supplier, but he is also in charge of maintaining the equipment after the renovation process is completed.
Cost / benefit	-Installation fees +Installation costs

Table 21 Equipment (heat pump/pV/etc)

Value Proposition	The equipment suppliers provide the renovation's technical functionality.
Co-production activity	The equipment suppliers are responsible for delivering the equipment required for house renovations following the requests of the Renovation Engineering and Consulting Supplier. The equipment suppliers deliver the equipment to the equipment installer, allowing the renovation to begin.

Cost / benefit	-Production Costs + Sales price
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Table 22 ESCO

Value Proposition	The ESCO provides a performance guarantee contract for certain savings on the homeowner's energy bill and for the house energy efficiency.
Co-production activity	The ESCO is responsible for ensuring that by implementing FORTESIE's Smart Contract, the Homeowner will benefit from a standard amount of energy efficiency, which will result in a predetermined percentage of decreased energy usage and, as a result, a reduced energy bill.
Cost / benefit	-Operational costs +Fees monthly based on performance improvements

Table 23 Digitisation Supplier

Value Proposition	The digitisation supplier is responsible to provide the FORTESIE platform and mobile application functionality.
Co-production activity	The digitisation supplier will be responsible to deliver the software: FORTESIE platform (front end and backend) and the mobile application and also operate the platform (handling of data and communication with the data consuming applications).
Cost / benefit	- FORTESIE platform operation and maintenance - FORTESIE mobile application operation and maintenance + Platform fee + Mobile application fee

Table 24 Government/ local government

Value Proposition	The government is committed (for example through the Paris agreement) to achieve some goals related to the CO ₂ emission reduction and energy savings and also comply with national and EC regulations. Hence, the government provides certifications related to Energy Efficient Behaviour or funding for the adoption of initiatives such as FORTESIE.
Co-production activity	The government sets targets based on national and EC regulations in order to foster Energy Efficient behaviour and achieve CO ₂ emissions reduction.
Cost / benefit	- Funding in Euro + Foster Green Society + Achieve social goals and policy targets

Table 25 ECB

Value Proposition	The ECB offer low cost financial feasibility to the CCO2.
Co-production activity	The ECB is in charge of the Climate Emergency Purchase Program, which will help CCO2 maintain a profitable green euro rate and convert their green euro to a digital euro.
Cost / benefit	+ GE as CBDC in the digital Euro + Experiment easy to understand by citizens - investment budget

Table 26 Refinancing Actor

Value Proposition	The Refinancing Actor will enable the financial feasibility of CCO2
Co-production activity	The Refinancing Actor is responsible for providing funds to the CCO2 in order for them to establish their green euro loan.
Cost / benefit	- Financing costs (they pay interest to their investors) + Interest margin from CCO2

Table 27 CCO2

Value Proposition	CCO2, as the operator of the CO2 credit management system, will facilitate CO2 transactions by allowing CO2s to be exchanged for Euros, thereby reducing the financial burden.
Co-production activity	Development and Operation of the CO2 credit management system (neobanking application), CO2s balance maintenance, monetarize the CO2 emission reduction, and provision of G€ loans
Cost / benefit	- Operational costs - Exchange from CO2 to Euro costs + Interest rate + Subscription monthly fees + CCO2 offset

8.2 TGT (Demo 1)

TGT Business Model Canvas

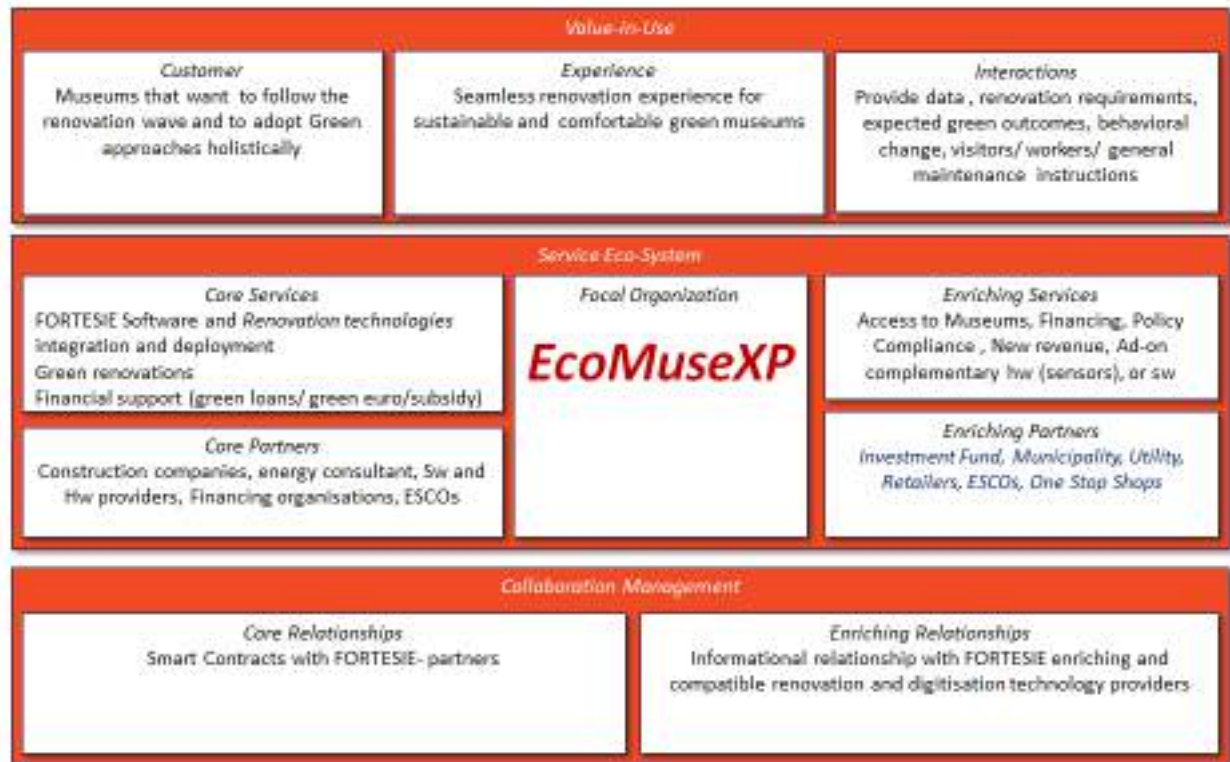


Figure 18 TGT's business strategy update for Museum

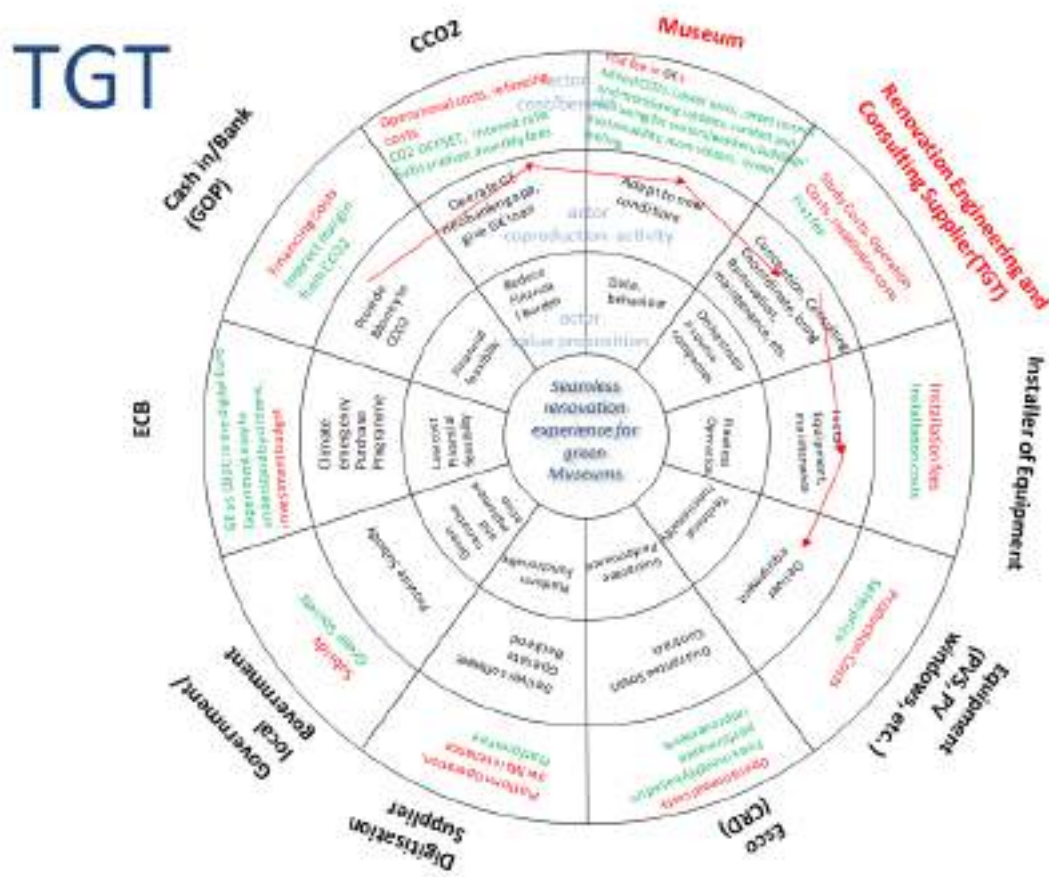


Figure 19 TGT’s business model radar for exploitation (early version)

Table 28 Offered experience

Focal organisation	TGT has the link to the customer, will stay the contact point with the customer and offer the entire renovation and financing service.
Experience offered	Seamless renovation experience for green museums: Renovation as-a-service, this means that when a museum goes to TGT they will get a complete end-to-end service, including, all the digital and renovation components, with guarantees, documented in smart contracts and financing.

Table 29 Customer: Museum

Value Proposition	Museum offer their data, energy usage pattern and energy consumption measurements for further analysis. They are the target group where the service is offered.
Co-production activity	Museum (workers/ visitors/ owner) can adapt their lifestyle to achieve green efficiency, adopt a more energy efficient behaviour, save energy and money and earn CO2 coins and enjoy an increased level of comfort at the museum. At the same time they enjoy care and pain free renovation services.

Cost / benefit	<ul style="list-style-type: none"> - Flat fee, includes energy costs and FORTESIE service, paid in Green Euro + Mined CO2s, + Lower costs + Smart control and monitoring systems + Comfort and wellbeing for visitors/workers + Buildings' sustainability + More visitors + Green feeling
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Table 30 Renovation Engineering and Consulting Supplier (TGT)

Value Proposition	The Renovation Engineer and Consulting Supplier orchestrates the entire renovation on behalf of the museum. They are the contact point for the customer and all the providers.
Co-production activity	The Renovation Engineer and Consulting Supplier will bring the renovation to the museum as well as design the concept and renovation approach. They are in charge of consulting the museum on what is required, coordinating the entire renovation process, and overseeing maintenance.
Cost / benefit	<ul style="list-style-type: none"> -Study Costs -Operation Costs - Installation costs + Flat fee

Table 31 Installer of Equipment

Value Proposition	The installer of Equipment supplies and installs the equipment and ensures flawless operation throughout the renovation process and during maintenance.
Co-production activity	The Equipment Installer is responsible for installing all renovation equipment per the requests of the Renovation Engineering and Consulting Supplier, but he is also in charge of maintaining the equipment after the renovation process is completed.
Cost / benefit	<ul style="list-style-type: none"> -Installation fees +Installation costs

Table 32 Equipment (PVs/PV windows/etc)

Value Proposition	The equipment suppliers provide the renovation's technical functionality.
Co-production activity	The equipment suppliers are responsible for delivering the equipment required for house renovations following the requests of the Renovation Engineering and Consulting Supplier. The equipment suppliers deliver the equipment to the equipment installer, allowing the renovation to begin.

Cost / benefit	-Production Costs + Sales price
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Table 33 ESCO

Value Proposition	The ESCO provides a performance guarantee contract for certain savings on the museum's energy bill and for the house energy efficiency.
Co-production activity	The ESCO is responsible for ensuring that by implementing FORTESIE's Smart Contract, the museum will benefit from a standard amount of energy efficiency, which will result in a predetermined percentage of decreased energy usage and, as a result, a reduced energy bill.
Cost / benefit	-Operational costs +Fees monthly based on performance improvements

Table 34 Digitisation Supplier

Value Proposition	The digitisation supplier is responsible to provide the FORTESIE platform and mobile application functionality.
Co-production activity	The digitisation supplier will be responsible to deliver the software: FORTESIE platform (front end and backend) and the mobile application and also operate the platform (handling of data and communication with the data consuming applications).
Cost / benefit	- FORTESIE platform operation and maintenance - FORTESIE mobile application operation and maintenance + Platform fee + Mobile application fee

Table 35 Government/ local government

Value Proposition	The government is committed (for example through the Paris agreement) to achieve some goals related to the CO ₂ emission reduction and energy savings and also comply with national and EC regulations. Hence, the government provides certifications related to Energy Efficient Behaviour or funding for the adoption of initiatives such as FORTESIE.
Co-production activity	The government provide subsidies and sets targets based on national and EC regulations in order to foster Energy Efficient behaviour and achieve CO ₂ emissions reduction.
Cost / benefit	- Funding in Euro + Foster Green Society (achieve social goals and policy targets)

Table 36 ECB

Value Proposition	The ECB offer low cost financial feasibility to the CCO2.
Co-production activity	The ECB is in charge of the Climate Emergency Purchase Program, which will help CCO2 maintain a profitable green euro rate and convert their green euro to a digital euro.
Cost / benefit	+ GE as CBDC in the digital Euro + Experiment easy to understand by citizens - investment budget

Table 37 Refinancing Actor (Cash in/ Bank) (GOP)

Value Proposition	The Refinancing Actor will enable the financial feasibility of CCO2
Co-production activity	The Refinancing Actor is responsible for providing funds to the CCO2 in order for them to establish their green euro loan.
Cost / benefit	- Financing costs (they pay interest to their investors) + Interest margin from CCO2

Table 38 CCO2

Value Proposition	CCO2, as the operator of the CO2 credit management system, will facilitate CO2 transactions by allowing CO2s to be exchanged for Euros, thereby reducing the financial burden.
Co-production activity	Development and Operation of the CO2 credit management system (neobanking application), CO2s balance maintenance, monetarize the CO2 emission reduction, and provision of G€ loans
Cost / benefit	- Operational costs - Exchange from CO2 to Euro costs + Interest rate + Subscription monthly fees + CCO2 offset

8.3 VEO (Demo 2)

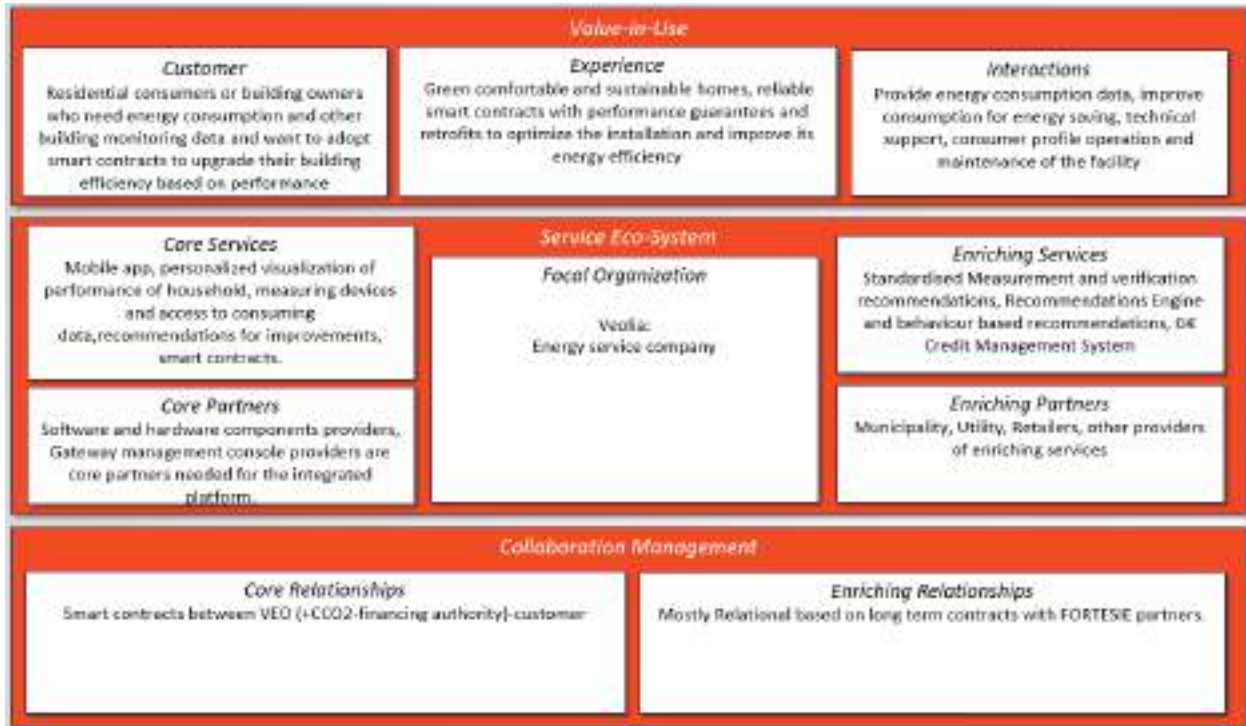


Figure 20 VEO business strategy for residential customers or building owners

VEO's business strategy is summarised in the tables below:

Table 39 VEO's value-in-use

Customer	Potential customers are homeowners and neighbors looking for savings and maximum comfort by improving the energy efficiency of their facilities.
Experience	The experience the customer is offered is a green comfortable and sustainable home, Veolia tries to reduce their costs by offering reliable smart contracts with performance guarantees, and optimize their installations to improve energy efficiency, user comfort and respect the environment.
Interactions	Regarding the interaction with the consumers, Veolia provides energy consumption data to improve the energy savings an also provides technical and maintenance support for each customer particular profile.

Table 40 VEO's eco-system

Core services	Access to mobile app with visualization of household performance including consumption measures to give energy improvement recommendations based on that information, all reflected in a smart contract provided by Veolia.
Core partners	Essential core partners for the integrated platform include software and hardware component providers, as well as gateway management console providers.
Enriching services	In order to enhance the app services, we rely on core components such as standardized measurement and verification recommendations, a behavior-based recommendations engine, and the G€ Credit Management System.
Enriching partners	Our network of enriching partners includes municipalities, utility companies, retailers, and various other providers of enriching services.

Table 41 VEO's collaboration management

Core relationships	The establishment of smart contracts plays a pivotal role, particularly in the connections between VEO (along with the CCO2 financing authority) and the customer. These smart contracts facilitate transparent and automated interactions to ensure the smooth execution of agreements and transactions.
Enriching relationships	Mostly Relational based on long term contracts with FORTESIE partners.

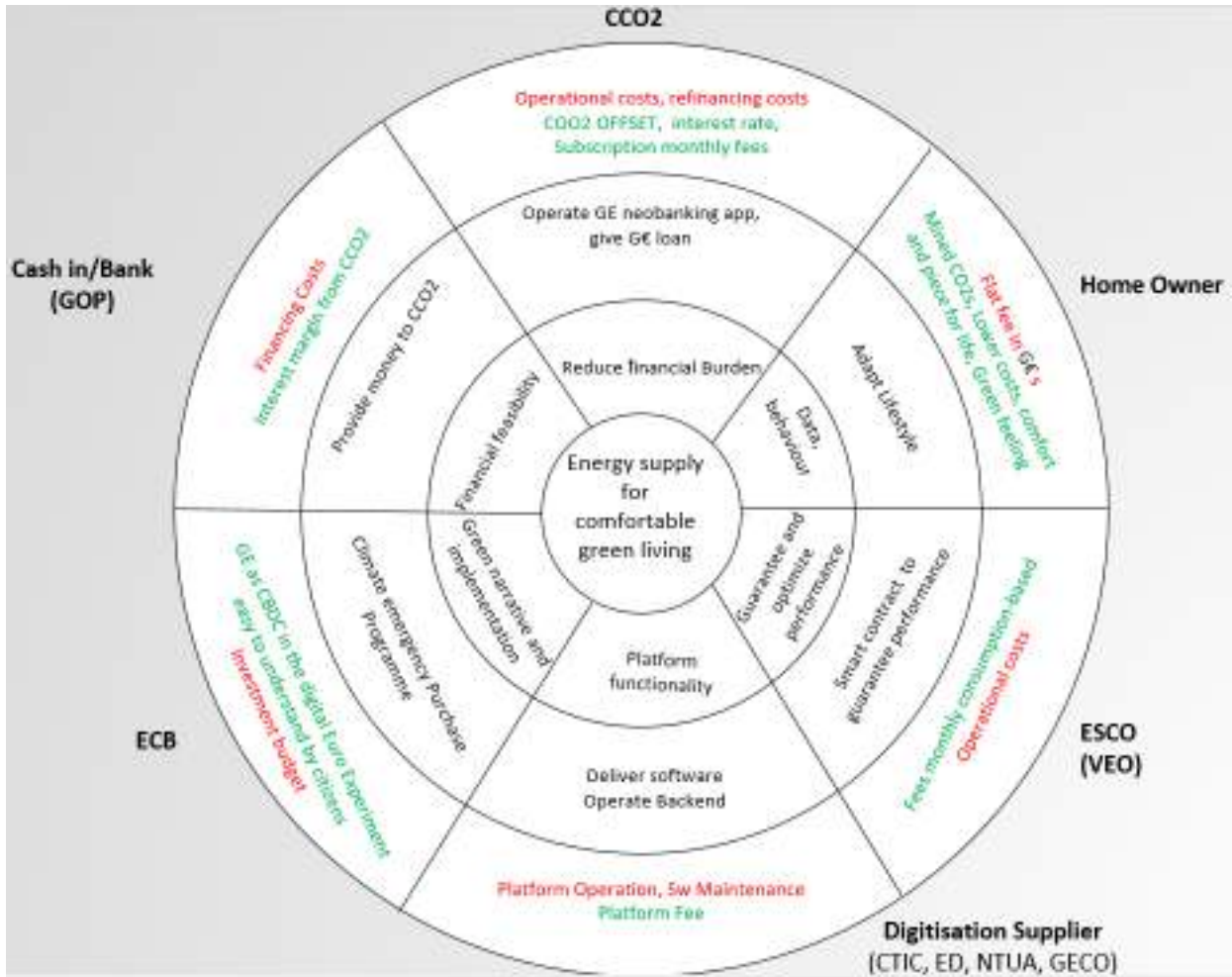


Figure 21 VEO business model radar for exploitation (early version)

Table 42 Offered experience

Focal organisation	Veolia guarantees homeowners and neighbors' savings and maximum comfort by improving the energy efficiency of their facilities.
Experience offered	Veolia puts its extensive experience and in-depth knowledge in the field of renewable energies at the service of homeowner's comfortable living. From photovoltaic systems that harness solar energy, to micro generation, to integrated management of the biomass chain, Veolia tries to reduce costs, extend the life of buildings, improve user comfort and respect the environment.

Table 43 Customer: Home Owner

Value Proposition	Residential energy consumers offer their energy usage pattern and energy consumption measurements for further analysis. They are the target group where the service is offered.
Co-production activity	Residential energy users have the opportunity to modify their daily routines to achieve greater environmental efficiency, adopt more energy-conscious behaviors, save energy

	and money, gain valuable information to optimize their consumption patterns, and improve the comfort of their homes.
Cost / benefit	<ul style="list-style-type: none"> - Service fee, includes energy costs and FORTESIE service. + Green euros outflow generated by compliance with the recommendations and/or challenges proposed. + Save energy and money (reduced energy bills) and enjoy upgraded comfort (less humidity, tailored to their preferences heating (without wastages). + Adopt a more energy efficient behavior and contribute to a green social community.

Table 44 ESCO

Value Proposition	The ESCO offers a performance assurance agreement that ensures energy savings on the homeowner's utility bills and enhances the overall energy efficiency of the house.
Co-production activity	The ESCO's responsibility lies in guaranteeing that through the implementation of FORTESIE's Smart Contract, the Homeowner will experience a consistent level of energy efficiency, leading to a pre-determined reduction in energy consumption and consequently, a lowered energy bill.
Cost / benefit	<ul style="list-style-type: none"> +Fees monthly consumption-based -Operational cost

Table 45 Digitisation Supplier

Value Proposition	The digitisation supplier is responsible to provide the FORTESIE platform and mobile application functionality.
Co-production activity	The digitisation supplier will be responsible to deliver the software: FORTESIE platform (front end and backend) and the mobile application and also operate the platform (handling of data and communication with the data consuming applications).
Cost / benefit	<ul style="list-style-type: none"> +Platform fee - Platform maintenance -Platform operation

Table 46 ECB

Value Proposition	The ECB provides affordable financial support to facilitate the implementation of green initiatives and projects within the CCO2 framework.
Co-production activity	The ECB is in charge of the Climate Emergency Purchase Program, which will help CCO2 maintain a profitable green euro rate and convert their green euro to a digital euro.
Cost / benefit	<ul style="list-style-type: none"> - Financing Costs +Interest margin from CCO2

Table 47 Bank/ Cash in

Value Proposition	The Refinancing Actor will enable the financial feasibility.
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Co-production activity	The Refinancing Actor is responsible for providing funds to the CCO2 in order for them to establish their green euro loan.
Cost / benefit	-Financing Costs +Interest margin from CCO2

Table 48 CCO2

Value Proposition	As the operator of the CO2 credit management system, CCO2 will enable CO2 transactions, allowing the conversion of CO2 credits into Euros, effectively alleviating the financial burden.
Co-production activity	As the operator of the CO2 credit management system, CCO2 will enable CO2 transactions, allowing the conversion of CO2 credits into Euros, effectively alleviating the financial burden.
Cost / benefit	-Operational costs, refinancing costs +COO2 OFFSET, interest rate, +Subscription monthly fees

8.4 GAR (Demo 2)



Figure 22 GAR business strategy for homeowners

GAR's business strategy is summarised in the tables below:

Table 49 GAR's value-in-use

Customer	Potential customers are homeowners of residential buildings seeking a turnkey energy rehabilitation solution for their buildings, aimed at enhancing energy performance. This includes the installation of new façade cladding with performance guarantees.
Experience	The experience they are offered is a seamless renovation package that involves enhancing the building's energy performance through a comprehensive turnkey rehabilitation of the building envelope. This includes the installation of new façade cladding with thermal insulation, and the possibility of further improving performance by replacing windows and installing PV-modules.
Interactions	GAR receives a request to enhance a building's energy performance and comfort. GAR offers a tailored turnkey rehabilitation project of the building, taking into consideration the needs and requests of the residents.

Table 50 GAR's eco-system

Core services	End-to-end renovation, beginning with the initial energy performance evaluation of the building, architectural project design, license application, execution of construction work, project management, and subsidy application.
Core partners	Rehabilitation Agent, as the entity responsible for coordinating the rehabilitation process; the local government, granting subsidies and construction work licenses; construction materials suppliers.
Enriching services	Automated building performance measurement devices, data analytics for insights into energy consumption, tailored recommendations based on behavioural patterns and data analysis, and smart contracts.
Enriching partners	Digital services providers, hardware components providers, OSS, and ESCOs.

Table 51 GAR's collaboration management

Core relationships	Transactional relationships with suppliers, energy performance-based contracts between the company and customers, coordination with local authorities for license applications and subsidies.
Enriching relationships	Relational with long-term contracts with FORTESIE partners. Transactional with OSS that bring in customers and compatible digital technology providers.

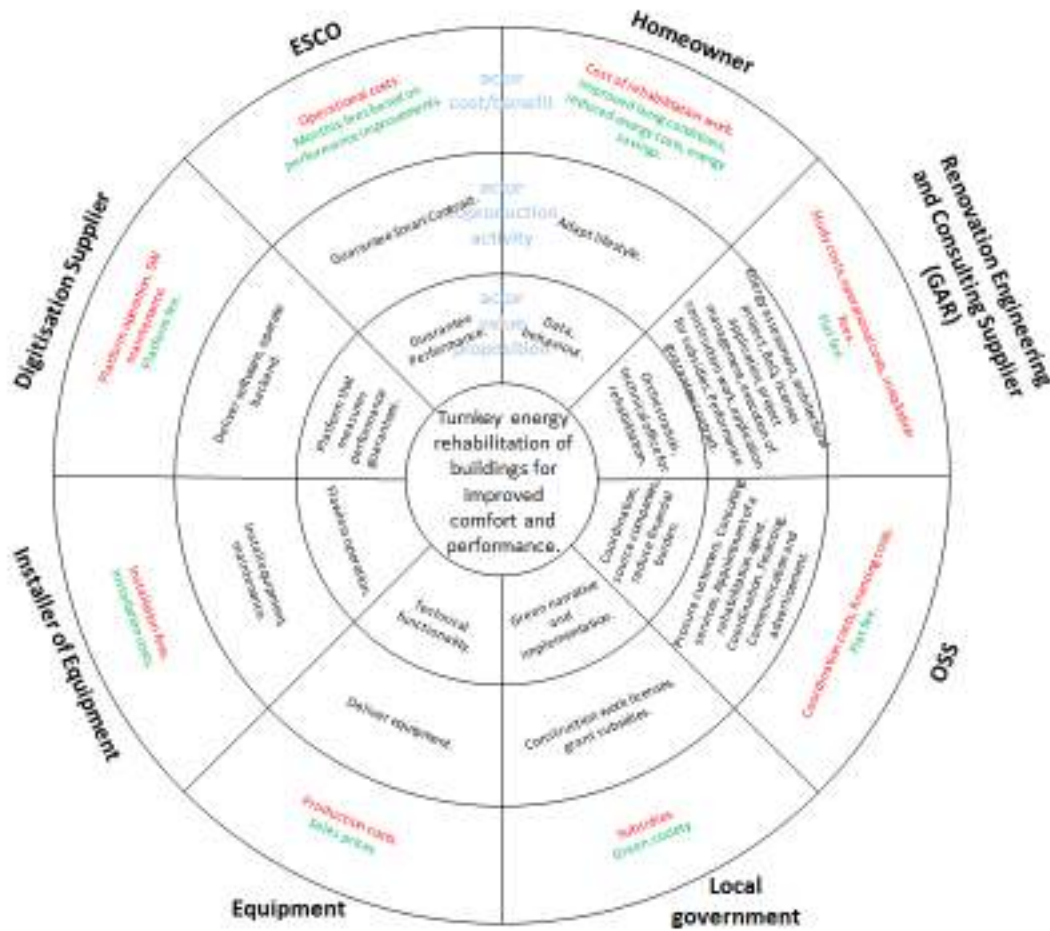


Figure 23 GAR business model radar for exploitation (early version)

Table 52 Offered experience

<p>Focal organisation</p>	<p>GAR serves as the central point of contact for homeowners, from the initial inquiry stage throughout the entire building energy rehabilitation process.</p>
<p>Experience offered</p>	<p>GAR offers a seamless turnkey renovation solution to enhance building comfort and energy performance. GAR provides comprehensive building renovation services, encompassing guidance, energy performance evaluation, license applications, façade installation, etc.</p>

Table 53 Home owner

Value Proposition	Homeowners in residential buildings seeking solutions for issues like detached façade coatings, water leakage, condensation, and dampness that impact building comfort and overall energy performance.
Co-production activity	Homeowners can enhance the comfort of their homes, save energy and money, reduce CO2 emissions, and gain valuable insights for optimising their consumption patterns.
Cost / benefit	<ul style="list-style-type: none"> - Cost of rehabilitation work. + Improved living conditions. + Reduced energy costs. + Energy savings.

Table 54 Renovation Engineering and Consulting Supplier

Value Proposition	The Renovation Engineering and Consulting Supplier oversees the entire renovation process, including the technical aspects of rehabilitation. They act as the central point of contact between the customer, the local government authorities, and suppliers.
Co-production activity	The Renovation Engineer and Consulting Supplier delivers the renovation to homeowners, including design concepts and renovation strategies. Their responsibilities encompass advising homeowners on project requirements, overseeing the complete renovation process (initial building energy performance assessment, architectural design, Bill of Quantities, licenses applications, project management, construction execution, and subsidy applications), as well as sourcing companies for the project.
Cost / benefit	<ul style="list-style-type: none"> - Study costs. - Operational costs. - Installation costs. + Flat fee.

Table 55 OSS

Value Proposition	OSS identifies and collaborates with the Renovation Engineering and Consulting Supplier, streamlining the entire process. They also source companies offering additional services such as financing and digital solutions, reducing homeowners' financial burden.
Co-production activity	OSS procures customers, provides consulting services, appoints a rehabilitation agent, coordinates the project, arranges financing, and manages communication and advertising efforts.
Cost / benefit	<ul style="list-style-type: none"> - Coordination costs. - Financing costs. + Flat fee.

Table 56 Local government

Value Proposition	The local government is committed to achieving goals related to reducing CO ₂ emissions and promoting energy savings. Consequently, the government offers certifications related to Energy Efficient Behaviour and subsidies for renovation projects aimed at enhancing energy efficiency. The local government is also essential for ensuring regulatory compliance, including obtaining construction licenses.
Co-production activity	The local government contributes a portion of the required funding for the interventions and facilitates the issuance of construction work licenses.
Cost / benefit	- Subsidies. + Foster a Green Society.

Table 57 Equipment

Value Proposition	The equipment suppliers offer the necessary equipment, devices, and building materials required for the renovation.
Co-production activity	The equipment suppliers are responsible for delivering the equipment required for the renovation project as per the requests of the Renovation Engineering and Consulting Supplier. They ensure timely delivery of the equipment to commence the construction work.
Cost / benefit	- Production costs. + Sales prices.

Table 58 Installer of Equipment

Value Proposition	The equipment installer provides the necessary devices, supplies, and ensures their seamless installation, guaranteeing optimal performance throughout the renovation process and upon project completion.
Co-production activity	The equipment installer is responsible for the installation of all renovation equipment as per the requests of the Renovation Engineering and Consulting Supplier. Additionally, they are in charge of the maintenance of the equipment even after the renovation process is completed.
Cost / benefit	- Installation fees. +Installation costs.

Table 59 Digitisation Supplier

Value Proposition	The Digitisation Supplier will offer a performance measurement platform that ensures guarantees are met. This platform will deliver insights on measurements both before and after the renovation, as well as the energy performance evolution of the building. This data will validate the renovation's impact.
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Co-production activity	The Digitisation Supplier will be responsible for delivering the FORTESIE platform software, both the front end and back end, along with the mobile application. Additionally, they will operate the platform, managing data and facilitating communication with data-consuming applications.
Cost / benefit	<ul style="list-style-type: none"> - FORTESIE platform operation and maintenance. - FORTESIE mobile application operation and maintenance. + Platform fee. + Mobile application fee.

Table 60 ESCO

Value Proposition	The ESCO offers a performance guarantee contract that ensures specific savings on the homeowner's energy bill and enhances the building's energy performance.
Co-production activity	The ESCO is responsible for ensuring that by implementing FORTESIE's Smart Contract, the homeowner will benefit from a standard amount of energy efficiency, leading to a predetermined percentage decrease in energy usage and, consequently, a reduced energy bill.
Cost / benefit	<ul style="list-style-type: none"> - Operational costs. + Monthly fees based on performance improvements.

8.5 CRD (Demo 5)

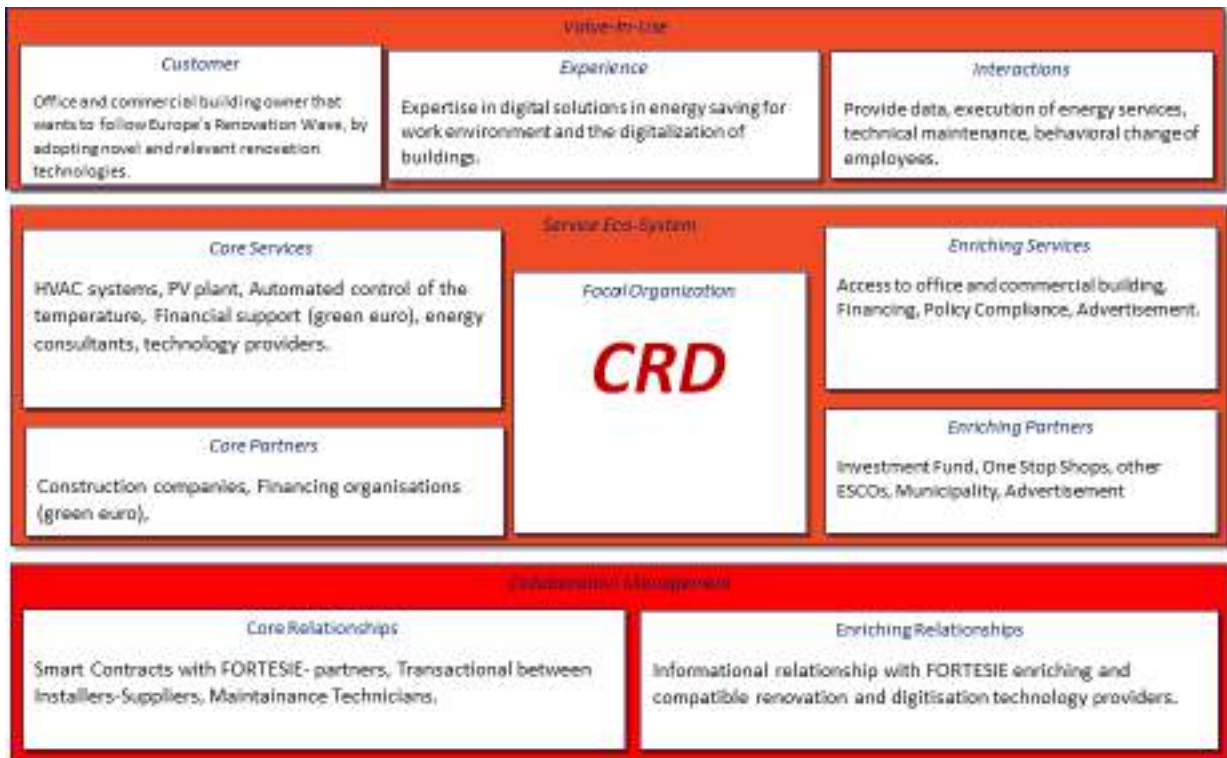


Figure 24 CRD business strategy for customers

CRD's business strategy is summarised in the tables below:

Table 61 CRD's value-in-use

<p>Customer</p>	<p>Building owner is the customer who needs to improve overall building performance by adopting novel and relevant renovation technologies. They are interested in reducing the energy costs of the building and the comfort level of employees.</p>
<p>Experience</p>	<p>The experience offered is a seamless expertise in facility management services, specializing in technical and energy services. Also, CRD provides optimal solutions aiming to improve the quality of life, energy saving and environmental sustainability.</p>
<p>Interactions</p>	<p>Regarding the high level of employee interaction, CRD will receive feedback from employees on their needs and will cover their requirements by offering better indoor conditions by implementing new technologies.</p>

Table 62 CRD's eco-system

Core services	The renovation of technologies aims to achieve energy efficiency, energy cost reduction and comfort level improvement.
Core partners	Renovation core partners are equipment maintenance technicians, banks providing financing and other construction companies.
Enriching services	Digitisation for M&V calculation and analytics, smart contracts execution, financing services, ESCO to provide the smart contracts.
Enriching partners	Technology providers, financial investors, ESCOs companies enrich partners who provide additional services.

Table 63 CRD's collaboration management

Core relationships	Transactional between installers-suppliers, maintenance technicians, digitization and financial partners.
Enriching relationships	Mainly enriching relations with FORTESIE partners.

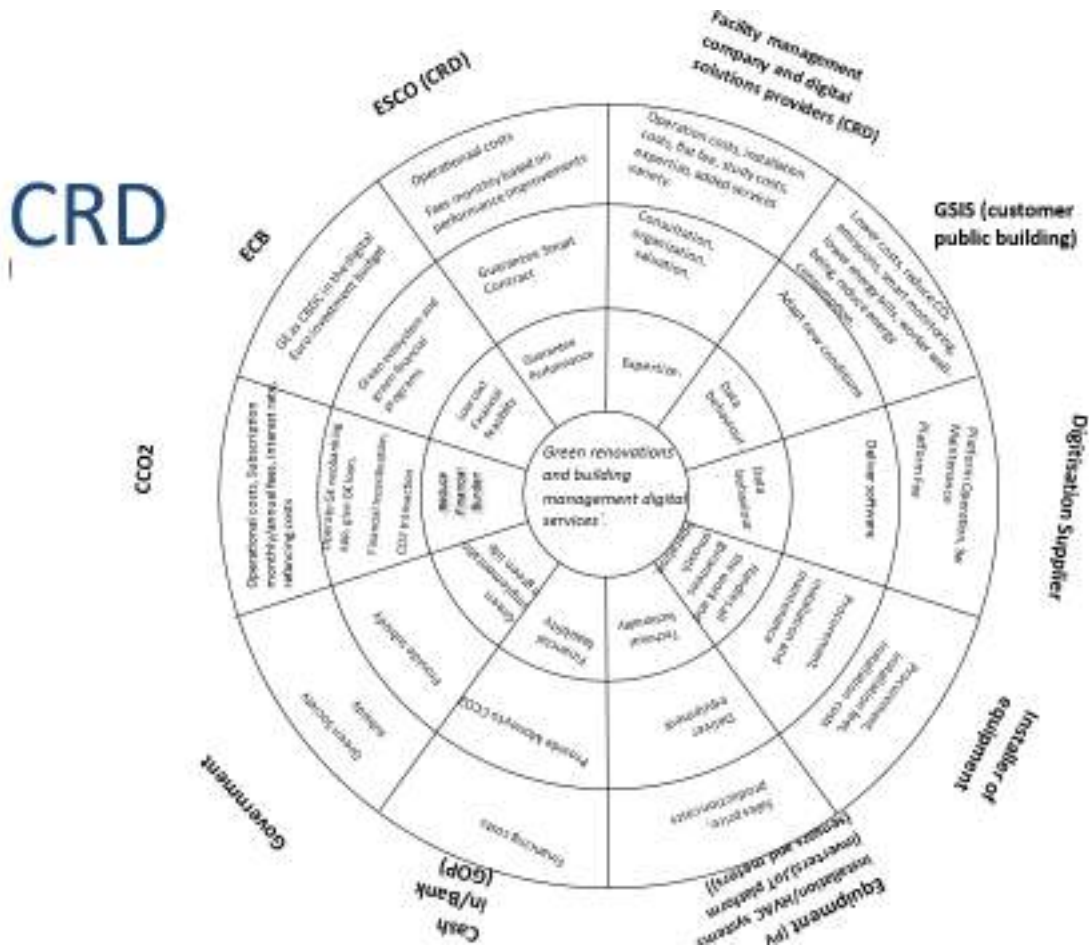


Figure 25 CRD business model radar for exploitation (early version)

Table 64 Offered experience

Focal organisation	CORDIA guarantees energy savings to the building owner, better indoor conditions and comfort level improvement.
Experience offered	The experience offered is a seamless expertise in facility management services, specializing in technical and energy services. Also, CRD provides optimal solutions aiming to improve quality of life, energy saving and environmental sustainability.

Table 65 Customer/ Public Building

Value Proposition	Customer/Public Building is looking for new solutions in order to reduce energy consumption in the building, lower energy bills, reduce CO ₂ emissions and improve employees' well-being.
Co-production activity	Customer/Public Building can adopt new habits and follow different procedures in order to achieve energy efficiency and better comfort level.

Cost / benefit	<ul style="list-style-type: none"> - Cost of rehabilitation work. + Energy and money savings +increase work comfort and satisfaction for employees + reduce the maintenance costs of the facility
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Table 66 Digitisation Supplier

Value Proposition	The digitisation supplier is responsible for providing the FORTESIE platform and mobile application functionality.
Co-production activity	The digitisation supplier is responsible for the delivery of the software (FORTESIE platform and the mobile application). Also, they have to be functional and user-friendly.
Cost / benefit	<ul style="list-style-type: none"> - FORTESIE platform operation and maintenance. - FORTESIE mobile application operation and maintenance. + Platform fee. + Mobile application fee.

Table 67 Installer of equipment

Value Proposition	The installer of equipment installs all necessary equipment. He/she ensures the optimal functioning of the devices.
Co-production activity	The installer of equipment is responsible not only for the installation of all renovation equipment but also he/she is in charge of the maintenance of the equipment even after the renovation process is completed.
Cost / benefit	<ul style="list-style-type: none"> -Installation fees +Installation costs

Table 68 Equipment

Value Proposition	The equipment suppliers provide all the necessary equipment, devices and materials required for the renovation.
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Co-production activity	The equipment suppliers are responsible for delivering all the necessary equipment required to installer of equipment in order to commence the renovation process.
Cost / benefit	-Production Costs + Sales price

Table 69 Cash in/ Bank

Value Proposition	This partner will provide an alternative financing in order to pursue the renovations.
Co-production activity	Ensuring financial feasibility of the renovations
Cost / benefit	-Financing Costs + Interest margin from CC02

Table 70 Government

Value Proposition	The government is committed to achieving reduction in CO ₂ emissions and energy consumption. Also, the government offers subsidies for renovation projects aimed at enhancing energy efficiency.
Co-production activity	The government supports renovation projects related to energy efficiency and provides funds to foster energy renovations.
Cost / benefit	- Funding in Euro + Enhance Green Society + Achieve social goals and policy targets

Table 71 CC02

Value Proposition	CC02 will facilitate CO ₂ transactions by allowing CO ₂ to be exchanged for Euros, thereby reducing the financial burden.
Co-production activity	CC02 will facilitate CO ₂ transactions by allowing CO ₂ to be exchanged for Euros, thereby reducing the financial burden.
Cost / benefit	- Operational costs - Exchange from CO ₂ to Euro costs

	<ul style="list-style-type: none"> + Interest rate + Subscription monthly fees
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Table 72 ECB

Value Proposition	The ECB offers low-cost economic feasibility to the CCO2.
Co-production activity	The ECB is responsible for the Green Ecosystem and Green Financial Programs.
Cost / benefit	<ul style="list-style-type: none"> - investment budget + GE as CBDC in the digital Euro

Table 73 ESCO

Value Proposition	The ESCO offers an energy performance guarantee contract that ensures energy savings for the building owner and improves building's energy efficiency.
Co-production activity	The ESCO is responsible for ensuring that with the implementation of the FORTESIE smart contract, there are certain benefits for the owner, such as reducing the facility maintenance costs, energy bills and improving the energy performance of the building.
Cost / benefit	<ul style="list-style-type: none"> -Operational costs +Monthly fees based on performance improvements

Table 74 Facility Management Company and digital solutions providers

Value Proposition	The facility management company and digital solutions providers oversee the entire renovation process.
Co-production activity	The facility management company and digital solutions providers are responsible for consulting the building owner on what is required, overseeing the entire renovation process and giving specific instructions and advice to the installers.
Cost / benefit	<ul style="list-style-type: none"> -Study Costs -Operation Costs - Installation costs + Flat fee

8.6 JUST (Demo 3)

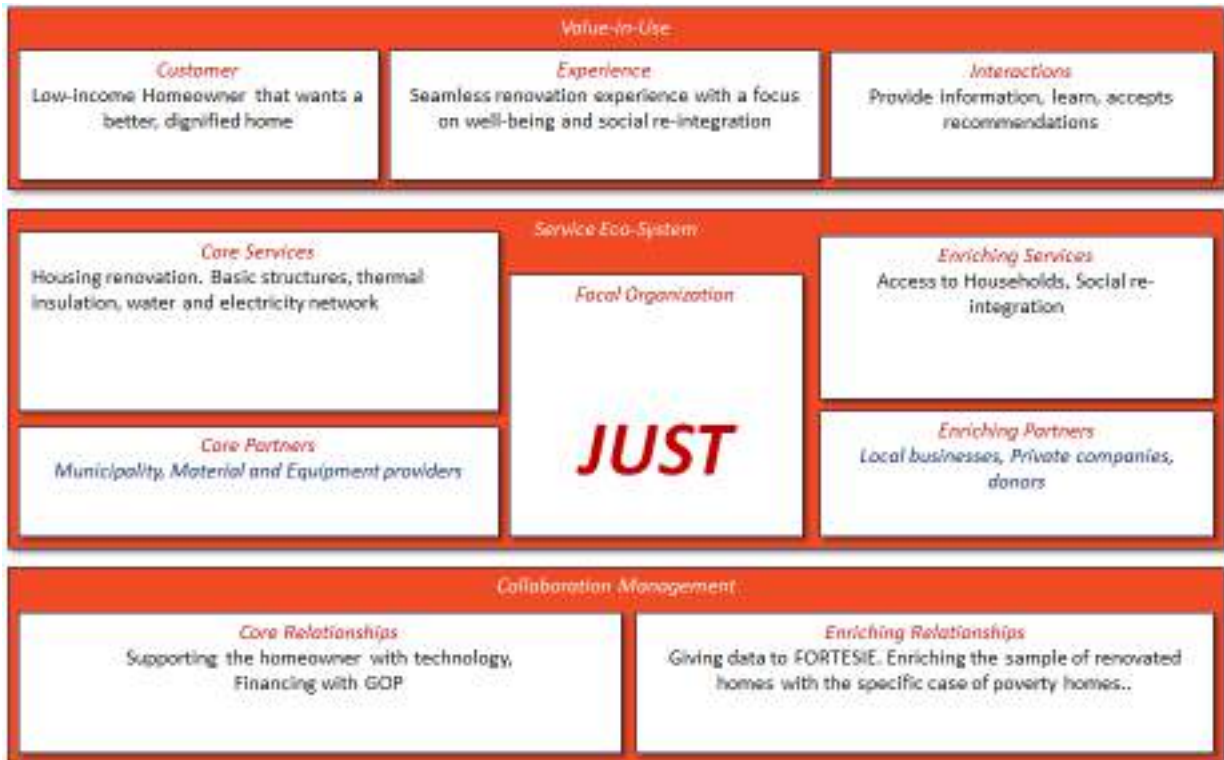


Figure 26 JUST business strategy update for homeowners

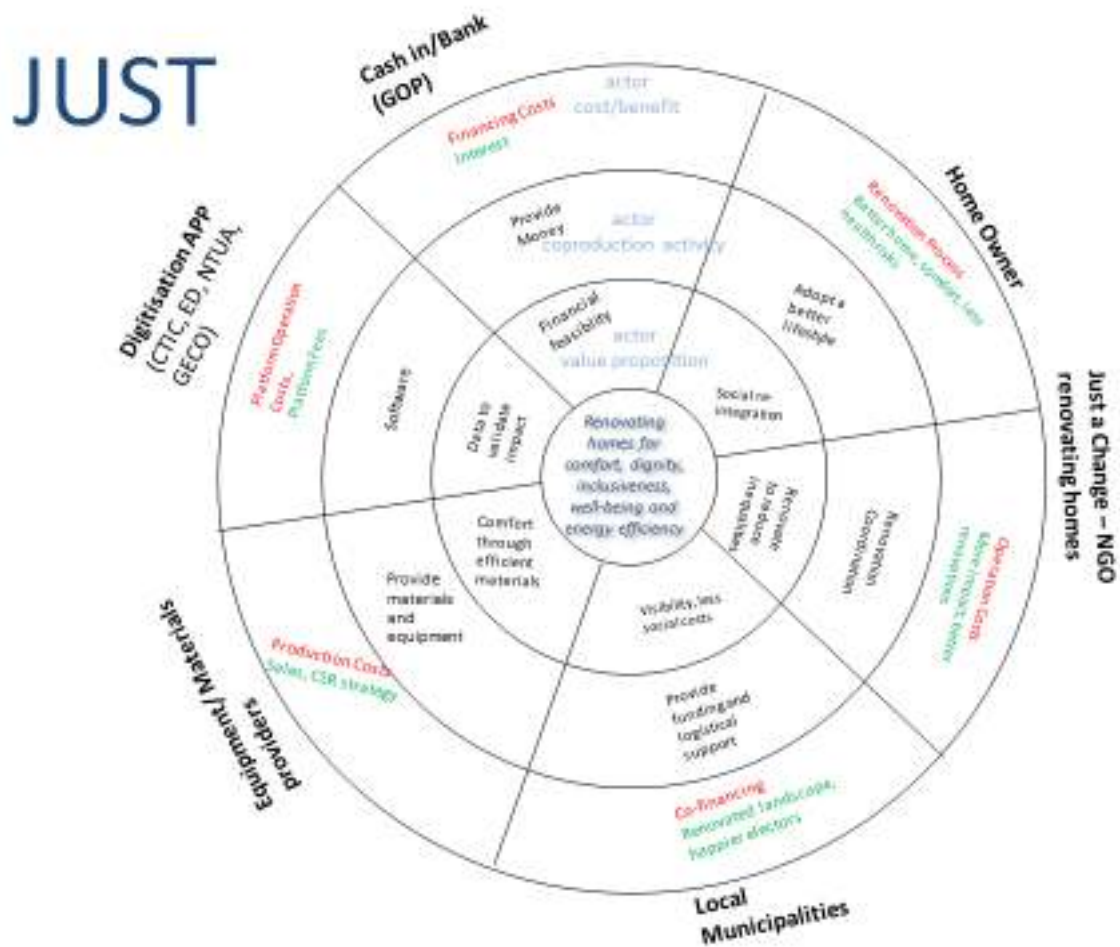


Figure 27 JUST business model radar for exploitation (early version)

Table 75 Offered experience

Focal organisation	JUST is the contact point with the home-owner, offering the house renovation and social support, also engaging with them and promoting better energetic behaviours
Experience offered	JUST offers a seamless renovation experience, focusing on well-being, energetic efficiency, comfort, dignity and social re-integration

Table 76 Home Owner

Value Proposition	Low-income home-owners who live in un-dignified homes, with no basic conditions. Usually there is an underlying condition who threw them into poverty and needs to be addressed. The measurements made in their house before and after the intervention will show the improvements made.
Co-production activity	Adopting a better lifestyle, gain some insights and basic information about energy efficiency and tips on how to improve their behaviour
Cost / benefit	- renovation process is quite disruptive and demanding

	<ul style="list-style-type: none"> + a better and dignified home to live + a comfortable dwelling + less home-associated health risks
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Table 77 NGO renovating homes

Value Proposition	JUST renovates homes to fight housing and energy poverty. they are in charge of the entire renovation and to accommodate special needs and requests from the beneficiary/home-owner.
Co-production activity	JUST is in charge of the coordination of the entire renovation. Dealing with many stakeholders and overseeing the works.
Cost / benefit	<ul style="list-style-type: none"> - Operating costs + More houses renovated + more impact + Less poverty

Table 78 Local Municipalities

Value Proposition	Local municipalities are interested in reducing local poverty levels, ensuring quality of life to all their population, and gaining visibility and reducing their social costs by not having to relocate these people to other facilities.
Co-production activity	They will provide a part of the funding needed for the interventions as well as logistical support in housing and feeding the volunteers.
Cost / benefit	<ul style="list-style-type: none"> - Co-funding costs + Local landscape renovated - Happier electors - Reduced social care costs

Table 79 Equipment Equipment/ Materials providers

Value Proposition	These providers will promote the usage of their equipment and building material that ensure proper insulation or thermal comfort.
Co-production activity	Providing the materials and equipment necessary
Cost / benefit	<ul style="list-style-type: none"> - Production Costs + Sales price + Installation costs

Table 80 Digitisation APP

Value Proposition	The digitisation app will provide insights on the measurements before and after the renovation and the energetic evolution of the dwelling. This data will validate the impact of the intervention.
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Co-production activity	This supplier will provide the software needed
Cost / benefit	- Platform operation costs + Platform operation fees

Table 81 Cash in/Bank (GOP)

Value Proposition	This partner will provide a financing alternative to pursue the renovations
Co-production activity	Ensuring financial feasibility of the renovations
Cost / benefit	- Financing Costs + Interests

8.7 ENE (Demo 2)

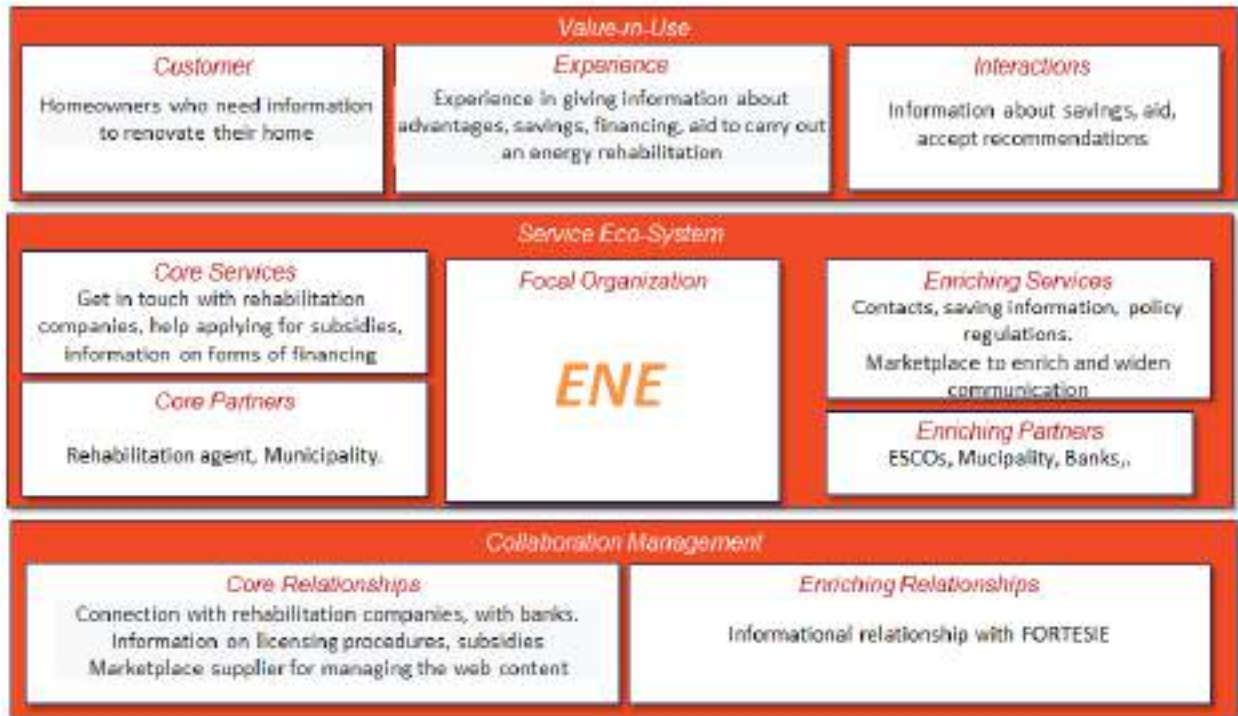


Figure 28 ENE business strategy for customers/ homeowners

ENE's business strategy is summarised in the tables below:

Table 82 ENE's value-in-use

Customer	Potential homeowners who need information to renovate their home. Information about energy efficiency systems, savings, contacts with banks, subsidies.
Experience	ENE offers experience in providing information on advantages, savings, financing and aid for energy rehabilitation. Putting in contact with companies specializing in it.
Interactions	ENE receives a request for information about aid, savings, and recommendations. ENE provides all the requested information, even putting you in contact with specialist companies.

Table 83 ENE's eco-system

Core services	Help from start to finish. Get in touch with rehabilitation companies, help applying for grants, information on financing methods.
Core partners	The entity responsible for coordinating the rehabilitation process, in this case the Rehabilitation Agent and; the local government, granting subsidies and construction permits. Apart from that, banks also provide financing.

Enriching services	Company contacts, regulations, energy policies. Marketplace to enrich and expand communication.
Enriching partners	ESCOs, Municipality, Banks.

Table 84 ENE’s collaboration management

Core relationships	Connection with rehabilitation companies, with banks. Information on licensing procedures, subsidies. Marketplace supplier for managing the web content.
Enriching relationships	Informational relationship with FORTESIE.

8.8 MESH (Demo 7)



Figure 29 MESH business strategy for customers

MESH’s business strategy is summarised in the tables below:

Table 85 value in use

Customer	Potential customers are public buildings such as schools, kindergartens, social houses, offices, storages etc., who wants to ensure and monitor air quality in buildings. And reduce energy consumption for any size buildings.
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Experience	The experience offered is trustworthy measurement of indoor microclimate (HVAC) and monitoring system that helps to reduce energy consumption in the building.
Interactions	Regarding the high-level interaction with the consumers, MESH can offer technical support, consumer profile maintenance and requirements coverage.

Table 86 eco system

Core services	Monitor of indoor air quality (temperature, CO2 level, humidity) – gathering data and analyze for purpose to reduce energy consumption without losing comfort in any indoor premises.
Core partners	Main core partners are public building owners and public building users.
Enriching services	Digitisation for M&V calculation and analytics and smart contracts execution, behavioural model, financing services and also ESCO to provide the smart contracts.
Enriching partners	Enriching partners provide enriching services.

Table 87 collaboration management

Core relationships	Transactional with compatible suppliers, and digitization or financing partners, service providers.
Enriching relationships	Mostly relational based on long term contracts with FORTESIE partners. Transactional: with those who bring customers and want to adopt our solution for integrating it to their own offering.

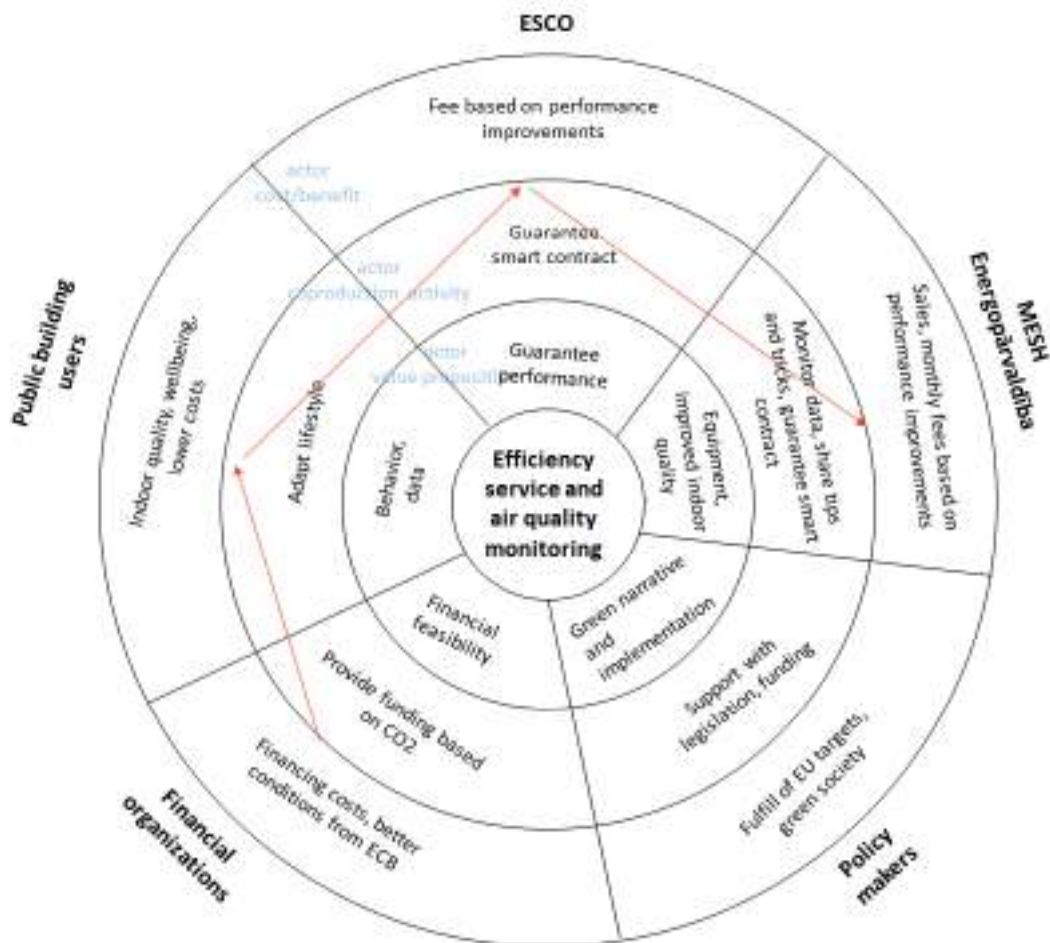


Figure 30 MESH business model radar for exploitation (early version)

Table 88 Offered experience

Focal organisation	SIA MESH Enerģopārvaldība
Experience offered	Efficiency service and air quality monitoring

Table 89 Public building users

Value Proposition	Public building users offer their energy usage pattern and energy consumption measurements for further analysis. They are the target group where the service is offered.
Co-production activity	Public building users can adapt their lifestyle to achieve green efficiency, adopt a more energy efficient behavior, save energy and money and enjoy an increased level of comfort at their premises.

Cost / benefit	<ul style="list-style-type: none"> - Service fee, includes energy costs and FORTESIE service + Save energy and money (reduced energy bills) and enjoy upgraded comfort (comfortable temperature, CO2 and humidity), tailored to their preferences heating (without wastages). + Adopt a more energy efficient behavior and contribute to a green social community.
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Table 90 MESH Energopārvaldība

Value Proposition	MESH ensures equipment, technical support, monitoring of data, analysis and recommendations. They are the contact point for the customer and all the providers.
Co-production activity	MESH Energopārvaldība will monitor data, analyze, give recommendations, share tips and tricks, guarantee smart contract. For building users there will be possibility to save energy and money and live in more qualitative microclimate.
Cost / benefit	<ul style="list-style-type: none"> - Production costs - Operation costs - Installation costs + Revenues + Sustainable image in society

Table 91 ESCO

Value Proposition	The ESCO provides a performance guarantee contract for certain savings on the public building's energy bill and for the building energy efficiency.
Co-production activity	The ESCO is responsible for ensuring that by implementing FORTESIE's Smart Contract, the building owner will benefit from a standard amount of energy efficiency, which will result in a predetermined percentage of decreased energy usage and, as a result, a reduced energy bill.
Cost / benefit	<ul style="list-style-type: none"> - Operational costs + Fees monthly based on performance improvements

Table 92 Policy Maker

Value Proposition	The government is committed (for example through the Paris agreement) to achieve some goals related to the CO2 emission reduction and energy savings and also comply with national and EC regulations. Hence, the government provides funding for the adoption of initiatives such as FORTESIE.
Co-production activity	The government sets targets based on national and EC regulations in order to foster Energy Efficient behavior and achieve CO2 emissions reduction.
Cost / benefit	<ul style="list-style-type: none"> - Funding in Euro + Foster Green Society + Achieve social goals and policy targets

Table 93 Financial Organization

Value Proposition	The financial organisations will enable the financial feasibility of MESH Energopārvaldība
Co-production activity	The financial organisations are responsible for providing funds to the MESH in order for them to establish their green projects.
Cost / benefit	- Financing costs (they pay interest to their investors) + Interest margin from MESH Energopārvaldība

8.9 +48 (Demo 6)

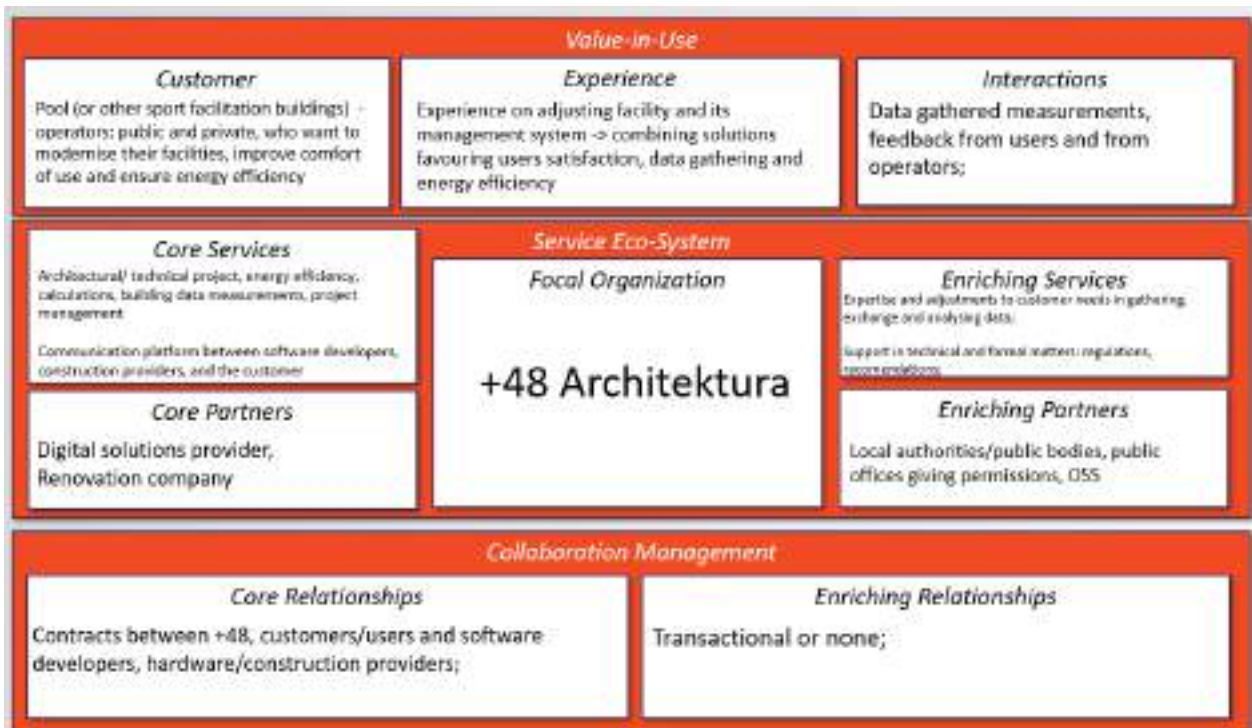


Figure 31 +48 business strategy for customers

+48's business strategy is summarised in the tables below:

Table 94 +48 Value-in-use

Customer	Operators of pool, or other sport facilitation buildings, both public or private, who want to modernize their facilities, improve comfort of use and ensure energy efficiency, and in the same time, platform to receive feedback from users.
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Experience	Experience on adjusting facility and its management system -> combining solutions favoring users' satisfaction, data gathering and energy efficiency.
Interactions	Data gathered measurements, feedback from users and from operators.

Table 95 +48 Eco-system

Core services	Architectural project, technical support, energy efficiency, calculations, building data measurements, project management. Communication link between software developers, construction providers, and the operator/customer.
Core partners	Digital solutions provider, Renovation/construction company.
Enriching services	Expertise and adjustments to customer needs in gathering, exchange and analyzing data. Support in technical and formal matters, such as regulations, recommendations.
Enriching partners	Local authorities/public bodies, public offices giving permissions, OSS.

Table 96 +48 Collaboration management

Core relationships	Contracts between +48, customers/users and software developers, hardware/construction providers.
Enriching relationships	Transactional or none.

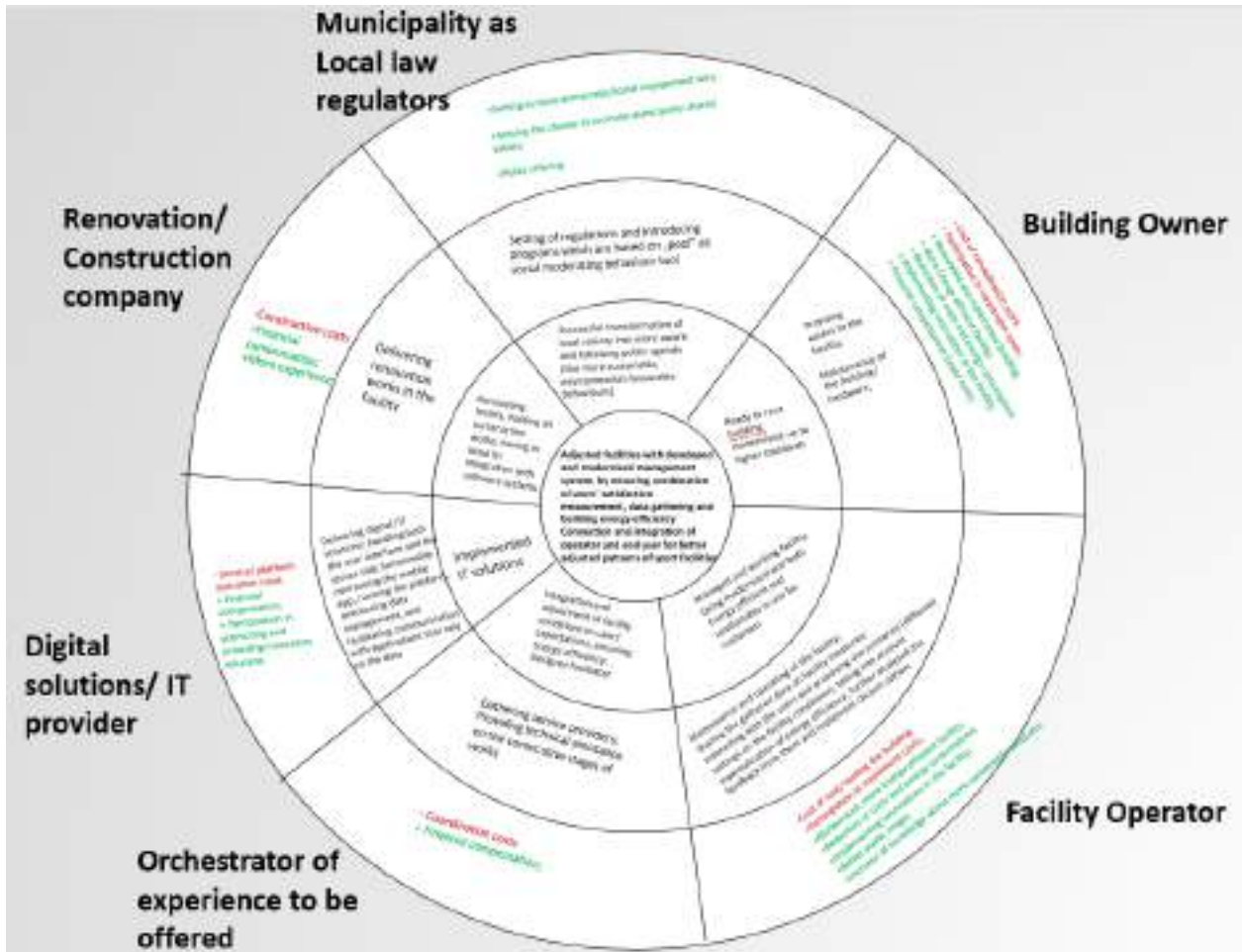


Figure 32 +48 business model radar for exploitation (early version)

Table 97 Offered experience

Focal organisation	+48 has the link to the customer, will stay the contact point with the customer, renovation company, Digital Solutions provider, supporting them in seamless renovation and delivery of user-adjusted, modern and energy efficient solutions.
Experience offered	+48 will provide experience in adjusting building/facility and its management system with combining solutions favoring users satisfaction and collecting feedback, data gathering and energy efficiency.

Table 98 Orchestrator of experience to be offered (+48)

Value Proposition	Designer facilitator; integration and adjustment of facility conditions to users' expectations, ensuring Energy efficiency
Co-production activity	Gathering service providers; Providing technical assistance on the consecutive stages of works

Cost / benefit	- Coordination costs + Financial compensation;
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Table 99 Digital solutions/ IT provider

Value Proposition	Implemented IT solutions, connection to renovated hardware
Co-production activity	Delivering digital/ IT solutions: handling both the user interface and the server-side functionality overseeing the mobile app, running the platform, overseeing data management, and facilitating communication with applications that rely on the data
Cost / benefit	- Service/ platform operation costs + Financial compensation; + Participation in promoting and providing innovatory solutions

Table 100 Renovation/ Construction Company

Value Proposition	Renovating facility, holding all construction works, having in mind its integration with software systems
Co-production activity	Delivering renovation works in the facility
Cost / benefit	- Construction costs + Financial compensation; + More experience

Table 101 Facility Operators

Value Proposition	Managed and working facility, being Energy efficient, comfortable in use for customers and giving the possibility to collect data/ users' feedback
Co-production activity	Maintenance and operating of the facility; Sharing the gathered data on facility measures; Interacting with the users and proposing use scenarios (different settings on the facility conditions), taking into account maximization of energy efficiency, further analyzed the feedback from them and implement chosen option;

Cost / benefit	<ul style="list-style-type: none"> - Cost of rent/ leasing the building - Participation in investment costs; +Modernised, more Energy-efficient facility; +Reduction of costs and energy consumption; +Implementing innovations in the facility; +Better public image; +Increase of knowledge about more sustainable solutions;
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Table 102 Building Owner

Value Proposition	Possessing modernized building, up to higher standards and ready to rent to customers/facility operators
Co-production activity	<ul style="list-style-type: none"> Providing access to the facility; Maintenance of the building/ hardware;
Cost / benefit	<ul style="list-style-type: none"> - Cost of rehabilitation work. - Participation in investment costs; + Renovated and modernized building; + More Energy efficient facility; + Reduction of costs and energy consumption + Implementing innovations in the facility; + Financial compensation (lease rent);

Table 103 Municipality as Local law regulator

Value Proposition	The government is committed to achieve some goals related to the CO2 emission reduction and energy savings and also comply with national and EC regulations. Successful transformation of local society into more aware and following public agenda (like more sustainable, resources-saving or environmental-favorable behaviors).
Co-production activity	Setting of regulations and introducing programs which are based on the pool as social moderating behavior tool
Cost / benefit	<ul style="list-style-type: none"> + Setting in more democratic/social engagement way; + Getting the chance to promote municipality shared values; + Policy offering

9 Conclusions

This deliverable has served as a comprehensive guide, offering a clear assessment of FORTESIE's position within the market. The initial business models for the FORTESIE pilots have been co-created in a generic and visionary approach. These will become actionable in the next periods, and will be used to guide business decisions, among the partners of the project, thus allowing us to test and validate their feasibility. It is important to note that these business models are dynamic and will undergo further refinement in the future. As we progress, alternative business models will be also developed to cater for the specific populations or specialized business contexts we want to address in each specific country, and target group.

In essence, our approach to business models within FORTESIE is adaptive and responsive, ensuring that our strategies remain aligned with the project's evolving needs and objectives, but also with our better understanding of the system capabilities and potential, and the real potential business cooperation's among the partners and the general roles they represent.

Additionally, this document has introduced the concept of "green-euros" (€G) and has underlined the pivotal role of €G in enhancing the execution of business models proposed for the demos, signalling exciting prospects for their implementation, such as a wide demonstration of the Green euro as a retail digital euro for ECB adoption.