This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

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D4.6MEDZEB PROTOCOL-First Batch

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TABLE OF CHANGES

Date	Change	Author	Resulting Document Version
			V1.1
			V2.0

PUBLISHABLE EXECUTIVE SUMMARY

The project is aimed at stimulating the market uptake of deep retrofitting of buildings, with special regard to the Mediterranean area and to the residential built stock, by tackling major bottlenecks such as the fragmentation of the supply chain, the lack of transparency and of the perceived reliability of the interventions, of adequate financial support mechanisms, of integration among the relevant aspects connected to retrofitting, the low return on investments, or the lack of a retrofit approach clearly tailored for the Med environments. To this extent, the project will be acting on the following complementary themes: engagement and empowerment of target groups such as owners, inhabitants, building professionals; technological insight for the development of optimized one-stop shop packages of solutions for deep and beyond retrofitting; financial solutions for supporting the market uptake of deep retrofitting, and proposal of suitable changes in the regulatory frameworks.

In the above described Project framework, the definition of the MedZEB Protocol in which the voluntary certification scheme conceived to overcome the different barriers encountered in undertaking deep retrofitting, plays a key role. This deliverable is related to the Work Package 4 entitled "Finance and Regulation", in particular to the Task T4.3 whose title is "Definition of the HAPPEN programme".

The aim of this deliverable is to provide a preliminary outline and structure of the MedZEB protocol. For this purpose, a first definition of the Protocol as well a list of its constitutive elements have been provided. Further developments are planned in the future in the framework of the design the MedZEB Protocol in order to allow the Protocol to be applied in all the Partner Countries.

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ACRONYMS AND ABBREVIATIONS

All acronyms and abbreviations (AAs) used in the report should be listed in alphabetical order in the table below (other than symbols for units of measurement) in the following way:

BRP	Building Renovation Passport
EE	Energy Efficiency
EPBD	Energy Performance Building Directive
EPC	Energy Performance Certificate
BRP	Building Renovation Passports
BPIE	Building Performance Institute Europe

AAs must be defined the first time they are used in the text of the report, and AAs should not be introduced if they are not used again in the document.

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1 INTRODUCTION

1.1 Aims and objectives

As it can be read in [1], buildings are the largest consumers of energy worldwide and will continue to be a source of increasing energy demand in the future. Globally, the sector's final energy consumption doubled between 1971 and 2010 to reach 2794 million tonnes of oil equivalent (Mtoe), driven primarily by population increase and economic growth. Under current policies, the global energy demand of buildings is projected to grow by an additional 838 Mtoe by 2035 compared to 2010, which is equivalent to the total current energy demand of the buildings sector of the United States and China combined. Buildings will therefore add substantial pressure on primary energy supply, if further policy action is not taken at a global level to improve their efficiency. When focusing on the existing building stock, about 35% of the EU buildings are over 50 years old, almost 75% of the building stock is energy inefficient. 75%-85% of those buildings will be still in use in 2050 [1,2]. At the same time, only 0.4-1.2% (depending on the country) of the building stock is renovated each year. Therefore, currently the European Union is facing a double challenge: increasing building renovation rates while aiming at achieving "deep renovations". The increase in the current EU renovation rate from 1.2% per annum to 2-3% plays a crucial role to meet both the EU 2020 targets and the commitment undertaken in Paris in December 2015.

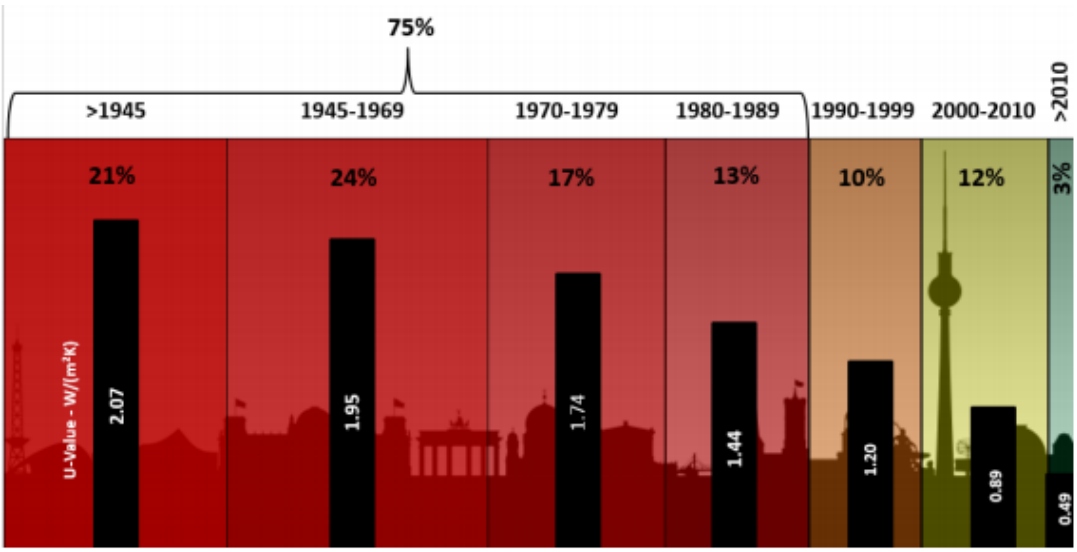

Figure 1. -Age of the EU building stock and corresponding average Unavalue (illustrated by the black bars) for building envelopes. The 2010 data for U-Value is based on an average of just 7 countries, while the others are based on average of all 28 Member States (Source: EU Building Stock Observatory) [2]

Renovation of existing buildings can lead to significant energy savings and is of a paramount importance when considering the clean energy transition, as it could reduce the EU's total energy consumption by 5-6% and lower CO_2 emissions by about 5%.
In addition to energy efficiency gains, a renovated building stock can also:
-create economic, social and environmental benefits;

-contribute to the improved health, comfort and wellbeing of their residents by reducing respiratory and other illnesses caused by a poor indoor climate;
-make homes more affordable and help households escape energy poverty.
Investments in energy efficiency also stimulates the economy, especially the construction industry, which generates about 9% of Europe's GDP and directly accounts for 18 million direct jobs. SMEs in particular benefits from a boosted renovation market, as they contribute more than 70% of the value added in the EU building sector.
Given the above described framework , the definition of the MedZEB Protocol represents one of the main outcomes of the Happen Project in order to overcome the barriers to the improvement in energy efficiency in the existing building stock in the Mediterranean area. The MedZEB protocol is designed as a guarantee that the retrofitting process is carried out properly along the whole value chain.
The aim of this deliverable is to present a first draft and structure of the MedZEB protocol and its constitutive elements. Firstly, a definition of the MedZEB protocol is provided. Then the main ambition of the MedZEB Protocol represented by the implementation of a renovation roadmap is shown. The MedZEB protocol in the HAPPEN Programme is then described, as well as the main components of the Protocol itself.
However, this is only a first draft. In fact, the outline of the MedZEB voluntary certification scheme will be furtherly fine-tuned in the next project activities. An ad- hoc designed system for the evaluation and the description of all the aspects concerning the design of the Protocol will be then provided, thanks also to the Consortium contribution, in order to allow the Protocol to be applied in all the Partner Countries.

1.2 Relations to other documents

1.2.1 Legal Framework

The Consortium and Project activities are regulated under the following legal framework:

- The Grant Agreement (GA) - contract between the Commission and the Consortium, especially relevant Annex 1 (also known as Description of Action - DoA);
- The Consortium Agreement (CA) - agreement among the Consortium members.

1.2.2 Other Project Documents

This deliverable is related to the following documents:

WP(n°) Title:

- D3.2 – Catalogue of reference buildings classes in MED countries (M 6)
- D3.3 – Abacus of "renovation measures" at building and district scale (M 15)
- D4.1 - Report on regulatory framework and incentive systems in the MED countries (M 3)
- D4.2 – Catalogue of "reference financial solutions" (M 6)
- D4.3 - Report innovative financial solutions (M 15)

- D4.4 - Guidelines and Principles for the construction of national and international funds
- D7.9 – Sustainability Plan – First Batch (M18)

1.3 Report structure

This report isstructured in seven chapters. Starting from the introduction, which describes the framework in which the Med-ZEB Protocol is conceived and the objectives of the deliverable, the definition of the Protocol is in chapter 2. The main ambition of the MedZEB Protocol is described in chapter 3; the MedZEB Protocol in the Happen framework is presented in chapter 4. Chapter 5 shows the main elements of the MedZEB protocol. Chapter six presents the conclusions and recommendations.

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2 MEDZEB PROTOCOL DEFINITION

The definition of the MedZEB Protocol represents one of the main outcomes of the Happen Project in order to overcome the barriers to the improvement in energy efficiency in the existing building stock in the Mediterranean area. The MedZEB protocol is designed as a guarantee that the retrofitting process is carried out properly along the whole value chain; this allows subjects involved in the retrofitting market to cooperate according to shared quality principles and procedures, where responsibilities and control levels are fully described.
HAPPEN is focused on the residential built stock (private and public) as main ground to build a prototype, test and validate its **holistic, transparent and adaptive** MedZEB approach, whose objectives are:

- reconnecting the fragmented value chain in the retrofitting market;
- rebuilding a framework of trust around the deep and beyond retrofitting market;
- increasing the overall viability and appeal of retrofitting interventions**.**

In particular, the MedZEB Protocol responds to the characteristic of transparency of the MedZEB approach. It is aimed at:
-bridging the gap between designed and actual energy performance;
-supporting and sharing reliable energy performance standards, quality of certification and labelling schemes.
Integrated cost optimal packages of solutions designed for each specific climate and for each specific country are included in the Protocol.
Moreover, the MedZEB Protocol sets up the quality requirements to access innovative financial solutions tailored for the retrofitting market. Only subjects who have undergone proper training in the MedZEB approach are allowed to join the protocol.
The MedZEB Protocol is signed by the all the stakeholders involved in the retrofitting value chain. In particular, the different categories are supposed to sign:

- professionals are going to sign a guarantee that all the technical aspects of the retrofitting process have been properly taken into account and that retrofitting interventions have been carried out in accordance with the shared quality principles and procedures on the basis of the cost-optimality approach developed (MedZEB Approach);
- real estate agents are signing a guarantee that the building they are selling or renting out has a higher added value in terms of lower energy consumption and higher sustainability;
- homeowners are signing up to a sort of «climate commitment».

Furthermore, different categories of stakeholders are going to make different commitments:

- professionals realize retrofit interventions in accordance with shared quality principles and procedures;
- building companies carry out work that is fully compliant with the quality goals of the renovation project;
- homeowners behave responsibly towards energy consumption.

Additionally, a Voluntary Certification Scheme tailored to the Med Area and in the framework of the MedZEB Protocol is going to be produced, aimed at integrating with existing Energy Performance

Certificate (EPC) schemes, rather than replacing them. While EPCs refer to "absolute" class definition (yearly standard consumption), the MedZEB Voluntary Certification Scheme proposes the definition of individual renovation roadmaps, focusing on "relative" assessment (such as MedZEB step1, step 2, etc., where "relative" savings are based on and related to absolute ones).
This allows triggering an assisted renovation pathway towards deep and nearly Zero Energy Building standards including the possibility of carrying out staged interventions (step-by-step approach) and "alternative Renewable Energy Sources investments". The MedZEB Voluntary Certification Scheme testifies that interventions have been executed in compliance with the MedZEB protocol requirements, and includes an exhaustive list of indicators, not only for energy savings, but also for environmental sustainability, indoor well-being, etc.
Sections from 2 to 6 outline the MedZEB protocol as well as the operative steps to be taken for the MedZEB Protocol to be issued.

3 MEDZEB PROTOCOL AMBITION

The main ambition of MedZEB Protocol is represented by the design and implementation of a building renovation roadmap devised as a long-term action plan to transform the old and inefficient building stock into a highly energy efficient and decarbonized building stock. This ambition is motivated by the recent developments in the European legislation concerning building retrofitting.

In order to boost building renovation and also increase the quality of the renovation process itself, the Amending Directive (2018/844/EU) was approved on 19th June 2018. It came into force on 9th July 2018 and the transition period ends on 10th March 2020. The main findings available in [3] are reported In this section.

"EuroACE [20] within a dedicated guidance, investigated in detail the amended EPBD to highlight the key changes and to also emphasize the need for robust implementation in all Member States of the EU. The main points underlined in the guide are the following:

- ✓ the move of the national Long-Term Renovation Strategies (LTRS) from Article 4 of the Energy Efficiency Directive to the Article 2A of the EPBD, with this provision being considerably strengthened;
- ✓ the option for Member States to develop the use of Building Renovation Passports (BRP) and the requirement for the European Commission to undertake, before 2020, a feasibility study on the possibilities and timeline for the introduction of BRPs as an option;
- ✓ a better accessibility to financing as well as links between financial measures and improved performance after renovation works;
- ✓ the introduction of a Smart Readiness Indicator
- ✓ the revision of Annex I on the methodology to describe the energy performance of buildings (increased transparency, and incentive to use EU standards).

With reference to the Long Term renovation strategies, a crucial change in the amended EPBD is represented by the request to each Member State to prepare an LTRS as a roadmap with an action plan on how to transform their building stock to a highly energy efficient and decarbonized building stock by 2050 with specific milestone in 2030 and 2040. The LTRS must be supported by measurable progress

indicators and must explain how they contribute to the achievement of the overall 32.5% energy efficiency target set by the EU for 2030 (in the Energy Efficiency Directive). The LTRS must include policies and actions to target the worst-performing segments of the national building stock and all public buildings and to set out actions to alleviate energy poverty. The implementation of the LTRS should lead to a real mobilization for energy renovation across the whole of the EU.

Moreover, the introduction of the Building Passport is also taken into consideration.
They have mainly the objective to provide information to a potential purchaser, investors, renter or user of the building. The concept of BP and its current applications, in some Member States (i.e. Germany, Belgium – Flanders region and France) mainly on residential buildings, they are demonstrating to be a possible way to achieve higher (and deeper) renovation rates. In Article 2a.1(c), the possibility for Member States to introduce an optional scheme for individual building renovation passports (BRP) is included for the first time in the context of the requirement that Member States prepare an LTRS for their building stock. The references to the possible use of a BRP in conjunction with the LTRS and, possibly the EPC, reflects the need for better guidance and support for owners throughout their energy renovation journey. The inclusion of the BRP as a complementary tool to the EPC, it is a recognition that well-planned step-by-step energy renovations are the most effective way to ensure the compatibility of short-term measures with the long-term goals set for the building stock. Sesana and Salvalai [21], with an overview on the BP concept evolution and the critical review of the running initiative, identified some important recommendations and needs to define a powerful BP for Renovation: (i) long-term perspective needed; (ii) timing and sequencing of actions developed; (iii) customer engagement and consideration of the individual renovation context; (iv) attractiveness and motivation; (v) automation and dynamism of the process instead of static tool.
In addition, Fabbri [22] remarked the importance of engaging users and considering their needs and habits to ensure a tailor-made roadmap with a long-term perspective and right timing and sequencing of renovation actions".
Moreover, as can be read in the BPIE document in [4],

A Building Renovation Roadmap[1] is defined as a document - in electronic or paper format - outlining a long-term (up to 15 or 20 years) step-by-step renovation roadmap for a specific building, resulting from an on-site energy audit fulfilling specific quality criteria and indicators established during the design phase and in dialogue with building owners.

The expected benefits in terms of reduced heating bills, comfort improvement and CO_2 reduction are a constitutive part of the BRP and are explained in a user-friendly way. The renovation roadmap can be combined with a repository of building-related information (logbook) on aspects such as energy consumption and production, maintenance works undertaken and building plans.

Given the above described framework, it appears clear that the capitalization of the running experiences (Flanders, Germany and France) regarding the building renovation roadmaps within the HAPPEN Project is a mandatory step to ensure a successful long-term step by step building renovation process.

[1] Amended "Roadmap" instead of Passport, because with the Passport only the Logbook (Dwelling ID) is intended

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An overview of the running experiences regarding the building renovation roadmaps is reported in Table 1. A detailed description of the three running experiences can be found in [4].

Process	BE-Flanders (EPC+)	France (PEE)	Germany (ISFP)	HAPPEN
Definitions (Deep Renovation ..)	V	V	V	V
Long term target for the existing building stock	V	V	V	V
Identified Barriers	V	V	V	V
Stakeholders Mapping	V	V	V	V
Stakeholders Engagement	V	!	V	V
Market Analysis	V	V	V	V
Energy Audit-On site Visit	X	V	V	V
Auditors Training	X	V	V	V
Tailored Solutions	!	V	V	V
CO_2 Reductions	V	!	V	V
LogBook / database	V	!	X	X
Integrated Financial Support	!	N/A	V	V

Table 1. Overview of key features in the three running experiences and the main features of the HAPPEN Renovation Roadmap

The main features of the HAPPEN renovation roadmap are also included in Table 1.

In particular, the HAPPEN approach and procedures needed to be compliant with all the key features in Table 1 are described below.

- Definition of deep renovation

Different definitions of "deep renovation" can be found in the literature summarized in Figure 2.

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Type of Renovation	Reference	Definition/Measures
Minor	BPIE [12]	It reduces final energy consumption up to 30% implementing from one to three improvement measures (e.g., new boiler plant, wall/roof insulation, windows), with an average total project cost of 60 €/m^2.
Moderate	BPIE [12]	It involves from three to five retrofit improvements resulting in energy reductions in the range 30%–60%, with an average total project cost of 140 €/m^2.
Deep	EED [1]	It reduces both the delivered and the final energy consumption by a significant percentage compared with the pre-renovation level leading to a very high energy performance.
	European Parliament report (July 2012) [15]	It reduces both the delivered and the final energy consumption of a building by at least 80% compared with the pre-renovation level.
	Commission SWD (2013) [16]	Significant efficiency improvements, typically more than 60%.
	GBPN [19]	Reduction in energy consumption for heating, cooling, ventilation and hot water of 75% or more.
	Entranze Consortium [14]	Renovation level implementing high-grade refurbishment packages (e.g., 30, 20 and 15 cm of insulation on roof, walls and basement; very efficient heating/cooling generators; heat recovery strategies).
	Zebra 2020 project [10]	Deep thermal renovation with more than two improved thermal solutions (e.g., efficient heating plus insulation of wall/roof, etc.).
	BPIE [12]	It adopts a holistic approach, viewing the renovation as a package of measures working together, resulting in energy reductions in the range 60%–90%, with an average total project cost of 330 €/m^2.
Major	EPBD [2]	Renovation of a building where: (a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25% of the value of the building, excluding the value of the land upon which the building is situated; (b) more than 25% of the surface of the building envelope undergoes renovation.
NZEB	EPBD [2]	Renovation that leads to 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 RES, including energy from RES produced on-site or nearby.
	BPIE [12]	It leads to more than 90% final energy saving, with an average total project cost of 580 €/m^2.

Figure 2. Different definitions for diverse levels of building renovation [D'Agostino D. *, Zangheri P. Castellazzi L., Towards Nearly Zero Energy Buildings in Europe: A Focus on Retrofit in Non-Residential Buildings, Energies 2017, 10, 117; doi:10.3390/en10010117]

The definition of deep renovation adopted in the HAPPEN framework is to be found in [5]. For its modelling approaches on deep renovation, the BPIE adopts an achieved energy saving between 60% and 90%. Moreover, the MedZEB modularity will allow a further reduction of primary energy consumption (up to 70-80%), thus achieving „beyond deep retrofitting" not only by means of a staged intervention based on HAPPEN integrated cost-optimal solutions (technical and financial), but also by taking into account deep renovation interventions at district level (green roofs, mitigation of heat islands), as well as by introducing the RESALT concept as a last step of energy refurbishment towards nearly Zero Energy Building.

- Long term target for the existing building stock

Unlike the other running experiences, in which the long-term target is defined according to the national policy of each Country, in the HAPPEN context the long-term strategy is the one defined in the project impacts, and herewith summarized:

- ✓ The estimated energy consumption reduction allowed by the MedZEB approach is assumed to be at least 60% for Frontrunner Pilots, Thematic/Perspective Pilots and Replication Potential (RP);
- ✓ The Renewable Energy Sources production triggered is assumed to be 50% of the total energy consumption after deep renovation;
- ✓ Annual and cumulative GHG (Greenhouse Gases) savings associated with energy savings are evaluated so as to assess the sustainability improvement of the HAPPEN pilot actions. The consideration of the CO_2 reduction is also included in this framework.

- Identified Barriers

An extensive analysis of the barriers to deep renovation targeted for the MED Area was carried out on the basis of literature and of the different Consortium experiences. The relevant observations are shown in the excellence section of the Application Form. The main outcomes of the analysis concerning the bottlenecks in the renovation process in the MED Area are shown in Figure 3. The division into four groups allows covering all the key aspects.

SOCIO-ECONOMICAL	MARKET RELATED
— prevalence of private ownership coupled with a fragmentation of properties, leading to a fragmentation of the market and to a lack of coordination; — difficulties in mutual decision making among tenants and apartment owners, due to multi-ownership; — tendency to a "self-attempt approach" based on good sense and not on expert support; — lack of general awareness on the benefits of energy savings and on the necessity of behavioral changes; — higher proportion of low-income house owners (.ca 40% in the Mediterranean area)[19]; — low availability to long-term investment in deep retrofitting in private houses; — difficulties to deal with certain owners (slumlords);	— lack of a consistent body of successful case-studies, to be capitalized and disseminated; — lack of transparency and of the perceived reliability of the interventions; — lack of accessible and reliable expert consulting; — lack of a complete energy information over the Mediterranean building stock; — lack of effective communication campaigns; — perception that investments in retrofitting do not translate directly into an added value of the real estate; — uncertified contractors and problems of unavailability or unsuitability of equipment and building materials; — competition of low energy prices and the law of diminishing returns; — Energy Service Companies & Energy Performance Contracts are few, young and not widely spread.
TECHNICAL	**FINANCIAL AND REGULATORY**
— lack of skills, specialization and capacity among the actors of the retrofitting market; — lack of administrative capacity and long bureaucracy; — lack of integration of the relevant aspects connected to retrofitting (building envelope, plants and technological devices, Renewable Energy Sources implementation); — lack of a retrofitting approach clearly tailored for the Mediterranean environments; — low return of investment, also due to the lower potential of energy savings. — lack of tangible results sue to low verification and measurement of results;	— hard access to finance, especially for the weakest subjects; — lack of effective financial support mechanisms; — effects of economical crisis respect to the availability to big investments — regulations not specifically targeted for the exigencies of the Mediterranean area; — lack of coordination between policies designed and implemented by different institutions at several levels, contributing to a dispersion of the funds dedicated to energy efficiency in buildings. — undeveloped funding schemes (limited to low energy buildings): few incentives in interest rates.

Figure 3- Main barriers and bottlenecks in the deep renovation process targeted for the Med Area [Project Application Form]

- Stakeholder Mapping

Task T 7.2 of WP7 entitled "Communication, Dissemination, Exploitation" provides for the creation of a database for all the stakeholders. This aspect, however, has to take into account the recent entry into force of the new GDPR regulation (General Data Protection Regulation) at EU level.

- Stakeholder Engagement

The activities carried out in order to engage and train stakeholders are mainly described in WP2 of the Project, in particular in task T2.1. The stakeholders are engaged not only by means of the LoS signed during the Project drafting, but also and mainly through the Living Lab Methodology. Thanks to the Living Lab implementation it is possible to create both direct contact within the pilot sites and a dedicated communication activity. The Living Labs represent the chance to engage stakeholders in a co-design activity related to the integration of energy renovation projects within the urban regeneration strategy carried out by the Pilot Project Leaders.

- Market Analysis

The Business Model Canvas (BMC) has been chosen in order to develop the draft Business Model for the economic sustainability of the HAPPEN programme. An extensive analysis of the HAPPEN Sustainability Plan is described in Del. 7.9.

- Energy Audit- On site visit

The Energy audit could be planned in different phases of the renovation process, in particular in the initial phase in order to draft the renovation project. In the later phases of the renovation, if a quick energy analysis shows that the planned renovation level has not been achieved, alignment measures will be taken. This situation occurs, for example, when energy consumption is still too high, although the renovation intervention has been carried out. In the long term, it is also planned to introduce the automated audit on the platform.

- Auditor training

Specific training is designed in order to build the professional figure of the "MedZEB expert", who will be able to perform the energy audits and assist the applicant in the renovation journey. Training activities will be held at different levels:

- ✓ on-site/on-line training: organization of MedZEBinars on the pilot sites, which will be accessible via streaming through the HAPPEN platform or other sources;
- ✓ on-line training: creation, on the basis of the previous levels, of MedZEBinars (on-line courses), which will be implemented exclusively through the platform, as a do-it-yourself e-learning approach.
- ✓ A specific certification will be issued after the completion of different courses.

The MedZEB expert will be trained in technical (abacus of renovation measures, cost –optimal solutions etc), financial and procedural aspects and the HAPPEN platform, in particular with reference to the application for the Protocol.
Different kinds of experts will be trained, such as the MedZEB Assessor and MedZEB Professional, so that different experts can play different roles in the renovation process, according to principles of impartiality.
This choice is tailored to the national regulations of each country, as reported in the questionnaires listed in Appendix F.
Moreover, the experts will have to pass specific tests/exams designed on different levels in order to demonstrate knowledge of the HAPPEN tools and aspects.

- Tailored Solutions

The activities developed within the Project framework, in particular in WP3, are aimed at the definition of:

- ✓ reference climate conditions in each country on the basis of climate severity indexes;
- ✓ reference building typologies through a deep analysis of the existing building stock in each country;
- ✓ an extensive set of integrated and holistic cost-optimal Packages of Solutions to be applied to the different building and climate references typologies targeted by the project, taking into consideration the MEdZEB step-by-step approach;
- ✓ the holistic impact of the integrated Packages of Solutions fine-tuned according to the specific context of the application.

The definition of integrated and holistic cost-optimal Packages of Solutions plays a pivotal role in HAPPEN. In Med regions, in many cases, local climate conditions discourage the approach of insulating the building by sealing it. For this purpose, it is also necessary to produce an effectiveness matrix of selected passive solutions, by identifying the cost-optimal solutions in relation to incremental heating contributions generated. This matrix is the basis to define a standard set of solutions to be applied to the reference building typologies. Finally, the packages of solutions will also be analysed in terms of "holistic impact" in order to foster optimal refurbishment process.

- Integrated Financial Solutions

Work Package 4 activities are aimed at providing ad hoc tailored and integrated financial solutions, with a two-fold objective: creating and testing tailored financial solutions, on the basis of a state-of-the art review, which will be essential to unlock the market uptake of deep retrofitting in the Med Area, also in connection with existing incentive systems at national, regional, local levels. On the other hand, such solutions will be associated with proposals for suitable changes in the current regulatory frameworks and policies, with special emphasis on the necessity for dedicated instruments tailored to the Med Area.
The MedZEB Protocol has been completed with a MedZEB Voluntary Certification Scheme, intended as the main instrument for de-fragmenting the supply chain, and recreating trust among all stakeholders, with the additional aim of facilitating access to credit at convenient rates.

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4 MEDZEB PROTOCOL WITHIN THE HAPPEN PROGRAMME

The MedZEB Protocol represents a fundamental element of the HAPPEN Programme.
The HAPPEN programme is the general framework of intervention developed by HAPPEN. It constitutes a facilitated path for defragmenting the retrofitting supply chain and for incentivizing clients to invest in the energy retrofitting of their houses, thanks to enhanced trust and transparency, as well as to a stronger system of guarantees.
The overall picture of the HAPPEN Programme is provided in Figure 4.

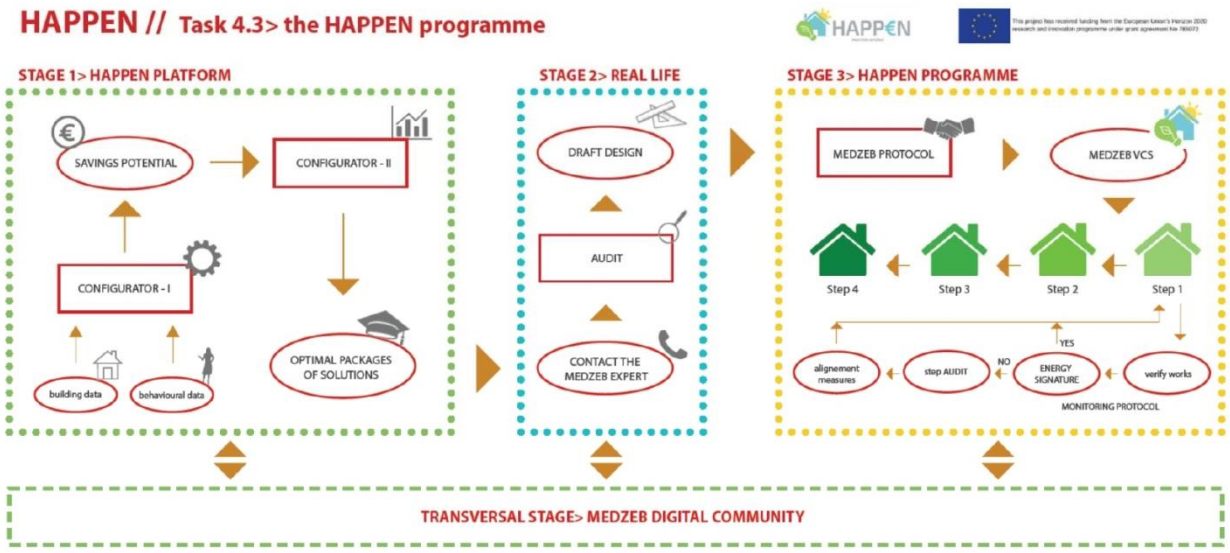

Figure 4-Overall picture of the HAPPEN programme

Key-figure of the HAPPEN program is the MedZEB expert, a trained professional who will manage the whole process after the first engagement of the client, which will be performed via the platform. The expert will be trained through dedicated MedZEBinars, which will allow him or her to understand in depth the structure of the programme, as well as the tools and products which he/she will need to use in order to accompany the client throughout his/her travel along the renovation pathway. In particular, thanks to co-design activity, which will be developed with the Partners of the Consortium, it will be possible to define how many kinds of MedZEB experts should be trained and their different roles and tasks.

The HAPPEN programme is divided into three main stages:

- First stage: It is entirely performed on the platform, thanks to the availability of a full set of services and tools, such as e-pills, self-training, digital spaces for gathering further information from the community, and finally, a user friendly initial configurator of optimal retrofitting solutions that may push clients to create a direct contact with a local expert.

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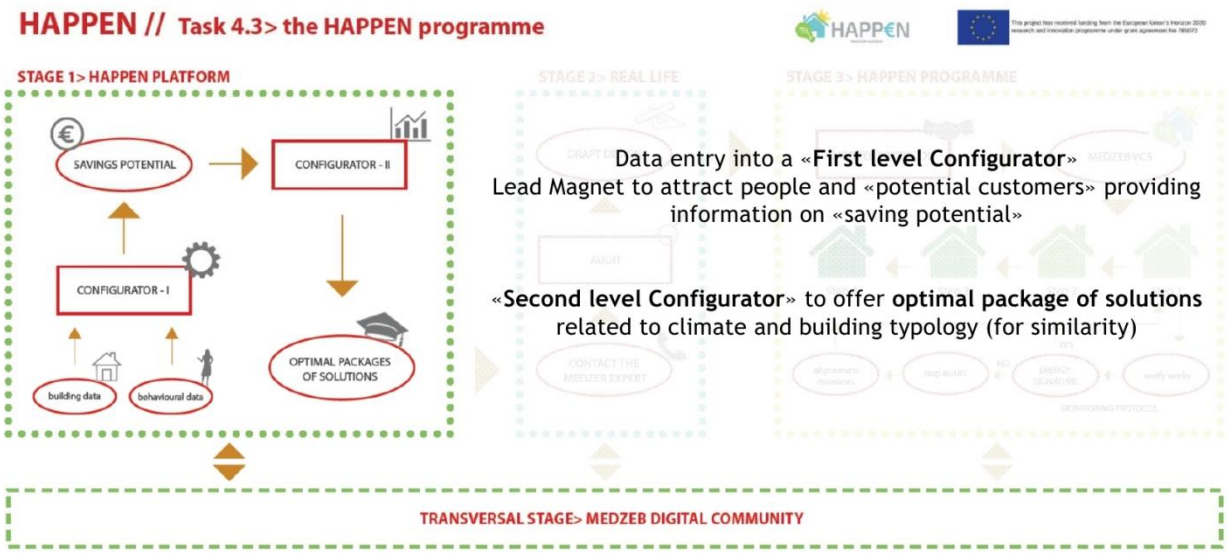

Figure 5-Stage 1 - the HAPPEN platform

The local MedZEB expert, supported by professional tools available on the platform, produces a draft design, including step-by-step retrofitting solutions and a preliminary business plan, according to the HAPPEN financial solution.
Basing on the draft design, the MedZEB protocol is signed among all subjects involved in the retrofitting enterprise, including the very client; the protocol acts as a guarantee that the intervention is performed coherently with the energy savings targeted by the retrofitting design at every intervention step.
Such programme can be summarized in the following graphics (full table is reported in Annex 4 of Del. 7.9 about sustainability plan):

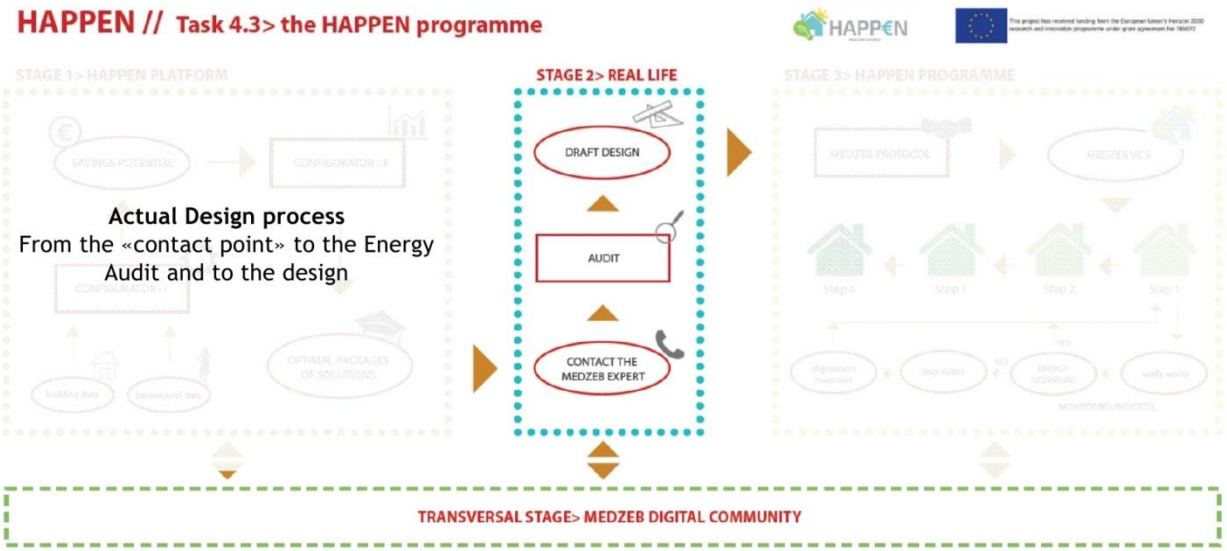

Figure 6 - Stage 2 - real life contact with the MedZEB expert

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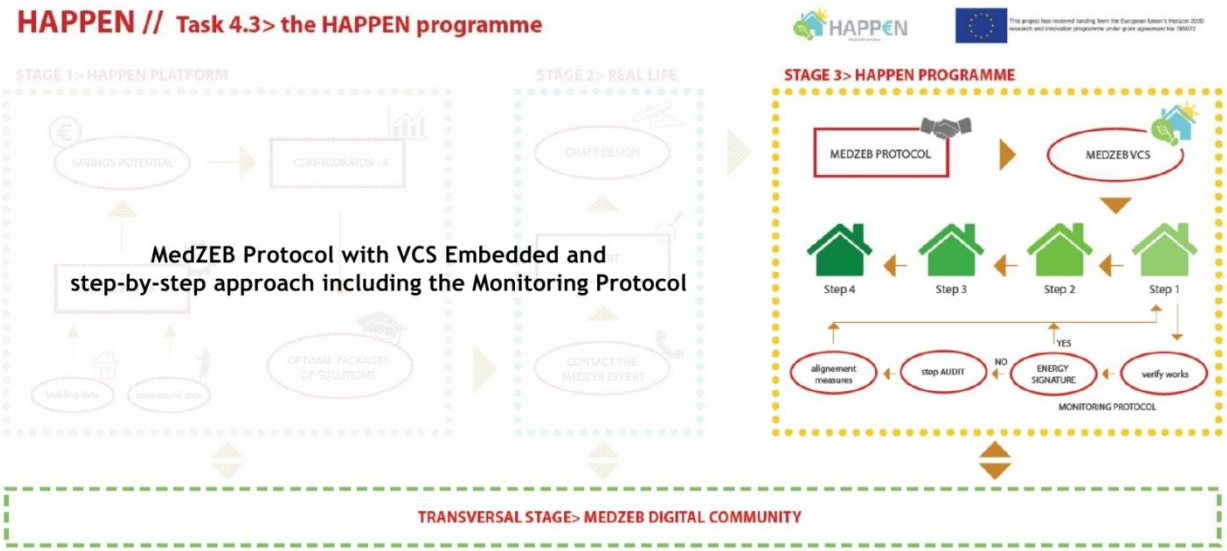

Figure 7: Stage 3 - activation of the MedZEB protocol

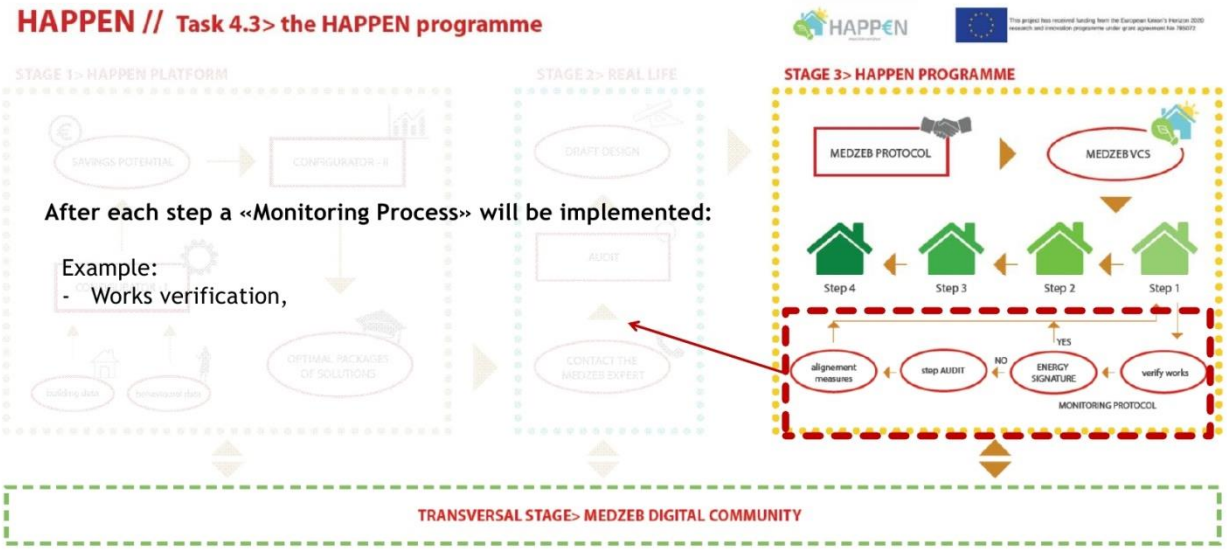

Figure 8- Stage 3 - quality control routine of the HAPPEN step-by-step approach

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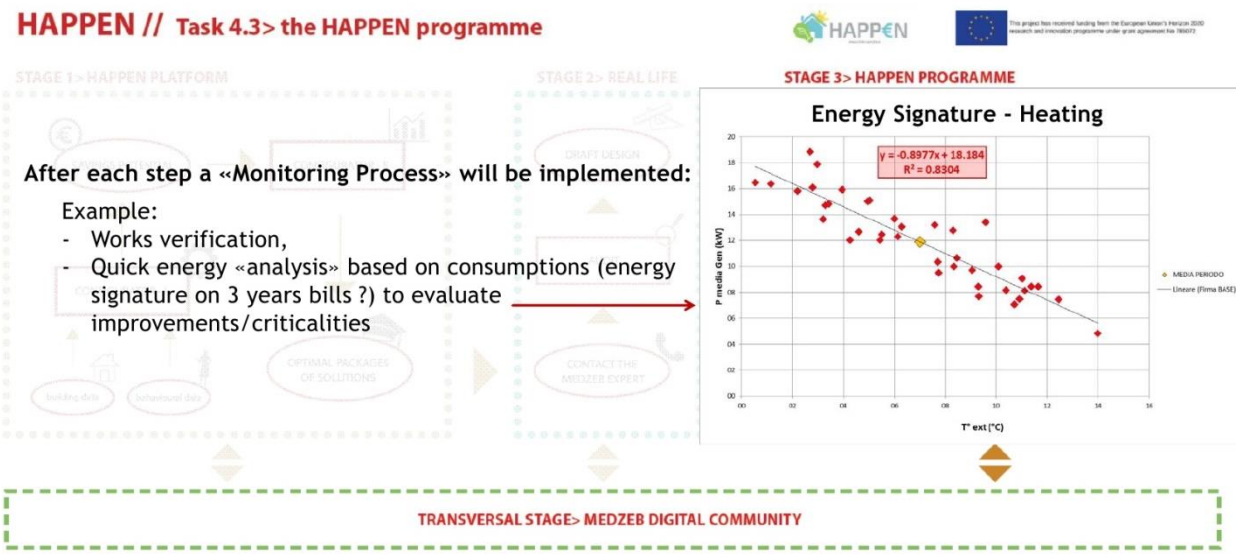

Figure 9: Stage 3 - the role of the energy signature

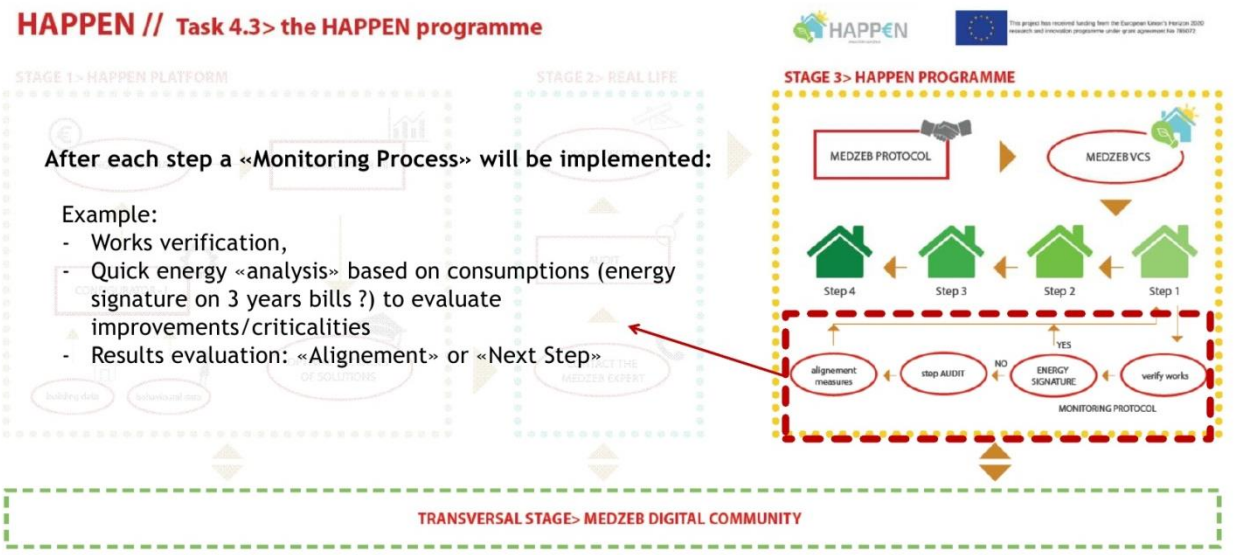

Figure 10: Stage 3 - conclusion of the quality control routine

The MedZEB Protocol is intended as a guarantee that retrofitting process will be carried out properly along the whole value chain by ensuring energetic, financial, environmental and wellbeing performances this will allow subjects involved in the retrofitting market to cooperate according to shared quality principles and procedures, where responsibilities and control levels be fully described only subjects who have undergone a proper training on the MedZEB approach will be allowed to join the protocol. In this frame, a step by step approach from basic to advanced monitoring is proposed in

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Figure 11, referring to pre and post retrofitting period. The monitoring protocol should be in align with MedZEB protocol in order to complete the stepwise aim for optimum energy savings (>70%) in the building as shown in the Figure 4. Specifically, the valid results from monitoring campaigns can be used for the calculation of the building's energy signature.

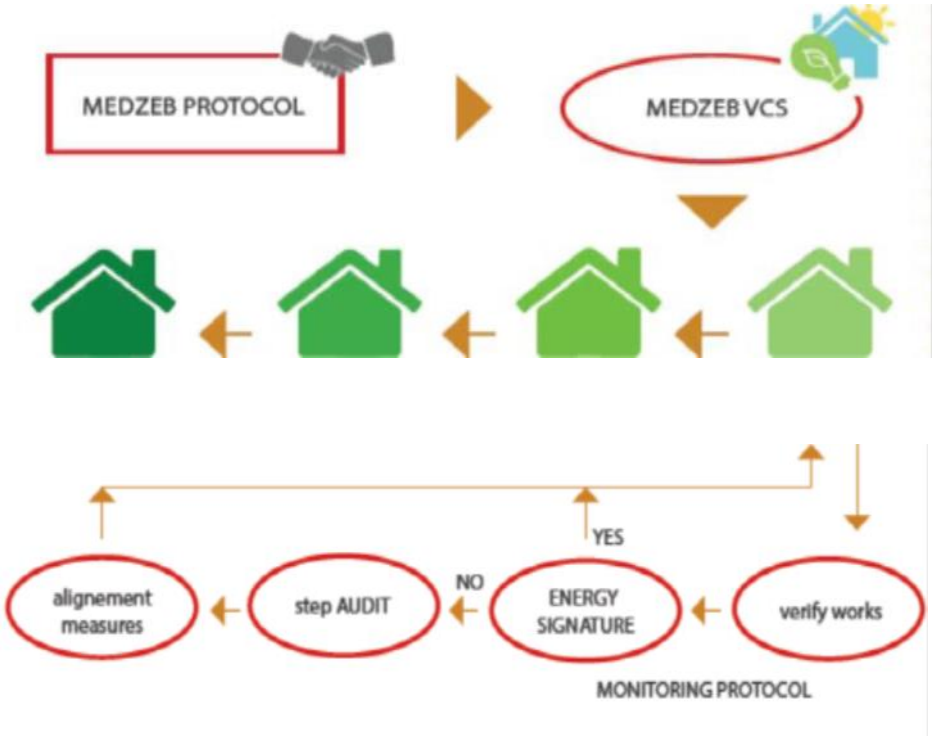

Figure 11: MedZEB Protocol approach along with Monitoring Protocol

Figure 12 presents a draft of the stepwise monitoring protocol procedure according to the intended building categories: the basic (Bronze), the intermediate (Silver) and the advanced (Gold).

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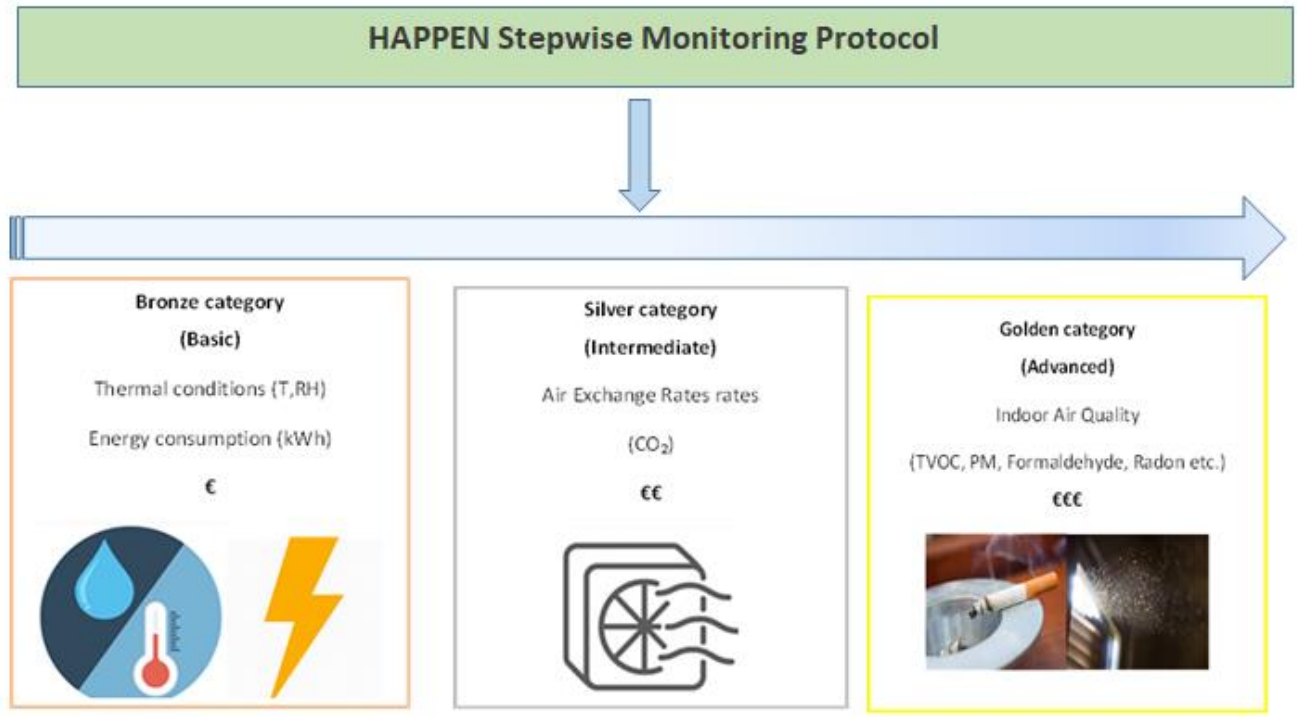

Figure 12. MedZEB stepwise monitoring protocol

4.1 Development of the monitoring system

According to Grant Agreement — 785072 — HAPPEN a standard monitoring system should be adopted from all partners in order to allow the later comparability of the results. All the work produced will be distilled into MedZEB monitoring principles, which are going to be followed. In particular, the following elements will be considered:

1. Monitoring of the pilot buildings. The parameters related to the building will be obtained by a smart interoperable sensor network which will be installed in the buildings under investigation. The measurements will be deployed before and after the interventions, covering a variety of meteorological conditions (warm and cold periods).
2. Evaluation program of the retrofitted pilot buildings. The set of data obtained above will be analyzed statistically to evaluate the pilot buildings performance before and after the interventions. The expected annual energy and thermal performance of the buildings after the retrofit will be determined with the aid of thermal and energy simulation software such as EnergyPlus or TRNSYS.
3. Post-occupancy evaluation. It will be applied in pilot buildings before and after interventions, in order to evaluate the behavioral contribution of households to the planned energy savings. The post-occupancy evaluation will be aimed at the evaluation of the energy saving connected with the behavioral contribution of the households of an entire pilot building or entire pilot intervention

4. Climate change impact on retrofitted pilot buildings. For the selected climatic regions in which the pilot buildings belong climate change data from the existing literature will be collected and analyzed to assess the expected impact of the different scenarios.

Specifically, monitoring is accredited through ISO 17025 (Accreditation Certificate no. 676) and involves specialized scientific personnel and all the necessary equipment.

Monitoring protocols are strongly connected with sampling objectives. In the frame of HAPPEN Grant Agreement — 785072— a standard monitoring system should be adopted from all partners, including the following parameters related to each Pilot building, before and after energy retrofitting actions:

- Temperature, Relative Humidity
- Infiltration/ventilation rates
- Indoor environmental quality
- Visual comfort levels
- Energy profiles/demands and actual consumption
- Meteorological data

In order to fulfill this task measured parameters, methods and national standards can be summarized in Table 2.

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Parameter	Method/Device	Comments
Temperature, Relative Humidity (and other thermal comfort indexes)	Real time /Sensor	ISO 7730:2015
Air Exchange Rates (CO_2 or other tracer gas)	Real time /Sensor	ISO 12569:2017
TVOC, PM, Formaldehyde, Radon etc.	Real time /Sensor	EN 12341:1999
Illunminance	Real time /Portable instruments	EN 15251:2007
Energy consumption	Real time/ BMS	If a BMS system is not available, metering can be implemented from the bills
Meteorological data	Real time /Sensor	Outdoor sensor or local metrological station

Table 2. Methods and national standards to monitor the different parameters

Quality assurance of the equipment used will be performed in several occasions during the experimental campaign and all instruments are calibrated according to the manufacturers' standards. Table 3 presents the parameters to be monitored according to the requirements of the project and the related NKUA experimental instrumentation.

Parameters to be monitored	NKUA experimental equipment
Temperature, relative humidity indoor environmental quality	**IAQ Tongdy sensors (Air quality and thermal conditions)** • T range from 0 to 50 °C • RH range from 0 to 95% RH, non-condensing • CO_2 range from 0 to 2000 ppm and accuracy of ± 40 ppm • TVOCs range from 1 to 30 ppm with accuracy of 1 ppm.
Infiltration/ventilation	**Innova 1312 (Air Infiltration)** Photoacoustic monitor, measuring air exchange rates and air tightness of a room • Use of **SF6 or CO_2** as **a tracer gas** Recording the decay of concentration over short time periods (h^{-1})
Thermal comfort	**SWEMA Thermal environment (thermal comfort)** According to **ISO 7730** three indices will be measured: PMV, PPD and DR • PMV: Predicted Mean Vote • PPD: Predicted Percentage Dissatisfied. • DR: Draught Rate
Internal illuminance	**TES-1335 (Internal illuminance)** Digital Light Meter Measuring • Lux range from 40 to 400000 • Resolution of 0.01 Lux

Table 3. Parameters to be monitored according to the requirements of the project and the related NKUA experimental instrumentation.

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5 COMPONENTS OF THE PROTOCOL

A first draft of the possible components of the MedZEB Protocol is presented in this section. Further design and fine-tuning of all the elements will be carried out in the next Project phases.

5.1 EPC

The Energy Performance Certificates (EPC) was introduced at European level in the EPBD 2002 [2] as an important instrument that should contribute to the enhancement of the energy performance of buildings. EPCs play a central role in the context of the Article 20 (2) EPBD, which asks Member States to provide information: on the energy performance certificates and the inspection reports, on the cost-effective ways and, where appropriate, on the available financial instruments to improve the energy performance of the building to the owners or tenants of the buildings.
The main aim of the EPC is to serve as an information tool for building owners, occupiers and real estate actors and, as remarked by Arcipowska et al. [3]. To date, however, renovation rates in the EU are low and renovating the existing building stock to make it more energy efficient remains a challenge, even more so when considering the ambitious levels set by the EPBD which includes aims for nearly zero-energy buildings (nZEBs).
Increasing the renovation rate is not an easy task, many barriers have been individuated by the study for the ITRE Committee on 2016 [6]. In Annex C the key barriers to renovate the existing building stock are outlined and grouped into 5 main families: financial, technical, process, regulatory and awareness. In this context [7], EPC has been considered as a reaction to the "information deficit" that belongs to the framework of the barriers to renovation in the EU and referring to building owners' lack of awareness and knowledge of actions to take in order to enhance the energy performance of their building [6]. Moreover, it has been demonstrated by different researches, that the EPC is become a valuable instrument to support market transformation providing energy related building information (i.e. publication of energy performance indicator in commercial media advertisements) [8][9][10] and in parallel affecting the price of buildings and/or the time of sale [11][12].
Despite the EPC potentialities, González Caceres [13] in his work underlined that the different implementation process across the Europe and the weakness of LRs, limited their influence and impact on the renovation process, suggesting changes to improve the quality and impact of this EPC feature. More in depth, Geissler and Altmann [14] pointed out constraints on the role of the RMs within the EPC specifying advantages and disadvantages of the RMs and they proposed to include into the EPC two categories of recommendations: standard and tailor-made. The standard recommendations should show the improvement potential of the renovation measures such as providing the minimum U-value of the building elements, the upgrading or the possible change of heating, AC and domestic hot water systems into more energy efficient alternatives according to the building type and age. These recommendations are cheaper and are kept general providing a basic potential overview of the building components, but in this case, the building owner might not be motivated enough to carry out improvements.

The tailor-made EPC recommendations should not only demonstrate the energy efficiency potential of the building, but also propose detailed renovation measures, such as the thickness and quality of the insulation according to the calculated needed U-value, the quality of the windows, the appropriate heating and domestic hot water system or variations according to the condition and situation of the building. In order to obtain a reliable EPC and tailor-made recommendations. Those other recommendations would significantly increase the price of the EPC but provide more specific information. The detailed or tailor-made EPC recommendations give the building owner a proper support in what needs to be done in relation to the energy efficiency of the building [14].
This fact is moreover confirmed in the latest update of the EPBD, since the current directive 2018/844/EU [15] has not modified the articles related to issuing and displaying of the energy performance certificate (Articles 11, 12 and 13). Basically, the Directive requires the Member States to lay down the necessary measures to establish a system of certification of the energy performance of buildings, including a methodology for the calculation of the energy performance of buildings which shall be transparent and open to innovation. Several studies have addressed the EU implementation of energy labeling buildings empirically. Eichholtz et al. [16] investigating the commercial office segment, found that US office buildings with a "green rating" are sold for about 16% higher prices. Brounen and Kok [17] performed a hedonic regression analysis on housing sector and they provided a first evidence of the economic impact of EPC implementation for residential dwellings confirming that there is a price premium for houses labelled as more energy efficient. Similarly, the Bio Intelligence Service [18] report - prepared for the European Commission - stated that EPCs have a significant impact on transaction prices and rents in selected EU countries thanks to a literature review on 22 studies to examine whether the EPCs affect property values. The main recommendations suggested within the conclusion of this study were: (i) to strength the role of EPCs; (ii) to implement them faster, (iii) to anticipate the publishing phase within the transaction process (e.g., at the time of advertising) and (iv) to make them more visible and comprehensible (e.g., with a more eye-catching front page or by improving the layout and using common language).

5.2 Preliminary draft of the renovation project

The Protocol should include a reference design of the renovation project. The Renovation Project has to be described as a whole, by basing on the selected Cost Optimal Package of solutions and related costs. An appropriate design level for the Protocol will be pursued according to the specific national laws in each Partner Country. At the design level, some documents could be included as for example feasibility study, preliminary design, definitive design, etc. In order to properly design the renovation project.

5.3 Business Plan

Starting from the existing running experiences reviewed, a first draft of business plan is provided in this section. The business plan is mainly focused on the financial solution designed in the HAPPEN framework and extensively described in Deliverable D4.3 and shortly reported in the present

deliverable. The technical interventions and the financial instrument are designed to allow a step-by step retrofit to be carried aout and to avoid lock-in effects.

The buisiness plan could include a description also of the technical interventions as suggested in the EnerFHit Protocol, see

In particular, in the EnerPHIt experience which could be useful to draft a business plan taking into account the technical and financial aspects, several documents are included as the scheduler as reported below.

- **TITLE** – general information, chart illustrating the decreasing energy demand
- **SCHEDULER** – allows to enter lifecycles and illustrates the point of time to carry out retrofit steps to roughly schedule all the required steps to achieve EnerPHit Standard.
- **OVERVIEW** – allows a clear detection if the steps carried out allow the fulfilment of EnerPHit criteria for both component qualities or energy demand and shows the annual sum of investment costs and energy costs for all steps.
- **COSTS** – you can enter the estimated investment costs for the measures here, including the costs for any how-measures and financial support.

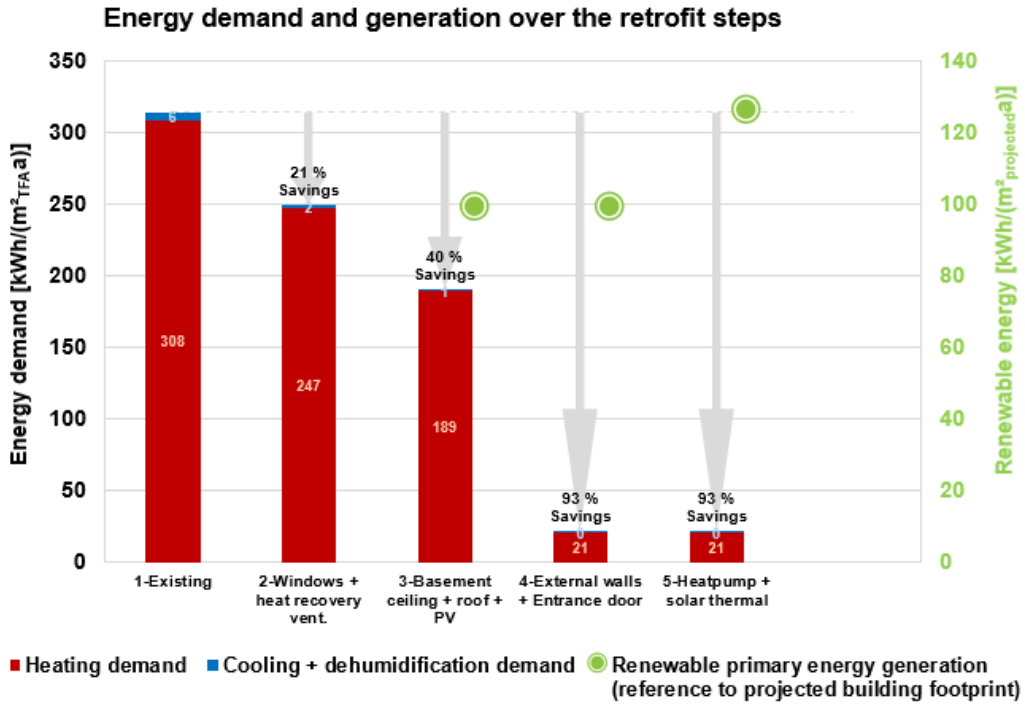

Figure 13 Energy demand and generation over the retrofit steps

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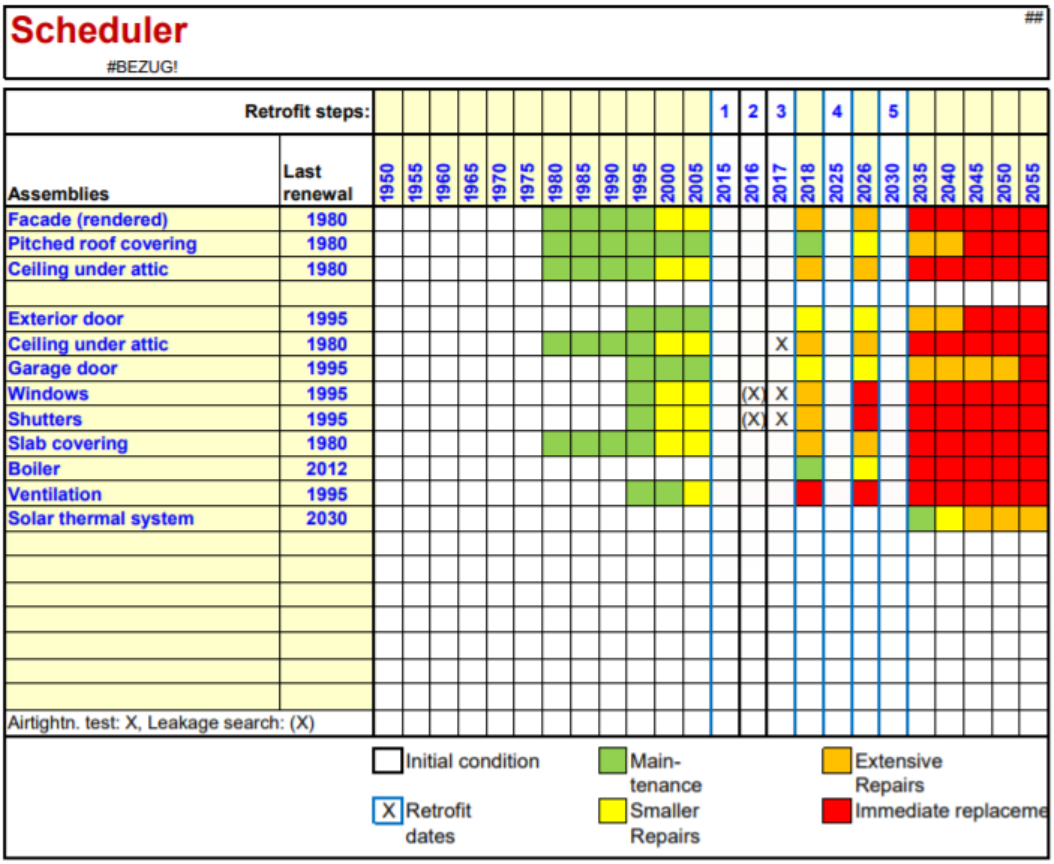

Figure 14, Scheduler

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Overview of measures

#BEZUG!

Retrofit step No.		1-1: Existing	2-2a: Windows + Doors	3-3a: Roofs + Ventilation	4-4a: External insulation + Slabs	5-5a: Grey water heat recovery + Solar thermal		Criteria	Alternative criteria
Year		2015	2016	2016	2025	2030			
Measures									
Occasion ("anyway measure")	a		Replacement of windows, entry door and shutters	Replacement of roof covering	Renewal and Paint of external render	Replacement of DHW distribution			
Energy-saving measure			Replacement to EnerPHit quality	Ceiling airtightness and insulation, Garage roof parking insulation	EIFS including connection to roof and windows	Grey water heat recovery + Solar thermal panels connected to gas boiler			
Occasion ("anyway measure")	b		Paint garage door	Replacement of ventilation nozzles and ventilator, replacement of attic trap door					
Energy-saving measure			Garage door replaced by glazed window-doors	Installation of mvhr unit and supply ducts, new attic trap door	Insulation under screed for garage slabs				
Occasion ("anyway measure")	c								
Energy-saving measure									
Occasion ("anyway measure")	d								
energy-saving measure									
Occasion ("anyway measure")	e								
energy-saving measure									
Occasion ("anyway measure")	f								
energy-saving measure									
Occasion ("anyway measure")	g								
energy-saving measure									
Occasion ("anyway measure")	h								
energy-saving measure									
Component characteristics									
Wall to ambient air, ext. insulation (U-value)	[W/(m²K)]								
Roof (U-value)	[W/(m²K)]								
Building envelope to ambient (U value)	[W/(m²K)]							####	-
Wall to ground, ext. insulation (U-value)	[W/(m²K)]								
Basement ceiling / floor slab (U-value)	[W/(m²K)]								
Building envelope to ground (U-value)	[W/(m²K)]							####	-
Wall, int. insulation to ambient air (U-Value)	[W/(m²K)]							####	-
Wall, int. insulation to ground (U-Value)	[W/(m²K)]							####	-
Flat roof (solar reflection index, SRI)	[W/(m²K)]							####	-
Inclined and vertical external surface (SRI)	[W/(m²K)]							####	-
Windows / doors ($U_{protected}$)	[W/(m²K)]							####	-
Windows ($U_{W,installed}$)	[W/(m²K)]							####	-
Windows ($U_{W,installed}$)	[W/(m²K)]							####	-
Glazing (g-value)	[]							####	-
Glazing/sun protection (max. solar load)	[kWh/(m²a)]							####	-
Ventilation (effective heat recovery efficiency)	[%]							####	-
Ventilation (effective humidity recovery efficiency)	[%]							####	-
Airchange at press. test n_{50}	[1/h]							####	-
Building characteristics									
Heating demand	[kWh/(m²a)]							####	####
Heating load	[W/m²]							####	####
Cooling + dehumidification demand	[kWh/(m²a)]							####	####
Cooling load	[kWh/(m²a)]							####	####
Frequency of overheating (> 25 °C)	[%]							####	-
Frequency of exc. high humidity (> 12 g/kg)	[%]							####	-
Non-renewable primary energy (PE demand)	[kWh/(m²a)]							####	-
Renewable primary energy (PER demand)	[kWh/(m²a)]							####	####
Renewable primary energy generation (reference to projected building footprint)	[kWh/(m²a)]							####	####
#BEZUG!									
Annual energy-related costs									
Energy-related invest. (interest+repayment)	[€/year]								
Expected energy costs (total of all energy use in the building)	[€/year]								
Total costs	**[€/year]**								

Figure 15- Overview of the measures

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Interrelations

###

	current step	subsequent steps			
		1-Thermal insulation on the outside	2-Insulation of the wall on the inside	3-Pitched roof insulation	5-Top floor ceiling insulation
1	Thermal insulation on the outside				
2	Insulation of the wall on the inside				
3	Pitched roof insulation	Provide an adequate roof overhang for later insulation of the façade. Provide temporary cladding of the underside of the roof overhang, keep in mind the thickness of the later wall insulation for connection of the downpipe to the ground			
5	Top floor ceiling insulation	Provide the possibility of later connection of insulation to the facade insulation without any gaps. Bring airtight membrane to exterior face of eave to get airtightness continuity when retrofitting walls			
7	Basement ceiling/floor slab insulation				
8	Perimeter insulation				

Figure 16. Interrelations to avoid lock-in effects

With reference to HAPPEN a first draft of business plan is presented in the next figures.

Moreover an introduction of the HAPPEN financial solution developed by the Partener H&D is shown in the next subparagraph.

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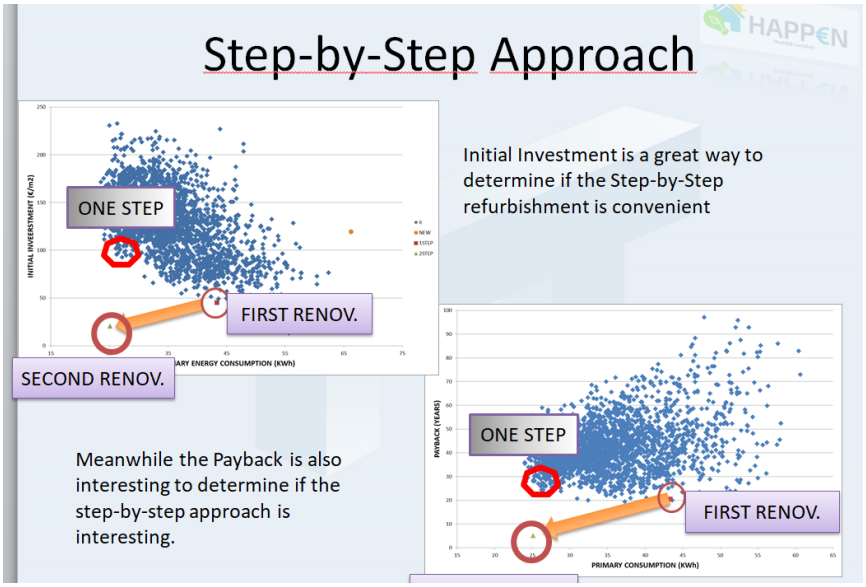

Figure 17. Step by step approach. an introduction to the business plan

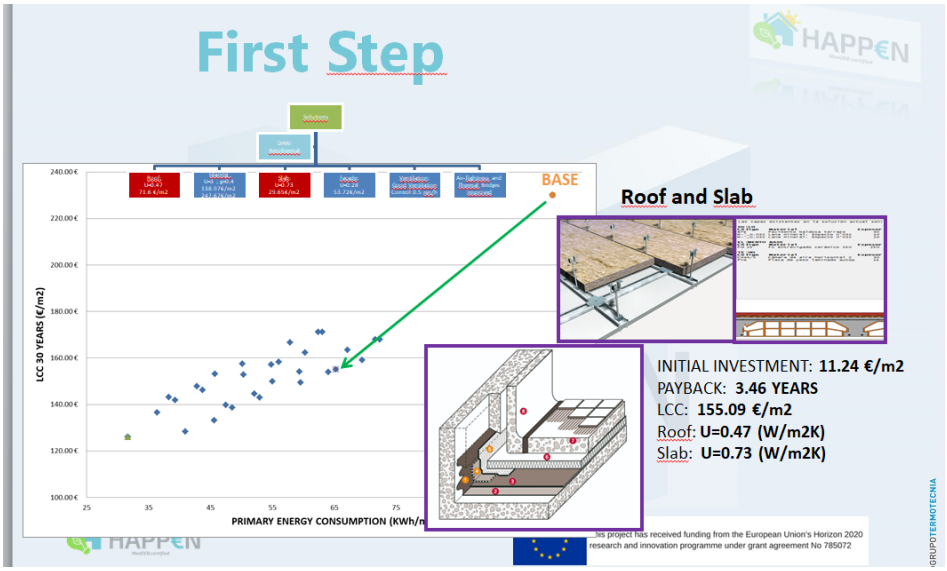

Figure 18. Example of the first renovation step

5.3.1 Mutual Versatile Energy

The HAPPEN project has set itself the objective of boosting the energy requalification of buildings located in cities of the European countries of the MEDzone, studying a uniform procedure for all States concerned. The real estate involved is significant and dated and the retrofitting interventions will have to be reasonably radical; these premises lead to significantly high cost estimates. To make this economic commitment sustainable, the completion of the retrofitting has been planned with several stages of intervention, in order to dilute the financial costs over time and allowing owners to take advantage of the energy savings that are generated by each stage.

The HAPPEN Consortium, with the collaboration of H&D and in particular the technical advice of Doct. Eraldo Stefano Menconi, has developed an innovative financial solution called VERSATILE MUTUAL

ENERGY, to adapt to the peculiar MEDzone necessities and to anticipate all possible risk factors. The solution consists in the contractual definition of a *cumulative mortgage loan* in year 0 for the estimated total expense for the deep requalification of the building. The solution has a *Step by Step design*, and it will entail three disbursement Steps to match the progression of the Step by Step Technical Optimal Solutions package individuated for the intervention. The total amount taken out will be based on the technical package and will take into account the expected financial savings generated by the energy optimization achieved through the completion of each Step of the intervention, which will contribute to make the repayment of the instalments sustainable for the owner.
Furtherly, VERSATILE MUTUAL ENERGY has been designed to provide maximum flexibility and versatility both to the Bank and to the applicant and to adapt to the specific necessities of each case, in order to increase the achievability and face the peculiar challenges of the retrofitting of existing buildings, especially condominiums, located in European cities of the MEDzone.

5.3.2 General Description

The technical structure of the financing envisaged is that of a mortgage loan including three Steps, each with a dedicated amortization plan and composed of different Work Phases (at the end of each of which the relative Project Status Report (PSR) and Interim Payment Certificate will be redacted). The financing will indicatively develop as follows:

- A technical project is prepared for the achievement of the total energy optimization of the building through three Steps of intervention, with an indication of the initial value, the restructuring costs, the economic savings that can be achieved and the estimated higher market value from which the asset will benefit, as a result of the work carried out in each phase;
- The bank will register a reasonable mortgage for the total costs expected for the intervention and the expected duration of the whole process;
- At the beginning of the first Step the first financing tranche is allocated, and at each Interim Payment Certificate the corresponding sum is disbursed, allowing for the payment of the PSRs connected with the first Step of the intervention, and the relative amortization plan begins with the duration established according to the technical plan and the hypothesized savings derived from the energy optimization;
- The bank (after having exceeded a significant percentage, indicatively 50-60%, of reimbursement of the total sum disbursed within the first Step) will then allow for the sourcing of the second Step's funds and the corresponding amortisation plan will also start;
- Approximately at the achievement of the full reimbursement of the first Step's financing and of a significant and specific percentage of the Second Step's financing, the bank will allow for the allocation of the third and last financing, with the beginning of the corresponding amortisation plan, with duration reassessed on the actual savings obtained and with its extinguishment marking the end of the whole amortization plan.

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In the following Figure 19 a possible declination with example percentages and time periods is presented. In particular: 50% disbursed in the context of the first Step, 30% in the second and 20% in the third, with second and third disbursements provided at the achievement of 50% of the previous reimbursement plan. In this example, each STEP's amortization plan will have an extinction period of approximately 15 years. Each case's specifics will be uniquely declined accordingly to the Technical Optimal Solutions package individuated and the specific needs of the borrower.

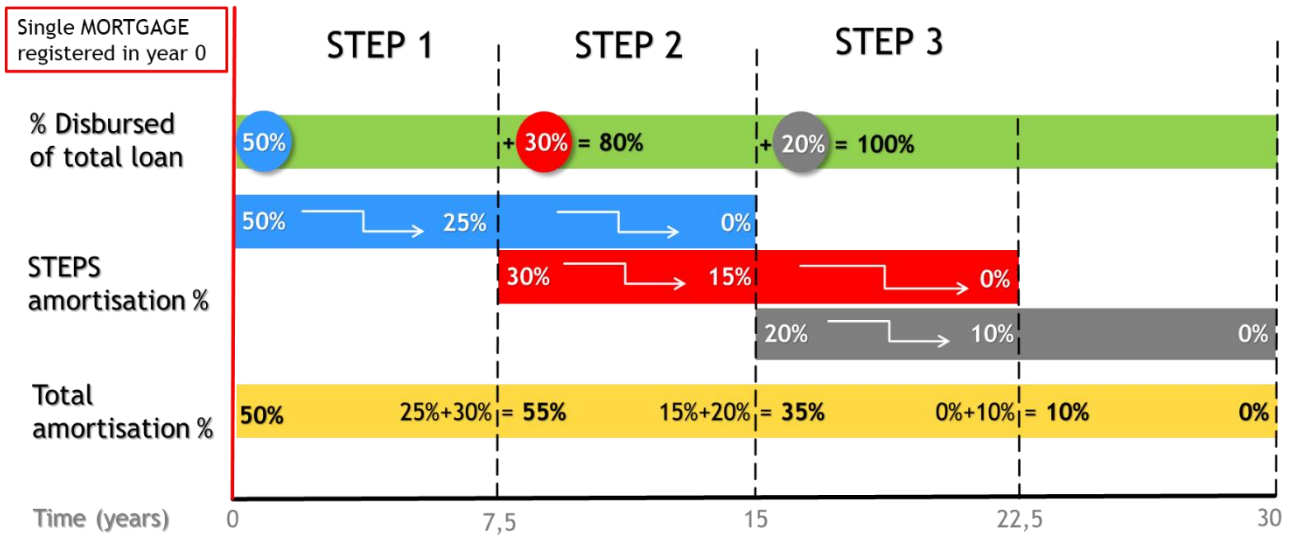

Figure 19- POSSIBLE DECLINATION OF THE OPTIMAL FINANCIAL SOLUTION

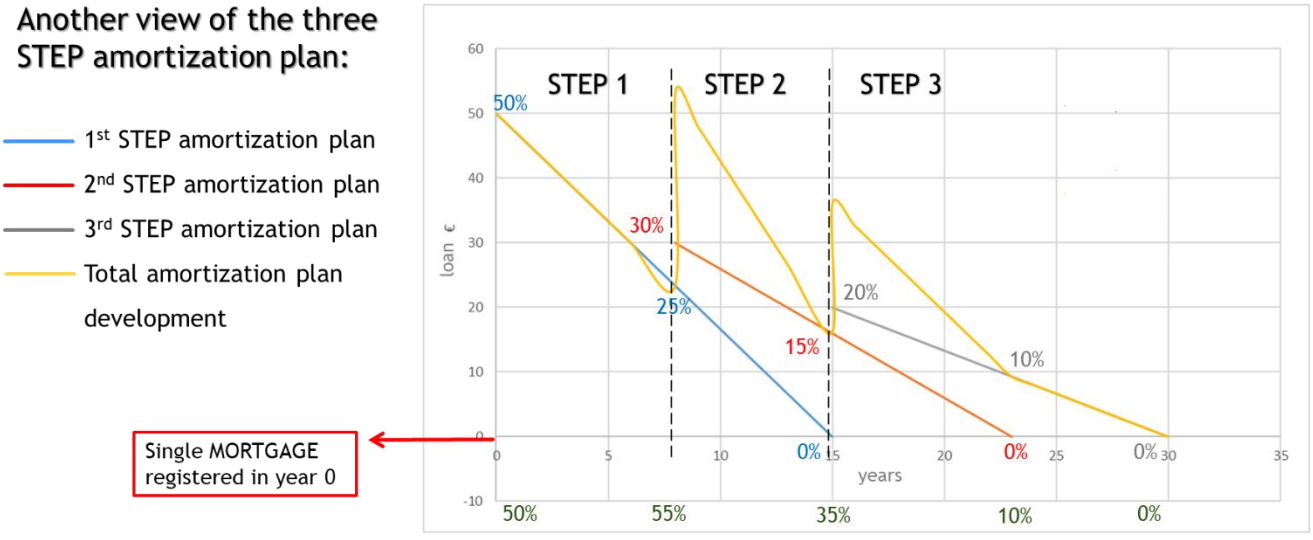

Figure 20. POSSIBLE DECLINATION OF THE OPTIMAL FINANCIAL SOLUTION

It is plausible that the first intervention allows the achievement of about 50% of the total savings that can be obtained (certified by a specific technical project), with the two subsequent interventions completing the remaining 50%. The aim of this proposal is to use these savings as a source of

reimbursement for the funding obtained to support the interventions; nonetheless, in each specific case a technical analysis will be needed to certify that the savings estimated would suffice, taking into consideration, among the other factors, the estimated evolution of the cost of energy over the duration of the process. All phases will evidently have to be assisted by technical experts who will update and certify the initial values and estimates, as well as the correctness and effectiveness of the interventions carried out during the Steps of the intervention.

It is clear that a period of several years has to be taken into account for the completion of the renovationprocesses and during this period events potentially hazardous for the project could verify. It is therefore crucial to offer a financial product (and not that alone) that helps and facilitates all the steps of the project, setting the best conditions for the success of the process and creating a natural deterrent for a possible anticipated exit from it.

This is why the borrower will be put, right from the beginning, in the best condition to successfully complete the retrofitting process and will be thoroughly followed all along. Nonetheless, the solution is designed to adapt to different possible scenarios and to address possible issues such as building, property and bureaucracy related issues such as transfers of ownership, inheritance, little interest in the completion of the process. The borrower will for instance have total flexibility to:

- Adhere to the three Steps (Technical and Financial) Solution or to part of it;
- Apply for the mortgage and then individually decide whether to privately fund a Step or to ask for its loan coverage;
- Extinguish the loan earlier than planned;
- Opt out of the retrofitting at any Step.

In particular, should the subject decide to privately fund the first Step, yet adhere to the mortgage in order to possibly ask the financing for the second or third Steps, the mortgage would be unenforceable until an actual debt is created. It is also important to note that, even if the mortgage is defined in year 0 for the total amount of the intervention, it can only be enforced on the outstanding debt, which, being each step's release subject to the reimbursement of a pre-defined percentage of the previous ones, never exceeds a ceiling percentage (e. g. 55%).

While the owner must always have the freedom to assess whether or not to proceed with the completion of the planned works, the project obviously relies on the interest of the owners to go forward with the established plan, for the benefits in terms of value upgrade of the asset and of the economic savings, whose benefits will presumably be felt mostly at an advanced stage of repayment of the debt. In addition, technological progress is likely to lead to further benefits in terms of cost savings and increased efficiency.

At the subscription of the loan, the creditworthiness of the client will be assessed through the criteria of propriety, reliability and consistency of the guarantees; however, all the benefits described above will enormously facilitate this process, reducing the debt, the risk and the economic exposure of the bank.

Lastly, in the event that a previous mortgage loan exists on the asset, the versatility of the financial solution offers the possibility of the subrogation of the mortgage to another credit institution, that takes over the guarantee. The ceiling on the possible debt and the savings generated from the interventions

would help minimize the amount added to the previous loan's outstanding debt, facilitating the concession of the mortgage guarantee and the access to the loan.

Credit institutions have the opportunity to play a fundamental role by providing adequate guarantees and commitments which, as mentioned above, could also be reduced compared to the initial estimates. The additional potential for cross-selling on patrimonialized retail customers and creating a trust dynamic should not be underestimated. The regulatory/contractual part will have to provide the versatility degree required by the design of the financial instrument, in order to support any occurrences that may verify during the life of the loan.

5.4 Building renovation roadmap

The Building Renovation Roadmap that is a step by step renovation roadmap in which the building is considered as a whole to avoid the lock-in effects. In the renovation plan, the **cost optimality of each package of solution** will be considered and the financial instruments to support the renovation process provided are described and quantified for each step. Moreover, the **comfort, the behavioural and wellbeing aspects** are taken into account.

A first draft of a list of KPIs to characterize both energetic and "non energetic" aspects is presented in the tables in the next paragraph.

5.5 Voluntary Certification Scheme

The Voluntary Certification scheme conceived in the HAPPEN Framework is intended **as a dynamic tool.** It has to be prepared at the beginning of the renovation works. The document will be completed after the energetic signature and at each renovation level it will be updated. This is to ensure that all the renovation stages will be achieved by means of the Renovation Roadmap.

In particular, the working principle of the voluntary certification scheme conceived in the HAPPEN framework is described in Figure 21.

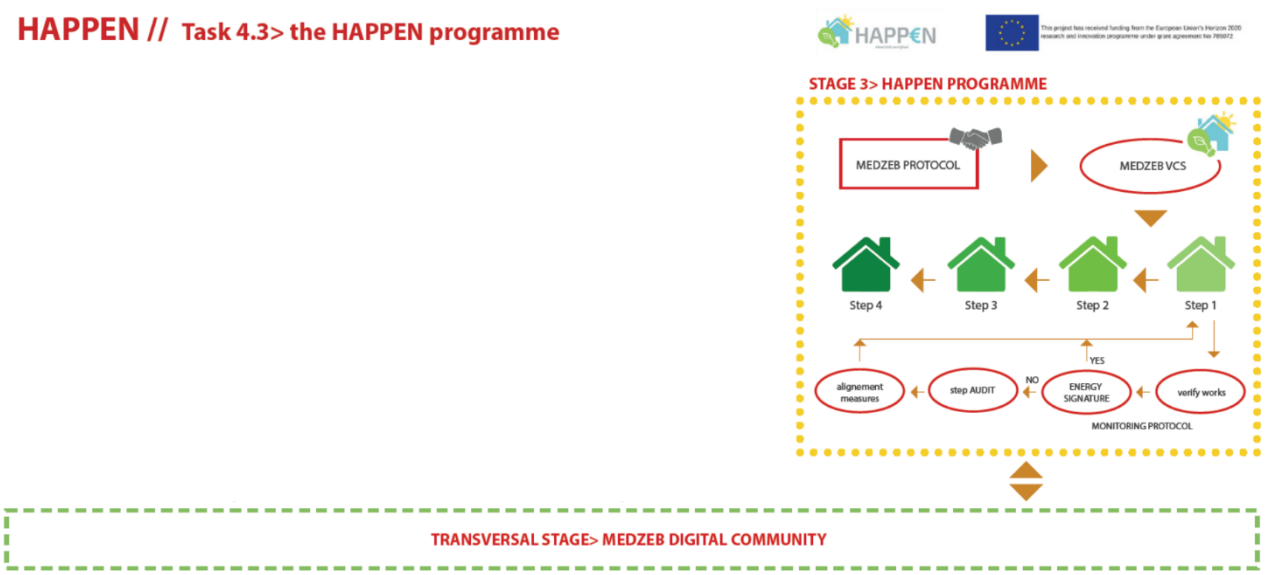

Figure 21- The MedZEB Protocol with the embedded VCS

The achievement of each step of the renovation will be verified by means of a dedicated Monitoring Protocol fulfilled by means of a monitoring procedure. The monitoring procedure is based on different steps. It starts from the work verification, then, a "quick" energy "analysis" based on consumptions (energy signature on 3 years bills, for example) to evaluate improvements/criticalities. Then, after performining an audit, the results will be evaluated. It will be decided if an alignment is necessary (for example if the energy consumptions are diifferent from what expected, some corrections have to be made) or to preoceed ahead to the next step.

The renovation levels achievable are identified with the MedZEB Levels chromatic fields displayed in Figure 22

MedZEB Levels - chromatic fields

LEVEL 0
LEVEL 1
LEVEL 2
LEVEL 3
LEVEL 4
LEVEL 5

Figure 22- MedZEB Levels chromatic fields

The five renovation levels are mainly and preliminarly as draft differentiated on the basis of the Primary Energy Demand Reduction and they ranges from low reduction of primary energy demand (first level) up to a reduction of the Primary energy demand similar to a n-ZEB bulding, as depicted in Figure 23.

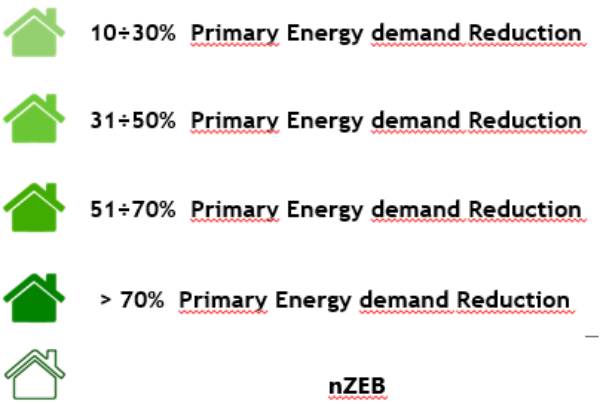

Figure 23- MedZEB Renovation Levels

As above specified, this introductory distinction of the Med-ZEB levels in the VCS framework based on the primary energy demand reduction is only preliminar, because different and "non-energetic" aspects, quantified with properly defined KPIs, have to be considered. These "non-energetic" aspects involve mainly the comfort issues and the sustainability. In order to quantify the improvement in the sustainability aspects, further investigations have to be carried out in the next steps of the project activities, as the sustainability is the focus of the Task T 3.4, entitled "Calculation of the holistic impact of the renovation interventions", starting in the month M16 of the Project.

Therefore, a scoring system which takes into account energetic aspects and "non energetic" aspects will be ad- hoc designed in the future activities. It may be evaluated also the chance to introduce a mixed system in which the improvement in the energetic aspects is quantified by means of the primary energy demand reduction and the comfort and the sustainalbilty aspects could be evaluated for example as performed in other voluntary cetification schemes as LEED, BREEAM or others as Perfil de la Calidad.

However, a first draft of the possible KPIs to be considered is listed in the following Tables. It is important to consider that each renovation level, which at present is identified only on the basis of the primary energy demand reduction (but this aspect will be furtherly fine-tuned considering also the other issues), may be achieved or in one step or in different steps.

The KPIs for the energetic aspects, listed in Table 4 are mainly based on those available in the EPC schemes. When considering the KPIs employed to characterize the building envelope, they are mainly based on those available in [20]. Moreover, KPIs for Air tightness and HVAC systems are listed in Table 6. The frequency of overheating in summer and the frequency of the excessive humidity are taken into consideration in the EnerPHit protocol, however they need futher investigations to be placed correctly in the HAPPEN framework. Moreover, the KPIs for comfort issues, heat Island effect mitigation and sustainability aspects are taken into account in Table 7 and will be furtherly developed also in cooperation with the other Project Partners as IVE and NKUA. This is because these indicators require an-in depth analysis both for their definition and for their evaluation. Moreover, a modular approach which forsees firstly the compulsory fullfillment of the energy requirements and then the fullfillment of the other requirements could also be taken into account.
Moreover, the possible consideration of a multi-level performance assessment as proposed in the LEVEL framework could also be examined.

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Retrofit Step	"As it is"	Level #1 (10÷30% Energy demand Reduction)	Level #2 (31÷50% Energy demand Reduction)	Level #3 (51÷70%Energy demand Reduction)	Level #4 (>70% Energy demand Reduction)	nZEB
Year						
Description of the renovation measures *Measure to be carried out Please add a brief description of the measures, which should be carried out for each step*						
General data						
Climatic Zone						
Heated Volume, Vh [m3]						
Heated Area/ Treated Floor Area, A [m2]						
Envelope area/Volume Factor, A/Vh [-]						
Energy Performance Indicators						
Primary Energy need for heating [kWh/y] – **XX**						
Primary Energy need for DHW [kWh/y]						
Primary Energy need for cooling [kWh/y]						
Primary Energy need for lighting [kWh/y]						
Primary enegy need for auxiliaries [kWh/y]						

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Global primary energy need [kWh/y]	0					
% Reduction	-	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Primary Energy need for heating [kWh/m2y]	#DIV/0!					
Primary Energy need for DHW [kWh/m2y]	#DIV/0!					
Primary Energy need for cooling [kWh/m2y]	#DIV/0!					
Primary Energy need for lighting [kWh/m2y]	#DIV/0!					
Primary enegy need for auxiliaries [kWh/m2y]	#DIV/0!					
Specific global primary energy need [kWh/m2y]	#DIV/0!					
% Reduction	-	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Non-Renewable Primary energy demand [kWh/m2y]						
% Reduction	-	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Renewable Primary energy demand [kWh/m2y]						
% Increase	-	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
GHG (CO_2), [kg/m2y]						
GHG (CO_2 reduction),[%]	-	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Table 4. KPIs for energetic aspects and renovation levels to be considered in the VCS

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Retrofit Step	"As it is"	Level #1 (10÷30% Energy demand Reduction)	Level #2 (31÷50% Energy demand Reduction)	Level #3 (51÷70%Energy demand Reduction)	Level #4 (>70% Energy demand Reduction)	nZEB
Year						
Description of the renovation measures *Measure to be carried out Please add a brief description of the measures, which should be carried out for each step*						
Envelope Characteristics						
Wall to ambient air, ext. insulation - U value [W/m2K]						
Roof - U value [W/m2K]						
Building enevelope to ambient - U value [W/m2K]						
Basement ceiling / floor slab - U value [W/m2K]						
Building enevelope to ground - U value [W/m2K]						
Wall int. insulation to ambient air - U value [W/m2K]						
Wall int. insulation to ground- U value [W/m2K]						
Windows/doors - U value Uw[W/m2K]						
Average Building U Value - Uavg [W/m2K]						
%Reduction	-	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Flat roof - SRI (Solar Reflection Index)						
Tilted roof - SRI (Solar Reflection Index)						
Vertical external surfaces - SRI (Solar Reflectance Index)						
Glazing - g value [-]						
Glazing - sun protection max. sun protection [kWh/m2y]						

Table 5- KPIs for the envelope features

Retrofit Step	**"As it is"**	**Level #1 (10÷30% Energy demand Reduction)**	**Level #2 (31÷50% Energy demand Reduction)**	**Level #3 (51÷70%Energy demand Reduction)**	**Level #4 (>70% Energy demand Reduction)**	**nZEB**
Year						
Description of the renovation measures *Measure to be carried out Please add a brief description of the measures, which should be carried out for each step*						
Airtightness and ventilation						
Type of ventilation system (MVS)						
Efficiency of Heat Recovery (if available or applicable) [%]						
Efficiency of humidity Recovery [%]						
Building Airtightness by 50 Pa (ventilation)						
Building Airtightness by 50 Pa 1/h (infiltration)						
Heating and Cooling Systems						

Heating System typology						
Global Efficiency of the heating system [-]						
Solar Energy Coverage for heating System [%]						
Domestic hot water production typology – DHW				Gas		
Solar Energy Coverage for DHW [%]						
Cooling System typology						
Global Efficiency of the cooling system - COP/SEER [-]						
Frequency of overheating[%]						
Frequency of exc. high humidity(>12g/kg)						

Table 6- KPIs for Air-tightness and HVAC

Indoor Air Quality		NKUA - monitoring IVE - perfile de la calidad				
Presence of MVS						
Emission level of Formaldehyde						
Indoor Air Quality Indicator Air exchanges rate (ACH) or CO2 concentration in indoor [n°/h)						
CO2 concentration in indoor air [PPM]						
PM and TVOC content in indoor air [PPM]						

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Noise Insulation						
Sound pressure level (dbA) in living room and in bedroom						
Artificial lighting & Daylight						
Type of lighting						
Lighting power installed [kW]						
Spacial light distribution						
Daylight factor						
Daylight authonomy						
Useful daylight illuminance						
Thermal Comfort Quantitative						
Use of PPD and PMV (EN ISO 7730)+ gender analysis		adaptive comfort has to be considered through the proper EN standard				
Water Impact	Topics concerning the sustainability issue and therefore to understand how to evaluate/include them in the VCS					
Efficiency of the installed hydraulic devices						
Degree of waterproofing of the surfaces						
Possible presence of recovery systems for rain water						
Systems for reusing grey water or disposing of waste water on site						

Heat Islands Mitigation		
Cool Roof (SRI inex)		
Green Roofs		
Possible presence of other elements (trees..)		
Sustainability		
Carbonfootprint of the "package of solution" ?		
LCA approach evaluation ?		
LCC approach evaluation ?		

Table 7. KPIs for "non-energetic" aspects

6 CONCLUSIONS AND RECOMMENDATIONS

This deliverable provides a first draft of the MedZEB Protocol and of its main tools. These are instruments designed to overcome the barriers to building renovation in the MedArea. A preliminary definition of the protocol as well as of its components is shown. However, the design of the MEDZEB Protocol and of its constitutives will be further developed in the next Project phases taking into account the contribution of all the Partner Countries in on order to allow the MedZEB Protocol application in the Consortium countries.

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