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Conduction of training courses for construction workers

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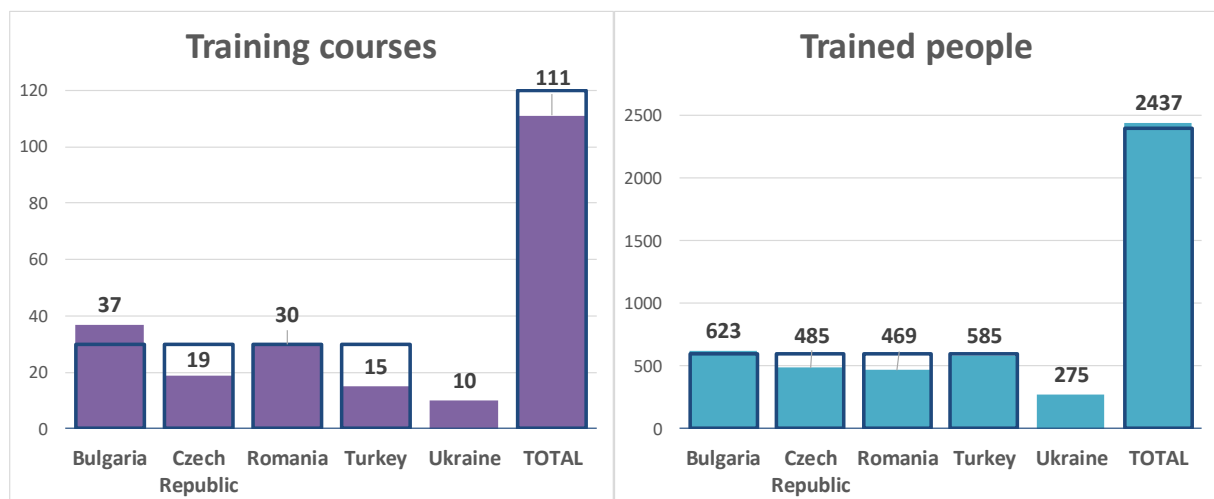
Executive summary

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 on-site professionals in each country, namely in Bulgaria, Czech Republic, Romania, Turkey and Ukraine.

The scope of the training programs for construction workers was to conduct 120 training courses. This report presents the relevant information related to the conduction of the training courses for construction workers (on programs set on BUILD UP Skills Pillar II where available), targeting additional qualification of 2400 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 111 training courses for designers / specialists were organised by project partners, summing up 2301 teaching hours and targeted 2437 participants (2% more than the envisaged target group).

List of training courses for on-site professionals 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 1.3.1.

Table 1.1

No.	Module	Results
1.	Certified Passive House Tradesperson	Learning outcomes according to the specifications of PHI http://www.passivehouse-trades.org/upload/20120426_learning_objectives_PH-Tradeperson.pdf
2.	General principles of nZEB	<ul style="list-style-type: none">✓ Acquired competences:<ul style="list-style-type: none">➤ Define nZEB: concept, criteria and performance.➤ Define dependencies between the underlying principles of nZEBs✓ Learning outcomes At the end of the training on the subject, the students must know:<ul style="list-style-type: none">- The characteristics of low-energy and passive buildings;- The basic principles of design and cost effectiveness of passive houses;- The specifics of the construction of the building envelope of passive buildings;

No.	Module	Results
		<ul style="list-style-type: none"> - The specifics of the construction of building systems of passive houses. <p>Students should be able to:</p> <ul style="list-style-type: none"> - 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. <p>✓ <u>Type of evaluation</u></p> <ul style="list-style-type: none"> - Direct observation, formative assessment
3.	Thermal insulation in nZEBs	<p>✓ <u>Acquired competences:</u></p> <ul style="list-style-type: none"> ➤ Define nZEB: concept, criteria and performance. ➤ Verify the nZEB opaque envelope thermal insulation and thermal bridges avoidance principles ➤ Analyse the external windows / glazing elements that meet the nZEB conditions <p>✓ <u>Learning outcomes</u></p> <p>On completion of the module the participants should know:</p> <ul style="list-style-type: none"> - The materials for insulation of facade walls, foundations and roof; - The rules for consistent execution of insulation of facade walls, foundations and roof; - How to control the implementation, acceptance and measuring of the insulation of facade walls, foundations and roof; - The basic requirements for labour safety, hygiene and fire safety. <p>On completion of the module the participants should be able to:</p> <ul style="list-style-type: none"> - To present the concept of nZEB, - To describe the principles underlying the realization of nZEB, - To list the criteria defining a passive house / nZEB, - Understand the principle of achieving high thermal performance envelopes, - Apply proper thermal insulation and avoid thermal bridges and their negative effects, - Know the general requirements for windows that are installed in a passive house/nZEB, <p>✓ <u>Type of evaluation</u></p> <ul style="list-style-type: none"> - Direct observation, formative assessment
4.	PV Systems	<p>✓ <u>Acquired competences:</u></p> <p>✓ Analyse the possibilities for integration of PV systems</p> <p>✓ Solve practical and application tasks; work safely with instrumentation, specialized tools and stands; assess the location of elements of the PV system.</p> <p>✓ <u>Learning outcomes</u></p>

No.	Module	Results
		<p>On completion of the module the participants should know:</p> <ul style="list-style-type: none"> - Purpose, principle of operation and construction of equipment and elements of installations producing electricity from the sun. - Circuitry of the connection of the solar generator to the power grid. <p>On completion of the module the participants should be able to:</p> <ul style="list-style-type: none"> - Work with experimental installation. - Measure the electrical parameters of the PV module, - Scale up a PV system - Connect elements of an autonomous photovoltaic system - Read and understand technical specification. <p>✓ <u>Type of evaluation</u> <u>Direct observation, formative assessment</u></p>
5.	Mechanical ventilation systems with heat recovery in nZEB	<p>✓ <u>Acquired competences:</u></p> <ul style="list-style-type: none"> ➤ Identify pollution factors and ventilation rates in nZEB. <p>✓ <u>Learning outcomes</u></p> <p>At the end of the training on the subject, the students must know:</p> <ul style="list-style-type: none"> - Why is ventilation essential: Indoor air contaminants; Relationship between the relative indoor air humidity and sources of humidity inside the building, the rate of fresh air supply and the outdoor temperature; prevention of mould formation - Controlled home ventilation with heat recovery: Heat recovery, the principle of cross-ventilation; Different ventilation concepts (centralised and decentralised ventilation systems) - Key components of ventilation systems - heat recovery unit, filters, fans, leading away of condensation; - Key components of ventilation installations - pipelines, grids, openings for fresh air and exhaust air. - Basic knowledge regarding dimensioning, selection, and setup of units <p>Students should be able to:</p> <ul style="list-style-type: none"> - To schematically arrange the equipment of the ventilation system <p>✓ <u>Type of evaluation</u> Direct observation, formative assessment</p>
6.	Demonstrations on airtightness and MVHR	<ul style="list-style-type: none"> ➤ <u>Acquired competences:</u> ➤ Check the airtightness of a thermal envelope of nZEB. ➤ Identify pollution factors and ventilation rates in nZEB. ➤ <u>Learning outcomes</u> <p>At the end of the training on the subject, the students must know:</p> <ul style="list-style-type: none"> - Planning principles regarding the airtightness of the building envelope - Typical points that generate air leaks,

No.	Module	Results
		<ul style="list-style-type: none"> - Identify solutions to achieve correct airtightness - Why is ventilation essential: Indoor air contaminants; Relationship between the relative indoor air humidity and sources of humidity inside the building, the rate of fresh air supply and the outdoor temperature; prevention of mould formation - Key components of ventilation systems - heat recovery unit, filters, fans, leading away of condensation; - Key components of ventilation installations - pipelines, grids, openings for fresh air and exhaust air. - Basic knowledge regarding dimensioning, selection, and setup of units <p>Students should be able to:</p> <ul style="list-style-type: none"> - Provide methods for checking airtightness of buildings, - Describe the procedures that can be used to measure airtightness, - Identify typical points that generate air leaks, - Identify solutions to achieve correct airtightness, - To schematically arrange the equipment of the ventilation system <p>➤ <u>Type of evaluation</u></p> <ul style="list-style-type: none"> - Direct observation, formative assessment
7.	Demonstrations on airtightness and pressurization tests	<p>➤ <u>Acquired competences:</u></p> <p>➤ Check the airtightness of a thermal envelope of nZEB during pressurization tests</p> <p>➤ <u>Learning outcomes</u></p> <p>At the end of the training on the subject, the students must know:</p> <ul style="list-style-type: none"> - Planning principles regarding the airtightness of the building envelope - Typical points that generate air leaks, - Solutions to achieve correct airtightness <p>Students should be able to:</p> <ul style="list-style-type: none"> - Provide methods for checking airtightness of buildings, - Describe the procedures that can be used to measure airtightness, - Identify typical points that generate air leaks, - Identify solutions to achieve correct airtightness. <p>➤ <u>Type of evaluation</u></p> <ul style="list-style-type: none"> - Direct observation, formative assessment

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.	Thermal insulation	6-7.02.2017	Employees of companies – members of BCC	16	32	Yambol
2.	Thermal insulation	6,10 February 2017	Employees of companies – members of BCC	16	26	Sliven
3.	Thermal insulation	17, 24 February	Employees of companies – members of BCC	16	32	Silistra
4.	Thermal insulation	10-11.03.2017	Employees of companies – members of BCC	16	31	Gabrovo
5.	Thermal insulation	02-03.04.2017	Employees of companies – members of BCC	16	28	Stara Zagora
6.	Certified Passive House Tradesperson	1-2.06.2017	Construction workers and specialists	24 (8 hours in distance learning)	10	BKH-BG
7.	Demonstrations on airtightness and MVHR	1-2.06.2017	Construction workers and specialists	4	10	BKH-BG
8.	Multicomfort house (in cooperation with ISOVER)	30.05.2017	Students with 3 rd class on EQF	8	5	BKH-BG
9.	General principles of nZEB	26.05.2017	Construction workers and specialists	8	7	BKH-BG
10.	Demonstrations on airtightness and pressurization tests	04.06.2017	Construction workers and specialists	4	8	BKH-BG
11.	General principles of nZEB	31.07.2017	Students with 3 rd class on EQF	8	14	BKH-BG
12.	General principles of nZEB	18.09.2017	Students with 2 nd class on EQF	8	52	BKH-BG
13.	Certified Passive House Tradesperson	5-6.10.2017	Construction workers and specialists	24 (8 hours in distance learning)	3	BKH-BG
14.	Demonstrations on airtightness and pressurization tests	7.10.2017	Construction workers and specialists	4	4	BKH-BG
15.	General principles of nZEB	31.10.2017	Construction workers and specialists	8	15	BKH-BG

No.	Course title	Date	Participant Profile	No. of hours	No attendees	Location
16.	General principles of nZEB	02.11.2017	Construction workers and specialists	8	15	BKH-BG
17.	General principles of nZEB	08.01.2018	Students with 2 nd class on EQF	8	25	BKH-BG
18.	Demonstrations on airtightness and pressurization tests	22.01.2018	Students with 2 nd class on EQF	4	22	BKH-BG
19.	Demonstrations on airtightness and MVHR	22.01.2018	Students with 2 nd class on EQF	4	24	BKH-BG
20.	Mechanical ventilation systems with heat recovery in nZEB	29.01.2018	Students with 2 nd class on EQF	8	10	BKH-BG
21.	Certified Passive House Tradesperson	15-16.02.2018	Construction workers and specialists	24 (8 hours in distance learning)	10	BKH-BG
22.	General principles of nZEB	19.02.2018	Construction workers and specialists	8	10	
23.	Energy and resource efficiency	20.02.2018	Students with 3 rd class on EQF	8	39	BKH-BG
24.	Certified Passive House Tradesperson (test preparation)	23.02.2018	Construction workers and specialists	4	14	BKH-BG
25.	Certified Passive House Tradesperson	16-17.05.2018	Construction workers and specialists	24 (8 hours in distance learning)	8	BKH-BG
26.	Demonstration session: General principles of nZEB	01.10.2018	Students with 3 rd class on EQF	4	6	BKH-BG
27.	Demonstration session: airtightness and pressurization tests	03.10.2018	Students with 3 rd class on EQF	4	9	BKH-BG
28.	General principles of nZEB	13.10.2018	Construction workers	8	12	BKH-BG
29.	PV Systems (EnerPro)	17.10.2018	Construction workers	8	12	BKH-BG
30.	Thermal insulation	19.10.2018	Construction workers	8	12	BKH-BG
31.	Demonstrations on airtightness and pressurization tests	24.10.2018	Construction workers	8	12	BKH-BG

No.	Course title	Date	Participant Profile	No. of hours	No attendees	Location
32.	Mechanical ventilation systems with heat recovery in nZEB	26.10.2018	Construction workers	8	12	BKH-BG
33.	Demonstrations on airtightness and MVHR	29.10.2018	Construction workers	8	12	BKH-BG
34.	General principles of nZEB	06.11.2018	Construction workers, employees by companies – members of BCC	8	28	Kyustendil
35.	General principles of nZEB	21.11.2018	Construction workers, employees by companies – members of BCC	8	43	Sliven
36.	Certified Passive House Tradesperson	29-30.11.2018	Construction workers and specialists	24 (8 hours in distance learning)	6	BKH-BG
37.	Demonstrations on airtightness and pressurization tests	30.11.2018	Construction workers and specialists	4	5	BKH-BG
Total:				380	623	

2. Czech Republic

The two pilot trainings “**Energy performance of buildings**” were organized in 2016 before the official opening of the Czech BKH in 2017. The course focuses primarily on the energy performance of buildings and nearly zero energy buildings (nZEB).

The course “**Implementation and construction of nZEBs**” focuses primarily on the correct implementation of construction details and structures of nearly zero energy buildings (nZEB). The target group are first of all construction workers, craftsmen, site managers, engineers, construction economists, construction supervisors, project managers 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.	Implementation and construction of nZEBs	<ul style="list-style-type: none"> ✓ <u>Acquired competence</u> <ul style="list-style-type: none"> ➤ 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. ✓ <u>Learning outcomes</u> <p>Trainee should be able:</p> <ul style="list-style-type: none"> - 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 and possibilities for using renewable energy sources in nZEB - properly and efficiently to resolve the design of construction details for new buildings and renovations - to describe the life cycle of the building and be aware of the progress of the costs over the cycle ✓ <u>Type of evaluation</u> <ul style="list-style-type: none"> - 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	Energy performance of buildings (pilot training)	17.5.2016	Energy specialists	7	9	Architecture and Building Foundation
2	Energy performance of buildings (pilot training)	1.12.2016	Energy specialists	7	15	Architecture and Building Foundation
3	Implementation and construction of nZEBs	20.4.2017 24.4.2017	Construction workers	14	10	BKH Prague
4	Implementation and construction of nZEBs	9.5.2017	Faculty of Civil Engineering, Czech Technical University in Prague	2	24	BKH Prague
5	Implementation and construction of nZEBs	1.6.2017 2.6.2017	Construction workers	14	7	BKH Prague
6	Implementation and construction of nZEBs	7.9.2017 8.9.2017	Construction workers	14	7	BKH Prague
7	Implementation and construction of nZEBs	30.11.2017	Faculty of Civil Engineering, Czech Technical University in Prague	2	32	BKH Prague
8	Implementation and construction of nZEBs	30.11.2017	Faculty of Civil Engineering, Czech Technical University in Prague	2	16	BKH Prague
9	Implementation and construction of nZEBs	19.12.2017	Professional school of civil engineering in Plzeň	4	41	BKH Prague
10	Implementation and construction of nZEBs	5.4.2018 6.4.2018	Construction workers	14	10	BKH Prague
11	Implementation and construction of nZEBs	23.4.2018	Faculty of Civil Engineering, Czech Technical University in Prague	2	62	BKH Prague
12	Implementation and construction of nZEBs	24.4.2018	Faculty of Civil Engineering, Czech Technical University in Prague	2	36	BKH Prague

No.	Course title	Date	Participant Profile	No. of hours	No attendees	Location
13	Implementation and construction of nZEBs	26.10.2018 2.11.2018	Construction workers	14	5	BKH Prague
14	Implementation and construction of nZEBs	5.11.2018	Professional school of civil engineering in Hradec Králové	4	35	BKH Prague
15	Implementation and construction of nZEBs	6.11.2018	Professional school of civil engineering in Havlíčkův Brod	4	38	BKH Prague
16	Implementation and construction of nZEBs	13.11.2018	Faculty of Civil Engineering, Czech Technical University in Prague	2	20	BKH Prague
17	Implementation and construction of nZEBs	19.11.2018	Professional school of civil engineering in Kadaň	4	28	BKH Prague
18	Implementation and construction of nZEBs	22.11.2018	Faculty of Civil Engineering, Czech Technical University in Prague	2	44	BKH Prague
19	Implementation and construction of nZEBs	22.11.2018	Professional school of civil engineering in Jihlava	4	46	BKH Prague
Total					485	

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

- Building Envelope in nZEBs (Insulation systems + windows)
- PV Systems (PVTRIN)
- Certified PH Tradesperson
- Thermal solar systems
- Legal framework and concepts for nZEBs – Basics

A short description of each course is presented in table 1.3.1.

Table 3.1

No.	Module	Results
1	Building Envelope in nZEBs (Insulation systems + windows)	<p>✓ <u>Acquired competences:</u></p> <ul style="list-style-type: none"> - Define nZEB: concept, criteria and performance. - Verify the nZEB opaque envelope thermal insulation and thermal bridges avoidance principles - Analyse the external windows / glazing elements that meet the nZEB conditions <p>✓ <u>Learning outcomes</u></p> <p>On completion of the module the participants should be able to:</p> <ul style="list-style-type: none"> - To present the concept of nZEB, - To describe the principles underlying the realization of nZEB, - To list the criteria defining a passive house / nZEB, - Understand the principle of achieving high thermal performance envelopes, - Apply proper thermal insulation and avoid thermal bridges and their negative effects, - Provide the functions of the window to ensure thermal comfort in the building,

No.	Module	Results
		<ul style="list-style-type: none"> - Know the general and specific requirements for windows that are installed in a passive house/nZEB, - Submit stages of windows installation with no thermal bridges, - Explain the role of energy certificates for glazed components <p>✓ Type of evaluation</p> <ul style="list-style-type: none"> - Direct observation, formative assessment
2	PV Systems (PVTRIN)	<p>Acquired competences</p> <ul style="list-style-type: none"> - Ensure permanent activities on the building site (Safety at work, Environmental protection, Fire protection) - Installs photovoltaic systems - Prepares the support structure for the photovoltaic system. - Connects the components of the photovoltaic system - Maintenance and repair of photovoltaic systems - Learning outcomes <p>On completion of the module the participants should be able to:</p> <ul style="list-style-type: none"> - Know norms and practices for ensuring the quality of the executed works, use the equipment to check the quality of the work done - Applying the rules and practices of organizing the execution of the works. - To follow the rules for safety at work, environmental protection and fire protection. - Ensure supply of necessary materials work. - Applies the procedures for the transport, handling and storage of products and materials for construction works; - Purpose, principle of operation and construction of equipment and elements of installations producing electricity from the sun; - Specify the factors that influence the efficiency of photovoltaic systems and explain how they affect the performance of the systems; - Compliance with the mounting conditions specified by the photovoltaic panel manufacturer - Check the instalment of the photovoltaic panels of the support structure in accordance with the operating instructions; - Analyse the roof structure for photovoltaic systems;

No.	Module	Results
		<ul style="list-style-type: none"> - Presents constructive elements that are mounted photovoltaic modules; - Read and understand technical specification (detailed design for mounting systems) - Indicate how a weatherproof seal is made for buildings where matrix cables pass through the building material; - Circuitry of the connection of the solar generator to the power grid. - Reads electrical schemes applicable to the installation of solar photovoltaic systems and correctly interprets the meaning of the symbols within them - Connect elements of an autonomous photovoltaic system; - Know the methods of measuring the electrical quantities and the specific equipment used for the measurement of electric current intensity, • electric voltage; electric power, electrical resistance. - Measure the electrical parameters of the PV module; - Describe methods to ensure the maintenance of photovoltaic panels; - Makes revisions to current photovoltaic systems, given their relevant components, with the plan of maintenance and use safe working equipment; - Perform simple repairs to solar photovoltaic systems safely using universal and specialized tools for mechanical and electrical interventions; - Present maintenance activities of photovoltaic systems and the conditions under which they are carried out with reference to cleaning photovoltaic modules, removing snow, removal of vegetation, indicates the work security elements specific to photovoltaic maintenance. <p>✓ Type_of evaluation</p> <ul style="list-style-type: none"> - Direct observation, formative assessment - Competence Certification Exam
3	Certified PH Tradesperson	<p>✓ <u>Learning outcomes:</u></p> <ul style="list-style-type: none"> - according to the specifications of PHI, http://www.passivehouse-trades.org/upload/20120426_learning_objectives_PH-Tradesperson.pdf
4	Thermal solar systems	<p>✓ <u>Acquired competence:</u></p> <ul style="list-style-type: none"> ➤ Define nZEB: concept, criteria and performance. ➤ Analyse the structure and influence of a ventilation system in nZEB.

No.	Module	Results
		<ul style="list-style-type: none"> ➤ Analyse the possibilities for integration of building services systems that work with renewable energy. ➤ Analyse solar thermal installations for nZEB. ➤ Apply quality assurance principles and procedures in the nZEB execution process <p>✓ <u>Learning outcomes</u> On completion of the module the participants should be able to:</p> <ul style="list-style-type: none"> - To present the concept of nZEB, - To identify the critical features for a building with nearly zero energy consumption, - To describe the principles underlying the realization of nZEB, - To list the criteria defining a passive house / nZEB, - Submit features a ventilation system parameters, - Describe the principle of cross ventilation, - List the components of a ventilation system, - Present the advantages and areas of use of solar energy, - List the forms of energy obtained through solar energy conversion, - Identify the components of the system and describe the operation, - Identify the components of a solar heating system, - Describe the operating principle of a solar system, - Read the specialized technical documentation, - Describe the facility for producing DHW using solar installations, - Present steps to connect the collectors to the interior installations. - List the renewable energy sources that can be used, - Interpret technical documentation of installations / RES schemes, - Ensure quality of work to achieve an nZEB building, - Provide quality assurance methods for site activities. <p>✓ <u>Evaluation</u> ✓ - Formative evaluation, direct observation</p>
5	Legal framework and concepts for nZEBs – Basics	<p>✓ <u>Acquired competences:</u> - Apply the national legislation for carrying nZEB</p> <p>✓ <u>Learning outcomes</u> On completion of the module the participants should be able to:</p>

No.	Module	Results
		<ul style="list-style-type: none"> - 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. <p>✓ <u>Type of evaluation</u></p> <ul style="list-style-type: none"> - 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, costs 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	Certified PH Tradesperson – Building Envelope	15-17.05.2017	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	14	BKH Bucharest
2	Certified PH Tradesperson – Building Services	15-17.05.2017	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	10	BKH Bucharest
3	Installer of PV Systems	12.05.2017 - 30.06.2017	On-site workers and engineers – qualified electricians	120	22	BKH Brasov
4	Installer of PV Systems	26.06.2017 - 15.08.2017	On-site workers and engineers – qualified electricians	120	27	BKH Brasov
5	Certified PH Tradesperson – Building Envelope	8-10.11.2017	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	14	BKH Bucharest
6	Certified PH Tradesperson – Building Services	8-10.11.2017	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	4	BKH Bucharest
7	Certified PH Tradesperson – Building Envelope	14-16.11.2017	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	14	BKH Bucharest
8	Certified PH Tradesperson – Building Services	14-16.11.2017	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	12	BKH Bucharest
9	Building Envelope in nZEBs (Insulation systems + windows)	09.11.2017	Construction workers and specialists	3	59	BKH Brasov
10	Certified PH Tradesperson – Building Envelope	20-22.02.2018	Construction workers and specialists	24	16	BKH Bucharest
11	Certified PH Tradesperson – Building Services	20-22.02.2018	Construction workers and specialists	24	12	BKH Bucharest

No.	Course title	Period	Participant Profile	No. of hours	No attendees	Location
12	Legal framework and concepts for nZEBs - Basics	28.03.2018	Students University of Architecture and Urban Planning “Ion Mincu” Bucharest	4	16	BKH Bucharest
13	Installer of PV Systems	29.01.2018 - 09.03.2018	On-site workers and engineers – qualified electricians	120	13	BKH Brasov
14	Building Envelope in nZEBs (Insulation systems + windows)	02.04.2018	Construction workers and specialists	4	11	BKH Brasov
15	Building Envelope in nZEBs (Insulation systems + windows)	30.04, 17.05, 26.05.2018	Construction workers and specialists	12	21	BKH Brasov
16	Certified PH Tradesperson – Building Envelope	14-16.05.2018	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	14	BKH Bucharest
17	Certified PH Tradesperson – Building Services	14-16.05.2018	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	6	BKH Bucharest
18	Certified PH Tradesperson – Building Envelope	21-23.05.2018	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	16	BKH Bucharest
19	Certified PH Tradesperson – Building Services	21-23.05.2018	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	11	BKH Bucharest
20	Legal framework and concepts for nZEBs	05.06.2018	Students from EFdeN Team (Solar Decathlon 2018 Dubai) – civil and building services engineering, architecture	8	16	BKH Bucharest
21	Thermal solar systems	19.07, 24.07, 26.07.2018	Building services workers and engineers, architects, energy auditors for building, technology suppliers	12	19	BKH Brasov
22	Installer of PV Systems	27.08.2018 - 13.10.2018	On-site workers and engineers – qualified electricians	120	18	BKH Brasov

No.	Course title	Period	Participant Profile	No. of hours	No attendees	Location
23	Installer of PV Systems	01.10.2018 - 17.11.2018	On-site workers and engineers – qualified electricians	120	23	BKH Brasov
24	Legal framework and concepts for nZEBs - Basics	31.10.2018	Rockwool Romania representatives (sales managers and technical support)	4	11	BKH Bucharest
25	Certified PH Tradesperson – Building Envelope	07-09.11.2018	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	13	BKH Bucharest
26	Certified PH Tradesperson – Building Services	07-09.11.2018	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	4	BKH Bucharest
27	Certified PH Tradesperson – Building Envelope	13-15.11.2018	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	14	BKH Bucharest
28	Certified PH Tradesperson – Building Services	13-15.11.2018	Construction workers and engineers, architects, energy auditors for building, technology suppliers	24	8	BKH Bucharest
29	Building Envelope in nZEBs (Insulation systems + windows)	26.11.2018	Construction workers and specialists	6	15	BKH Brasov
30	Building Envelope in nZEBs (Insulation systems + windows)	28.11.2018	Construction workers and specialists	6	16	BKH Brasov
Total attendees					469	

4. Turkey

The training format consists of different modules. Construction workers have to take modules 1-3-6 to complete the training. Theoretical trainings were performed in of Ege and Balikesir Universities which were then supported by practical training / exercises (on models, mock-ups, demonstration equipment etc.).

Table 4.1 Modules for construction workers courses

No.	Module	Results
1.	nZEB Basic	Learning outcomes: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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
6	Practice	<p>Learning outcomes:</p> <ul style="list-style-type: none"> • 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 <p>Type of evaluation Direct observation, formative assessment</p>

The monitoring of the training courses comprises by 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 and a short exam.

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 construction workers	6.10.2017	On-site professionals (with related on-site activity)	10	50	Ege University
2		13.10.2017			60	Ege University
3		20.10.2017			45	Ege University
4		27.10.2017			56	Ege University
5		8.12.2017			44	Ege University
6		22.12.2017			37	Ege University
7		10.01.2018			18	Ege University
8		24.01.2018			18	Ege University
9		02.03.2018			36	Ege University
10		23.03.2018			45	Ege University
11		20.04.2018			56	Ege University
12		26.04.2018			20	Ege University
13		3-10.10.2018			35	Ege University
14		3-10.10.2018			58	Ege University
15		21.11.2018			7	Balikesir University
	Total attendees				585	

5. Ukraine

During 2017-2018, 10 training courses were organized for construction workers; 275 workers were trained.

The training format is designed for on-site courses – theoretical training in classrooms at the Ukrainian NZEB Hub and practical exercises (workshops) on models, mock-ups, airtight room, demonstration equipment etc. at the NZEB Hub and at training and manufacturing facilities provided by manufacturers/vendors of EE equipment and materials - Project partners.

Manufacturers/vendors of EE equipment and materials delegated 15 specialists for conducting of the trainings for construction workers.

In Ukraine, construction workers do not have qualification necessary and appropriate for the implementation of design solutions in energy efficient buildings and application of modern energy efficiency technologies, including alternative energy sources. This is the competence and authority of the higher qualification specialists. Moreover, erectors and workers do not show much interest in the trainings and new skills development. With this said, in the Ukraine's context, the target audience "construction workers" was expanded to include on-site specialists in construction surveillance, construction techniques, development and implementation of construction projects in buildings, specialists carrying out technical inspections and follow-on technical supervision of construction and assembly works at site.

Moreover, specialists who intend to deal with energy certification of buildings and energy examination (energy audits) of engineering systems were included into the target audience "workers" and participated in several past trainings and received certificates on completion of the training course (a certificate issued by the Train-to-NZEB Project and a state certificate, now mandatory in Ukraine). Trainings for energy auditors will be organized at the Ukrainian NZEB Centre in the future. Course duration for energy auditors is 120 hours, of which 80 hours is for distance learning and 40 hours – in-class training and a test.

As per the Law "On Energy Efficiency of Buildings" (Article 9) the Ukrainian NZEB Hub, a division of Kiev National University of Construction and Architecture, signed the agreement with the State Agency for Energy Efficiency and Energy Saving of Ukraine according to which the Attestation Committee was created for certification of specialists in energy certification of buildings and energy examination of engineering systems. The interest in such trainings organized by the Ukrainian NZEB Hub is rather high.

The trainings for energy auditors were organized for the first time in Ukraine under the Train-to-NZEB Project and 73 specialists were trained, incl. 47 specialists in energy certification of buildings and 26 specialists in energy examination of engineering systems.

In September 2018, at the presentation of the first energy certificate of the building Vice Prime Minister – Minister of Regional Development, Construction and Housing and Municipal Economy of Ukraine Genadiy Zubko awarded qualification certificates to energy auditors trained by the Ukrainian NZEB Hub and to the members of the team who prepared first energy certificates (passports) of buildings.



Table 5.1 - Trainings for workers

No.	Module	Results
1.	Physical processes in building envelope during heat, humidity and air transfer and norms and standards on the insulating jacket. Licensing in the building sector	The trainees were familiarized with: <ul style="list-style-type: none"> - processes running in building envelopes; - requirements to EE buildings, including engineering and other requirements to the insulating jacket; - licenses and certificates applicable in the building sector; design documentation; relevant procedures.
2.	Energy efficient solutions and heat insulating materials	The trainees were familiarized with: <ul style="list-style-type: none"> - types of façade systems; - insulation materials used during construction and for assembly works; blown-out concrete; self-bearing ceramic envelope.
3.	Sources of heat supply in the building	The trainees were familiarized with: <ul style="list-style-type: none"> - types of heat loads, calculating the annual

		consumption of the organic fuel; - daily and seasonal schedules on heat energy consumption by heating systems; - diversification and decentralization of energy sources; - cogeneration and trigeneration; - heating substations.
4.	Energy saving heating and hot water supply systems	The trainees were familiarized with: - norms and regulations and requirements to heating and hot (tap) water supply systems; - recent changes in the relevant State Building Norms B.2.5-67:2013 and B.2.5-64:2012; - average and maximum load in the centralized hot water supply systems. Selecting the best heat energy source and tanks for indirect heating when hot water is accumulated in the tanks; - monitoring of heat energy loss.
5.	Energy efficient ventilation and cooling systems	The participants were familiarized with: - systems with natural air intake and with forced circulation of air; - recuperation; - passive and active cooling systems.

Training for energy auditors

No.	Module	Results
1.	Regulatory framework and procedures on energy efficiency of buildings and structures	The trainees were familiarized with: - energy certification in the national legislation; certification procedures and routine examination of engineering networks; - energy efficiency methodologies; net consumption of heat energy consumed for space heating, cooling, hot water supply; changing the energy efficiency class of buildings; - general requirements to energy examination of engineering systems in buildings; definition of “examination” and how examination is related to energy audit.
2.	Thermal insulation of buildings	The trainees were familiarized with: - climate situation to be taken into consideration and reflected in design documentation for new buildings and during thermal modernization of the existing buildings; impact of climate on heat loads of buildings; - norms and standards on energy efficiency of buildings; - modern engineering and technical solutions and construction and decoration materials; - design of the insulation jacket of the building.

3.	Energy examination of building envelopes and engineering systems	<p>The trainees were familiarized with:</p> <ul style="list-style-type: none"> - concepts, methodologies and standards; - requirements to automation and dispatch control in engineering systems as per the energy efficiency class; increasing energy efficiency: measures and actions; - instrumental examination; metering energy and resource consumption; measuring temperature and temperature fields; micro-climate in the building; heat flows in building envelope; - data gathering: geometric, energy and thermal properties of buildings; - renewables in heating and energy supply in buildings; how alternative energy sources change energy demand and energy consumption; - preparing a report on energy examination of building envelope and engineering systems in the building.
4.	Software used for generation of energy passports and certificates for buildings	<p>The trainees were familiarized with:</p> <ul style="list-style-type: none"> - types of software, incl. Ministry's of Regional Development Audytor OZC 6.11 software; - energy efficiency indicators presented in the energy passport; how these indicators are assessed (methodologies); mandatory additional information; - norms and regulations on determining net demand in energy for space heating, cooling, warming water and water supply into the heating system; energy demand for ventilation systems, lighting systems; - estimation of GHG emissions; - determining the energy efficiency class of a building.
5.	Economic and environmental output of energy efficiency projects from the angle of energy efficiency classes of buildings	<p>The trainees were familiarized with:</p> <ul style="list-style-type: none"> - determining simple payback and discounted payback; - physical and financial and economic methods applied to analysis of proposals (design documents) on increasing energy efficiency of buildings; cash flows in energy efficiency projects; - international programs and technical assistance projects and grants for energy efficiency; - GHG emissions and environmental aspects about energy efficient projects; environmental impact assessment for the projects under implementation.

For monitoring purposes MDI :

- collected information on training courses conducted and a number of attendees (by course and overall);
- prepared reports on each training course;
- completed Fact Sheets on each training course for analysing expectations, results, considerations.

The Ukrainian NZEB Hub specialists are in the regular contact with former trainees and communicate with them about activities which are in demand regarding design and in building market. Based on this communication with the industry, it was decided to launch trainings for energy auditors. Such communication is also the ground for the Centre's sustainability plan and scientific research.

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.	Specialist in construction of nearly zero-energy buildings	18-23.09.2017	On-site professionals (with related on-site activity)	44	22	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
2.	Specialist in construction of nearly zero-energy buildings	20-25.11.2017	On-site professionals (with related on-site activity)	44	21	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
3.	Specialist in construction of nearly zero-energy buildings	27.11–02.12.2017	On-site professionals (with related on-site activity)	44	22	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
4.	Specialist in construction of nearly zero-energy buildings	18-23.12.2017	On-site professionals (with related on-site activity)	44	20	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
5.	Specialist in construction of nearly zero-energy buildings	29.01–03.02.2018	On-site professionals (with related on-site activity)	44	26	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
6.	Specialist in construction of nearly zero-energy buildings	12-17.03.2018	On-site professionals (with related on-site activity)	44	27	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
7.	Specialist in construction of nearly zero-energy buildings	21-26.05.2018	On-site professionals (with related on-site activity)	44	25	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
8.	Specialist in construction of nearly zero-energy buildings	18-23.06.2018	On-site professionals (with related on-site activity)	44	39	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture

No.	Course title	Date	Participant Profile	No. of hours	No attendees	Location
9.	Specialist in Energy Certification of Buildings and Energy Examination of Engineering Systems	29.10- 17.11.2018	On-site professionals (with related on-site activity)	120	47, incl. 23 (Specialists in Energy Certification of Buildings); 24 (Specialist in Energy Examination of Engineering Systems)	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
10.	Specialist in Energy Certification of Buildings and Energy Examination of Engineering Systems	26.11- 15.12.2018	On-site professionals (with related on-site activity)	120	26, incl. 13 specialists in Energy Certification of Buildings) and 13 specialists in Energy Examination of Engineering Systems	Ukrainian NZEB Hub at the Kyiv National University of Construction and Architecture
Total attendees:					275	