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Train-to-NZEB
The Building Knowledge Hubs

Conduction of training courses for non-specialists

Deliverable 4.4 of the

TRAIN-TO-NZEB project, financed under grant agreement No 649810 of HORIZON 2020 Programme of the EU

Contents

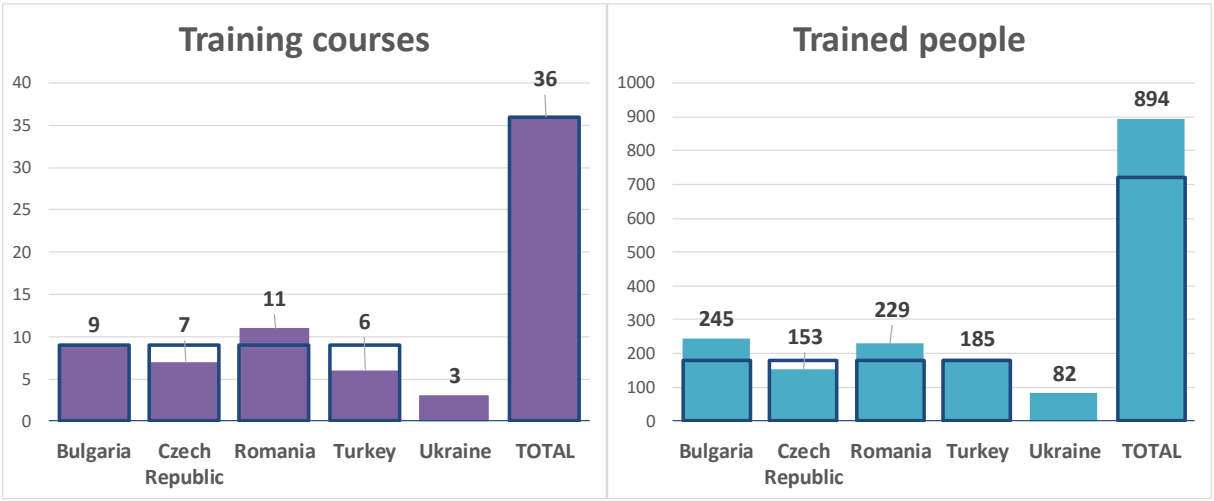
Executive summary

The Train-to-NZEB project aims to provide world-class training on energy efficiency and RES in buildings, based on new training programmes, business plans and up-to-date training equipment for various training and consultation centres around Europe. Its goal is to improve the knowledge and skills in the construction sector and to provide practical trainings, demonstrations and comprehensive consulting services for the design and construction of Nearly Zero-Energy Buildings (nZEB). In order to provide such an amenity, BKHs were equipped with state-of-the-art equipment and training facilities to fulfil the nZEB obligations, training programs were developed and implemented in all participant target countries for three target groups: specialists/designers, on-site professionals and decision makers.

This document is to summarise and illustrate how each responsible partner have implemented the developed training programs for non-specialists in each country, namely in Bulgaria, Czech Republic, Romania, Turkey and Ukraine supplemented by an international e-learning programme in English language.

The scope of the training programs for non-specialists with decision-making functions was to conduct 36 training courses. This report presents the supporting documents related to the conduction of the training courses for non-specialists targeting additional qualification of 720 trainees.

The total distribution of completed training courses and trainees is represented in the following graphs against the initial targets per country and in total.



Distribution of training courses and participants per country and as total

A total of 36 training courses for designers / specialists were organised by project partners, summing up 108 teaching hours and targeted 894 participants (24% more than the envisaged target group).

A web-based, publicly accessible e-learning course for non-specialists with decision making capacity was developed by the Passive House Institute, defined for three distinct target subgroups (end users, investors and politicians). The content of the module is briefly described in this report.

List of training courses for decision-makers used in the BKHs

1. Bulgaria

The training format is designed for courses conducted in the Bulgarian BKH – theoretical training in classrooms supplemented with practical training / exercises (on models, mock-ups, airtight room, demonstration equipment etc.). In several occasions, the courses were conducted in other cities, where the practical training was conducted using portable equipment (blower-door testing equipment, thermal imaging camera, airtightness products and small-size practical training models).

In Bulgaria, several training programs were implemented, with focus on on-site personnel, as follows:

- Certified Passive House Tradesperson
- General principles of nZEB
- Thermal insulation in nZEBs (Insulation systems, thermal bridges)
- PV Systems (EnerPro)
- Mechanical ventilation systems with heat recovery in nZEB
- Demonstrations on airtightness and MVHR
- Demonstrations on airtightness and pressurization tests
- Multicomfort house (in cooperation with ISOVER)

A short description of each course is presented in table 1.3.

Table 1.3

No.	Module	Results
1.	General principles of nZEB	**Learning outcomes** **Knowledge**: - The characteristics of low-energy and passive buildings; - The basic principles of design and cost effectiveness of passive houses; - The basic principles of the building envelope of passive buildings; - The basic principles of the building systems of passive houses. **Skills** - To present the concept of nZEB, - To describe the principles underlying the realization of nZEB, - Determine if a building is low energy or passive; - Analyze the advantages of low-energy and passive buildings and their energy efficiency. - **Type of evaluation** - Direct observation

No.	Module	Results
2.	Economic principles of resource and energy efficiency	**Learning outcomes** **Knowledge**: - Knowledge on current price of energy and energy price developments - Knowledge on sustainable economic development with reference to energy and resource efficiency - Knowledge of Life cycle cost theory **Skills** - Explain the economic efficiency of certain measures of set of measures - Suggest individual case-by-case measures on resource and energy efficiency in respect to the economic suitability - Use Life cycle estimations to defend specific measures on resource and energy efficiency
3.	Climate change protection and adaptation	**Learning outcomes** **Knowledge**: - Knowledge on climate change mechanism and correlation of the different factors influencing climate change - Knowledge on the effect of climate change on different economic fields - Knowledge greenhouse gas emissions and CO2 emitters - Knowledge on climate change mitigation political initiatives and climate change mitigation measures **Skills** - Explain the principle behind climate change and global warming and the challenge to limit climate change - Suggest individual case-by-case measures on greenhouse gas emission reduction
4.	Energy Efficiency	**Learning outcomes** **Knowledge**: - Knowledge on energy efficiency principles in buildings - Knowledge on energy efficiency measures in buildings and their correlation - Knowledge energy efficiency measuring equipment **Skills** - Explain the basic principles of resource efficiency in buildings and enterprises - Ability to suggest resource efficiency measures within a building and identify their effectiveness

No.	Module	Results
5.	Resource Efficiency	**Learning outcomes** **Knowledge**: - Knowledge on economic importance of natural resources - General knowledge on production and usage resource efficiency in buildings and enterprises - Knowledge on environmental load theory **Skills** - Explain the basic principles of resource efficiency in buildings and enterprises - Ability to suggest resource efficiency measures within a building and identify their effectiveness
6.	Energy efficiency in transport and mobility	**Learning outcomes** **Knowledge**: - Knowledge on transport and mobility means and their environmental impact - Knowledge on mobility patterns, factors influencing mobility patterns and logistics - General knowledge on mobility trend analysis **Skills** - Explain the basic principles of mobility patterns - Ability to suggest ways to influence already established mobility patterns - Explain the environmental impact of different means of transport

The summary of all courses organised for on-site professionals is presented in table 1.2.

Images from the courses




Table 1.2

No.	Course title	Date	Participant Profile	No. of hours	No attendees	Location
1.	General principles of nZEB (specialized workshop in the Bulgarian Eco Pret-a-Porter Forum)	10.12.2016	NGOs, municipalities, end users, real estate companies, policy makers, building professionals, general audience	8	140	National Palace of Culture
2.	General principles of nZEB	12.09.2017	Municipal officials	8	7	BKH-BG
3.	General principles of nZEB	12.09.2017	Municipal officials	8	18	Troyan
4.	Economic principles of resource and energy efficiency	20.06.2018	"Energy scouts" of business companies – employees with task to undertake EE projects	8	15	BKH-BG
5.	Climate change protection and adaptation	11.09.2018	Energy scouts	8	21	BKH-BG
6.	General principles of nZEB	22.06.2018	Municipal officials, NGOs, representative of companies	8	32	National NZEB conference - Burgas
7.	Energy Efficiency	26.09.2018	Energy scouts	8	14	BKH-BG
8.	Resource Efficiency	10.10.2018	Energy scouts	8	5	BKH-BG
9.	Energy efficiency in transport and mobility	31.10.2018	Energy scouts	8	13	BKH-BG
Total attendees					**245**	

2. Czech Republic

The course **"Sustainable development of construction, management and use of nZEBs"** focuses primarily on the sustainable development of construction, maintenance and use of nearly zero energy buildings (nZEB). The target group are first of all general public, state authorities, municipalities, media, managers, buildings' administrators etc. The course consists of three parts that are the theoretical lessons, practical exercises and self-study with training materials. The course finishes up with a test and after its successful completion the trainees are awarded with certificates.

Table 2.1

No.	Module	Results
1.	**Sustainable development of construction, management and use of nZEBs**	✓ **Acquired competence** ➢ The course is included into life-long education program of the CZ chamber of certifies engineers and technicians. The training program is rated with 1 credit point. ✓ **Learning outcomes** Trainee should be able: - to describe principles of nZEB including its material and technical solutions - to explain the principles of sustainable development and the importance of energy savings - aware of the importance of the quality of nZEB design and implementation, as well as of the impacts on its functionality and durability - overview of the legislative requirements to nZEB and international instruments for assessing quality of buildings - to explain the differences between energy audit, EPB certificate and assessments - to understand the principles of technology used in nZEB principles of their proper use and facility management - to describe the life cycle of the building and be aware of the progress of the costs over the cycle - to have an overview of related decrees, laws and European directives ✓ **Type of evaluation** - The theoretical part will be finished with the final test. - After evaluating the test, successful graduates will be awarded with certificates.

The summary of all courses organised for on-site professionals is presented in table 2.2.

Images from the courses

Table 2.2

No.	Course title	Date	Participant Profile	No. of hours	No attendees	Location
1	Sustainable development of construction, management and use of nZEBs	14.3.2017	Faculty of Civil Engineering, Czech Technical University in Prague	6	13	BKH Prague
2	Sustainable development of construction, management and use of nZEBs	13.4.2017	Masaryk University in Brno	6	14	BKH Prague
3	Sustainable development of construction, management and use of nZEBs	13.6.2017	Facility managers	6	12	BKH Prague
4	Sustainable development of construction, management and use of nZEBs	18.9.2017	Professional school of civil engineering in Letohrad	6	33	BKH Prague
5	Sustainable development of construction, management and use of nZEBs	20.3.2018	Professional school of civil engineering in Karlovy Vary	6	48	BKH Prague
6	Sustainable development of construction, management and use of nZEBs	16.4.2018	Faculty of Electrical Engineering, Czech Technical University in Prague	6	21	BKH Prague
7	Sustainable development of construction, management and use of nZEBs	26.4.2018	Masaryk University in Brno	6	12	BKH Prague
Total attendees					**153**	

3. Romania

The training format is designed for on-site courses – theoretical training in classrooms (e.g. conference centre of NIRD URBAN-INCERC in Bucharest and FPIP premises in METROM Brasov) supplemented with practical training / exercises (on models, mock-ups, airtight room, demonstration equipment etc.).

In Romania, the course module demanded by non-specialists with decision-making functions is "Legal framework and concepts for nZEBs" as the most comprehensive, interesting and time saving. This target group is formed by: Building Administrators, representatives of building owners' associations, Decision factor in Local Administration (investment & urban planning departments) and within Central Authorities, Building/Real Estate Developer, Construction materials & technology Sales Agents and representatives of financial institutions/banks and Energy Auditors for buildings (as introductory course).

A short description of each course is presented in table 3.1.

Table 3.1

No.	Module	Results
1.	**Legal framework and concepts for nZEBs**	✓ **Acquired competence:** ➢ Apply the national legislation for carrying NZEB. ✓ **Learning outcomes** On completion of the module the participants should be able to: - Interpret correctly the legal framework for carrying nZEB, - Understand the relationship between the passive house concept and the concept of nZEB, - Understand the importance of ensuring an appropriate indoor environment, - Define the energy performance of a building, - Define the energy audit of a building, - Introduce minimum energy performance requirements, - Identify legal steps for the energy certification of buildings. ✓ **Type of evaluation** - Direct observation, formative assessment

The monitoring of the training courses comprise:

- Collecting the information regarding the course/target group status, course organization (each month course type, number of participants etc.),
- Collecting the feedback from the questionnaire: the gap in training, how were tasks performed, what knowledge and skills are required by attendees, the training quality,
- Dissemination of the organized activities.

The summary of all courses organised for on-site professionals is presented in table 3.2.

Images from the courses






Table 3.2

No.	Course title	Period	Participant Profile	No. of hours	No attendees	Location
1	**Legal framework and concepts for nZEBs**	06.07.2017	Decision-makers in Local Administration (Brasov, Fagaras, Metropolitan Agency Brasov)	2	23	Brasov City Hall, In workshop combined with ProgRESHeat
2	**Legal framework and concepts for nZEBs**	28.09.2017	Building Administrator	4	15	BKH RO, Brasov
3	**Legal framework and concepts for nZEBs**	29.01.2018	Decision factor in Local Administration (Brasov, Codlea, Sacele)	6	15	Brasov City Hall
4	**Legal framework and concepts for nZEBs**	05.02.2018	Decision Maker - Local Administration Ploiesti	6	31	County Council Prahova, Ploiesti
5	**Legal framework and concepts for nZEBs (incl. practical training)**	27.03.2018	Decision Makers in County Council Dolj, City Hall Ploiești and Poiana Campina	8	9	BKH RO, Bucharest
6	**Legal framework and concepts for nZEBs**	21.06.2018	Decision Makers in Local Administration, Sf Gheorghe (ADR Centru)	6	31	Event room Sf. Gheorghe
7	**Legal framework and concepts for nZEBs (incl. practical training)**	23.08.2018	Decision Makers at Ministry of Regional Development and Public Administration	8	16	BKH RO, Bucharest
8	**Legal framework and concepts for nZEBs (incl. practical training)**	13.09.2018	Decision Makers in Local Administration Brasov	8	24	BKH RO, Brasov
9	**Legal framework and concepts for nZEBs**	02.10.2018	Decision makers in Local Administration Iasi, Building Administrator	6	21	City Hall Iasi
10	**Legal framework and concepts for nZEBs**	25.10.2018	Decision makers in Local Administration Cluj-Napoca, Building Administrator	6	14	Cluj Hub, Cluj-Napoca
11	**Legal framework and concepts for nZEBs (incl. practical training)**	30.10.2018	Decision makers in Local Administration District 1 Bucharest and various banks	8	30	BKH RO, Bucharest
Total attendees					**229**	

4. Turkey

In Turkey, the non-specialists have to take modules 1-3-5-6. This target group consists of Local administrators from municipality, Building/Real Estate Developer, construction materials sales agents, and Energy Auditors.

Table 4.1 Modules for non-specialists' courses

No.	Module	Results
1.	nZEB Basic	**Learning outcomes:** • To understand the nZEB concept and definition • To understand basic building physics with respect to heat loss and gain, energy efficient building materials, construction techniques, measurement techniques, installation and maintenance • To understand the heat transfer techniques; conduction, convection and radiation • To familiarize with common thermal insulation materials and its application techniques and their respective benefits • To introduce available renewable energy systems used in buildings and renewable energy need in an nZEB **Type of evaluation** • Direct observation, formative assessment
3.	Retrofitting towards nZEB	**Learning outcomes:** • To define and apply the tools to perform energy audits • To understand the advantages and disadvantages of various renovation strategies in certain situations • To understand the technical and practical considerations of renovation decision-making • To understand the possibility of renovation of current buildings to nZEB • To understand the cost optimal renovation solutions • To define the suitable renewable energy systems for renovation of current buildings **Type of evaluation** Direct observation, formative assessment

No.	Module	Results
5	Preparation of funding schemes	**Learning outcomes:** • To understand the financial mechanisms for implementing energy efficient solutions in nZEB • To understand different options to provide incentives from financial institutions • To understand current policy and regulatory approach suits best for a given situation **Type of evaluation** Direct observation, formative assessment
6	Practice	**Learning outcomes:** • understand the key design, installation, operation and maintenance issues of nZEB • understand advantages of usage of right implementations in nZEB • ability to cooperate on an equal basis with partners in and outside their chosen field • ability to analyze problems and development needs in nZEB practice **Type of evaluation** Direct observation, formative assessment

The summary of all courses organised for on-site professionals is presented in table 4.2.

Images from the courses

Table 4.2

No.	Course title	Date	Participant Profile	No. of hours	No attendees	Location
1	**NZEB Training for non-specialists**	10.05.2017	Local administrative students	10	50	Ege University
2		17.05.2017				
3		23.05.2017				
4		12.10.2017	Architecture students	10	50	Yasar University
5		19.10.2017	Local administrative and architecture students	10	13	Yasar University
6		3.04.2018	Architecture students	10	72	Balikesir University
Total attendees					**185**	

5. Ukraine

In Ukraine, three trainings (44 hours each) were conducted for non-specialist decision makers in 2018 and 82 persons were trained. The trainings were organized as group exercises, individual tasks, classroom discussions, practical tasks in the classroom and at the REHAU Training Centre, workshops conducted by manufacturers/vendors of energy efficient equipment and materials.

In Ukraine, most of decision makers believe consumption of energy resources in buildings and facilities is linked exclusively to thickness of insulation materials used in building envelopes. The training course aimed at increasing awareness of non-specialist decision-makers of basic principles of construction of nearly zero-energy buildings, design of engineering systems, applicable solutions and technologies for apartment blocks, and use of locally available alternative energy sources.

Non-specialist decision makers who are the specialists in charge of construction surveillance and construction techniques, design and implementation of construction projects at public and residential buildings, included: public servants at governmental agencies, experts working for local city councils and oblast state administrations, city planners and architects in municipalities, managers at public buildings, policy makers, Individual Entrepreneurs, representatives of NGOs, etc.

Training modules and results and details on the trainings are presented in Table below.

Table 5.1

No.	Module	Results
1.	**Legislation on energy efficiency in building industry**	The trainees were familiarized with: - Requirements to energy efficiency in Ukraine. - Current national norms and relevant international norms. - Improving energy efficiency norms in Ukraine for achieving consistency with the approach to environment in the world. - Engineering, technical, financial issues, housing management in energy efficient buildings.
2.	**Design and installation of energy efficient heat supply systems**	The trainees were familiarized with: - Regulating heat supply in the building: individual apartment and in the building in whole. - Energy efficient heating systems. - Systems used for estimating and monitoring consumption of heat resources. Local and centralized monitoring of heat energy consumption. - Installation of thermostats and heat meters with convectors and heaters.
3.	**Design of energy efficient power supply systems**	The trainees were familiarized with: - Optimizing power supply in the building for attaining autonomous energy saving operation. - Integration of alternative energy sources into power supply system in the building. - Systems used for monitoring and control of consumption of electric energy. Local and

No.	Module	Results
		centralized monitoring of electric energy consumption.
4.	**Energy efficiency measures in gas supply and water supply systems in modern buildings**	The trainees were familiarized with: - Efficient consumption of natural gas. Estimation and monitoring and regulation of natural gas consumption. - Reduction of water consumption. Estimation and monitoring of water consumption.
5.	**Improving maintenance of buildings and facilities**	The trainees were familiarized with: - Thermal modernization of buildings: requirements; energy audit and examination of engineering systems. - Energy performance certificates of buildings. - Estimation of heat losses through building envelope and ventilation; solar radiation; energy efficiency type of the building. - Thermal modernization o buildings: technical and economic issues. - Deep retrofit of residential buildings: mandatory and optional improvements.
6.	**Automated systems for regulation of energy consumption and micro-climate control in the building**	The trainees were familiarized with: - Regulation and monitoring of heat energy, water, electric energy consumption in the building. - Regulating and monitoring micro-climate in the building. - Regulating and monitoring air exchange in the building. - Software for monitoring and regulation of consumption of energy resources in the building.
7.	**Certification of buildings**	The trainees were familiarized with: - Certification of green buildings. - Energy performance certification of buildings. - What energy performance indicators are under consideration during energy performance certification of buildings?
8.	**Energy audit of buildings**	The trainees were familiarized with: - What buildings and constructions should be energy audited. - What equipment is used during energy audit - Stages of energy audit. - Assessment and analysis of energy consumption in the building.
9.	**Investments in construction of new energy efficient buildings. Government support**	The trainees were familiarized with:

No.	Module	Results
		Programs and financing options provided by banks, private investors and under national programs initiated by the Government.
10.	**Heat supply sources, diversification and decentralization of energy sources. Alternative energy sources**	The trainees were familiarized with: - Heat pump as the alternative heating technology. - Selecting a heat pump. Effective operation of a heat pump. - Estimating payback period for heat pumps.

The summary of all courses organised for on-site professionals is presented in table 5.2.

Images from the courses

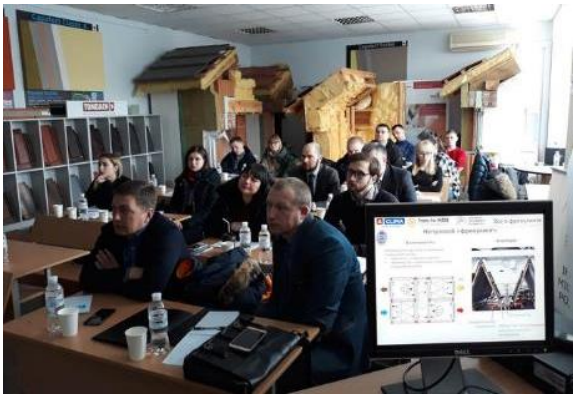
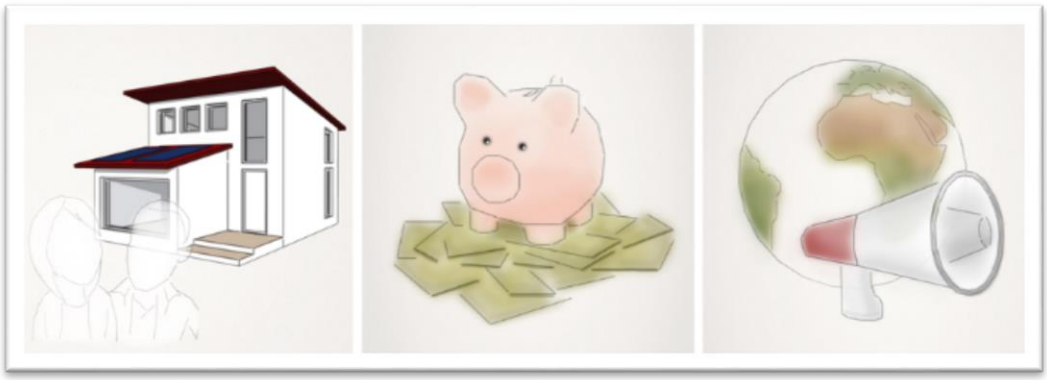




Table 5.2

No.	Course title	Date	Participant Profile	No. of hours	No attendees	Location
1.	**Nearly Zero-Energy Buildings Project Manager**	19-22.02.2018	Decision-makers	44	29	Ukrainian NZEB Hub
2.	**Nearly Zero-Energy Buildings Project Manager**	19-22.03.2018	Decision-makers	32	27	Ukrainian NZEB Hub
3.	**Nearly Zero-Energy Buildings Project Manager**	2-5.04.2018	Decision-makers	32	26	Ukrainian NZEB Hub
Total attendees					**82**	

International web-based e-learning

In order to support the local partner's activities and reach beyond the geographic limitations of the consortium a web-based, publicly accessible e-learning course for non-specialists with decision making capacity was developed by the Passive House Institute. In order to cater for different background and needs the "non-specialist" group of persons was subdivided into three subgroups:



End Users **Investors** **Politicians**

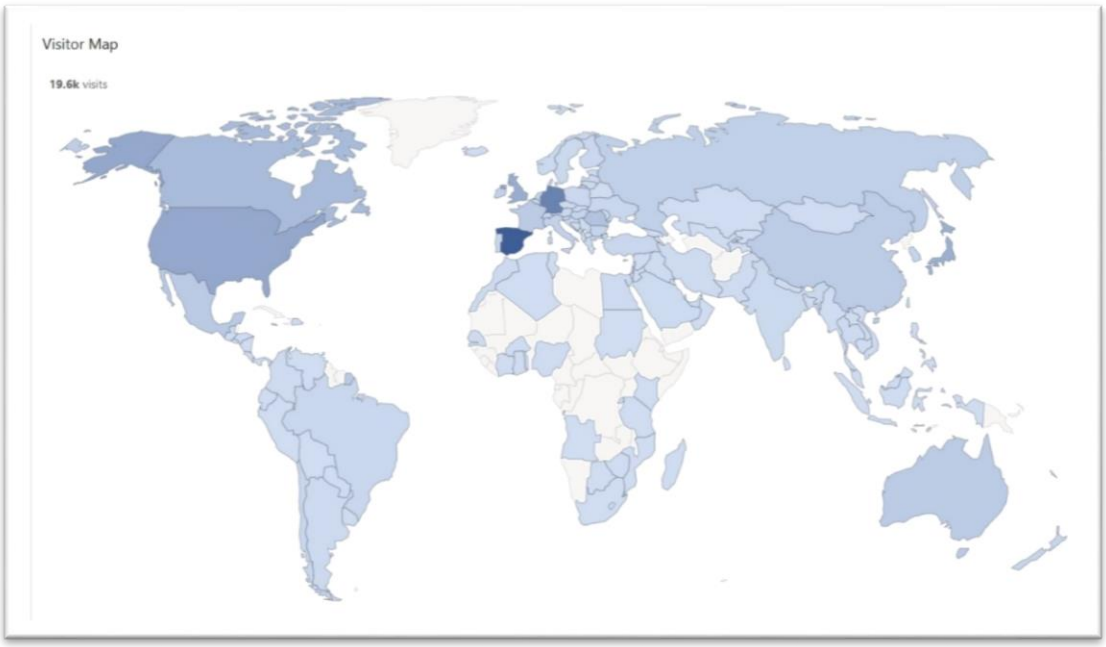
While sharing some of the contents a dedicated path for each group is offered, adding or leaving out information as relevant for the identified needs. This allows a target-group specific approach and a very concise course in each case. No user should be put off by content that is not immediately relevant. It will also enable executives with tight diaries to use occasional spare time on their NZEB information.

Any additional desire for more in-depth information can be answered by links to websites, wiki-type resources, videos and, last but not least, far more comprehensive e-learning programmes.

The courses were developed in English language and can thus be used in all partner countries and the EU as a whole. Subsequent translation is invited but was not possible in the scope of the project.

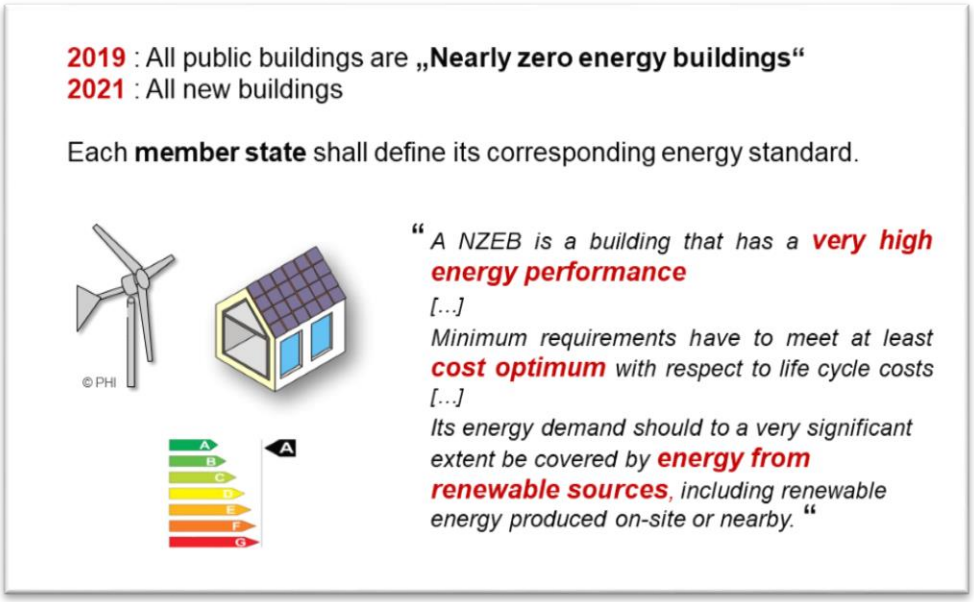
A further application of the e-learning courses is as a possible primer for classroom courses for non-specialists or construction workers, thanks to the focused and concise approach and generally understandable language. This will offer a powerful enhancement to the learning experience as it frees the parties involved from time and spatial constraints. Valuable classroom time may be more effectively used as the attendance has already appreciated the basics of Passive House/NZEB concepts and terminology.

The course can be accessed by the following link:
https://elearning.passivehouse.com/course/view.php?id=19

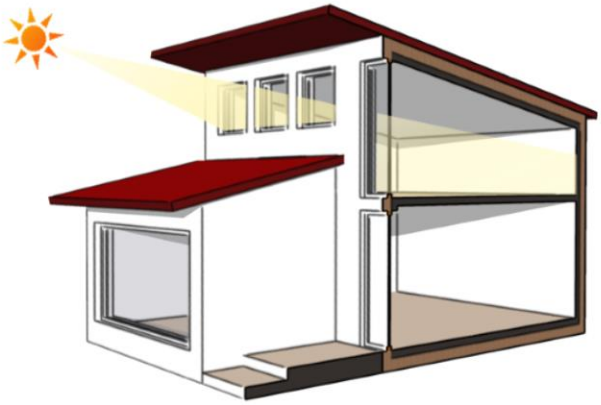


The above map gives an indication of the activity on the Passive House Institute's e-learning platform from 2017 when the non-specialists courses started until the end of the Train-to-NZEB project. Despite not all visitors focusing on the said course it becomes apparent that an important and valuable range of influence is gained in Europe and beyond.

The following pictures illustrate the e-learning programme with a selection of screen shots. The true interactive experience will of course only be conveyed by using the on-line material.

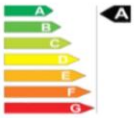


1. Continuous insulation
2. Passive House windows

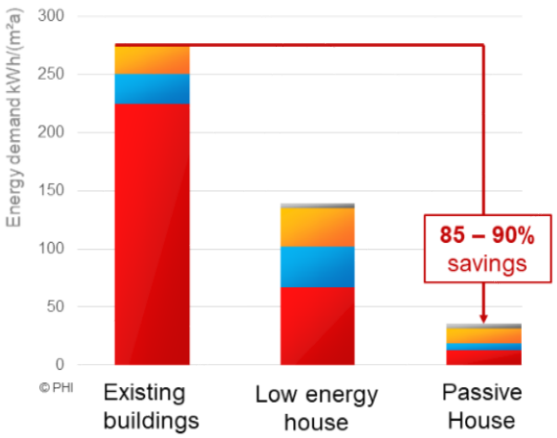


2019 : All public buildings are **„Nearly zero energy buildings“**
2021 : All new buildings

Each **member state** shall define its corresponding energy standard.



“ *A NZEB is a building that has a* ***very high energy performance***
[…]
Minimum requirements have to meet at least ***cost optimum*** *with respect to life cycle costs*
[…]
Its energy demand should to a very significant extent be covered by ***energy from renewable sources****, including renewable energy produced on-site or nearby.* “

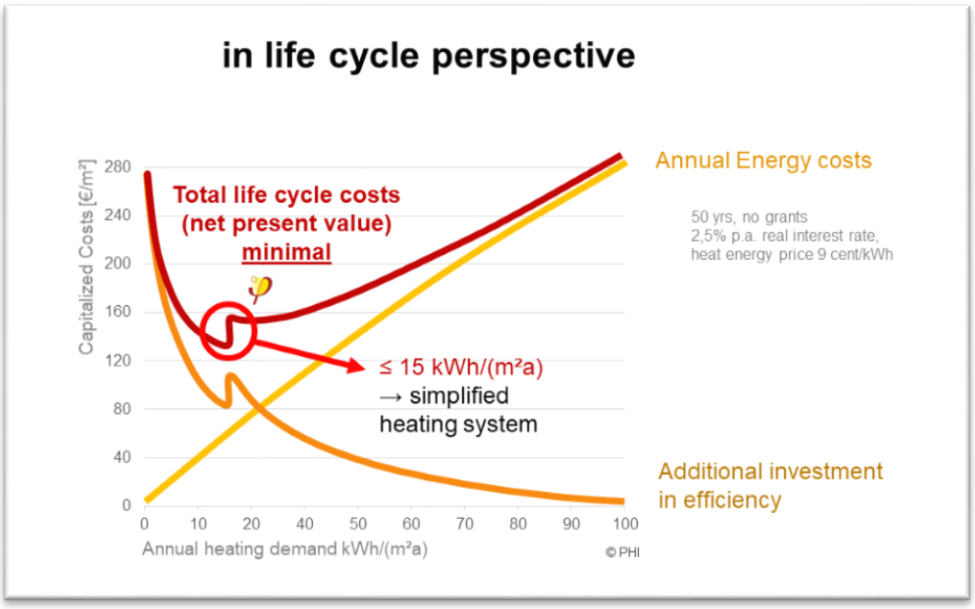


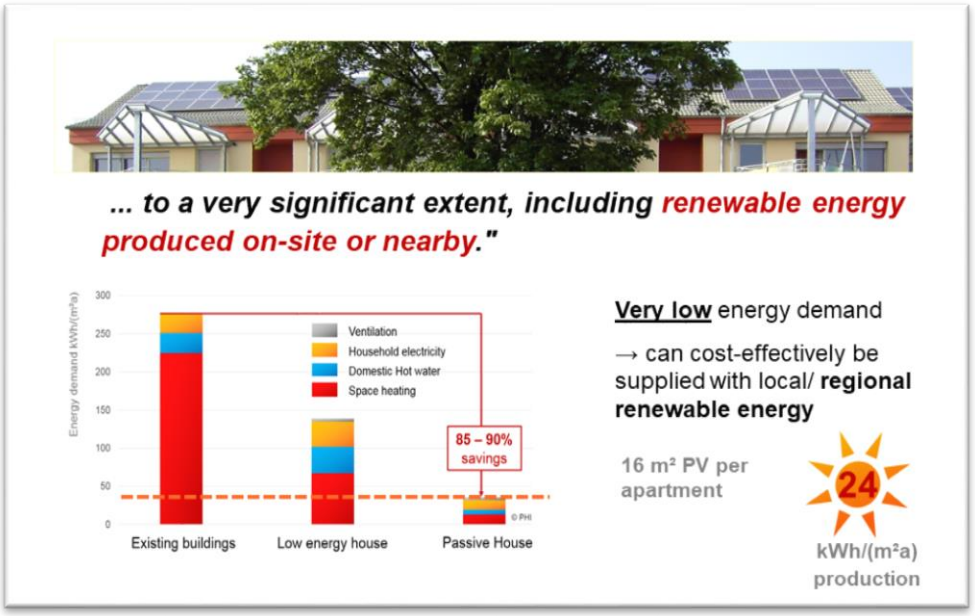
Heating and cooling demand
≤ 15 kWh/(m²a)

Very low heating/cooling load

Primary energy demand
≤ 120 kWh/(m²a)

Ventilation
Household electricity
Domestic Hot water
Space heating


in life cycle perspective
Capitalized Costs [€/m²]
280
240
200
160
120
80
40
0
Total life cycle costs
(net present value)
minimal
≤ 15 kWh/(m²a)
→ simplified
heating system
Annual Energy costs
50 yrs, no grants
2,5% p.a. real interest rate,
heat energy price 9 cent/kWh
Additional investment
in efficiency
0 10 20 40 50 60 70 80 90 100
Annual heating demand kWh/(m²a)
© PHI


... to a very significant extent, including renewable energy produced on-site or nearby."
Energy demand kWh/(m²a)
300
250
200
150
100
50
0
Ventilation
Household electricity
Domestic Hot water
Space heating
85 – 90% savings
© PHI
Existing buildings
Low energy house
Passive House
Very low energy demand
→ can cost-effectively be supplied with local/ regional renewable energy
16 m² PV per apartment
24
kWh/(m²a) production