DISCOVER MORE ABOUT ECENTRAL

Addressing poor energy performance of public buildings is at the core of the **EU Energy Efficiency Directive - EED and Energy Performance Building Directive - EPBD**, but it is also becoming a growing financial issue in central European countries. In order to address this issue, **eCentral** supports key stakeholders in better understanding benefits of **nZEB - nearly Zero Energy Buildings**. The project proves that the nZEB approach, although innovative, is an **optimal and cost-effective solution** for the renovation and construction of public buildings.

By improving efficiency in public buildings, public authorities **save energy and are important role models.** Within the **eCentral project**, various financial instruments such as **public private partnership (PPP), energy performance contracting (EPC**) and **crowdfunding (CF)** have been tested in Croatia, Hungary and Slovenia. This decision support tool uses the experiences from these pilot actions and provides guidance for other interested public authorities.

MORE INFORMATION

Learn more about the project and our activities:

www.interreg-central.eu/ecentral

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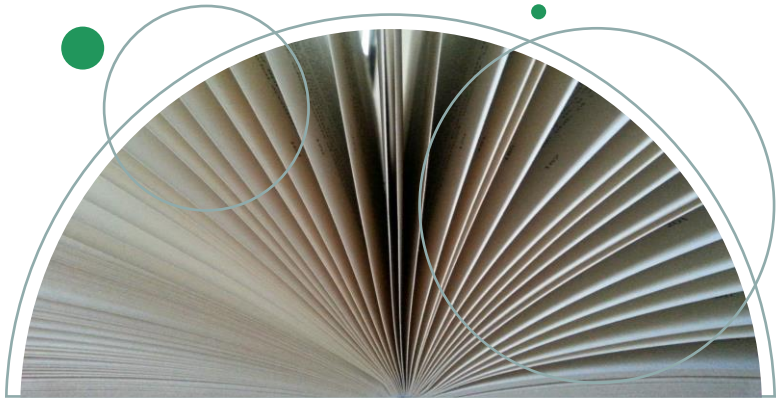
nZEB renovation with innovative financing schemes

CONTENT



ABOUT THIS GUIDE

According to the Directive 2010/31/EU on the energy performance of buildings each Member State must support the renovation of the national stock of residential and non-residential buildings and achieve a highly energy efficient and decarbonized building stock by 2050. Therefore, the cost-effective transformation of existing buildings into nearly zero-energy buildings (nZEBs) must be facilitated. Based on the European definition, a *nZEB 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 nearby.*

This guide was developed during the eCentral project, which lasted from September 2017 to February 2021.

It provides information about nZEB renovation (nearly zero energy building) with innovative financing schemes **Public Private Partnership (PPP), Energy Performance Contracting (EPC**) and **Crowdfunding (CF).** This guide uses results from policy analysis, from the eCentral pilot actions in Croatia, Hungary and Slovenia and from literature research.

NZEB RENOVATION

The European goal is to achieve a highly energy efficient and decarbonized building stock by 2050. This requires the transformation of existing buildings into nearly zero-energy buildings. In addition**, all new buildings need to be nZEBs since 01.01.2021,** whereas some member states defined **nZEB standard for building renovations** as well. Main regulation on European level:

- Directive 2010/31/EU (EPBD), Regulation (EU) 2018/1999 and Directive 2018/844/EU on energy performance of buildings
- Directive 2012/27/EU (EED) on energy efficiency
- Directive 2018/2001/EU on renewable energy

Every member state has chosen its own **nZEB target values** by limiting annual primary energy demand and/or setting minimum requirements for share of renewables. In addition, long-term renovation strategies were also developed by every member state.

A summary of actual nZEB regulation in eCentral target countries is available here.

NZEBS IN A NUTSHELL:

» low energy demand and low energy costs for heating, cooling, ventilation and lightning
» low independency from increasing energy prices
» high share of renewable energy sources and low CO_2 emissions
» high thermal comfort (air quality, heat distribution, mold prevention)
» high quality and sustainable value of building
» low life cycle costs due to lower energy demand

NZEB RENOVATION MEASURES

The following table provides a rough overview on most common nZEB renovation measures, including a simplified rating on investment costs and effects on the total primary energy demand of a building.

INVESTMENT COSTS AND EFFECTS OF ENERGY RENOVATION MEASURES SHOULD BE EVALUATED CASE BY CASE, BECAUSE THEY DEPEND ON THE BUILDING'S CONDITIONS (AGE, HEATING SYSTEM, USER PROFILE, LOCATION, …). **BUILDING ENERGY EXPERTS** SHOULD BE INVOLVED AND CONSULTED TO CHOSE THE **RIGHT RENOVATION STRATEGY**.

Improving building's envelope usually has a high impact on the investment and energy savings. Reducing the heating energy demand should be done before changing the heating system (generator, new energy carrier, new distribution system). Comparably cheap measures are insulation of heating distribution system, efficient circulation pumps, efficient lighting system and energy efficient user behavior. Installing **renewable energy systems** could be necessary to reach the nZEB target.

More details on nZEB renovation measures are available here.

Measure	Investment	Effect on total primary energy demand
Thermal insultion of walls, ceilings, roof and basement	€€€	
Change of windows	€€€	
Change of old heat generator	€€	
Change of heating system - from fossil to renewables	€€€	
Change of heating and distribution system (e.g. radiator, surface heating…)	€€€	
Insulation of heating distribution system (pipes, pumps, storage…)	€	
Efficient circulation pumps	€	
Change of cooling system	€€	
Adding a central ventilation system or cooling system	€€€	*Increases demand*
Renewable energy use (e.g. PV, solar thermal…)	€€	
Efficient lightning	€	
User behaviour	€	
€€€ high €€ medium € low		high medium low

INNOVATIVE FINANCING SCHEMES

Using **innovative financing schemes** for energy renovation requires additional know-how compared to traditional procurement. For choosing the **right financing form** based on factors like equity rate, available know-how and risk spread, a simple decision-making-tree was developed (next page).

In a first step the **equity rate** for the investment should be assessed. In general, it is recommended to already have sufficient or major public monetary resources before commencing PPP models for keeping the financial part of the project in public responsibility. Although the financial liabilities can be outsourced and considered as off-balance sheet in certain cases, they are still present and affect the public budget in a long-term. In addition, public parties usually get cheaper financing from banks, since they usually have a better rating (creditworthiness) than private companies.

If public monetary resources aren't sufficient for implementing the project, the equity can be increased in the first place by using financing forms like **crowdfunding or subsidies**.

Another important factor when choosing innovative financing schemes is the availability of internal **technical** and **economical know-how** and sufficient internal personnel resources. If not, these services can be provided by private partners as well. In addition, it must be clarified, if the distribution of risks (construction, operation…) to the private partner is desired, which is also an advantage of PPP.

Sufficient public financing might be secondary, if the project is **fully sustainable under market conditions** and therefore attractive to private partners. In this case, different forms of PPP or EPC could be evaluated.

The last option is to **postpone or downgrade the project** until its implementation feasibility is realistic.

More information on innovative financing schemes is available here.

THREE TYPES INTO DETAIL

Public Private Partnership (PPP)

PPP is an agreement between **public institutions and one or more private partners.** The private partners deliver the service to meet the objectives of the public party as well as to create profit. The effectiveness of the alignment depends on the sufficient transfer of risk to the private partners. There are several ways of implementing a PPP, depending on distribution of tasks, risk sharing and duties. More information is provided by the EUROSTAT guide 2016.

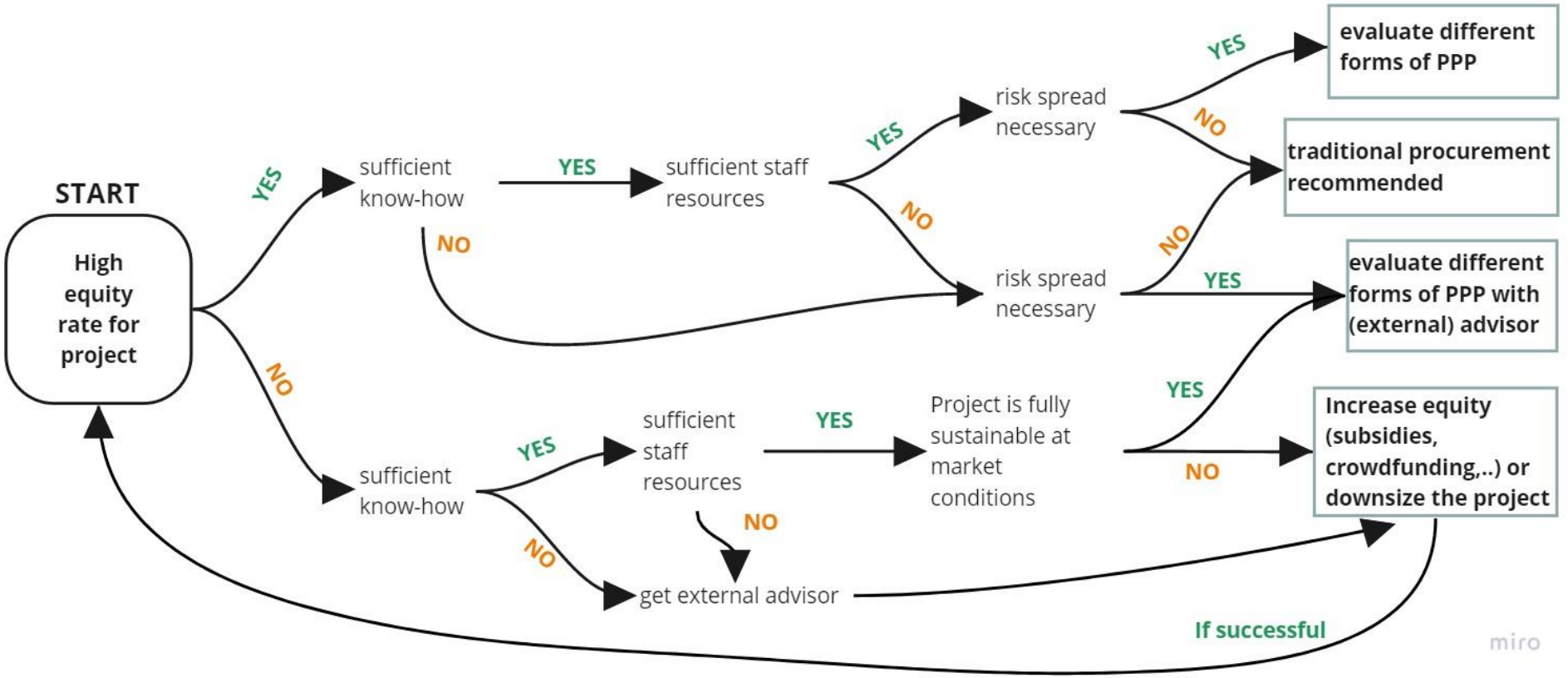
Energy Performance Contracting (EPC)

EPC is a type of PPP. It allows **funding energy upgrades from reducing energy related costs**. An external organization (e.g. Energy Service Company) introduces measures in buildings or other infrastructure to reach energy efficiency goals. The main idea is to use the surplus of income from the cost savings to repay the projects costs, including the investment costs. If more than 50 % of the investment is covered by the public partner, EPC is considered as on-balance sheet. Otherwise, it is off-balance sheet for the public authority (more information available at EUROSTAT criteria catalogue 2018).

Crowdfunding (CF)

The aim of CF is to **raise capital through small collective efforts** (amounts of money) from a large number of people, friends, family members, customers and individual investors to finance a project. There are different typologies available such as reward based, donation based, crowd investing or crowd lending, which may increase equity. The most suitable type for public authorities depends on the respective country legislation. More information on CF for managing authorities is provided by FI Compass 2020.

DECISION-MAKING TREE

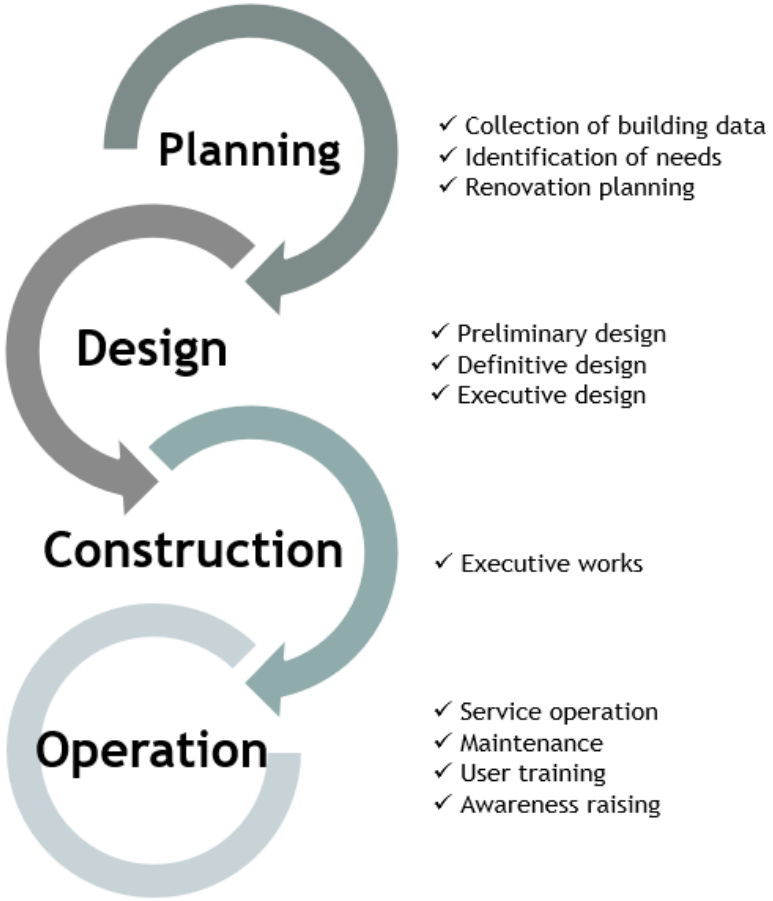


In addition to the decision-making tree, the following guide on choosing adequate financing depending on the investment type can be given:

	Equity-financing	Loans	Subsidies	PPP	EPC	Crowdfunding
Advantages	Low implementation risk	Low interest rates	Increase of equity	Different PPP types available; risk sharing	Guaranteed energy savings; risk sharing	Campaign can be set up quite easy; possibility for citizen participation
Disadvantages	Commitment of resources; full financial risk	Increase of public debt under Maastricht definition; financial know-how in loan application phase; full financial risk	Know-how for application process necessary; implementation requirements	Intensive preparation phase and internal know-how necessary; poor public perception	Relatively unknown model in some countries; know-how needed	Poor legal framework in some countries; low experiences with public projects
Recommended investments in nZEB measures	Comparably simple energy efficiency measures and projects with low payback times		Innovative projects	Complex projects with high volume (>€ 5 Mio.); usually for new buildings	For buildings with initial energy costs > € 70.000 per year; complex projects with payback times up to 10 years	Small scale-projects with good storyline, e.g. PV plant

Sources: eCentral project and pilot experiences, eCentral events, FEEDSCHOOLS project, QualitEE project

PHASES OF BUILDING RENOVATION



A schematic guide of the building renovation phases is available here.

The guide is also available in five national versions, with specific nZEB regulations of the project partners countries: > AT > HR > HU > IT > SI

PHASES OF BUILDING RENOVATION

I. Planning

The planning phase is the first step when it comes to the refurbishment of a public building. It includes several tasks like a detailed collection of building data and information, the identification of needs and improvement (functional requirements or legal requirements) and thoughts about the design process as well as the financing of the deep renovation. In this phase the integral planning approach is key to ensure a successful deep renovation process. If the deep renovation shall be fragmented due to financial causes, an even more detailed planning is needed.

II. Design

The second phase involves the whole design process. After the decision about how the design process is performed (e.g. procuring design services or design contest) the preliminary design is made. Usually, the financing scheme has already been decided in this phase. After the preliminary design is finalized the definitive design and the executive one follow. Several feedback loops are mandatory until the final design is approved.

III. Construction

The construction phase is heavily characterized by executing the work. Alongside with the actual building process, which is based on public procurement, public works and serving contracts it is recommended to provide information about the construction progress (e.g. photos, videos, …) to the public and other important stakeholders. Especially when using crowdfunding, transparency throughout the process is key.

IV. Operation

This phase lasts for several decades and includes the whole operating life of the refurbished building. Monitoring the performance, maintenance of the building technologies and user training is of high importance since the operation causes 60-80 % of the life cycle costs. It is advised to include building monitoring systems for continuous supervision of the performance.

PHASE 1 - PLANNING

The goal of this first phase is to identify building's needs and improvements as well as renovation targets (nZEB requirements).

Firstly, a detailed **collection of building data and information is required.** A checklist for necessary and helpful information is shown on the right site. This information serves as base for the **recommended building inspection** and to start the integral planning phase.

Secondly, the identification of the building's needs and improvements follows. This should include at least the definition of the energy performance targets, operational hours, static requirements, definition of usage concept and room concept as well as other requirements (accessibility, energy carrier…). Surveys or interviews with **facility management and building users** create a better insight about the users' needs. The result should be a rough estimation of the necessary investment budget.

The third element in the planning phase is the **beginning of the deep renovation planning.** This includes the definition of the financing scheme and the next steps in the design process as well as support from external experts. Services of external experts need to be compliant with public procurement laws. Design services can be acquired by public tenders or a design contest.

IT IS RECOMMENDED TO INCLUDE FROM THE EARLY PLANNING PHASE A COMPETENT ADVISER (E.G. ARCHITECT, ENGINEER, BUILDING TECHNOLOGIES EXPERT….), WHO IS FAMILIAR WITH DIFFERENT CHALLENGES OF NZEB RENOVATION.

The financing of deep renovations can be carried out traditionally such as public financing or bank loan or with alternative financing schemes such as energy performance contracting (EPC) or public private partnership (PPP). It is also possible to use crowdfunding. Which financing option suits best for certain projects is described on page 4. If EPC or PPP is desired, possible contractors are usually included in very early project development phase.

PHASE 1 - PLANNING

CHECKLIST FOR COLLECTION OF INFORMATION

Energy performance certificate	☐
General building information (geometry, materials, room list…)	☐
Specific building information (building's history, possible issues…)	☐
Plans of the building	☐
Description of building physics	☐
Results of thermography	☐
Information about building technologies	☐
Energy consumption (electricity, heat…) data of last 3 years	☐
Information about building's use (user types, operational hours…)	☐

USE INTEGRATED PLANNING APPROACH FROM THE BEGINNING

The **integral planning approach** is a key factor to ensure a successful deep renovation process. Key elements of the integral planning approach are:

- ✓ Attention to all professional disciplines involved,
- ✓ Unite all professional disciplines,
- ✓ Consideration of all building aspects over its life cycle
- ✓ Demand a building monitoring concept for the operation phase

RESULTS OF PHASE 1:

- » Collection of necessary building information
- » Results of on-site building inspection
- » Definition of renovation goals (nZEB requirements) – WHAT?
- » Definition of requirements of users (usage and room concept) – WHY?
- » Identification of building needs and improvements – HOW?
- » Estimation of investment budget
- » Decision on preferred financing scheme
- » Decision on next steps for design phase (traditional tender or design contest)

PHASE 2 - DESIGN

The second phase is characterized by the creation of the building design. As a base for these activities serves a cooperation with a planner or a design contest.

The following **key aspects** should be considered for procuring design services or awarding a design contest:

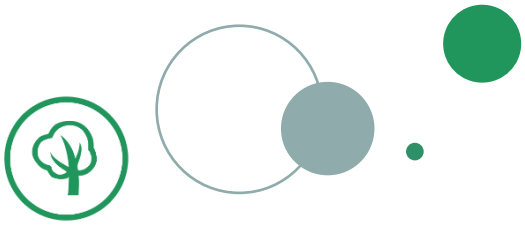
- ✓ Clear objectives towards energy efficient and sustainable buildings with innovative solutions,
- ✓ Clear minimum requirements and target values regarding energy efficiency,
- ✓ Claim for architectural solutions to ensure low energy demand,
- ✓ Award scoring with nZEB criteria, life-cycle costs
- ✓ Clear minimum eligibility criteria for experts to be involved in the design phase

The decision-making jury should consist of **experienced building experts,** who evaluate the **degree of sustainability** and **life-cycle costs** of the submissions.

After this, the **preliminary design** process starts, which serves as base for the **definitive** and **executive design**. All design steps experience several feedback loops until the final design is approved by all participating stakeholders.

USE INTEGRATED DESIGN APPROACH. A KICK-OFF WORKSHOP WITH ALL STAKEHOLDERS (E.G. PLANNERS OF DIFFERENT TRADES, CONTRACTORS) IS RECOMMENDED TO CREATE A COMMON VISION AND SHARING PROJECT TARGETS.

Besides the public authority and planners, the involved stakeholders at this stage of the process depend on the way of **financing the renovation project**. If PPP or EPC is desired, possible contractors and their building experts are usually included in the preliminary design phase (depending on contractual obligation). In the **crowdfunding process**, the funders are only informed about the current design stage. Usually, they are not taking an active part throughout the design process.



PHASE 2 - DESIGN

After agreeing on the framework of the nZEB renovation project and definition of the executive design, the **tender process** for the construction works starts.

It's depending on the requirements of national procurement laws (thresholds, type of tender process…) but usually public authorities are obliged to implement public tender processes and to **choose the most economic and reliable offer**.

FACTORS FOR A SUCCESSFUL PLANNING AND DESIGN PROCESS

Use integrated planning approach	☐
Define clear goals and requirements	☐
Include nZEB experts in the project team	☐
Faciliate interdiscplinary project team (different trades, stakeholders…)	☐
Assign a moderator for all project phases (e.g. main planner)	☐
Include PPP or EPC contractor in early planning phases	☐
Create a common vision of the result with all stakeholders	☐
Faciliate a flat hierarchy and team building	☐
Assure fluent communication (e.g. periodic meetings, workshops…)	☐
Good documentation of all decisions, agreements, specifications, used materials and building technologies	☐

PHASE 3 - CONSTRUCTION

High quality of construction works need to be ensured in order to achieve an energy efficient renovation of the building. Quality management activities such as building site control or blower door tests should be included in the construction process.

Building site controls on behalf of the client are usually carried out by the planner or construction consultants with the site manager. The procedure for such an on-site visit could be:

- Arrange appointment with site manager
- Preparation of list with materials to be used (product, producer, field of application)
- Examining of actual used materials and comparison with prepared list
- Documentation of evaluation and deviations
- If applicable: agreeing on how to proceed with deviations with site manager

For highly energy efficient buildings such as nZEBs, it is strongly recommended to carry out **"Blower-Door"-measurements** to test the airtightness of the building. This is especially important when operating a central ventilation system. In addition, hidden weak points could be discovered in the building's envelope. Another quality management tool is the use of **thermography scans**. If thermography is used and interpreted in the right manner, it could provide valuable information about the building's envelope quality, thermal bridges, etc.

In this phase, a **crowdfunding campaign could be launched for increase public participation** and collect additional financing for some aspects of the renovation, e.g. on-site installation of renewables, new façade, etc. If the construction is ongoing, possible investors directly see the progress of their investment.

TO ENSURE A SMOOTH START OF THE BUILDING'S OPERATION, THE CHARACTERISTICS OF THE BUILDING'S TECHNOLOGY SYSTEMS NEED TO BE DOCUMENTED AND HANDED OVER TO THE FACILITY MANAGEMENT.

PHASE 4 - OPERATION

Besides the owner of the newly renovated nZEB, possible EPC or PPP contractors are also in favor of achieving low operating and energy costs.

To minimize the operational costs, **a monitoring system and continuous building management** is recommended, especially for big public buildings. Especially during the first years of operation, monitoring allows to track deviations from ideal operation and to detect potential for improvements.

THE OPERATION OF A BUILDING IS RESPONSIBLE FOR 60-80 % OF THE BUILDING'S LIFE CYCLE COSTS. A WISE LIFE-CYCLE ORIENTED INVESTMENT DECISION SHOWS ITS FULL POTENTIAL DURING THE OPERATION PHASE.

Maintenance and fine tuning

The goal of maintenance is to keep an efficient performance of the building technologies. Appropriate facility management includes the development and supervision of a maintenance plan and the documentation of incidences.

Training of users

High quality nZEBs with complex housing technologies need to be used properly in order to achieve the demanded efficient energy performance. Users of the building should be informed about the building technology and be accompanied during the first months of operation. Depending on the type of users, this can be done with short workshops (e.g. during opening event), with brochures or online information.

Awareness raising

To raise awareness about energy efficient buildings it is recommended to communicate the whole renovation process in the municipality (public participation in the planning phase, monthly updates from the construction site, opening event….) in addition, the energy performance certificate should be displayed somewhere nearby the entrance.

BEST PRACTICE EXAMPLES

PUBLIC PRIVATE PARTNERSHIP (PPP)

The European PPP market is well documented. According to EPEC statistics, 1868 projects in different sectors with a total value of € 392.9 billion were closed in Europe since 1990. Some chosen best practice examples for PPP projects for public buildings are (partially in national languages):

- Renovation of 48 public buildings in Ljubljana (Slovenia)
- Educational building Berresgasse, Vienna (Austria)
- Educational building Gertrude Fröhlich-Sandner, Vienna (Austria)

ENERGY PERFORMANCE CONTRACTING (EPC)

EPC markets have also experienced a quite big growth in the past years. The causes are seen in the improvement of the legal situation, promotion and clarification of the definition. Some chosen best practice examples for EPC projects for public buildings are (in national languages):

- Geological institute Munich (Germany)
- Nursing center Bad Radkersburg (Austria)
- 9 buildings of municipality Hude (Germany)

CROWDFUNDING (CF)

In Europe, CF gained more importance recently. From 2013 to 2017, the annual market volume increased from € 1.1 to € 10.4 billion. Some chosen best practice examples for CF for public infrastructure are (partially in national languages):

- Civic crowdfunding supported by City of Milan (Italy)
- Luchtsingel bridge in Rotterdam (The Netherlands)
- Public energy park with PV and wind power in Gladbeck (Germany)

More information on innovative financing schemes is available here.

ECENTRAL PILOT ACTIONS - STATUS 2021

PPP in Sveta Nedelja (Croatia)

A large two-building **kindergarten** was planned to be implemented through PPP model (design-build-maintain concept, project volume approx. € 4 million) in Sveta Nedelja. Due to changed circumstances, the project was downsized, and the existing kindergarten was enlarged. The enlarged annex was built in line with the nZEB standard- using high-efficient building materials and implementing RES systems. The new project volume of € 1.6 million wasn't very attractive to PPP investors. However, two more feasibility studies for evaluating the PPP approach in cities of Marija Bistrica and Stupnik were created. Implementation is expected to take place in the upcoming years.

EPC in 18th district of Budapest (Hungary)

Goal was to renovate **Vackor Kindergarten** to nZEB standard (expected volume € 560 000). Necessary measures would have been insulation of walls, roof, and ceiling as well as replacement of windows, installation of ventilation with heat recovery and 37 kWp photovoltaic system. Additionally, there have been static problems in the building. However, low energy prices cause low savings of energy costs compared to the necessary nZEB renovation investment. Therefore, it was decided not to proceed with further development of this pilot action. For future projects it is recommended to bundle several buildings to create an attractive investment package for ESCOs.

CF in Velenje (Slovenia)

The goal was to renovate an **educational building** in the city center (project volume approx. € 113 000). Implemented measures have been the modernization of interior lightning, roof insulation and installation of solar power plant to reach nZEB standard. Despite a very well-prepared crowdfunding campaign, it failed to reach the pledged amount of money (€ 10 000) to be raised. The current lack of relevant legal framework poses several limits on crowdfunding. In Slovenia there is only one platform for crowdfunding available. Nevertheless, it was the very first project in Slovenia and it paved the way for upcoming projects.

PILOT ACTIONS: CHECK OUT MORE DETAILS AND HIGH-QUALITY VIDEOS **HERE!**