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BUNG: Developing nearly zero energy building skills through game - based learning
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BEST PRACTICE COMPENDIUM

BUNG

Compilation Report
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Executive Summary

This report has been prepared in the framework of the ERASMUS+ project KA202 – Strategic Partnerships for vocational education and training, entitled: Developing nearly zero energy building skills through game based learning (BUNG) and under IO1-T.1.1: Analysis of the National and European successes in nZEB sector: A best practice compendium.

The research presented in this compendium is aimed to provide a brief summary of the key energy and climate concerns of each participating country (with a particular focus on improving the performance of the nation's buildings and homes), and identify best practices on adopting, implementing and enforcing energy efficiency standards and energy efficiency technologies for the building sector. The compendium will serve as a basis to improve the knowledge of the participating member states concerning energy efficiency best practices related to existing standards and technologies, so that they will be able to develop and implement more effective energy efficiency policies in buildings. Furthermore, the publication aims to improve the quality of the debate, involve as much as possible representatives of the target audience into the knowledge sharing and best practices dissemination process and set out a basis for better information sharing.

The Compendium is organized in two different sections:

- National overview in the nZEB sector in partner countries

- Best practices in the nZEB sector in partner countries

Information on the national overview in the nZEB sector was gathered via literature desk research and included:

- The status of the country's shift to renewable energy sources including energy efficiency oriented legislation and design standards in terms of harmonization with international (or EU) practice, in order to increase current specific energy efficiency parameters in buildings
- Any emission or energy use reduction targets and policies or initiatives that support improving energy efficiency in the building sector
- Any obstacles and limitations in achieving a robust energy efficiency building scheme

Information on case studies was gathered via desktop research and stakeholder outreach and include,

- National/regional/local programs, initiatives and tools to promote energy efficiency of buildings,
- Exemplars of high energy performance buildings and
- Best practice relevant to the training/capacity building field.

19 case studies have been received and assessed by each partner according to the following criteria:

- **Significant outcomes**. A best practice in the nZEB sector must prove its strategic relevance and ability to contribute to a large energy demand reduction and significant multiple benefits. Best practices in the nZEB sector will be those that have demonstrated that they produce or are essential to delivering significant quantifiable results including but not limited to:

  Large scale implementation;

  Large energy savings;

High cost effectiveness;
High dissemination and awareness raising rates

- **Functionality/usability:** High level of accessibility for convenient, fast and accurate servicing of the initiative at any level of implementation and high level of user-friendliness.
- **Replicability**: In short a best practice should have the potential for replication and should therefore be adaptable to similar objectives in varying situations. Are there possibilities of extending the good practice more widely?

1. Introduction

The awareness that the building sector plays a pivotal role in reducing energy consumptions and greenhouse gas emissions has grown during the last decades together with the recognition of its increasing potential in the exploitation of energy from renewable sources. At the same time, better and more energy efficient buildings improve the quality of citizens' life while bringing additional benefits to the economy and the society.

To boost energy performance of buildings, the EU has established a legislative framework that includes the Energy Performance of Buildings Directive 2010/31/EU (EPBD) and the Energy Efficiency Directive 2012/27/EU. Together, the directives promote policies that will help achieve a highly energy efficient and decarbonized building stock by 2050 create a stable environment for investment decisions enable consumers and businesses to make more informed choices to save energy and money.

Both directives were amended, as part of the Clean energy for all Europeans package, in 2018 and 2019. In particular, the Directive amending the Energy Performance of Buildings Directive (2018/844/EU) introduces new elements and sends a strong political signal on the EU's commitment to modernize the buildings sector in light of technological improvements and increase building renovations.

In October 2020, the Commission presented its renovation wave strategy, as part of the European Green Deal. The strategy contains an action plan with concrete regulatory, financing and enabling measures to boost building renovation. Its objective is to at least double the annual energy renovation rate of buildings by 2030 and to foster deep renovation.

In this framework, The BUNG best practice compendium aims to create a better understanding of the issues surrounding the achievement and delivery of low energy buildings, increase knowledge on national legal aspects, improve the quality of the debate, and ultimately contribute to achieving the targets set by the EU for reducing greenhouse gas emissions and improve energy efficiency. To this end this report provides an overview of the nZEB national policies and legislative framework in France , Italy, Germany, Greece and Slovenia, an analysis of the key energy and climate concerns of each partner country and how they are working to address these issues especially in the building sector and a collection of good and promising examples in the building sector ranging from national initiatives of high energy performance and best practice examples relevant to the training/capacity building field.

Overall, this compendium will serve as a basis to improve the knowledge of Member States concerning energy efficiency best practices related to existing standards and technologies, so that they will be able to develop and implement more effective energy efficiency policies in buildings.

2. National overview of the Nearly Zero Energy Building (nZEB) sector in partner countries

FRANCE

nZEB Legislative Framework in FRANCE

1. Loi Grenelle II or law n°2010-788 of 12 July 2010 transposes the EPBD in France. The implementation of the EPBD has been the responsibility of the French Ministry for an ecological and solidary transition and the Ministry of territory cohesion.

2. After this latter regulation, a new thermal regulation, 'RT 2012', was implemented and brought energy efficiency of new buildings to nZEB level. Since 2013 it is mandatory for all new buildings to be nZEB. It sets general performance objectives but it does not include any requirements on systems efficiency nor on building components. Instead, it uses three parameters ('Bioclimatic conception', 'ambient indoor temperature of the building reached after the 5 hottest days of the year' and 'Primary energy consumed') that have different maximum values depending on the type of building. New buildings should conform to these maximum values. Moreover, RT 2012 includes requirements for renewable energy use (at least 5 kWhEP/m²/year).

3. The Energy Transition for Green Growth Act (LTECV) (decree 2015-992) of 17 August 2015 contains many provisions related to energy and the environment (some of which concern buildings' performance). Its objective is to list concrete objectives and actions to implement the 2015 Paris Climate Agreement (Ministère de la Cohésion des Territoires et des Relations avec les Collectivités Territoriales, 2019). It is a legal framework that contains numerous articles that entail actions that stimulate both new and existing buildings to be nZEB.

4. To apply EPBD to existing buildings, the French government implemented two regulations. The first one is called 'Regulation by Building Component and the second one is called 'Global Thermal Regulation'. Both were already in place before the RT 2012 was implemented but were reviewed in 2016 and the new requirements came into force in 2018 and will be followed by supplementary requirements in 2023. The appropriate regulation to be implemented depends on the building size and the extent of renovation. The French government encourages old building renovation via tax benefits (CITE), 0%-Eco-Loans (loans with a 0% interest rate), financial support provided by the National Agency for Housing Improvement (Anah) to low-income households to finance renovation works, a reduced VAT (5.5%) applicable to renovation works in residential buildings, public campaigns providing information about financial schemes and finally stimulation to install intelligent meters for both electricity and gas.

For existing residential buildings, two quality seals exist 'High Performance Energy 2009', demanding a level of 150 kWh/m²/year, and 'Low Energy Consumption Renovation 2009', demanding a level of 80 kWh/m²/year. For non-residential buildings only the 'Low Energy Consumption Renovation 2009' seal exists. It certifies that the energy

consumption of the renovated building is at least 40% less than the reference building. By the end of 1016, 56000 residential buildings and about 1.35 million renovated m2 of non-residential buildings were given this seal.

5 To transpose Article 15 of the EPBD about AC systems, France has chosen to adopt the default approach, which consists of a periodic inspection scheme for AC systems above 15 kW and reversible heat-pumps above 12 kW. The same approach has been chosen for boilers of more than 400 kW. For boilers between 4 and 400 kW, alternative measures involving an annual maintenance visit have been taken. This regulation on AC systems has been imposed by one decree and two ministerial orders and has been in force since 16 April 2010.

To control adherence to the AC regulations, penalties are set in the regulation (Art L.226-2 and L.226-8 of the environment code). The relevant authorities can apply the following measures if upon control the regulation has not been properly adhered to:

- carry out a new inspection of the AC system at the owner's expense
- oblige the owner to pay a fine
- force the owner to stop the AC system
- oblige the owner to deposit the equivalent of the inspection costs as a guarantee until compliance is achieved.

6. The most recent thermal regulation is the RE 2020 that succeeds the RE 2012. It has similar objectives but has new standards and criteria to accelerate France's transition to nZEB building. Detailed information about RE 2020 are given below under (3) National policy for improving the performance of the nation's buildings and homes.

National policies for improving the performance of the nation's buildings and homes in FRANCE

The RE 2020 is the new thermal regulation that will come into force in 2021 (postponed to 1st Jan 2022 actually), and which imposes new standards in construction. These new criteria aim to obtain buildings that are more efficient, more respectful of the environment and that will produce their own renewable energy.

The official objectives of the RE 2020: "reducing the carbon impact of buildings, pursuing the enhancement of their energy performance and ensuring freshness during canicular summers".

France being engaged to meet the carbon neutrality in 2050, one of the main levers is to act on buildings emissions that represents 25% of the national greenhouse gas emissions.

The RE2020 will bring new changes and advances compared to the RT2012:

The RE 2020 imposes an expenditure of 0kWh/m²/year, instead of the 50kWh/m²/year allowed by the RT2012, since the new regulation will impose an energy production higher than the one consumed.

The RE 2020 reinforces the criteria taken into account for the calculation of consumption; the RT 2012 did not take into account the consumption of household appliances and electrical goods.

The strategy for optimizing energy consumption. The RT 2021 sought to reduce the consumption of equipment, while the RE2020 goes beyond this by tracking down waste, in particular by integrating the notion of intelligent management of our consumption.

In addition to the previous point, the buildings will produce energy and thus the improvements will not be limited to insulation only.

Obstacles and limitations in implementing nZEB policies in FRANCE

One of the main barriers identified for years is the energy renovation of the buildings and particularly the difference between expectations/objectives and those meet actually.

The low actual reduction in consumption is another obstacle to the nZEB policy, since studies have found that after renovation work many households think first of comfort rather than reducing energy consumption. Thus they forget energy recommendations and tend to overuse energy. For example, increasing the heating of one's home from 19°C before the work to 21°C after the work, which has the effect of nullifying the energy reduction and making it worse.

It also requires a real political will, not only in terms of the means necessary to carry out this project, but also in the creation of a solid network involving associations, agencies and authorities competent in the field, allowing not only the realization of studies and data processing, but also to transform them into concrete actions, national strategies and policies aimed at ultimately improving the building sector as a whole.

This can also be explained by an overestimation of the energy recovery of operations. Studies have shown that technical data sheets have higher values than those measured in practice.

In addition, the number of craftsmen with the RGE label is insufficient and if the industrial sector does not mobilize, this problem will persist. Some programs have begun to implement building renovation on an industrialized basis.

However, given the diversity of France's built heritage, not all buildings can be renovated on an industrial scale. Indeed, studies have found that renovation practices tend to become more uniform, particularly those concerning the insulation of walls with the use of materials that in some cases are not suitable.

Energy-efficient technologies are still in the development phase. Most materials still have little feedback, especially in terms of durability.

The manufacture of insulators and photovoltaic panels are often oil-based and therefore the upstream energy balance of the production of this equipment should be taken into account.

Ventilation is also an issue: the construction of a building without thermal leakage requires reducing air exchanges between inside and outside, therefore we must be concerned that this environment is viable and that the air quality is satisfactory.

ITALY

nZEB Legislative Framework and Policies in ITALY

The national government has issued decrees implementing EPBD (2005) primarily focusing on minimum energy requirement for buildings, methodologies for calculating energy performance of buildings and national guidelines for Energy Performance Certification (2009). However, later acts implementing Directive 2010/31/EU through Law 90/2013, include stricter requirements to limit energy consumption in buildings.

National policies for improving the performance of the nation's buildings and homes in ITALY

The energy requalification of public and private buildings in Italy is one of the strategic priorities indicated in the National Integrated Energy and Climate Plan for 2030, precisely with the aim of promoting a reduction in energy consumption and CO2 emissions, as well as the development and the integration of energy production based on renewable sources.

Improving the energy performance of buildings is one of the main objectives to accompany the energy transition of our country with significant economic benefits: the energy requalification interventions, in fact, have generated in the last 10 years about 39 billion euros of investments and 270 thousand places of direct work every year.

In recent years, Italy has put in place a set of incentive tools and regulatory measures capable of accelerating the energy efficiency rate of buildings. One tool is the tax deductions that have recently been enhanced with the so-called "Superbonus 110%", in order to incentivize the implementation of energy requalification of buildings, such as the thermal insulation system and the replacement of existing heating systems. These are measures that have a strong impact both in terms of reductions in energy consumption and mobilization of investments. The Energy Performance Certificates (APE) are an important tool for understanding the energy performance of buildings and the interventions that should be carried out to improve their performance.

As mentioned before, the mandatory "nZEB deadlines" for new or significantly renovated buildings in Italy are: 1st January 2019 for public building and 1st January 2021 for private buildings.

However, some Italian Regions (like Lombardy and Emilia Romagna) anticipated the above-mentioned deadlines. Another example of local regulations which anticipated the national law is given by the Province of Bolzano which starting from 1st January 2017, applied the Energy Class A, according to Klima Haus standard (considered comparable to nZEB standards by EPBD).

Among the national government economic incentives, we can mention the 65% of cashback (repaid to private citizen in terms of tax reductions) of the total amount spent for retrofitting intervention according to energy efficiency standards and the brand-new State incentives law of May 2020, called "Super Bonus 110%" which, not only covers totally the renovation costs, but gives even a 10% more of the spent amount, always in terms of tax reduction. The total cost is recovered in 5 years. The interventions concerning the 110 % are: thermal insulation interventions on the building

envelope, replacement of air conditioning systems on the common parts, anti-seismic interventions, energy efficiency interventions, installation of solar and photovoltaic systems, etc. All these interventions must improve the building on its whole by at least two energy classes.

This energy efficiency improvement hast to be demonstrated by an energy performance certificate issued by ENEA (National Agency for New Technologies, Energy and sustainable economic development.

Obstacles and limitations in implementing nZEB policies in ITALY

The obstacles and limitations of the implementation of nZEB policies occur due to the difficulty of coordination between the fundamental elements which are: technologies, bureaucratic aspects (complexity of the different laws involved), incentives and research.

The measures to promote nZEB in Italy are mainly regulatory instruments (more severe building standards over time) and financial instruments (deductions, medium-long term financing with zero-credit interest rate, non-repayable contributions, etc.). In order to fully exploit the potential of implementation of the best technologies, it would be necessary to implement structural actions to improve skills and information, stimulating demand and differentiating the offer also by virtue of the climatic, socio-economic and environmental features of the specific areas.

With the exception of school buildings, the availability of data on proven cases of deep refurbishment at nZEB level proved to be particularly critical.

GERMANY

nZEB Legislative Framework and Policies in GERMANY

The regulation to implement the EU legislation in the nZEB sector in Germany is *Gesetz zur Einsparung von Energie und zur Nutzung Erneuerbarer Energien zur Wärme- und Kältebereitstellung in Gebäuden* – short: *Gebäudeenergiegesetz (GEG)*, 08.08.2020. The GEG came into force on November 1st, 2020. The GEG brings together three previous directives, the *EnEG, EnEV and EEWärmeG* in one modern law. A uniform coordinated set of rules was created for the energy requirements for new buildings, for existing buildings and for the use of renewable energies for the heating and cooling of buildings.

The European requirements for the total energy efficiency of buildings are fully implemented and the regulation of the nZEB is integrated into the unified energy saving law. The current energy requirements for new buildings and renovations are not tightened. Energy requirements for buildings are already making an important contribution to achieving European and national climate protection and CO2-reduction targets in the building sector.

In accordance with the climate protection program 2030, a clause was included in the GEG to review the energy requirements for new buildings and existing buildings in 2023. (*Bundesministerium des Inneren, für Bau und Heimat*)

According to GEG, the final energy requirement of a new building is 45-60 kWh/m² per year. That is 65 to 73 percent less than the average final energy consumption in existing buildings, which is 167 kWh/m² per year. (*Bundesministerium für Wirtschaft und Energie* - BMWi)

The GEG was developed by the Federal Ministry of Economics and Technology (BMWI) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB).

Three laws are included in the GEG which are:

1) The Energy Saving Act

The Energy Saving Act ("*Energieeinsparungsgesetz*" (EnEG) was issued in 1976 to improve the balance of trade, more precisely to reduce the dependency of the Federal Republic of Germany on imported energy carriers. The act does not contain any regulations directly affecting the citizen but empowers the Federal Government to legislate ordinances. Thereby the approval of the "*Bundesrat*" (Parliament representing the German Federal States) is necessary. Since then, ordinances that pose energetic requirements on buildings and their appliances can be legislated based on the EnEG.

Since it is effective, the following ordinances have been enacted based on the Energy Saving Act:

- Heating Plant Operation Ordinance (invalid since 1989)
- Thermal Insulation Ordinance (invalid since 2002)
- Heating Appliance Ordinance (invalid since 2002)
- Heating Cost Ordinance
- Energy Saving Ordinance

The Energy Saving Act was adjusted in some points for the implementation of the European Directive on Energy Performance of buildings. The amendments essentially concerned the addition of principles for energetic requirements on lighting systems as well as energy certificates. In a further step (2nd April 2009), the act was amended with provisions for the implementation of the German Integrated Energy and Climate Program ("IEKP 2007")

The most recent amendment by the "Fourth Law amending the Energy Saving Act" of 4th July 2013 mainly served for the implementation of the recast European directive on Energy Performance of Buildings (2010/31/EU) and created the legal basis for the changes included in the recent amendment of the Energy Saving Ordinance. This mainly concerns the basic obligation that new buildings will have to be "Nearly Zero Energy Buildings" (buildings owned and used by public authorities from 2019, all other new buildings from 2021). Furthermore, initiated by the "*Bundestag*", the requirement to shut-off electrical storage heaters – intended to get into force in 2020 – was abandoned (see Article 1a of the "Fourth Law amending the Energy Saving Act"

According to the *Bundesinstitut für Bau-, Stadt- und Raumforschung*, the last version of the EnEG with the provisions that came into force on 13th July 2013 empowered the Federal Government:

- to set up requirements concerning the thermal insulation of new buildings, in connection with the abovementioned basic obligation that new buildings have to be nearly zero energy buildings,
- to set up requirements on the energy performance of these buildings,

- to set up requirements concerning design, selection and construction of systems or installations for heating, ventilation, cooling, lighting and hot water supply,
- to set up requirements concerning thermal insulation and technical appliances in case of buildings undergoing major renovations, and – under certain preconditions – to foresee specific requirements for buildings and appliances not subject to any other changes,
- to set up requirements concerning the operation of systems and installations for heating, ventilation, cooling, lighting and hot water supply,
- to set up requirements on the determination and distribution of costs of collective heating or ventilation systems or systems for collective supply of hot water,
- to define content and use of energy certificates based on energy demand and metered energy as well as
- to set up general requirements on the control of energy certificates and inspection reports.

2) Renewable Energies Heat Act

The Renewable Energies Heat Act (EEWärmeG) aims to increase the share of renewable energies in heat provision and cooling. It came into force on January 1st, 2009. The law is part of the Integrated Energy and Climate Program (IEKP) passed by the Federal Government on December 5th, 2007 and introduced for the first time a nationwide obligation to use renewable energies in the construction of new buildings. The law took precedence over an EU directive dated April 23rd, 2009 on renewable energies which introduced an obligation to use renewable energies for heating and cooling, both for new and, under certain conditions, for old buildings imposed on the member states until December 31, 2014. The EEWärmeG set the legal target of covering at least 14% of the heating and cooling energy requirements of buildings with renewable energies by 2020. To achieve this goal, the law established the general obligation to supply new buildings with a prescribed percentage with renewable energies. This affects around 150,000 newly constructed buildings every year. For old buildings, the law provided for funding for appropriate retrofitting, which can affect around 600,000 modernized heating systems per year. (Wikipedia)

3) Energy saving regulations

The EnEV is a regulation in Germany describing minimum requirements regarding energy use of new and renovated buildings. To obtain a building license, private buildings and most commercial buildings must be built according to the regulation.

The EnEV lays down the requirements concerning the yearly demand of primary energy and the performance of the building envelope; residential and non-residential buildings are treated differently. Since the amendment of the EnEV in May 1st, 2014, property sellers and landlords have to state the energy efficiency in advertisements when a building is offered for sale or rent. These energy performance certificates are the subject of an independent control system.

The following provisions of the “Second Ordinance amending the Energy Saving Ordinance” came into force from 1st January 2016:

- The requirements on the maximum yearly primary energy demand of a new building are strengthened by the provision that it has to be 25 percent lower than the respective value calculated for its reference building.

- For electricity henceforth a lower primary energy factor is applied. This reduces the effect of the strengthened primary energy requirement for electric systems.
- The maximum specific transmission heat loss of a new residential building is limited to the value calculated for its reference building. Normally, this means a strengthening by 20 % in relation to the former level.
- The maximum average heat transmission coefficients of a new non-residential building are strengthened by 20 percent in relation to the respective former values. (*Bundesinstitut für Bau-, Stadt- und Raumforschung*)

National policies for improving the performance of the nation's buildings and homes in GERMANY

In Germany, buildings account for around 35 percent of total energy consumption and around 30 percent of CO2 emissions. (*Umweltbundesamt*).

The building-related final energy consumption fell by around 17 % to 2,983 petajoules between 2008 and 2018. This is equivalent to 33.2 % of the final energy consumption in Germany. Although over the years, residential and effective space have increased, energy consumption for room heating decreased. This is mainly the result of higher energy efficiency standards for new buildings and refurbished old buildings.

In its 2010 Energy Concept, the Federal Government set the target of reducing heat requirements in buildings, defined as final energy consumption for heat, by 20 % by 2020 (BMWi, BMU 2010). Reaching this target remains a challenge. Measures laid down in the National Action Plan of Energy Efficiency (NAPE) and the Energy Efficiency Strategy for Buildings (ESG) are intended to help with the implementation (BMWi 2014 and 2015). (*Umweltbundesamt*).

Building stock, overview Germany

According to the German Energy Agency, in 2018 the building stock in Germany consisted of 18.8 million residential buildings; 15.5 million detached and semi-detached houses and 3.2 million apartment buildings. 40.3 million residentials units could be divided in 21.5 million residential units of apartment buildings and 18.8 million residential units of detached and semi-detached houses. 1.5 million m² of living space in apartment buildings and 2.2 billion m² of living space summed up to 3.7 billion m² of total living space. There were 2.7 million non-residential and non-industrial buildings with 1.35 m² of heated net floor space and a share of 37 % of building energy consumption. 62 % of living space in Germany was built before 1979, and so before the 1st Thermal Insulation Ordinance came into effect. According to Statista, there were over 19.2 million residential buildings in 2019 in Germany. The number of residential buildings and the total size of living space grows every year. In 2019 it was a total of around 3.78 billion m². Statistically, 47 m² of living space are available for every resident in Germany.

Most of the apartments can be found in apartment buildings, almost a third in two-family houses. Most of the apartments are in the most densely populated state of North Rhine-Westphalia, followed by Bavaria and Baden-Württemberg. These states are more populated, and most people there live in apartments.

The plan of the climate policy in Germany is to reduce greenhouse gas emissions by 80 to 95 per cent by 2050 compared to their 1990 levels. In 2016, a total of 2,542 TWh of final energy in Germany, 826 TWh were used for heat in the building sector alone. Therefore, the transformation of the building sector is of key importance.

The first Thermal Insulation Ordinance in 1977 started to challenge energy efficiency standards in buildings in Germany. Since then, the regulatory standards have been continually raised.

In order to reduce the amount of carbon emissions and the consumption of energy, the buildings sector will need to find new ways to increase the rate of refurbishment and improve construction technologies as well as the supply of energy.

Obstacles and limitations in implementing nZEB policies in GERMANY

The following obstacles and barriers are based on online research, expert interviews and a study.

According to the *Immobilienscout24* (Online portal for real estate providers, owners, tenants and buyers. The platform has around 13.5 million visitors per month); the main barriers and limitations in implementing nZEB policies in Germany are outlined below:

- Higher initial costs, additional costs between 5 and 15 percent on average compared to classic single-family houses
- Personal contributions, that reduce costs when buying for example a prefabricated house, cannot be made because the technology used in a nZEB is very complicated. Mistakes can occur if the work is not done by skilled workers.
- Ventilation system and airtightness can lead to dry air and mold.
- Complicated repairs and maintenance are required.

According to a study: Potential barriers in the construction of a nZEB and Energy+ Buildings, 2017, the main barriers and limitations in implementing nZEB policies in Germany are outlined below:

- Lack of information
  Often, actors do not have sufficient information in order to independently identify cost-effective efficiency measures. This requires knowledge of existing savings potential, their own energy consumption and optimization possibilities. In order to eliminate information deficits, independent energy advice is preferred.
- Interest in energy efficiency is diminishing
  After significant increases in the energy consumption of natural gas and heating oil up until 2013, energy prices have fallen in recent years. The issue of energy saving has thus lost importance. Negative media reports on individual cases in which there have been problems with the insulation of buildings as well as reports of significantly lower energy savings than predicted have damaged the discourse regarding energy efficiency.
- Expert deficit / demand for construction services
  The economic climate in Germany is good. In the case of the relevant exporting companies, there is often even a shortage of skilled workers. This also leads to energy efficiency measures rising in price or being left out.

- Application for funding
  Applying for funding is often perceived as complicated and restrictive. Often, the complicated and limited funding application process is the reason why projects are postponed or not undertaken.
- Complex legal requirements
  The legal requirements for the building energy standard and the use of renewable energies are regulated in Germany in two different directives: the EnEV and EEG. The interaction between the two legal requirements is comprehensible only for experts and even the planned merger of the legal framework in the "GEG" will probably not simplify the requirements substantially.
- Investor-user dilemma
  In contrast to other EU member states, housing is often rented in Germany. About 57 % of households rent. In rental housing so-called investor-user dilemma exists: While the owner invests in energy efficiency measures, the renter benefits from the lower energy costs. This is often cited as a reason for lack of interest in energy efficiency, but solutions for this also exist. However, current models which solve this issue are not yet sufficiently well-known.
- The financing framework is tight
  In Germany, construction is particularly concentrated in metropolitan areas. In these regions, building and construction costs are very high and the financing framework is tight. Additional and nonessential investments in energy saving measures are therefore often put aside.
- Implementation of efficient heat pump systems
  Electricity prices in Germany are around 27 cents / kWh higher in comparison to other European prices. A special electricity tariff for heat pumps is therefore often not worthwhile in energy-efficient buildings. Efficient heat pump systems thus achieve only low energy cost advantages compared to modern boilers.
- Implementation of energy efficiency measures within the building
  A highly heat-insulated building envelope and three-pane heat protection glazing are economically attractive measures in Germany. Ventilation systems with heat recovery, however, are often not yet as affordable as exhaust air systems (see [AkkP 42], [AkkP 50])

According to expert interviews carried out by the BZB the main barriers and limitations in implementing nZEB policies in Germany are outlined below:

- collaboration and cross-trade understanding (best design can nevertheless be executed in a poor way)
- diligence in executing the construction work (even excellent materials/product are not of any benefit, when applied in the wrong way
- less errors are tolerable when applying materials and constructing a building
- construction workers need to be upskilled in order to work with new regulations, materials and methods
- manufacturing more sustainable and energy efficient construction materials must be more precise in order to exploit their potential
- nZEB content should be included in the VET-schools´ canon
- regulations are too scientific (they must be closer to practice as they often seem to be worked out by non-practitioners; often too complicated/sophisticated for blue collar workers)

- material producers should be involved more in terms of sustainability and energy efficiency. They should label products more precisely with the respective characteristics (degree of energy consumption and / or ecological footprint in total, i.e. energy need from production followed by mode of delivery up to consumption in operation and finally energy need to demolish and dispose (life cycle consideration).

GREECE

nZEB Legislative Framework and Policies in GREECE

Various laws and numerous amendments have been passed, in an effort to legislate the area of nZEB in Greece. More specifically:

1. Performance Buildings Regulation" (KENAK). 'Approval of the Energy Performance for Buildings' (Government Gazette B 407/09.04.2010 and revised by Government Gazette B' 2367/2017) specifies the minimum requirements and the methodology for the calculation of energy performance of buildings. The KENAK aims to reduce the amounts of conventional energy consumed for heating, cooling, air conditioning, lighting, and domestic hot water, while, at the same time, ensuring comfortable conditions inside buildings. This aim is achieved by the energy efficient design of the envelope, the use of energy efficient construction materials and electromechanical (E/M) installations, renewable energy sources (RES) and cogeneration of heat and power (CHP).In particular, the KENAK introduced integrated energy design for buildings in the aim of increasing the energy performance of buildings, energy savings and environmental protection by:
    - requiring an energy performance study for new buildings and for existing buildings subject to deep renovation;
    - setting minimum standards for the energy performance of buildings;
    - classifying buildings in Energy Performance Certificates;
    - requiring inspection of heating and air-conditioning systems by energy inspectors
2. Law 3851/2010 "Accelerating the development of Renewable Energy Sources to deal with climate change and other provisions relating to the jurisdiction of the Ministry of Environment, Energy and Climate Change" (Government Gazette 85/A/4.6.2010), set out measures for the use of RES in buildings and compensatory contributions at local level for the establishment of RES plants. This Law transposed into Greek legislation the European Directive 2009/28/EC. The national law on RES (N.3851/2010) extends the obligation to perform an energy design study to all new buildings, regardless of their size, and allows audits in individual units (properties) of a building (e.g. an apartment**)**. Accordingly, all public buildings by 2015 and all new buildings by 2020 should cover their primary energy consumption from RES, combined heat and power, district or block heating or cooling, and energy efficient heat pumps. In addition, N.3851/2010 sets some very ambitious national targets by 2020: reach a contribution of 20% from RES in the national gross final energy consumption (from 5% in 2007), 40% in gross electricity generation (from 4.6% in 2007), and 20% in final energy consumption for heating and cooling
3. Law 3855/2010 "Measures to improve energy efficiency in end judgment, energy services and other provisions" set the basic strategies, regulations, measures to develop the market for energy services in Greece, and the basis

for a major development of energy service companies (ESCOs). This Law transposed into Greek legislation Directive 2006/32/EC on energy end-use efficiency and energy services.

4. Law 4122/2013: "Energy performance of buildings" (Government Gazette A/42/19.02.2013) transposes Directive 2010/31/EU of the European Parliament and of the Council into the national legislation. This legislative act updates the minimum energy performance requirements for buildings adopted by KENAK and provides that from 1 of January 2021, all new buildings shall be nearly zero-energy buildings, (an amendment postponed it to 1st June 2021) whereas with regard to new buildings owned by the public and the wider public sector this obligation shall be implemented from 1 January 2019.
5. Law 4342/2015 provided the required framework for Greece to fully comply with Directive 2012/27/EU on energy efficiency (Government Gazette A / 143 / 09.11.2015) . Law 4342/2015 also provides measures to encourage energy efficiency, for Greece to contribute towards achieving the fundamental 2020 20 % energy efficiency target and lay the foundation for further energy performance improvements in the long run. There are also indicative national energy efficiency targets set for 2020, along with measures for promoting them and rules to overcome energy market weaknesses that prevent the efficient supply and use of energy.
6. Ministerial Decision no: 7547/104 (Government Gazette 287 B/27.1202), launches the Electronic Building Identity as of 31 September 2021 . The Electronic Building Identity is obligatory for all old and new buildings in the country and constitutes the complete electronic file of a building that includes all its information such as: its building permit, floor plans, millimeter table, construction control certificate, energy efficiency certificate, declarations of subordination to arbitrary laws, etc. linked to the buildings' identity, in order to increase the number of buildings that not only meet the existing minimum requirements for energy efficiency but are also characterized by higher energy efficiency, national plans are currently being drawn up to increase the number of Nearly Zero Energy Buildings (nZEB).

National policies for improving the performance of the nation's buildings and homes in GREECE.

According to the 2016 Energy Balance Sheet, buildings (residential, commercial etc.) in Greece consume 6 322 ktoe or 39 % of total energy consumption, with the residential sector accounting for 27 %. These data illustrate the huge impact of the building sector on the overall energy balance sheet and the massive potential (margin) to reduce the energy consumption of buildings and improve their energy performance.

Building Stock, Overview (Greece).

The building stock in Greece consists primarily of residential buildings and a number of other tertiary sector buildings, of which a census is taken every ten years across Greece. According to the last buildings census of 2011 which was undertaken by the Hellenic Statistical Authority (ELSTAT), the number of buildings in Greece amounted to 4,105,637; the highest percentage of these buildings, 19.1% (783,752 buildings), is located in the region of Attika and the lowest, 3.4% (140,810 buildings), in the region of Ionia Nisia. From this percentage, 92.0% (3,775,848) are exclusive-use buildings (mostly residential buildings), while only 8.0% (329,789) are mixed-use buildings. The building census of 2011 recorded also some qualitative characteristics of the building envelope. 55% of residential buildings in Greece were constructed

before 1980 and therefore they have no thermal protection and, given the economic recession, the number of buildings constructed after 2010 in compliance with the minimum requirements set out in the Regulation on the energy efficiency of buildings (KENAK) represent only 1.5% of the total stock of typical residences used by households.

Moreover, Greek buildings lag significantly behind in terms of their energy behaviour. The introduction of thermal insulation is the most effective way to improve this situation. only the 22.4% of the Greek residential buildings have thermally insulated walls and 42.7% have double glazed windows. Regarding space heating, 67.7% uses diesel oil or natural gas central heating systems (autonomous or not).

The National Plan for Increasing the number of nearly zero-energy buildings (Athens, December 2017) was prepared in cooperation with staff members of the Ministry of the Environment and Energy (YPEN) and the Coordinating Committee and with the collaboration of the Centre for Renewable Energy Sources and Saving (CRES). The Plan aims to define nearly zero-energy buildings and describe the policies and actions that need to be adopted for increasing the number of nearly zero-energy buildings, in accordance with the requirements laid down in Article 9 of Directive 2010/31/EU. The report refers initially to the current situation in Greece and describes the characteristics of the building stock and mentions the regulations on the energy performance of buildings. Then it sets out the characteristics of nearly zero-energy buildings and the intermediate targets set for improving the energy performance of new buildings. Finally, it describes the policies that need to be adopted and the measures that need to be implemented to achieve the targets, and also details the possible obstacles that could prevent Greece achieving them and stresses the major role that can be played by the available funding instrument.

In addition, Greece has recently adopted a new National Energy and Climate Action Plan (NECP) (EC, 2020d,e) that was presented in December 2019 following a public consultation and a debate in the Greek Parliament.

The NPEC, comprises among others, the following axes concerning RES and Buildings:

- Renewable Energy Sources (RES) are projected to reach the 65% of electricity production in 2030, becoming the main national energy source in Greece. Natural gas share in the national energy mix will thus decrease in 2030 in comparison to 2020. Moreover, an objective has been set for promoting RES systems in buildings and dispersed generation systems, through auto-production and net metering schemes. More specifically, a forecast has been made for having such RES power generation systems in operation with an installed capacity of 1 GW, capable of covering the average electricity consumption of at least 330 000 Greek households, by 2030. Effort will also be made, inter alia, to promote photovoltaic systems on rooftops and buildings and small wind turbines, which have developmental and social advantages, as well.
- Concerning Climate Change issues, a higher greenhouse gas emission reduction target has been set, with a reduction of more than 42% over 1990 emissions and more than 56% over 2005 emissions. These targets are necessary in order to enable the transition to a climate-neutral economy by 2050 in accordance with EU targets. Reduction in GHG emissions is among others envisaged to be achieved by: Developing integrated consumption management and monitoring tools for residential buildings and business premises,
- Concerning energy-saving initiatives, plans are also being made for providing targeted incentives for energy efficiency improvement interventions in the stock of private buildings by adopting an ambitious strategy for the renovation of the building stock in its entirety, to make sure that 12-15% of the buildings have undergone energy

renovation by 2030. Overall, the energy upgrading of the building stock is expected to increase added value by EUR 8 million and create and maintain over 22 thousand new full-time jobs.

- More specifically, the total number of buildings or building units to be renovated by 2030 is expected to reach 600 000, compared to an estimated 400 000 in the initial NECP draft. The annual objective is to have an average of 60 000 buildings or building units upgraded in terms of energy and/or replaced with new more energy-efficient ones.

Figure 1 shows the individual quantitative targets in the context of attaining the national energy and environmental objectives for 2030.

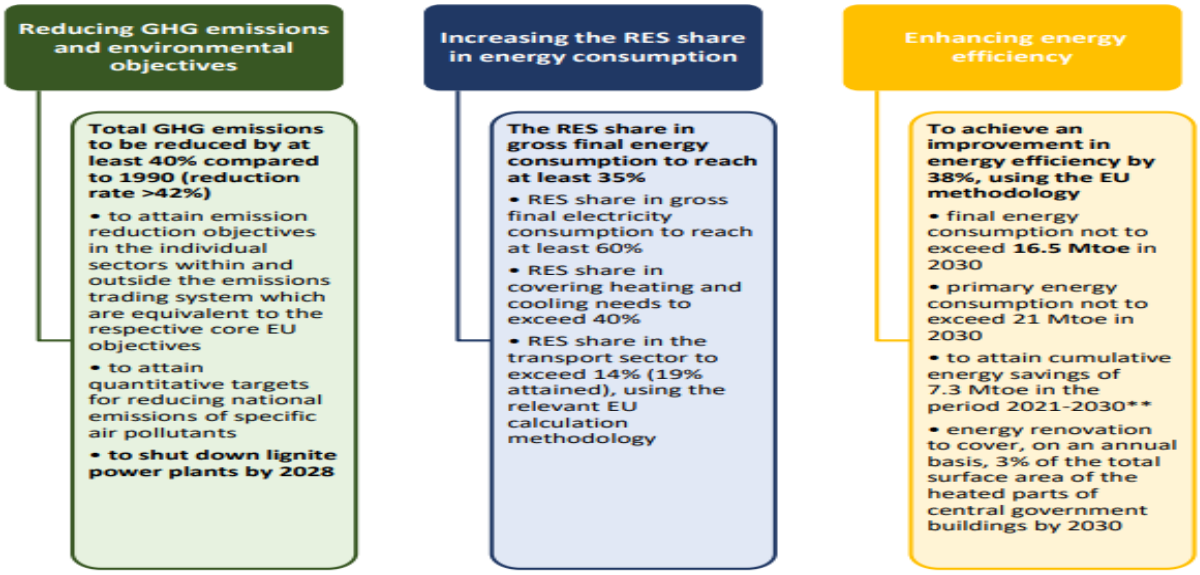


Figure 1: National energy and environmental objectives for the period 2021-2030 in the context of EU policies.

The Plan also envisages the overall strategy in relation to Bioclimatic town and urban planning indicating that the key policy objective consists in using bioclimatic design (in town planning and architecture), aiming to bring buildings, roads and public and other spaces in urban areas in harmony with the environment and local climate, which will yield immediate results in terms of energy savings, while at the same time improving the urban environment and quality of life. It also states the policy priorities for the energy efficiency of buildings, mentioning the optimal use of RES technologies to cover heating and cooling needs and of RES auto-production systems to cover the needs of buildings for electricity.

In addition to the NECP, a National Strategy for Circular Economy has been developed as a horizontal action aiming at the optimal use of resources (energy, water, raw material) in every economic sector. Under a Green Financing Scheme, a series of financing incentives is foreseen for companies investing in circular economy and industrial symbioses, in water reuse after biological treatment etc. Green innovation concerning sustainable green investments will also be supported.

In this context Greece, via the Recovery Fund, has launched the program "Save II" (continuation of the Save I program). The new program will not only have the dimension of energy saving, but also that of energy autonomy, through the production and storage of energy and the management of energy with "smart" systems". The program is set to cover

60,000 buildings per year. Along with the "Electra" program and the "Save at Home", they will improve energy efficiency for households and public buildings.

Obstacles and limitations in implementing nZEB policies in GREECE.

With a view to ascertain the feasibility of the implementation of the policies and measures proposed for increasing the number of nearly zero-energy buildings, it is also important to mention certain impediments and barriers, which were due to the inherent features of Greece and its economic situation.

Firstly, we should mention the reduced income and change of household consumption patterns as a result of the economic crisis. On the basis of the findings of a family budget survey carried out by ELSTAT for 2013, there have been remarkable changes to the spending structure of Greek households in recent years, relating inter alia to declining thermal comfort conditions and increasing energy poverty levels, which make it impossible for them to improve the energy performance of their buildings.

Secondly, we should mention the increasing difficulty in accessing bank funding. Bank lending was the key funding instrument for meeting consumer and investment needs in Greece. The credit crunch in the domestic financial system over the last years (given its declining lending capacity) has contributed to a reduction in investment spending on building renovation.

Finally, the increased vulnerability of banks and the need to secure refinancing and protection against ever-increasing competition has led to significant restructuring in the banking sector, primarily through mergers and buyouts that have taken place. This has led to a reduction in the number of available banks and in the range of available funding instruments, and therefore there are currently no banking products for financing energy performance improvement actions.

SLOVENIA

nZEB Legislative Framework and Policies in SLOVENIA.

Energy Act (EZ-1) defines that all new buildings (built after 31st December 2020) shall be built as almost zero-energy, whereas all public buildings already need to follow nZEB from 31st December 2018! The term 'virtually zero-energy building' in this law means a building with very high energy efficiency or a very small amount of energy needed for operation, whereby the required energy is largely produced from renewable sources on site or in the vicinity. In the EZ-1 in the field of energy efficiency it is defined that 3% of the area of public buildings need to be renovated annually (in terms of energy efficiency measures). This will stimulate new jobs and at the same time bring savings in public expenditure. In the field of energy infrastructure, the procedures for obtaining all necessary permits for the construction of energy infrastructure are being simplified, which will make investments cheaper.

In the Slovenian Act on Energy Efficiency (Zakon o učinkoviti rabi energije (ZURE) (pisrs.si)), in article 3 defines objectives in the field of energy efficiency and energy consumptions. Some of these objectives are: reducing energy consumption; efficient use of energy; the transition to a climate-neutral society using low-carbon energy technologies; ensuring the quality of the internal environment in buildings; raising the awareness of end customers about the benefits of greater energy efficiency, energy consumption and the energy efficiency of their facilities; increasing the energy efficiency of all

stakeholders, especially the public sector; ensuring social cohesion; and protection of consumers as final consumers of energy.

In article 9 where long-term strategy for energy renovation of buildings is, it is written that the Ministry (responsible for energy) shall adopt a long-term strategy for the renovation of the national fund of existing public and private residential and non-residential buildings into a highly energy efficient and decarbonised building fund by 2050, the cost-effective conversion of existing buildings into near-zero-energy buildings and send it to the European Commission with a summary of public participation. In Article 25 there is a definition of nZEB which is from article 5 of the EU Directive 2010/31/EU. It also defines that all new buildings must be almost zero energy (nZEB).

Rules on efficient use of energy in buildings with a technical guideline were adopted in June 2010, pursuant to the Recast EPBD (PURES 2010), which introduces the methodology for calculating the indicators of energy efficiency in buildings in accordance with the CEN EPBD standards or the SIST EN ISO 13790 standard, and lays down the minimum energy-efficiency requirements for new buildings and the major renovation of existing buildings; it also prescribes the minimum requirements relating to maintenance and technical improvements (prior to the end of the lifecycle of an individual element, system or sub-system of a building). PURES 2010 laid down requirements for all public buildings that were 10 % more stringent.

National policies for improving the performance of the nation's buildings and homes in SLOVENIA

National nZEB national plan (Nacionalni Akcijski načrt za skoraj nič-energijske stavbe za obdobje do leta 2020 (AN sNES https://www.energetika-portal.si/dokumenti/strateski-razvojni-dokumenti/akcijski-nacrt-za-skoraj-nic-energijske-stavbe/) from 2015) includes objectives, programs and measures to achieve these objectives (objectives that are defined in act on Energy Efficiency), as well as human and financial resources to implement these programs and measures. In this plan, the government is also formulating policies and measures to encourage the energy renovation of buildings into near-zero energy ones. In this plan, the government is also formulating policies and measures to encourage the energy rehabilitation of existing buildings into nZEB ones.

National plan for increasing the number of nearly zero-energy buildings in accordance with Article 9 of the Recast EPBD1, https://www.energetika-portal.si/fileadmin/dokumenti/publikacije/an_snes/an_snes_slovenija_en.pdf, from 2014, solely English document).

Long-Term Strategy For Promoting Energy Renovation Of Buildings (https://www.energetika-portal.si/dokumenti/strateski-razvojni-dokumenti/dolgorocna-strategija-za-spodbujanje-nalozb-energetske-prenove-stavb/).
The requirement is transposed from the directive into national law under Article 348 of the Energy Act (EZ-1). The Government, on the proposal from the Ministry responsible for energy and the Ministry responsible for the property management system, has adopted a long-term strategy to encourage investment in the energy renovation of buildings (hereinafter "the strategy").

In accordance with the requirements of the Directive and EZ-1, the strategy includes:

- designation of persons from the narrower and wider public sector for the needs of energy renovation,
- areas of buildings owned and used by public sector entities,
- determining the share of renovation of the total floor area of buildings owned and used by persons of the narrower public sector,

- review of the national building stock on the basis of statistical sampling, defining cost-effective renovation approaches for different types of buildings,
- according to the category of buildings, their location and climate zone, identification of cost-effective renovation approaches for different types of buildings,
- policies and measures to promote cost-effective thorough renovation of buildings,
- measures to guide the investment decisions of individuals,
- the construction industry and financial institutions,
- an assessment of expected energy savings and wider benefits.

The Energy Efficiency Directive (2012/27 / EU) established a number of measures, including the allocation of a leading role in the energy renovation of buildings to the public sector. The Directive is transposed into Slovenian law by the Energy Act EZ-1 (Official Gazette of the Republic of Slovenia, No. 17/14). Articles 18 and 19 of the Directive require Member States to:

- support the public sector in accepting offers for energy services, in particular for the renovation of buildings, and
- take measures to remove regulatory and non-regulatory barriers to energy efficiency, in particular with a view to preventing individual public authorities from investing in energy efficiency improvements and from using contractual provision of energy savings and other third-party financing mechanisms on a long-term contractual basis.

In order to fulfill the aforementioned obligation, the Slovenian Ministry of Infrastructure, in cooperation with the Ministry of Finance and the professional public, has prepared "Guidelines for the implementation of energy efficiency improvement measures in public sector buildings according to the principle of energy contracting" (https://www.energetikaportal.si/fileadmin/dokumenti/podrocja/energetika/javne_stavbe/smernice_za_energetsko_pogodbenistvo-web.pdf). The document presents explanations, instructions and recommendations for the implementation of energy efficiency improvement measures in public sector buildings according to the principle of energy contracting. As the share of buildings protected under cultural heritage protection regulations in the segment of state buildings is very large, it was found that these buildings, as bearers of Slovenian identity, need special treatment. Therefore, additionally Guidelines for the energy renovation of buildings that are protected under the regulations for the protection of cultural heritage have been developed (https://www.energetika-portal.si/fileadmin/dokumenti/podrocja/energetika/javne_stavbe/smernice_kd_23.2.2017.pdf).

Strategic document for nZEB in Slovenia is also Operational Program for the Implementation of European Cohesion Policy in the Period 2014-2020 (OP-EKP) (https://www.energetika-portal.si/dokumenti/strateski-razvojni-dokumenti/operativni-program-za-izvajanje-evropske-kohezijske-politike/). It is a strategic implementation document, which was the basis for drawing 3.2 billion euros of available funds from European Regional Development Fund (ERDF), European Social Fund (ESF) and the Cohesion Fund (CF) in the period 2014-2020. The document was approved by the European Commission on 15 December 2014. The document defining the priority areas in which Slovenia invested in the period 2014-2020, document is in line with the Partnership Agreement between Slovenia and the European Commission for the period 2014-2020 and follows the EU 2020 strategy and meets the requirements of each EU fund, so economic, social and territorial cohesion will be ensured.

Increasing energy efficiency in the public sector:
Estimating savings in the public sector in Slovenia is relatively difficult, as the statistical recording system does not know the exact values for energy consumption in the public sector, because energy statistics are not kept separately, but together with other consumption in the service sector and agriculture. According to estimates, most of the final energy of the public sector without lighting was used by hospitals, followed by primary schools, public administration buildings and buildings for culture and entertainment. Project data show that energy savings in energy renovations are on average 50%.

Increasing energy efficiency in households:

The potential for improving energy efficiency in Slovenia is also great due to the structure of the building stock, which is quite unfavorable. More than 29 % of family houses have not yet been renovated in terms of energy, 26 % of existing family houses have already been partially energetically modernized, but further interventions are still needed. The same applies to multi-apartment buildings, where 34 % of the multi-apartment building stock has not yet been renovated in any way, and 28 % is partially renovated with a single energy renovation measure. Barriers to their faster rehabilitation will need to be removed for successful renovation of multi-apartment buildings; promote pilot projects in the field of energy contracting. Renovation of housing used by socially disadvantaged households will contribute to reducing the growing problem of energy poverty.

Eco Fund, Slovenian Environmental Public Fund (Eko Sklad) - Its main purpose is to promote development in the field of environmental protection by offering financial incentives such as soft loans and grants for different environmental investment projects. The Eco Fund also offers information leaflets on the most common measures.
Non- refundable financial incentives (grants) Eko Fund's 2020 Energy Efficiency Improvement Program were for the following purposes (associated with nZEB):

- up to EUR 15 million to citizens and other entities for energy efficiency measures and the use of renewable energy sources in buildings,
- up to EUR 6 million to municipalities for the construction or purchase of new almost zero-energy buildings,
- up to EUR 5 million to legal entities for energy efficiency and renewable energy measures,
- up to EUR 3 million for systems using renewable energy sources for self-sufficiency in electricity,
- up to EUR 0.5 million for energy audits.

Every three years, the Ministry responsible for energy prepares a report on the progress in increasing the number of almost zero-energy buildings and informs the European Commission.

Obstacles and limitations in implementing nZEB policies in SLOVENIA

The obstacles and limitations of the implementation of nZEB policies are because for majority of stakeholders it is too difficult to keep up with the changes, investors as well as much architects/engineers are lagging the ambitious national EE policy goals. All value chain needed to be supported in this complex process to accomplish national goals and contribute more to a greener Europe.

Some experts claimed, that also spatial legislation is lagging behind, it is slightly better with construction legislation, we have too few qualified architects and designers, and the biggest problem we see is with the qualifications of the contractors, upskilling of the workforce is needed , even more we would need to start thinking about how to differ from qualified and non-qualified contractors, physical people are many time first one to test the terrain with new installations and many mistakes occur there later additional investments needed to eliminate poor installation performance and energy indicators not being in accordance with building Energy Performance Certificate.

One of the problems is avoiding the EE legislation required measures by contractors and masters, since the construction sector is booming and much of projects are going on and time schedule for works is tight, supervision of the implemented services is poor, there is a lack of trained workforce and finally selection for criteria is the minimum service price

Experiences in single-family buildings are extensive (single-family house investors are also more aware / environmentally conscious - especially new builders, because they want to have lower operating and maintenance costs for a longer period)

than in other types of nZEB buildings, we have no more time to transfer technologically innovative and economical solutions for construction and living in high-energy-efficient buildings in concrete projects, as these must already be built from this year (2021) onwards. Problems are staying for non- residential, residential buildings, industrial buildings, etc. nZEB building should be a bit more expensive than classical building claim every architect, in the end it shows up it is much more expensive, not only a bit. Even project design is more expensive for such investments.
Systematic and an obligatory training of experts in specific areas of almost zero-energy buildings is essential.

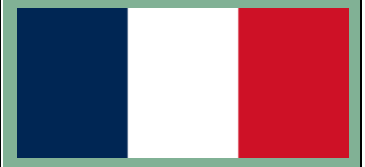
Investors would need a toolkit with special matrix measure to take decision which measure to select and combine and achieve lower investment costs (on building shell and on building installations) in before they will start actual nZEB investment in building to achieve lower initial or renovation investment costs to achieve best energy performance indicators for building, for example:

- with a compact thermal envelope and slightly less thermal insulation at the expense of additional, cost-effective photovoltaic panels integrated into the roof elements.
- as few underground parts as possible for basements and car parks,
- optimization of common areas and construction of an external staircase in a multi-apartment building, which means a smaller thermal envelope and a smaller heated volume
- the use of homogeneous materials and components (such as aerated concrete or monoblock window), which allow lower material costs and shorter construction time compared to the classic design of solid load-bearing structure and external thermal insulation cladding,
- shortening the construction time by using cross-laminated wooden panels, which consequently means a faster possibility of using the building, the use of photovoltaic panels modularly integrated into the roof,
- instead of another roof covering or a traditionally more expensive way of building a solar power plant on the roof of a building,
- installation of hygrosensitive ventilation instead of mechanical, where the air conditioning allows it.
- cheaper heating and hot water treatment systems in combination with decentralized heat recovery from wastewater,
- heat recovery in exhaust ventilation by returning heat to the heating system with air medium,
- better airtightness of the casing during mechanical ventilation with recuperation,
- bioclimatic planning,
- several standard solutions for certain components and systems,
- use of BIM in planning and effective control at all stages of construction, thus avoiding subsequent costs due to repairs and hiring qualified contractors (BIM cost management design is promising, but still requires a lot of development and significant support from construction manufacturers products and materials).

3. Best practice analysis of Nearly Zero Energy Buildings in partner countries

3.1 National programs, initiatives and tools to promote energy efficiency of buildings

FRANCE



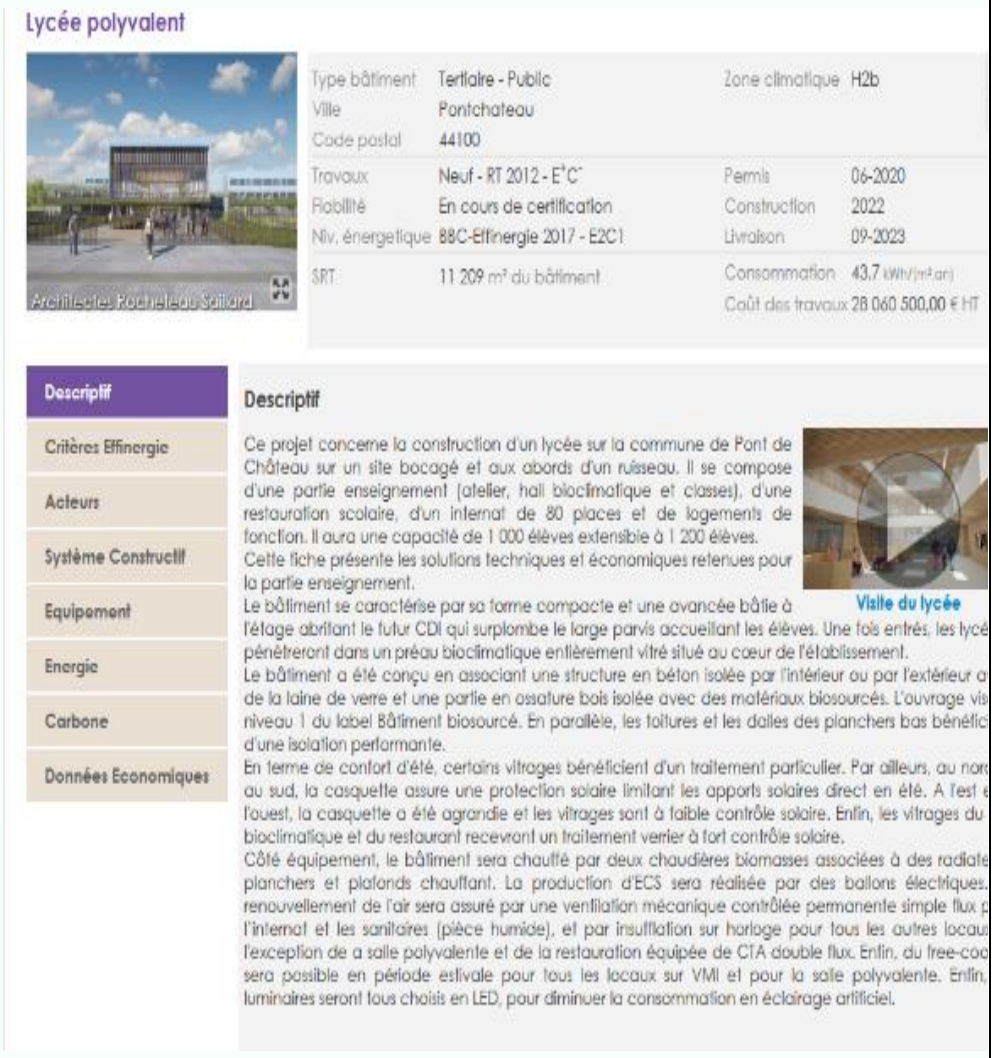
Observatoire BBC

The Observatory was initiated by the Ministry of Environment, Sustainability and Energy, the association EFFINERGIE and ADEME (French Agency for Ecological Transition)

Figure 1 Home page of the observatory

Launched and put online in 2009, l 'observatoire BBC is first a tool designed to share experiences and feedback on nZEB.
Then in 2014, the observatory adds the BEPOS module in order to provide a repository of the BEPOS sector in France and capitalize on the first Bepos-Effinergie 2013 actions.
Finally, in 2017, it includes the notion of "CO^2-Greenhouse Gas Emissions" with Effinergie 2017 Labels.
The objectives of the Observatory are:

- To publish technical and economical studies for the public entities and professionals annually
- To publish the dashboard of the Effinergie certifications quarterly
- To disseminate operation sheets monthly

	• To participate to focus groups on the future regulation • To animate lectures on nZEB and renovation  Figure 2 Screenshot of a project description from the Observatoire BBC
Best Practice Topic	· Heating, ventilation and air conditioning (HVAC) systems; · Electrical Installation · Building envelope · Energy performance certificate and energy efficient regulations · Development of energy culture in the building sector · Other relevant to Nzeb sector
Best Practice Methodology	L'Observatoire BBC — BBC Observatory addresses the following challenges: · Supporting the generalization of positive energy buildings and the massification of renovation · Enhancing the professional's know-how · Contributing to the development of future regulation · Identifying training needs The observatory provides efficient tools: · Search engines · Geolocation maps · A documentary base

	· Operation sheets presenting the technical and economic solutions for each project. · An interactive tool analysing the dynamics of low-energy construction and renovation at different territorial scales
Critical Success Factors	The BBC Observatory is a very complete tool, freely accessible, available to all and contains a large database. In view of these characteristics, the objective of encouraging the dissemination of the generalization of positive energy buildings and the massification of renovation is greatly facilitated. Each project sheet available from the search engine is very complete and detailed. It includes general information about the project (address, year of construction, surface area, etc...), a description of the project but above all very detailed energy data (equipment, energy balance, carbon balance, etc.) as well as economic data about the project. It allows the integration of videos presenting the project, graphs, various data tables, etc... The BBC Observatory also regularly publishes various studies on the technical and economic aspects of positive energy buildings. These studies, which are carried out on a regular basis, make reliable data available to all interested parties, identify trends in the sector and thus facilitate decision-making and the implementation of effective and appropriate strategies. Finally, the replicability of this tool is quite conceivable on a local, regional or national scale for countries that would like to have such a tool.
Constraints	The tool requires the involvement of projects leaders and managers, ..., in the publication of projects, providing the observatory with exploitable data.
Contact details **URL of the practice (if applicable)**	Contact: SébastienLefeuvre Head of the Observatoire BBC and Training Address: 18 Boulevard Louis Blanc 34000 Montpellier e-mail : lefeuvre@effinergie.org Phone : 07 69 38 20 46 https://www.observatoirebbc.org/

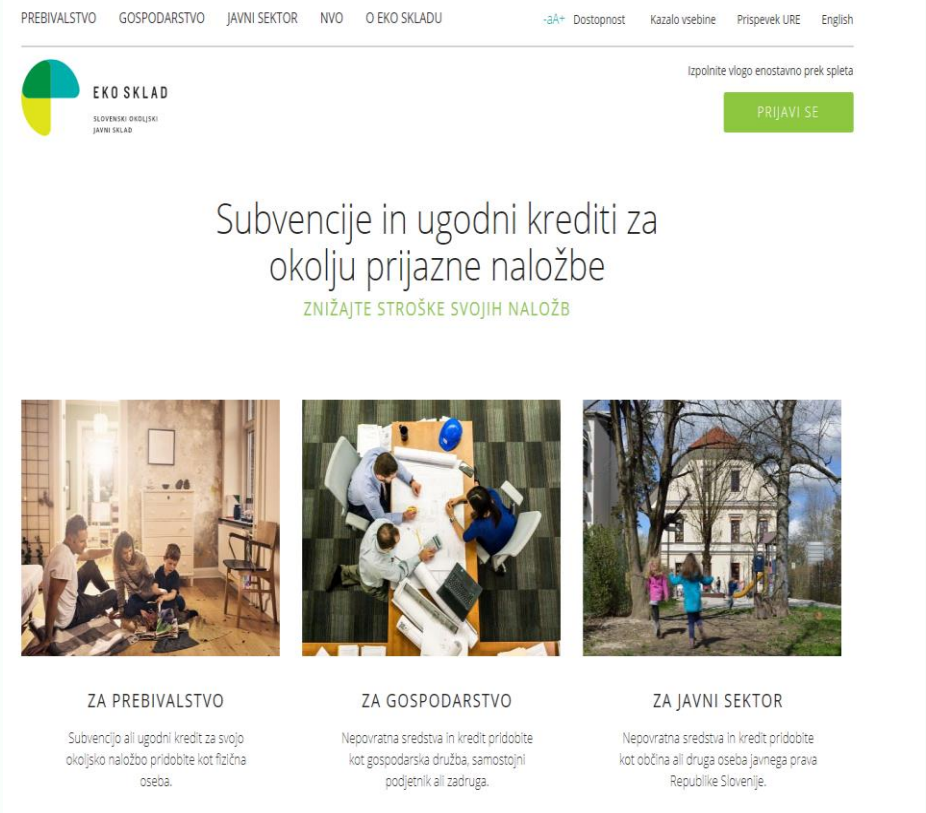
ITALY 	**Super Bonus 110%** The Italian State has introduced the so-called "Superbonus": a 110% deduction on the expenses incurred for those individuals who will carry out thermal insulation interventions, replace the heating systems and reduce the seismic risk of the building. The Superbonus is applied both to condominiums and individual homes. The 110% tax deduction is valid for works carried out from 1 July 2020 to 30 June 2022. The Superbonus 110% objectives are: 1. improving the energy performance of buildings 2. improve the thermal insulation using materials that respect the environment 3. the replacement of heating systems with centralized condensing, heat pump, hybrid, geothermal systems, also combined with photovoltaic panels, will improve the energy consumption. Buildings will be autonomous using the passive house techniques 4. reduction of fossil emissions

	5. augmented production of energy from renewable sources in order to accelerate an energy conversion towards sustainable development **6.** support the client with competent professional figures better quality of life for people
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems Electrical Installation Energy performance certificate and energy efficient regulations Development of energy culture in the building sector
Best Practice Methodology	The Superbonus method was created to improve the energy performance of buildings. In fact, to obtain the Bonus, the building must be improved by two energy classes at least. To obtain the Superbonus, all energy efficiency interventions must guarantee, as a whole, the improvement of at least two energy classes or, if not possible, the achievement of the highest energy class. It should also be noted that all the interventions envisaged by law no. 63/2013 give the right to the Superbonus also in the exceptional case that it wouldn't be possible to carry out what are defined like main interventions (for instance the thermal insulation of the building envelope) due to constraints linked to the Regulations of the authority for landscape heritage or for special environmental regulations. It remains the obligation to record an improvement of at least two energy classes or, if not possible, to obtain the highest energy class. The main interventions provided are: thermal insulation, interventions on the building envelope, replacement of heating systems, replacement of windows (with high efficiency ones) and the replacement of the boiler/heater with a heat pump system. For the realization of the insulation the Ecobonus guidelines indicate that the thermal wall of the opaque vertical, horizontal and inclined surfaces affecting the building envelope is envisaged. This intervention must have an incidence greater than 25% of the "gross dispersing surface of the building"; for single-family buildings there is a budget limit of 50.000,00 € for the construction works; for condominiums, the budget limit is set at 40.000,00€ per property unit (if the building consists of 2 to 8 property units) or 30.000,00 € (if the building consists of more than 8 units). The deduction is recognized to the extent of 110%, and it is paid back to the individual in 5 years through a tax return. Alternatively, the construction company can take over the credit (in this way the individual will not pay the invoice of the construction company) and have a tax return of the company taxes in five years.
Critical Success Factors	The advantages of the Superbonus are: **1.** improvement in the energy performance of the buildings. **2.** retrofit the building structure practically for free. **3.** reduction of environmental impact thanks to the use of innovative and sustainable materials. **4.** augmented use of renewable sources for energy production. **5.** Better cost impact for families. This law is intended as an help from the Italian State to restart the Italian economy after the Covid-19 impact.
Constraints	**1.** Only physical persons can take advantage of the SuperBonus (for instance, a building for offices or a shop cannot access to the Superbonus) **2.** The bonus is valid only for works carried out in 18 months, which is not a very long time considering the amount of works needed to improve the energy performance of 2 classes **3.** Not all construction companies accept to take over the credit: this means that the individual has to anticipate all the costs to be recovered in the following 5 years (not all the citizens have the economic capacity to anticipate payments for some hundred-thousand Euros

Contact details **URL of the practice**	www.agenziaentrate.gov.it/portale/superbonus-110%25 www.governo.it www.lavoripubblici.it

GREECE 	**Saving at Home National Programme** The 'Saving at Home' National programme aimed at providing financial incentives for energy-saving interventions in the residential building sector with a view to reducing energy needs. The types of housing that could be subsidized by the programme were: Single-family houses, Apartment blocks for the part of the block which relates to all the apartments in the building, Individual apartments.
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems; Building envelope
Best Practice Methodology	The proposal (combination of interventions) for energy upgrade which was submitted with the application should cover the following requirement which was the minimum energy objective of the Programme: the building should be upgraded by at least one energy class or, alternatively, provide an annual primary energy savings greater than 30% of the reference building consumption (kWh/m2). Beneficiaries were categorized based on income and societal criteria in 3 different categories, and the level of subsidy and low interest loan was differentiated accordingly
Critical Success Factors	The applications completed by June 2016 as part of the 'Saving at home' programme amounted to 51,659 of a total budget of €529million. 83 % of the completed applications involved the replacement of window frames, 53.9 % thermal insulation and 71.6 % upgrade of the heating system and domestic hot water supply. The total area of renovated residences amounted to 5.2 million m2 resulting in total annual primary energy savings of 853.6 GWh.
Constraints	No constraints were recorded
URL of the practice	Energy Efficiency trends and policies in Greece (CRES, July 2018) https://www.odyssee-mure.eu/publications/national-reports/energy-efficiency-greece.pdf

SLOVENIA 	**Eco Fund incentives (grants) for almost zero-energy buildings** (slov. Spodbude Eko sklada za skoraj nič-energijske stavbe). Its main purpose is to promote development in the field of environmental protection by offering financial incentives such as soft loans and grants for different environmental investment projects. Perhaps the most significant aspect of Eco Fund's operating environment is the requirement that Eco Fund maintains the real value of its assets. For this reason, Eco Fund has provided support to environmental investments through soft loans and developed a strong focus on the financial sustainability of the projects it supports. In 2008, Eco Fund was granted the use of additional financial mechanisms such as grants to support environmental investments. In order to reach its goals, Eco Fund prepares and carries out yearly plans which serve as a basis for the publishment of public calls. co Fund's subsidies have had a positive effect on tax revenues, diminishing of grey economy, new green jobs, sustainable development of the construction planning and business, as well as on the development of the use of strategic resources such as wood. A few years ago, Eco Fund has taken over the organization and financing of free energy advisory network offering free expert advice on how to improve energy efficiency to households. It has also taken over part of the task of energy poverty reduction by covering

	the entire cost of several environmental investments of households struggling with energy poverty. ECO FUND Grants for environmental investments (renovation of building with EE measures) are financed mostly by fees paid by end users of energy and funds from the climate change fund (revenues from CO2 allowances). GRANTS/LOANS are available for Residents, companies (private sector) as well as public sector! Home page of Eco Found: https://www.ekosklad.si/ Fund publishes new financial incentives every year. 
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems; Electrical Installation Building envelope Energy performance certificate and energy efficient regulations Development of energy culture in the building sector Other relevant to nZEB sector
Best Practice Methodology	Offers financial incentives such as soft loans and grants for different environmental investment projects.
Critical Success Factors	Eco Fund's subsidies have had a positive effect on tax revenues, diminishing of grey economy, new green jobs, sustainable development of the construction planning and business, as well as on the development of the use of strategic resources such as wood.
Constraints	They do not check the quality of every approved application (Bad monitoring of implemented investments leads to frauds). There is no control of measures on terrain, all is documented in papers with photos and different statements only. It is not a transparent system in terms of price. Problem with prices of contractors and built-in installations (benchmark). Some contactor have poor works quality but they can still work, there is no special list of a bad performance contractor. Investors are sometimes mislead by the providers of the installation systems, and not invest properly (value for money).

Contact details **URL of the practice**	Address: Eko sklad, Slovenski okoljski javni sklad Bleiweisova cesta 30 1000 Ljubljana E-mail: ekosklad@ekosklad.si Phone: 01/ 241 48 20 https://www.ekosklad.si/

SLOVENIA 	**PROJECT OFFICE FOR ENERGY RENOVATION OF BUILDINGS (PP-EPS)** National free consultancy service for all investors" The area of energy renovation of existing buildings is carried out within the priority direction Energy rehabilitation and sustainable construction of buildings within the development priority Sustainable energy use. Due to the crucial importance and scope of the field, a project office for energy renovation of buildings was established in October 2015 at the Ministry of Infrastructure (MZI). It includes experts from the fields of construction, mechanical engineering, law and economics, who together master all areas of the measure. The tasks of the project office are: ● preparation of an appropriate support environment and necessary documentation on the basis of applicable legal acts; ● providing assistance and technical support to intermediary and Implementing Bodies, public sector entities, energy service providers, applicants, public-private partnership providers and beneficiaries of the operation during the preparation and full implementation of operations; ● establishing the necessary records (records of public buildings that will be energetically renovated) and ongoing recording of changes; ● monitoring and control of the implementation of operations; ● transfer of knowledge and good practices. The project office issued written instructions for the work of the intermediary and implementing bodies. The instructions contain guidelines and instructions for preparation for the operation, preparation of the necessary documentation and instructions for carrying out all the necessary procedures of the operation. As an appendix to the instructions, the following have been prepared: more detailed guidelines for public partners, technical guidelines, a manual of eligible costs and guidelines for the implementation of energy renovation of cultural heritage buildings. All the mentioned documents are prepared in order to provide all the necessary information to the entities that will participate in the energy renovation of public buildings.
Best Practice Topic	Other relevant to nZEB sector FREE CONSULTANCY
Contact details **URL of the practice**	https://www.energetika-portal.si/podrocja/energetika/energetska-prenova-javnih-stavb/projektna-pisarna/

SLOVENIA	**ENSVET** Form project to national incentive: Free and in live national consultancy for residents in Slovenia(in last years offered through ECO FUND web site) Builders of residential houses, including almost zero-energy prefabricated buildings, must find the right answers about energy efficiency at the beginning of the project, ie at the conceptual stage. and it is the turn of ENSVET network consultants, free of charge and throughout Slovenia for all Slovenian resident thinking of renovation of building new house
Best Practice Topic	Other relevant to nZEB sector: PRESENTATION OF EE MEASURES AS ELIGIBLE AND REASONABLE FOR INVESTMENT BY NATURAL PERSON
Best Practice Methodology	Free and live consultancy for natural person offered 1x a week on local level in local authorities' premises!
Critical Success Factors	Project is successful, so it becomes a part of national ECO FUND service.
Constraints	Different expert offering and advice and consultancy in local community different knowledge, on some areas they are weaker on other they are strong, so you have to visit more experts/consultants.
Contact details **URL of the practice**	https://www.ekosklad.si/prebivalstvo/ensvet/svetovalec

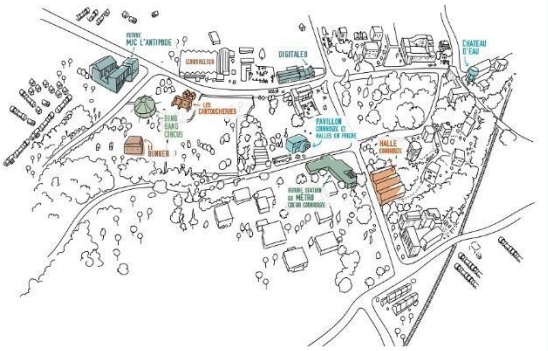
3.2 Exemplar of High-performance buildings

FRANCE	**La Courrouze** La Courrouze is a suburban redevelopment of a former army base. It is a live-work community, denser than typical suburbs, with an emphasis on energy efficiency and a large percentage of park space. The project was born in 2003 from the common will of the cities of Rennes and Saint-Jacques-de-la-Lande.

Figure 3 source www.lacourrouze.fr

	This vast 115-hectare project was certified as an eco-neighborhood in 2013. An eco-neighborhood is an approach, supported by the Ministry of Ecological Transition, which promotes development projects that integrate the issues and principles of sustainable cities and territories. La Courrouze integrates social diversity, quality of life and sustainable development. It is a project that is still in development and entering its final phase. Housing, shops, offices, leisure and cultural facilities are already built and alive.  *Figure 4 source www.lacourrouze.fr* The project also includes the renovation of buildings including those in a former military zone. The project extends to 2028, at which time it is scheduled to be completed.
Best Practice Topic	Other relevant to nZEB sector

Best Practice Methodology	 *Figure 5 source www.lacourrouze.fr* It is a large-scale project with a global approach. In terms of housing the criteria are based on a high-level standard: · Maximum energy performance · Optimized housing orientation · Comfort of life: insulation, brightness, distribution of surfaces · Balcony terraces · Photovoltaic solar panels · Vegetated roofs for rainwater recovery · Water management through natural gullies and embankments around the residences · Positive Energy Residence · Valorization of the existing vegetation and topography Moreover, it is a project that tends to bring people together and promote active citizenship by valuing proximity and exchanges. The design of the buildings and the infrastructures present are in line with this approach.
Critical Success Factors	Goals: 20% energy reduction from conventional construction. Energy demand: 27.3 – 50 kBtu/ft2 . Strategies: LEED ND Platinum, passive solar design strategies. Repurposed buildings. Energy use mandates The project benefits from several tangible results: · Promotion of soft mobility (numerous pedestrian areas and secure bicycle paths, etc.) · Optimization of accessibility, particularly for people with reduced mobility · New generation public transport · Facilitation of selective sorting · Sustainable development of green spaces, particularly with regard to rainwater management · Valorization of citizenship and exchanges: collective vegetable gardens, neighbours' parties, festive events, … · Construction of infrastructures according to high standards of sustainability
Constraints	A vast real estate project, it requires the active involvement of politicians in the project and a very important economic investment. The will to combine various aspects such as housing, transport, employment, social life, etc… in a sustainable manner requires political decisions that facilitate the creation of

	infrastructure (transport, public institutions, shops, etc…) but above all that this will be materialized in concrete projects.
Contact details **URL of the practice (if applicable)**	https://www.lacourrouze.fr/ Anaïs Landwerlin, operational mediation officer for the neighbourhood email: anais.landwerlin@territoires-rennes.fr Phone: 06.71.97.03.53 40 rue des Munitionnettes, 35000 Rennes 

ITALY

Title: K19B Building Milan (Italy)
ARCHITECTS: LPZR Architects
PLACE: Milan (Italy)
REALIZATION: 2012-2014
SURFACE:600sqm
These two buildings, for a total of 15 apartments, are the result of the requalification of and abandoned and degraded urban area in the suburbs of the city of Milan. In fact, the seven-floors block house is built on the ruins of a disused workshop and the other building is instead a renovation project of a 1950's garage.
The K19 Milan buildings are "Nearly Zero Energy Buildings", capable of producing practically all the energy they need, ensuring maximum comfort, thanks to the technologies adopted to reduce the consumption and use of renewable energy

Best Practice Type	Exemplar of High performance buildings
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems Electrical Installation Building Envelope Energy performance certificate and energy efficient regulations Development of energy culture in the building sector
Best Practice Methodology	The K19 Milano buildings are nZEBs, thanks to the technologies adopted to reduce the consumption of non-renewable energy. The use of geothermal energy and the

	deep study of all the details of the building envelope led to an extremely energy efficient construction, in which architecture and technology are combined. The characteristics of the apartments are based on a high standard: Maximum energy performance Controlled ventilation Minimal heat losses Optimized building orientation Comfort of life: insulation, brightness, surface distribution Balcony, terraces Photovoltaic solar panels Redevelopment of a suburban area through the enhancement of the existing building Transformation of a building into a passive house The building is characterized by very efficient low-emission windows. The building is also provided with storage tanks to maximize the benefits of geothermal system. The K19A renovation is characterized by multilevel terracing, which was the roof of the old garage. The building materials are of Italian origin, like the "Piasentina" stone from the northern region of Friuli Venezia Giulia (a very valuable material) that covers the building stands and oiled treated larch wood.
Critical Success Factors	The success factors of these two buildings are: - Requalification of a suburban degraded area by the complete building renovation of two old abandoned buildings; - Creation of high efficiency buildings; - Perfect integration of the very modern architecture of these buildings with the other construction surrounding them The city of Milan is evolving, the building project led to a greater concentration of use of resources to redevelop an area of little interest for citizens. Safe pedestrian areas have been created around the neighborhood, accessibility has been optimized for people with reduced mobility, and the metro that connects the whole city has a stop near the nZEB building
Constraints	Very high price of apartments, despite the suburban location. This fact affected the sales campaign
Contact details **URL of the practice**	www.lpzr.it/progetto/k19b/ www.infobuildenergia.it www.domusweb.it

GERMANY 	**B10** This research project – named ´B10´ after its location ´Bruckmannweg 10" – is an ActiveHouse. This ActiveHouse is based on the concept, that it will produce 200 % of the energy it will consume itself, i.e. 100 % surplus. A part of this will have a direct effect on the electro-mobility on its residents. Once the storages are full, surplus energy will be provided for the Le Corbusier House (Centre of the Stuttgart World Heritage Weißenhof-Siedlung / Bauhaus) in Stuttgart, which is in close distance to B10. Planning: 2013-2014, Building: 2014
Best Practice Type	High performance buildings
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems Electrical installation Building envelope Energy performance certificate and energy

	efficient regulations Development of energy culture in the building sector
Best Practice Methodology	To merge technique and humans´ interests, there is an intense monitoring all over the facility. Temperatures on different surfaces, humidity in the air and inside building elements as well as thermal volumes and electrical streams running through elements like house-technique, sockets and light will be recorded entirely. In contrast to that the integrated photovoltaics unit including thermal-solar unit should buffer the energy surplus using a storage system in order to take energy from this when needed. Hence, information about surplus and use are available at any time; this supports decisions like when to wash clothes, when to clean up or when to bake a bread.
Critical Success Factors	Outcomes: showing how innovative building materials, constructions and technology can have a sustainable impact on ecology. Functionality/replicability: in August 2019 (5 years after finishing the construction at the primary location) the experimental building was lifted up by crane and put on a heavy load lorry which transported it to the place where the elements had been produced (in Hohenstein-Oberstetten)
Constraints	What are the challenges/barriers encountered in applying the good practice? The pre-dominant challenge in local assembling was to merge the residential unit with the technical one including control technique as well as heating and ventilation. Considering a partly new developed software and new interfaces, among others for monitoring, this was not an easy task but eventually successful. The facility could be handed over to technicians for final installations at the end of that same day. After related outdoor jobs the façade was covered with weather-resistant and UV-resistant textile fiber.
Contact details **URL of the practice (if applicable)**	What is the address of the people or the project to contact if you want more information on the best practice? https://www.schwoererhaus.de/bauweise/aktivhaus-b10/ Where can one find the good practice on the Internet? https://youtu.be/NTGRb6WMlvQ

GERMANY 	**Demonstrationszentrum Bau und Energie** **(**Engl.: Construction and Energy Demonstration Centre) The Demonstration Centre is a unique information and communication centre in Germany that shows how future-proof buildings can be constructed. The Competence Centre for Construction and Energy supports the transfer of know-how between all groups involved in construction. Craftsmen, engineers, architects and builders can be informed about the latest specialist knowledge through advice, specialist events, exhibitions and courses. First phase of construction: 2002-2004 Since May 2013, the Construction and Energy Demonstration Centre has been expanded to include a timber framing competence center
Best Practice Type	Exemplar of High performance buildings Training and capacity building projects targeting the nZEB sector
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems; Electrical Installation Energy performance certificate and energy efficient regulations Development of energy culture in the building sector
Best Practice Methodology	The Chamber of Crafts in Münster built the demonstration centre as an information and training forum for craftsmen, engineers, architects and clients to combine energetic, ecological and aesthetic aspects of construction. The demonstration

	centre displays numerous objects in an exhibition that make energy-efficient and sustainable building visible and tangible. The building units of the centre are constructed from different materials and provided with 500 measuring points on temperatures, humidity etc. for research and teaching of craftsmen, apprentices and students. The demonstration centre covers the following topics: measurement technology renewable building materials buildings services (solar cooling and heating, heat pump, heating with wood, electricity from the sun, rainwater utilization systems, ventilation)
Critical Success Factors	The goal of the centre is to direct the attention of the different actors involved in construction to the building as a whole. The holistic consideration of the construction, material and technology is crucial in order to meet quality requirements of the future. Thinking and acting across different trades is a must at the demonstration centre.
Constraints	Challenges and barriers are not mentioned.
Contact details **URL of the practice (if applicable)**	Contact: Paul-Schnitker-Haus Demonstrationszentrum Bau und Energie Franz-Meis-Straße 1 48163 Münster Roland Laabs Tel. 0251 / 705-1309 roland.laabs@hwk-muenster.de Reference: http://www.demozentrum-bau.de/messtechnik/index.php https://www.hwk-duesseldorf.de/artikel/demonstrationszentrum-bau-und-energie-der-hwk-muenster-31,1788,2462.html https://referenzbauten.fnr.de/index.php?id=13202&objektid=24

GREECE 	**AVAX S.A. Building** In Greece one of the oldest and more characteristic examples of high-performance buildings is the Offices of the Construction Company AVAX S.A. It is considered a model of bioclimatic architecture. Reaching Near Zero Energy Building (nZEB) operational performance requires a combination of bioclimatic design, efficient energy technologies, smart monitoring and renewable energy deployment[1] (Karlessi t al, 2017). Bioclimatic architecture refers to the design of buildings and spaces (indoor and outdoor) based on the local climate, in order to ensure conditions of thermal and visual comfort, utilizing solar energy and other environmental sources and natural climate phenomena. Basic elements of bioclimatic design are the passive systems that are integrated in the buildings in order to utilize the environmental sources for heating, cooling and lighting of the buildings. Bioclimatic design - although embedded in the architecture - is considered a new "vision" in architecture. Nevertheless, bioclimatic architecture has been a key

1

	approach to building construction worldwide in recent decades due to the lower energy requirements for heating, cooling and lighting of buildings resulting from the practice of bioclimatic architecture and multiple benefits that entail: energy (savings and thermal / optical comfort), economical (reduction of installation costs) electromechanical, (pollution reduction) and socially. The study of the building was done in 1993 and its construction was completed in 1998. The building is located on the east side of the hill of Lycabettus and houses the offices of the contractor AVAX S.A. Its gross area is 3,050m2, and is divided into three basements, ground floor and five floors with a planted roof. Its design includes principles and techniques of bioclimatic design, which covers part of the energy needs of the building and creates a pleasant and comfortable environment for its users. The building has an open view to the east and is exposed to the sun all morning, while the west side is shaded by neighboring buildings and its narrow sides (north and south) are adjacent to neighboring buildings.
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems; Electrical Installation Development of energy culture in the building sector
Best Practice Methodology	The facade is dominated by five 16m high concrete columns, which characterize the structure of the building, as well as the solar awnings. These are vertical glass curtains with silk screen printing that provides a shading rate of 70%. These shutters are controlled by the central energy management system to rotate automatically, responding to temperature and solar radiation. The shading system is complemented on each floor by a series of fixed railings with horizontal white metal grilles that provide access for maintenance. The top floor and mezzanine are shaded by classic exterior blinds that are also controlled by a central system. All the main areas are located along the glass facade and are separated from the secondary ones by a traffic zone. In addition, openings have been created for natural ventilation and night ventilation (for cooling) through the false floor vacuum, while there are ceiling fans in all office spaces which extend the comfort zone from 25 ° to 29 ° C. In the basement there are "ice basins" for storing cooling energy during off-peak hours. The refrigerant load is covered by the combination of different technologies in order to reduce energy consumption and power demand. These technologies include night ventilation, minimizing indoor profits, using ceiling fans, using an ice pump heat pump, and selecting 28 ° C as the comfort temperature. The refrigerant load is covered mainly during the day by the ice basins and the power demand for cooling was transferred from day to night with the corresponding economic benefit. Also, the ice basins cover the refrigeration load during the days of the week without additional operation of the heat pump. Sensors regulate the opening and closing of artificial lighting according to external lighting conditions. Special automation systems (BMS) regulate ventilation, shading, air conditioning, etc., thus achieving the maximum possible energy savings. The building carries out measurements of the total energy consumption, which is estimated to be significantly lower than 50% of corresponding conventional buildings. A significant percentage of the building's electricity is consumed for cooling, 15% to 40%, while for lighting 5% to 17%. Compared to the energy consumption of typical office buildings, these percentages are very low, which proves that energy saving techniques in air conditioning and lighting of the building are efficient. Overall, linked to nZEB targets (Magrini et al)

	• the building thermal mass allows to reduce the temperature variations due to the outdoor climatic conditions; • the thermal regulation is finalized to maintain the design indoor conditions, with the aim both to guarantee the internal comfort and to limit energy consumption. • the solar shading is fundamental to avoid overheating in summer.
Critical Success Factors	Critical success factors of the project constitute: Energy savings from the significant reduction of losses due to the improved protection of the shell and the behavior of the structural elements, production of thermal energy (heat) through solar systems direct or indirect profit by contributing to the thermal needs of the attachment spaces and partial coverage of the heating requirements of the building, creating conditions of thermal comfort and reducing the requirements regarding the regulation of the thermostat (at lower temperatures in winter and higher in summer), maintaining the indoor air temperature at high levels in winter (and correspondingly low in summer), resulting in a reduction of the load to meet the energy requirements of the ancillary systems during the use of the building. The utilization of solar energy and environmental sources, in general, as shown by bioclimatic design, is achieved in the context of the overall thermal operation of the building and the building-environment relationship. The thermal operation of a building which: • depends on the local climatic and environmental parameters (sunshine, outside air temperature, relative humidity, wind, vegetation, shading from other buildings), but also the conditions of use of the building (home, offices, hospitals, etc.) and • is based on the corresponding energy behavior of its structural elements and (consequently) of the integrated passive solar systems, but also the energy profile resulting from the operation of the building.
Constraints	No constraints were reported.
Contact details **URL of the practice (if applicable)**	AVAX S.A - Member of PEDMEDE https://avax.gr/ http://www.cres.gr/energy-saving/efarmoges_abax.htm

SLOVENIA

LUMAR PRIMUS-R 150 iEDITION individual house

The house is built according to the Lumar Zero Emission Living® concept, which comprehensively addresses the key sustainable aspects of construction; living comfort, energy and environmental impact. That the concept represents sustainable aspects of construction is confirmed by the certificate obtained under the certification scheme of the Active House Association based in Brussels. It the first residential house in Slovenia with an Active house certificate. Considering modern technological solutions and the possibility of using renewable energy sources, a solar power plant was installed on the canopy.

Year of construction 2019.

Living area 149.86 m^2

	 **https://www.lumar.si/referenca/vzorcna-hisa-dragomelj**
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems; Electrical Installation
Best Practice Methodology	Savings with the use of renewable energy source (Solar), perfect thermal insulation, a high-quality air conditioning system with a recuperator, intelligent control and management of electric.
Critical Success Factors	Low operating and maintenance costs and the highest level of living comfort.
Constraints	The house is not affordable for average family with average Slovenian income.
Contact details **URL of the practice (if applicable)**	Address: Lumar IG d.o.o.Limbuška cesta 32 A, 2000 Maribor Slovenija Phone: +386 2/421 67 50 E-mail: info@lumar.si https://www.lumar.si/

SLOVENIA

The 'eco silver house' high rise apartment block

(CONCEPTION AND METHODOLOGY STUDIED IN 7tk FRAMEWORK PROGRAMME project HIGH-RISE, http://www.ee-highrise.eu/)

The Eco-Silver House is a multi-residential highrise building located in Ljubljana, Slovenia. It is part of the FP7 EE-Highrise demonstration project, aiming to demonstrate new nearly zero energy building (nZEB) technologies, integrated design concept, systems for sustainable, nZEB.

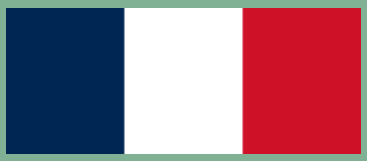
The energy concept of the building with good insulation of thermal envelope and dynamic shading as well ensures that each apartment can function like an independent passive house. The U value of the building envelope varies between 0,17 W/(m2K) (walls) and 0,14 W/(m2K) (roof), while the U value of triple glazed (Ug = 0,58 W/(m2K) window of standard dimensions is 0,83 W/(m2K). The measured airtightness level of the building sectors, n50, is between 0,45 h-1 and 0,59 h-1 (Blower door test), i.e. bellow the design value of n50 = 0,6 h-1. https://core.ac.uk/download/pdf/82204407.pdf

The house meets PH design criteria and is registered in the PH database https://passivhausprojekte.de/index.php?lang=en#k_4522. The design meets the minimal requirements of cost-optimal for apartment building with Net Present Value of 272 EUR/m² and primary energy use of 79 kWh/m²/y.

	Currently the renewables aspect comprises district heating based on a mix of 9 % of biomass, grid electricity, with 33.5 % hydroelectricity and a photovoltaic array together comprising 44.3 % of total PE. The construction was partly funded by the EU ENERGY EFFICIENT DEMO MULTIRESIDENTIAL HIGH RISE BUILDING Basic information Grant agreement no: 285209 Location of the house: Ljubljana, Slovenia Ground surface: 3.717 m2 Walled in surface: 1.568 m2 Net ground plan of the house: 23.456 m2 Net residential surface: 9.993 m2 Total number of floors: 17 Number of residential units: 128 Number of parking spaces: 279 Green roof: 750m2 Renewable sources: Solar power plant: 33 kW, Rainwater: 60 m3 A passive standard (PHPP) with the use of energy for heating 12kWh/m2 a year. The limit for passive standard is less than 15kWh/m2a. Energy class A (energy identity card) with annual need for energy 2,4 kWh/m2a. https://www.ekosrebrnahisa.si/files/Gjerkes_et_al_Dnevi_energetikov_2016_v1.pdf https://www.ekosrebrnahisa.si/files/Eko_srebrna_hisa_energetska_izkaznica.pdf. 
Best Practice Topic	Building envelope Energy performance certificate and energy efficient regulations Development of energy culture in the building sector Other relevant to nZEB sector
Best Practice Methodology	The overall objective of the project s to demonstrate and validate new technologies, concepts, and systems used, in order to test and assess the technological and economic feasibility of innovative energy solutions in Eco Silver House building, and to contribute directly to the EU energy and climate change

	policy. The fundamental principles of the sustainable development of a high-rise building are reflected in Eco silver house through comprehensive planning of the energy efficiency project savings, among others with renewable energy sources, perfect thermal insulation, wall soundproofing, a high-quality air conditioning system with a recuperator, sun protection, extremely rational airconditioning appliances, intelligent control and management of electric and echanical devices, machinery and tools, ecological materials, use of rainwater, micro solar power station on the roof, green roof, etc. The building is designed to fulfil the requirement for the passive standard (PHPP07) with the consumption of 10 kWh/m2 energy for heating per year. https://rralur.si/wp-content/uploads/2020/03/SMART-MR_Newsletter-5_Apr_2018-web.pdf
Critical Success Factors	Energy efficiency and more intensive use of renewable energy sources. The building is still monitored in many EE indicators till today. Technologies changed dramatically in last decade, so even the latest installment was a bit outdate after few years. The selection of built in materials and technologies was very difficult, event for contractors to follow and be trained (they were trained via this project in design phase). Important milestone was that majority of building user went through special training how to use the apartment and its installations; it was so innovative.
Constraints	It is nice residential building but not so much advanced as now forthcoming ones are entering the market. So technology and material changes as well as users habit has changed. Some structural (construction) mistakes have lowered promising EE indicators being set at the begging of the project. Much was learnt by building this house. Investors insolvency.
Contact details **URL of the practice (if applicable)**	Address: Eko srebrna hiša Dunajska cesta 144 1000 Ljubljana https://www.ekosrebrnahisa.si/ It is said MELANIA TRUMP owes 1 apartment here as well as the richest Slovenian entrepreuners.

3.3 Training and capacity building projects targeting the nZEB sector

FRANCE 	Hands-on Training for positive construction Buildings Management and Energy efficiency, BEPOS (positive energy building) This is a diploma and professional training in the field of energy management, and particularly renewable energy for the building industry. Its objective is to provide new equipment and above all to rehabilitate individual housing, buildings and tertiary buildings in a concern of efficiency (rational use of energy). This specialization is not only oriented towards design, diagnosis and consulting, but also marketing, coordination, coordination, and implementation and exploitation of innovative and economical solutions in the field of energy.
Best Practice Type	Training and capacity building projects targeting the nZEB sector
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems; Electrical Installation Building envelope

	Energy performance certificate and energy efficient regulations Development of energy culture in the building sector Other relevant to Nzeb sector
Best Practice Description	Buildings Management and Energy efficiency, BEPOS (positive energy building) This is a diploma and professional training in the field of energy management, and particularly renewable energy for the building industry. Its objective is to provide new equipment and above all to rehabilitate individual housing, buildings and tertiary buildings in a concern of efficiency (rational use of energy). This specialization is not only oriented towards design, diagnosis and consulting, but also marketing, coordination, coordination, and implementation and exploitation of innovative and economical solutions in the field of energy.
Best Practice Methodology	The training is made of 7 learning units: · Energy and Environment · Energy Management · Thermic energy · Businesses/English · Manufacturing systems and energy management · Tutored project · Business internship 3 types of training: · Initial training · On-going training · Apprenticeship training The training can be performed in professional-study
Critical Success Factors	Skills addressed in this training: · Knowing how to configure buildings technical management · Mastering basic hydraulic notions · Knowing how identify heat sources · Knowing how to use architectural tools of the bioclimatic construction · Knowing how to design electrical installation · Knowing how to select the proper energy according labels/regulations on sustainability · Knowing how to size and choose the equipment best suited to the objectives of improving a building's passive and active energy efficiency · Participate in the definition, design and pre-dimensioning studies of a cogeneration plant at the preliminary design stage. · To be able to propose a solution for heating with wood energy · Design, install, implement and maintain in continuous improvement the installations of an intelligent building. · Knowing how to choose the components of a photovoltaic energy production chain Duration: 450 hours including a 14-weeks internship for the initial or on-going trainings
Constraints	To perform the training, prerequisites are needed. The submission are performed online and through a selection process.
Contact details **URL of the practice (if applicable)**	URL: https://www.effinergie.org/web/formations/2451-maitrise-de-l-energie-electricite-developpement-durable-gestion-efficacite-energetique-des-batiments-bepos-en-abrege-g-e-e-b

	Contact: https://iutgeii.umontpellier.fr/contact.php

ITALY	**Title: KlimaHaus certification course** Course type :online course Language: Italian Duration: 17 Hours Cost: 400,00 € The "Basic KlimaHaus course for designers" introduces the principles of design and construction in of buildings with high performance energy requirements (nZEB) according to the KlimaHaus protocol
Best Practice Type	Training and capacity building projects targeting the nZEB sector
Best Practice Topic	Energy performance certificate and energy efficient regulations Development of energy culture in the building
Best Practice Methodology	The course illustrates the minimum standard requirements of KlimaHaus protocol, mainly with reference to: - Building envelope system - Fundamentals of applied physics and thermal balance (winter and summer), - Principles of living comfort - Use and correct installation of materials - How to get the KlimaHaus certification The final part of the course summarizes the concepts learned during the previous modules through the free "KlimaHaus" software for calculating the energy performance of the building / plant system, the comfort indicators, the contribution of renewable sources and the cost-benefit assessment.
Critical Success Factors	The advantages of KlimaHaus accreditation are: the release of a certification that endorses the energy saving, comfort and environmental protection of a construction, thus increasing the market value of the building itself.
Constraints	KlimaHaus courses are not carried out throughout Italy and this is not a protocol nationally recognized.
Contact details **URL of the practice (if applicable)**	www.agenziacasaclima.it/it/formazione-73.html

GERMANY	**Title: Passivhaus Institut (PHI)** The Passivhaus Institut (PHI) was founded in 1996 and is an independent research institute with a constantly growing, interdisciplinary team. In particular, the development of the passive house concept was significantly shaped by the PHI: In the first demonstration project (Passive House Darmstadt-Kranichstein, 1990), a regularly inhabited apartment building with a documented heating energy consumption of less than 10 kWh / (m²a) was planned, built, measured and accompanied for the first time in Europe.

	The institute occupies a leading international position in the research and development of building concepts, building components, planning tools and in the validation of particularly energy-efficient buildings. The PHI was responsible for building physics advice and scientific support for the first Passive House office building, the first Passive House factory, the first Passive House schools and sports halls, the first Passive House swimming pools and the first Passive House renovations. New innovative projects are currently being supported
Best Practice Type	Independent research institute: Research and development of building concepts, building components, planning tools and in the validation of particularly energy-efficient buildings Exemplar of High performance buildings Training and capacity building projects targeting the nZEB sector
Best Practice Topic	Heating, ventilation and air conditioning (HVAC) systems; Electrical Installation Building envelope Energy performance certificate and energy efficient regulations Development of energy culture in the building sector Other relevant to nZEB sector
Best Practice Methodology	The PHI organizes the International Passive House Conferences and has been leading the low-cost passive house working group since 1996, which provides developers, architects and building services planners with the latest research results, tools and information for the construction of passive houses and highly energy-efficient renovations. Numerous passive house construction projects implemented in Germany have been initiated from this working group. To date, the working group has met 40 times on current research and implementation topics. The PHI lead the scientific management of the EU-project CEPHEUS (Cost Efficient Passive Houses as European Standards). Within CEPHEUS, a total of more than 220 residential units were built and evaluated as passive houses in Europe (www.cepheus.de). The PHI was significantly involved in EU projects in the "Intelligent Energy Europe" program area: "Promotion of European Passive Houses (PEP)", "Passive On" and "Certified European Passive House Designer (CEPH)". It is also a partner in IEA Tasks 28 ("Sustainable Solar Housing") and 37 ("Advanced Building Renovation"). Many projects and detailed reports can be found on the homepage of the institute.
Critical Success Factors	Develop and distribute a common methodology for affordable and high quality near zero energy buildings, also in different climatic zones in Europe By providing the framework through training and distributing it in informational materials, the PHI aims to contribute to the incorporation of valuable knowledge about affordable, nearly zeroenergy buildings
Contact details **URL of the practice (if applicable)**	Contact: Passivhaus Institut Rheinstraße 44/46 D-64283 Darmstadt 06151 / 82699-0 mail@passiv.de Webpage: https://passiv.de/de/01_passivhausinstitut/01_passivhausinstitut.htm YouTube channel: https://www.youtube.com/channel/UCpLOA6rSWanUu_X7mLU7i5A reference: https://wissenwiki.de/Passivhaus_Institut

GREECE 	**Fit-to-nZEB.** The Fit-to-nZEB is a Horizon 2020 project dedicated to improve the knowledge and skills of the building professionals to deliver quality renovations works with significant energy saving impact. In particular it aims to increase the competence and skills of the building professionals in all participating countries - Czech Republic, Romania, Bulgaria, Italy, Croatia, Ireland, Austria and Greece - through unique educational programmes and pilot training courses, which contribute to both the quality and the scale of the deep energy building renovations. The project produced all necessary requisites for the introduction of educational content on deep energy retrofit in the curricula at all levels of the vocational training and education system - universities, professional high schools and colleges, vocational training centers. Today, Fit-to -nZEB project shares the following results: - A full review of deep renovation training programmes and materials; - A set of learning outcomes on 17 topics related to deep energy retrofit, distributed according to the relevant EQF levels; - 7 model training programmes, ranging from Master programmes' classes to short-term upskilling courses; - Training materials on each of the 17 topics, including annotated presentations, exercises, examination questions and references; Fully equipped training facilities in 7 European countries; - More than 150 newly trained trainers, capable to deliver the new training content using the practical training facilities; - 20 pilot courses conducted in universities, professional high schools and vocational training centers, subject to continuous monitoring for improvement of the training schemes; - More than 10 Memoranda of Understanding with education and training providers willing to use the new training programmes and materials; A large and constantly growing network of dedicated professionals, for whom deep energy retrofit has become a part of the daily routine and a source of professional pride and identity.
Best Practice Topic	Development of energy culture in the building sector
Best Practice Methodology	Based on a thorough review of the existing training programmes and materials on deep energy retrofit and an analysis of the training gaps in the involved countries, a compendium of the knowledge, skills and competences required for deep energy retrofit was developed. The learning outcomes, organized in 17 distinct topics of relevance to nZEB level retrofit process, were defined for each targeted level along the EQF. The required technical competences were also collected and analyzed according to the identified needs of the pre-defined target groups – the main beneficiaries of the project, in close cooperation within a broad network of local stakeholders. In Greece, three pilot training courses were conducted with a total of 128 trainees.

	 Piot training in Greece  Piot training in Greece
Critical Success Factors	Building a strong professional community to spread the knowledge about nZEB construction – that was the key word for the activities in Greece, which were adeptly carried out by local partner Hellenic Passive House Institute. Based on a continuous partnership with local and international suppliers of nZEB-suitable products and materials, a new Building Knowledge Hub was founded in two locations in Athens, displaying all that is needed to reach national and international sustainable building construction standards. A number of training activities were completed, from very intense train the-trainer courses combined with the biggest events in the sector (In Greece, the traditional national Passive House conference was brought to a new life, hosting events with more than 200 participants in Athens and Thessaloniki), to agreements with the professional associations of distributors of insulation materials and window installers for dedicated courses for their members. On top of the well-visited and appreciated training for construction workers, the market development is visible: with the help of Fit-to-nZEB support, the market demand for nZEB projects is steadily rising – and so is the need for vocational education and training in the field.
Constraints	Key challenges encountered by the teams in the delivery of the trainings is summarized below (with further details provided later in this report): A general low awareness of nZEB The construction sector is not generally aware that a whole new skill-set will be required to deliver cost-effect deep retrofits. Construction workers are not so keen to participate in trainings A few of the partners found that whilst workers might initially be anxious about taking time to attend a training event, once they are exposed to the learning experience, they

	often declare an interest in taking further courses. The key challenge, therefore, is to get them to make the decision to 'give it a go' in the first place. If the training center is not located close to where the trainees live, it will be more difficult to convince them to attend. If the training is scheduled to take place during peak construction period (which will differ from region to region, greatly influenced by climate), then participation rates will be lower. While delivering training at building knowledge hubs provides an opportunity for hands-on practice of deep retrofitting skills, the optimal experience for construction workers would be to hold the training directly at the construction site. When delivering training on the job-site, it is important to involve experienced practitioners who can professionally demonstrate the skills required (most full-time trainers will not have extensive practical experience in all envelope and mechanical systems required to deliver deep-retrofits). The sequencing of training is important when delivered at the construction site. It is important to deliver the training ahead of the work taking place on-site, otherwise elements already completed might have to be removed or modified, causing frustration for the construction workers. Inclement weather (or indeed, extreme heat, in some climates) can adversely impact on the training delivered on-site (this is not an issue when training is delivered at a building knowledge hub where the indoor environment is conditioned).
Contact details **URL of the practice (if applicable)**	http://www.fit-to-nzeb.com/

SLOVENIA

Best Practice Title: Vet4lec (project oriented in vocational education and training for low energy construction)

This project is jointly undertaken by FIEC and the EFBWW in the framework of the EU sectoral Social Dialogue for the construction industry.

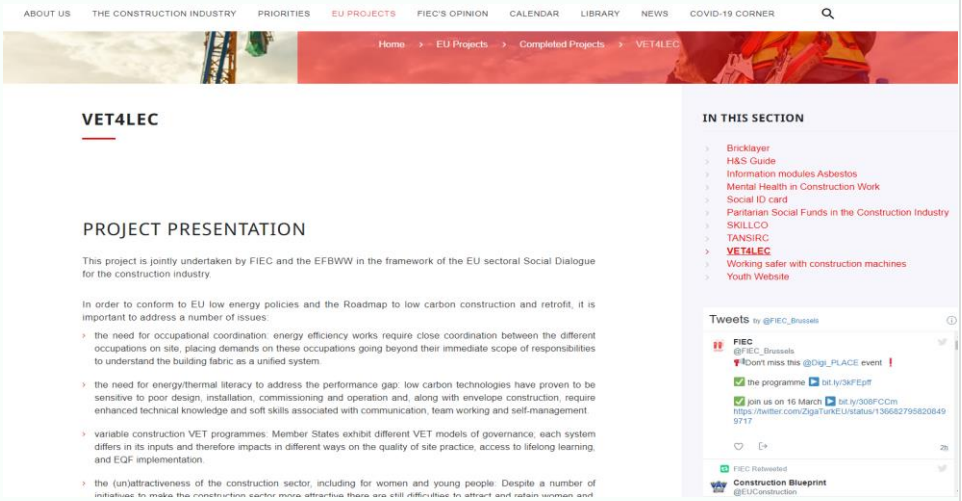
To conform to EU low energy policies and the Roadmap to low carbon construction and retrofit, it is important to address several issues:

- the need for occupational coordination: energy efficiency works require close coordination between the different occupations on site, placing demands on these occupations going beyond their immediate scope of responsibilities to understand the building fabric as a unified system.
- the need for energy/thermal literacy to address the performance gap: low carbon technologies have proven to be sensitive to poor design, installation, commissioning, and operation and, along with envelope construction, require enhanced technical knowledge and soft skills associated with communication, team working and self-management.
- variable construction VET programmes: different VET models in different countries; each system differs in its inputs and therefore impacts in different ways on the quality of site practice, access to lifelong learning, and EQF implementation.

The project intends to detail what this implies and how some of the above-mentioned problems can be addressed through alliances between key stakeholders. Its aim is to identify the ways in which:

- coordination between occupations involved in low energy construction on site can be improved so as to reduce the performance gap between design intent and implementation and meet energy efficiency targets;

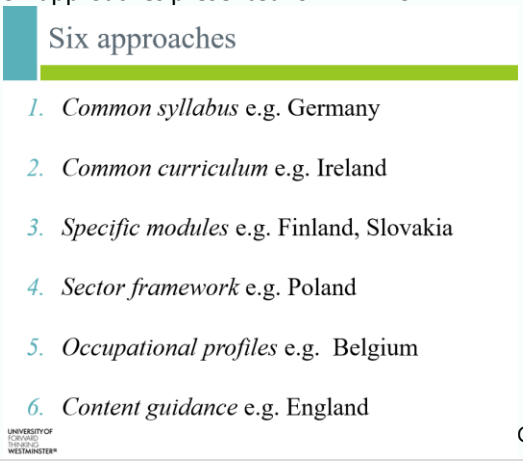
- the opportunities for low energy construction (LEC) and interdisciplinary VET can be extended so as to enhance the attractiveness of the sector and advance energy literacy, in particular for women and youth, in line with the EQF;
- trainers can become more aware of LEC requirements and the difficulties of implementation at site level.



VET4LEC FIEC home page
https://www.fiec.eu/our-projects/completed-projetcs/vet4lec

The project lasted from first of January 2017 to thirty-first of December 2019.
Conclusion of this project is that there are LEC skills shortages – including in green skills, social abilities such as planning and co-ordination, literacy, health and safety, and ICT. And LEC training is not yet properly included in IVET programmes. However, due to lack of resources, it has not been possible to implement the recommendations for upgrading VET. Currently national SRIP networks (Strategic Development and Innovation Partnerships) appear to be the triggers of LEC developments, including in construction.
Project and final report was divided in 4 parts:
Chapter 1: National context LEC (for 10 EU countries)
Chapter 2: Case Studies
Chapter 3: Vocational Education and Training (VET)
Chapter 4: Projects
Analysis for following items in construction was prepared:

- *Syllabus*: a detailed setting out of a curriculum in terms of pedagogic materials such as lesson plans, teacher notes or supporting textbooks.
- *Curriculum*: detailed prescribed content for a qualification or programme of learning to be used as the basis for planning delivery of a qualification.
- *Qualification profile*: the knowledge, know-how and attitudes involved in an occupational qualification cross-referenced with the operations necessary to carry out that occupation.
- *Qualification framework*: A structure within which qualifications can be compared with each other. Typically, these are constructed at the national and/or the European level.
- *Module*: a segment of a qualification, usually with guidelines for the type and amount of learning necessary for a candidate to complete it.
- *Guidance notes*: a set of instructions and suggestions for the development of qualification profiles, curricula or syllabi.
- *Occupational overlap*: areas of activity which are covered by the profiles of more than one occupation in a sector.

	○ *Sector framework*: a profile of the knowledge, know-how and attitudes required within a particular economic sector. Occupational profiles will typically use the sector framework as parameters. ○ *European VET policy tools*: these are structures within which qualifications can be compared (EQF, ECVET) or systems of classification of activities which can be used as the basis for the construction of curricula and qualifications (ESCO) *Accreditation of Prior Experiential Learning (APEL):* the formal recognition of knowledge, know-how and attitudes acquired through non-formal and informal learning, usually in the workplace.
Best Practice Topic	Other relevant to nZEB sector
Best Practice Methodology	See best practices reports: https://www.fiec.eu/our-projects/completed-projetcs/vet4lec Six approaches presented for VET LEC:  2018-09-19-VET4LE C-SG3-UoW present
Critical Success Factors	Where and how LEC low energy construction knowledge needed to be included in iVET (which qualification) and cVET.
Constraints	EU VET system is different so for different countries different methods are applied so LEC knowledge is applied differently in different EU countries.
Contact details URL of the practice (if applicable)	https://www.fiec.eu/our-projects/completed-projetcs/vet4lec

SLOVENIA 	**Care4Climate (PROJECT LIFE+).** LIFE IP CARE4CLIMATE (LIFE17 IPC/SI/000007) is an eight-year-long integrated project that, through the awareness-raising, education and training of key stakeholders, will encourage the implementation of measures to help Slovenia effectively meet its greenhouse gas emission reduction targets by 2030 and enable a faster transition to a low-carbon society. The project is based on the connections between sustainable mobility, energy efficiency, sustainable land use and practices for the transition to a low-carbon economy. It strives to help solve one of the most pressing issues of modern societies — the climate crisis. General project objectives: ● increasing personnel capacities and competences, which will enable high-quality drafting and the implementation of measures and thus GHG emissions reduction by 2030; ● training personnel for a faster transition to a low-carbon society (LCS);

	 **Home page** https://www.care4climate.si/en
Best Practice Topic	Energy performance certificate and energy efficient regulations Development of energy culture in the building sector Other relevant to nZEB sector
Best Practice Methodology	Care4Climate is launching a multi-year systematic training of experts in specific areas of nZEB and nZEB renovation First training on the topic on nZEB was in December 2020. Building and Civil Engineering Institute (ZRMK) within the integral project LIFE CARE4CLIMATE, coordinated by the Ministry of the Environment and Spatial Planning (MOP) organizes a three-day training for key stakeholders in the process of renovation of buildings with the aim of accelerating energy renovation of buildings while taking into account other important aspects. With this training they want to address the challenges of wider renovation of buildings. Training of the professional public on wider, energy and earthquake renovation of buildings (U6-1). https://www.care4climate.si/sl/novice/ozavescanje-in-krepitev-zmogljivosti-za-prehod-v-nizkoogljic/usposabljanje-o-sirsi-energijski-in-protipotresni-prenovi-stavb-u6-1 Participants got acquainted with current legislation, policies and strategies, as well as with innovations and challenges in the field of wider renovation of buildings. They learned about the guidelines for renovation, where priorities are set based on good building management and cost-effectiveness, and by meeting all the essential requirements for construction works, including the principles of cultural heritage protection. They gain knowledge about building deficiencies, problems due to dilapidation, decay, incorrect details of construction, under-dimensioning of buildings and on the other hand about good practice of wider building renovation, system solutions, triggers and promoters of renovation in Slovenia and neighboring countries They published an article on Energy renovation of the building in the journal Gradbenik. https://www.care4climate.si/sl/novice/vse-novice/stavbe-in-energetski-izziv , FULL ARTICLE PUBLISHED: https://www.care4climate.si/_files/223/STAVBE-IN-ENERGETSKI-IZZIVI-GRADBENIK.pdf They published an article on renovation of multi-apartment buildings in the journal Eges - Energetika, Gospodarstvo in Ekologija Skupaj. https://www.care4climate.si/sl/novice/vse-novice/prenova-vecstanovanjskih-stavb ,FULL ARTICLE PUBLISHED: https://www.care4climate.si/_files/224/PRENOVA-VSS-EGES-2-20.pdf Training of managers on the comprehensive energy renovation of multi-apartment buildings. In the LIFE IP CARE4CLIMATE project, special attention is paid to raising the profile of the qualifications of professionals and the impact of this factor on the market. The topic of the training is the higher quality of comprehensive and at the same time sustainable renovation of multi-apartment buildings with an emphasis on greater energy efficiency and the use of renewable energy sources. The main goals were:

	• training of managers for comprehensive energy renovation of multi-apartment buildings, • greater social visibility of key knowledge and skills related to energy renovation, • better transparency over the qualifications of persons in the labor market (system for recording knowledge, skills and competences acquired in non-formal learning), • establishing a competitive advantage in the labor market for employees who successfully complete non-formal education and demonstrate this with evidence. https://www.care4climate.si/sl/novice/vse-novice/usposabljanje-upravnikov-o-celoviti-energijski-prenovi-vecstanovanjskih-stavb Lecture on the topic of Novelties in the construction and renovation of buildings with examples of good practice. The lecture will show examples of good practice, namely: modern installation of windows and doors with energy efficient windows, solutions with assemblies and implementation of walking and non-walking flat roofs, system solutions for almost zero-energy houses, ventilation systems, state-of-the-art energy efficient and up to environmentally friendly heat pumps (the fruit of our own development) for heating and preparation of hot water, a small treatment plant and a set of measures and procedures for deep or. comprehensive renovation of multi-apartment buildings. https://www.care4climate.si/sl/novice/vse-novice/novosti-pri-gradnji-in-prenovi-stavb-s-primeri-dobre-prakse In-depth analysis to support the preparation of a financial plan for the energy renovation of buildings for the period 2020-2030 https://www.care4climate.si/_files/1344/Izrocek_IJS_C6_1.pdf In-depth analysis for the design of financial instruments for investment in comprehensive energy renovations of residential buildings https://www.care4climate.si/_files/1343/Izrocek_IJS_C6_2.pdf D7-1 An evolving annual report on the development of a supportive environment and a platform for sustainable construction https://www.care4climate.si/_files/197/025-19-0063-2020-1-LIFE-IP-C4C-C4-4%20D7-1.pdf
Critical Success Factors	Multi-year (7) systematic training. Publishing articles.
Constraints	The project is still on going.
Contact details **URL of the practice (if applicable)**	life-klima.mop@gov.si https://www.care4climate.si/en/contact

4.Conclusions of the nZEB Best Practice Compendium

Ambitious requirements for energy performance in buildings are an effective way to foster innovation and achieve a significant reduction of GHG emissions and energy use, contributing to the energy independence of the EU. In order to further stimulate an increased number of energy efficient buildings, the Energy Performance of Buildings Directive (EPBD, 2010/31/EC) introduced the definition of nZEB as a building with very high energy performance where the nearly zero or very low amount of energy required should be extensively covered by renewable sources produced on-site or nearby. The EPBD foresees that after 31st of December 2020, all new buildings will be nZEBs, while for public buildings the deadline was set for 31st of December 2018. Furthermore, Member States are all required to draw up national plans that include the countries' detailed application in practice.
The overview of France, Italy, Germany Greece and Slovenia legislative and national policies status concerning the nZEB sector showed that these five countries named a wide range of legislative initiatives and national policies for improving the energy efficiency of their building sector and all transposed the Directive 2010/31/EU on the energy performance of buildings ('EPBD') into their national regulatory frameworks.

4.1 Regulatory Framework overview:

In France, the implementation of the EPBD has been the responsibility of the French Ministry for an ecological and solidary transition and the Ministry of Territory Cohesion. With the aim to replicate the successful transposition of Directive 91/2002/EC, France has been working on implementing Directive 2010/31/EU since 2010. Law 2010/788 of 12 July has significantly improved the energy performance certification process, while the implementation of the new thermal regulation, RT 2012, has brought energy efficiency of new buildings to nZEB level. The Energy Transition for Green Growth Act (LTECV) of 17th of August 2015 provided also new tools, e.g, requirements for insulating envelope parts in case of restoration, aiming at increasing thermal renovation. However, with the new thermal regulation' RE2020', that will come into force on 1st of January 2022, - France imposes new standards in construction and goes further focusing on BEPOS (Positive Energy Building). A BEPOS is a building whose overall energy balance is positive, i.e. it produces more energy than it consumes.

In Italy, Law n. 63/2013 implemented Directive 2010/31/EU. Complementary, Law n. 90/2013 and Decree 26/06/2015 "Minimum Requirements", strengthened the previous acts and provided an updated energy performance calculation methodology, the rules for taking into account the use of RES in buildings and the system boundary, new stricter minimum energy performance requirements for buildings, building systems and building components, as well as conversion factors. The new legislation also defined nZEB. In addition, Italy implements strong national initiatives according governmental economic incentives. The 65% of cashback (repaid to private citizen in terms of tax reductions) of the total amount spent for retrofitting intervention according to energy efficiency standards and the brand-new state incentives law of May 2020, called "SuperBonus 110%" which, not only covers totally the renovation costs, but gives even a 10% more of the spent amount, always in terms of tax reduction are two of the most recent energy efficiency incentives.

Germany has progressively tightened building energy performance requirements in line with the EPBD since at least 2005, however the latest requirements aligned with nZEB standards entered into force in November 2020 with *Gebäudeenergiegesetz* (GEG) regulation. The GEG brings together three directives, the EnEG (Energy Saving Act), EnEV (Energy saving regulations) and EEWärmeG (Renewable Energies Heat Act) in one modern law. A uniform coordinated set of rules was created for the energy requirements for new buildings, for existing buildings and for the use of renewable energies for the heating and cooling of buildings. The European requirements for the total energy efficiency of buildings are fully implemented and the regulation of the nZEB is integrated into the unified energy saving law. In addition, the national plan of the climate policy in Germany is to reduce greenhouse gas emissions by 80 to 95 per cent by 2050 compared to their 1990 levels. Therefore, the transformation of the building sector is of key importance.

For Greece New buildings or building units must meet minimum energy performance requirements set out in the "Regulation on the Energy Performance of Buildings" (KENAK). In combination with the obligation set in Law 4122/2013, these regulations ensure that every new building of the public sector, from 1st of January 2019 should be nZEB. This obligation applies also for all new buildings constructed after 1st of January 2021. Regarding existing buildings, the definition of major renovation is set in Law 4122/2013, after being amended in Law 4409/2016, Article 49 (A' 136). Law 4342/2015 also provides measures to encourage energy efficiency, for Greece to contribute towards achieving the fundamental 2020 20 % energy efficiency target and lay the foundation for further energy performance improvements in the long run. There are also indicative national energy efficiency targets set for 2020, along with measures for promoting them and rules to overcome energy market weaknesses that prevent the efficient supply and use of energy. The Electronic Building Identity will also be launched by the Ministry of Environment, as obligatory for all old and new buildings in the country. This identity constitutes the complete electronic file of a building that includes all its information such as: its building permit, floor plans, millimeter table, construction control certificate, energy efficiency certificate, declarations of subordination to arbitrary laws, etc. Greece has recently adopted a new National Energy and Climate Action Plan (NECP) (EC, 2020d,e) that was presented in December 2019 following a public consultation and a debate in the Greek Parliament. The NECP is an ambitious plan in accordance with the UN Agenda 2030 and its 17 global Sustainable Development Goals as well as with the recently adopted European Green Deal, setting, in some cases, even higher goals at national level.

In Slovenia, the transposition of the EPBD is the overall responsibility of the Ministry of Infrastructure and is primarily transposed by the Energy Act, covering the topics of nZEB, energy performance certification, inspection of heating and AC systems and energy efficiency information programes. In addition, the Building Construction Act gives the legal basis for building codes (with minimum requirements for building energy performance, technical building systems and the calculation methodology), while the Environmental Protection Act addresses the inspection of boiler. Further, in June 2010, pursuant to the Recast EPBD, Slovenia adopted the Rules on Efficient Use of Energy in Buildings (PURES 2010), which introduces the methodology for calculating the indicators of energy efficiency in buildings in accordance with the CEN EPBD standards or the SIST EN ISO 13790 standard, and lays down the minimum energy-efficiency requirements for new buildings and the major renovation of existing buildings; it also prescribes the minimum requirements relating to maintenance and technical improvements (prior to the end of the lifecycle of an individual element, system or sub-system of a building). PURES 2010 laid down requirements for all public buildings that were 10% more stringent.

4.2 Obstacles and limitations overview

Although all countries demonstrated their willingness to support and encourage improvements in existing and old buildings towards the nZEB goal, most countries reported also common obstacles and various limitations in applying more aggressive performance targets and achieve deep retrofits.

In particular, France reported that one of the main barriers that can lead to an effective nZEB policy is the lack of real political will, not only in terms of the means necessary to carry out this project, but also in the creation of a solid network involving associations, agencies and authorities competent in the field, allowing not only the realization of studies and data processing, but also to transform them into concrete actions, national strategies and policies aimed at ultimately improving the building sector as a whole. Italy reported obstacles due to the difficulty of coordination between the fundamental elements which are: technologies, bureaucratic aspects (complexity of the different laws involved), incentives and research. In order to fully exploit the potential of implementation of the best technologies, it would be necessary to implement structural actions to improve skills and information, stimulating demand and differentiating the offer also by virtue of the climatic, socio-economic and environmental features of the specific areas.
Germany also reported, lack of information and Interest in energy efficiency, expert deficit, complex legal requirements, investor-user dilemma.

In Greece, as a result of the economic crisis, there have been remarkable changes to the spending structure of Greek households relating inter alia to declining thermal comfort conditions and increasing energy poverty levels, which made it impossible for them to improve the energy performance of their buildings. The increasing difficulty in accessing bank funding, as well as the increased vulnerability of banks and the need to secure refinancing and protection against ever-increasing competition has led to significant restructuring in the banking sector, reduction in the number of available banks and in the range of available funding instruments fact that led to very limited resources for financing the energy sector.

Lastly, the obstacles and limitations of the implementation of nZEB policies in Slovenia occur due to the fact that there are too few qualified professionals in the nZEB sector, investors are lagging behind ambitious national EE policy goals, zero energy building are much more expensive than the conventional ones and additional investments are needed to eliminate poor installation performance and energy indicators not being in accordance with building`s Energy Performance Certificate.

4.3 nZEB Case studies

As regards the demonstration of practical examples of nZEB, the cases presented in this report show that there are pilot projects referring to national initiatives, high energy buildings and training schemes, capable to inspire and accelerate the energy renovation and at the same time increase the demand for training on energy efficiency in buildings.

These examples are considered best practices as their methodological approach, innovative character, success factors and, impact are illustrative in the implementation of low and zero carbon initiatives, have the potential to lead to improved energy efficiency in the short and long term and minimize greenhouse gas emissions.

Proof of the above mentioned strong points can be indicatively traced in the La Courrouze project in France which is a suburban redevelopment of a former army base. It is a live-work community, denser than typical suburbs, with an emphasis on energy efficiency and a large percentage of park space. The goal is to reach a 20% energy reduction from conventional construction - Energy demand: 27.3 – 50 kBtu/ft2. Strategies used are: LEED ND Platinum, passive solar design strategies; repurposed buildings; energy use mandate. Moreover, it is a project that tends to bring people together and promote active citizenship by valuing proximity and exchanges.

More recently Italy, has introduced a strong government economic incentive called super bonus which accords 110% deduction on the expenses incurred for those individuals who will carry out thermal insulation interventions, replace the heating systems and reduce the seismic risk of the building. The 110% tax deduction is valid for works carried out from 1st of July 2020 to 30th of June 2022.

In Germany the Passive House Institute (PHI) - an independent research institute, has played an especially crucial role in the development of the Passive House concept. The first pilot project developed by PHI (Kranichstein Passive House, Darmstadt, Germany, 1990) was Europe's first inhabited multi-family house to achieve a documented heating energy consumption of below 10 kWh/(m^{2}a). Since then, the Passive House Institute has assumed a leading position with regard to research on and development of construction concepts, building components, planning tools and quality assurance for especially energy efficient buildings.

Further, one of the oldest and more characteristic examples of high-performance buildings in Greece are the Offices of the Construction Company AVAX S.A. It is considered a model of bioclimatic architecture. The utilization of solar energy and environmental sources, in general, as shown by bioclimatic design, is achieved in the context of the overall thermal operation of the building and the building-environment relationship.

In Slovenia the Eco-Silver House is a multi-residential high rise building located in Ljubljana, Slovenia. It is part of the FP7 EE-Highrise demonstration project, aiming to demonstrate new nearly zero energy building technologies, integrated design concept and systems for sustainable, nZEB. The design meets the minimal requirements of cost-optimal for apartment building with Net Present Value of 272 EUR/m² and primary energy use of 79 kWh/m²/y, meets PH design criteria and is registered in the PH database.

Overall, the analysis of the national policies and regulatory framework as well as the best case scenarios with regard to the nZEB sector in France, Italy, Germany, Greece and Slovenia showed that efforts are increasing. to support a long term commitment to Zero Energy Buildings.

Realizing the pace and scale of emissions reductions would require a far-reaching set of actions going above and beyond the already ambitious measures set by the EU. A large number of unparalleled changes across all parts of the energy sector would need to be realized simultaneously.
Setting long-term goals, fully exploit the potential of implementation of the best technologies, raising awareness, increase nZEB specific trainings, strengthening building codes or reforming the public procurement processes to focus more on energy efficiency requirements can push nZEBs from a demonstration stage to becoming the new normal.

5.List of References

- Agence de la transition écologique. (2017, March 27). Bâtiments à énergie positive. Retrieved March 25, 2021, at: https://www.ademe.fr/expertises/batiment/quoi-parle-t/batiments-a-energie-positive
- Bac Pro TEB EE & BIM. (2020, April 20). Qu'est-ce que le label BEPOS. (Youtube). Retrieved March 25, 2021, from https://www.youtube.com/watch?v=tqccRTT5IqQ
- Bordier, R., Rezai, N., Gachon, C. (2016, December). EPBD implementation in France. Retrieved March 25, 2021, https://epbd-ca.eu/wp-content/uploads/2018/08/CA-EPBD-IV-France-2018.pdf
- EDF. (n.d.). Quels engagements pour la loi de transition énergétique ? Retrieved March 25, 2021, at https://www.edf.fr/collectivites/transition-energetique/faire-de-la-transition-energetique-une-realite/reglementations-et-objectifs/quels-engagements-pour-la-loi-de-transition-energetique
- Legifrance. (2019, November 10). LOI n 2010-788 du 12 juillet 2010 portant engagement national pour l'environnement. Retrieved March 25, 2021, at https://www.legifrance.gouv.fr/loda/id/JORFTEXT000022470434/
- Le Monde de l'Energie. (2020, June 16). RE2020 : la neutralité carbone du bâtiment a l'épreuve des controverses. Retrieved March 25, 2021, at https://www.lemondedelenergie.com/re2020-neutralite-carbone-batiment/2020/06/16/
- Ministère de la Cohésion des Territoires et des Relations avec les Collectivités Territoriales. (2019, July 3). Loi relative a la transition énergétique pour la croissance verte (TEPCV). Retrieved March 25, 2021, from https://www.cohesion-territoires.gouv.fr/loi-relative-la-transition-energetique-pour-la-croissance-verte-tepcv
- Ministère de la Cohésion des Territoires et des Relations avec les Collectivités Territoriales (2020, January 14). RE2020 : une nouvelle étape vers future règlementation environnementale des bâtiments plus ambitieuse contre le changement climatique. Retrieved March 25, 2021, at https://www.cohesion-territoires.gouv.fr/re2020-une-nouvelle-etape-vers-une-future-reglementation-environnementale-des-batiments-neufs-plus
- Ministère de la Cohésion des Territoires et des Relations avec les Collectivités Territoriales (2021, January 18). Exigences réglementaires pour la construction des bâtiments (RT 2012). Retrieved March 25, 2021, from https://www.ecologie.gouv.fr/exigences-reglementaires-construction-des-batiments-rt-2012
- Re2020 (n.d.). Reglementation Environnementale 2020. Retrieved March 25, 2021, from http://re2020.fr/reglementation-environnementale-re2020-fr/
- enea.it; Agenziadellentrate.it; agenziacasaclima.it
- ingenio-web.it
- http://www.Bundesanzeiger.de
- https://www.bmwi.de/Redaktion/DE/Downloads/G/gebaeudeenergiegesetz-zusammen-gefasst.pdf?__blob=publicationFile&v=6
- https://de.wikipedia.org/wiki/Geb%C3%A4udeenergiegesetz
- https://en.wikipedia.org/wiki/Energieeinsparverordnung

- https://ec.europa.eu/energy/content/introduction-12_mt
- http://www.gesetze-im-internet.de/geg/GEG.pdf
- https://www.bmi.bund.de/DE/themen/bauen-wohnen/bauen/energieeffizientes-bauen-sanieren/energieausweise/gebaeudeenergiegesetz-node.html
- https://www.bbsr-energieeinsparung.de
- https://de.wikipedia.org/wiki/Erneuerbare-Energien-W%C3%A4rmegesetz
- https://www.bbsr-energieeinsparung.de/EnEVPortal/EN/EnEV/EnEV2013/EnEV2013_node.html
- https://de.wikipedia.org/wiki/Energieausweis
- https://www.baunetzwissen.de/nachhaltig-bauen/fachwissen/regelwerke/die-eu-gebaeuderichtlinie-675080
- https://xn--grneskino-r9a.de/blog/die-neue-eu-gebaeude-richtlinie/
- https://www.umweltbundesamt.de/themen/klima-energie/energiesparen/energiesparende-gebaeude#eigentuemer
- https://www.umweltbundesamt.de/en/indicator-energy-consumption-for-buildings#environmental-importance
- https://www.dena.de
- https://de.statista.com/statistik/daten/studie/70094/umfrage/wohngebaeude-bestand-in-deutschland-seit-1994/
- https://www.immobilienscout24.de/wissen/bauen/niedrigenergiehaus.html#anchor3
- https://azeb.eu/wp-content/uploads/2019/04/Potential-barriers-for-the-construction-of-nZEBs-and-energy-buildings.pdf
- The National Plan for Increasing the number of nearly zero-energy buildings (Athens, December 2017)
- E.G. Dascalaki, C.A. Balaras, A.G. Gaglia, K.G. Droutsa, S. Kontoyiannidis: Energy performance of buildings- EPBD in Greece, 2012, Energy Policy.
- Report on the long-term strategy to mobilise investment in the renovation of private and public residential and commercial buildings in the national building stock YPEN, Athens, April 2018)
- 2011 Buildings Census, Hellenic Statistical Authority (HSA), Athens 2015. http://www.statistics.gr/el/2011-census-pop-hous.
- Report on long term strategy for mobilising investement in the renovation of the national stock of residentailoa and commercial buidlsings, both public and privat – Athens December 2014
- Athina G.Gaglia, Aikaterini G.Tsikaloudaki, Costantinos M.Laskos, Evangelos N.Dialynas, Athanassios A.Argiriou, The Impact of the Energy Performance Regulations' updated on the construction technology, economics and energy aspects of new residential buildings: The case of Greece, Energy and Buildingshttp://dx.doi.org/10.1016/j.enbuild.2017.09.008
- Karlessi, T. et al, The concept of smart and NZEB buildings and the integrated design; Approach, Procedia Engineering 180 (2017) 1316 – 1325
- Magrini, A, Lentini G, Guman, S, Bodrato, A, Marenco, L, 2020, From nearly zero energy buildings (NZEB) to positive energy buildings(PEB), Developments IN THE Built Environment, p.3-13.
- National plan for increasing the number of nearly zero-energy buildings (energetika-portal.si) -2014
- Akcijski načrt za skoraj nič-energijske stavbe za obdobje do leta 2020 (AN sNES) (energetika-portal.si) -2015
- Energetski zakon (pisrs.si)
  Portal Energetika - Energetski zakon EZ-1 (energetika-portal.si)
- Pravilnik o učinkoviti rabi energije v stavbah (pisrs.si)
- Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (europa.eu)
- "Guidelines for the implementation of energy efficiency improvement measures in public sector buildings according to the principle of energy contracting"(https://www.energetika-portal.si/fileadmin/dokumenti/podrocja/energetika/javne_stavbe/smernice_za_energetsko_pogodbenistvo-web.pdf)
- Guidelines for the energy renovation of buildings that are protected under the regulations for the protection of cultural heritage have been developed (https://www.energetika-portal.si/fileadmin/dokumenti/podrocja/energetika/javne_stavbe/smernice_kd_23.2.2017.pdf)
- Eco fund grants Spodbude Eko sklada za skoraj nič-energijske stavbe | Eko sklad
- Eco fund Business policy https://www.ekosklad.si/informacije/o-skladu/poslovni-nacrt/poslovna-politika-eko-sklada-v-obdobju-od-2016-do-2020
- Zakon o učinkoviti rabi energije (ZURE) (pisrs.si)
- Overview of nzeb valid legislation and supporting documents in Slovenia https://www.energetika-portal.si/dokumenti/strateski-razvojni-dokumenti/akcijski-nacrt-za-skoraj-nic-energijske-stavbe/

- Operational Program for the Implementation of European Cohesion Policy in the Period 2014-2020 (OP-EKP) (https://www.energetika-portal.si/dokumenti/strateski-razvojni-dokumenti/operativni-program-za-izvajanje-evropske-kohezijske-politike/).
- Concerted Action EPBD Country Reports: https://epbd-ca.eu/archives/1859
- Energy performance of buildings directive: https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en