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Train-to-NZEB

The Building Knowledge Hubs

A Set of New/Adopted Training Programmes

Deliverable 3.1 of the

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

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Contents

1. Training programmes from projects with participation of project partners

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
BUILD UP Skills Enerpro www.busenerpo.com EnEffect, PHI	Trainings for construction specialists	10 training programmes on construction skills and RES: Building Envelope Building Systems Building Market, Products and Technologies PVs Solar thermal Biomass Mini-wind Thermal pumps Heating, ventilation and AC Hybrid systems	Modular training frameworks with learning outcomes in EN	Uploaded on Dropbox BG, EN
QualiBuild www.**qualibuild**.ie LIT	Introduction to low energy building construction	Training programme with a manual and six fully-elaborated units Unit 1: Energy and Buildings Unit 2: How Energy Works Unit 3: Building Fabric – 1 Unit 4: Building Fabric – 2 Unit 5: Heating and Ventilation Unit 6: System Thinking	Combined with train-the-trainer programme	Uploaded on Dropbox EN
Towards improved compliance and quality of the works for better performing buildings (QUALICHECK) http://www.qualicheck-platform.eu URBAN-INCERC	Quality assurance Energy Performance Certificates (EPC)	Transmission characteristics: this includes opaque components (walls, roofs, …) windows and doors, as well as the handling of e.g. thermal bridges. Ventilation and airtightness: this includes performance of ventilation systems, as well as envelope and	Webinars, Workshops Short university courses	http://www.qualicheck-platform.eu

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
		ductwork airtightness. Sustainable summer comfort technologies: this includes a wide range of technologies and concepts, e.g. solar control, thermal mass, ventilative cooling strategies, cool roofs, … Renewables in multi-energy systems: this also includes a wide range of energy systems, whereby the common feature is the presence of renewables (heat pumps, solar collectors, biomass, PV, …)		
RePublic_ZEB **http://www.republiczeb.org/** **(URBAN-INCERC)**	Define cost-benefit optimised "packages of measures" based on efficient and quality-guaranteed technologies for the refurbishment of the public building stock towards nZEB that are standardised and adopted by builders and building owners.	Preliminary Assessment of Public Building Stock Method and results in defining national reference buildings for each class The national implementation of the Energy Performance of Buildings Directive (EPBD) Common criteria and principles for public building nZEB definition in South and East European countries Best practices and lists of technologies useful for the refurbishment of buildings with detailed national sections & D3.4 Report on processed packages of measures Country assumptions for the application		Available online (EN)

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
		of the energy use (fossil and renewable) evaluation methodology to the case studies (reference buildings and detailed efficiency measures) & application of the cost optimal methodology to the case studies (reference buildings and defined efficiency measures).		
BUILD UP Skills QualiShell http://www.iee-robust.ro/qualishell/index.php URBAN-INCERC, BDG	National qualification schemes for construction workers to ensure high performance building envelopes (to achieve the needed qualified workers by 2020)	2 training programmes on construction skills:		National qualification schemes for construction workers to ensure high performance building envelopes (to achieve the needed qualified workers by 2020)
Passive House Regions with Renewable Energies (PASSREG) www.passreg.eu PHI, EnEffect	Political, economic and professional development at regional level of governance	PH tradesperson course PHI train-the-trainer programme	Translation of the PH tradesperson course in several EU languages TTT courses conducted locally	Available through bilateral agreements with PHI EN, DE, BG, FR, LV, IT, CR, NL, etc.
Improving the energy performance of step-by-step refurbishment and integration of renewable energies (EUROPHIT) www.europhit.eu PHI, EnEffect, MosArt/PHA	Step-by-step building renovations	Development of the PH tradesperson course with added modules on renovations and airtightness	Translation of the PH tradesperson course in several EU languages Training courses with focus on airtightness conducted locally	Available through bilateral agreements with PHI EN, DE, BG, FR, IT, etc.

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
Development of Guide for Energy efficiency renovation of buildings – Euro EnEff http://www.euroeneff.eu/welcome.php BCC	Transfer of methodologies for trainings in the construction sector	Installation of PVC windows Installation of radiators for central heating and related fittings / heating Installation of copper pipe - open installation Restored interior plaster of the exterior wall of a room located in the basement Training methodology Tests and supplementary materials		On request from BCC BG, EN
Senior engagement in a Green Economy (SeeGreen) http://www.see-green.e BCC	Energy Efficiency and RES for seniors	Beginner's Guide for Energy and Power Beginner's Guide on Devices for control of energy consumption Electricity Beginner's Guide on Fuel Training section on smart meters and smart energy consumers Thermal insulation Choosing a boiler or water heater How to feel comfortable Solar panels for hot water Beginner's Guide for Low energy lighting Windows A Beginner's Guide to Buying low-energy equipment Beginner's Guide on the use of kitchen with low energy consumption The curse of the anticipation mode Beginner's Guide on Renewable Energy Photovoltaics Beginner's Guide Saving energy in communal homes and residential		On request from BCC BG, EN

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
		settlements Beginner's Guide for generating one's own energy and getting paid for it Communicating with senior citizens Beginner's Guide for keeping cool Convincing arguments for reducing energy consumption Schemes for preferential purchase of electricity and programs for measures in households Save energy at home		
Energy efficiency for the building sector (Enef) http://www.enef-project.eu BCC	Energy efficiency for managers	Concepts Legislation - IT, ES, GR, SK, DE Marketing and procurement Thermal insulation of facades Glazing Plant Flat roofs		**Energy efficiency for the building sector (Enef)** http://www.enef-project.eu
Knowledge Transfer for Energy-Efficient Retrofitting (Ee-wise) www.ee-wise.eu BCC	Framework for knowledge transfer	A tool for knowledge transfer, Business Models, Market penetration, knowledge transfer on public procurement, standardization and certification - practical procedures and recommendations	With references to external websites	**Knowledge Transfer for Energy-Efficient Retrofitting (Ee-wise)** www.ee-wise.eu
IngREeS http://www.ingrees.eu/ SKSI, ViaEuropa, BOKU, TU Graz, SPS in CR, SEVEn	Education towards near Zero Energy Buildings	Presentations, Training programs	Project is in progress	In progress - EN, SK, CZ
Transparense	Energy Performance	Training modules		http://www.transparense.eu/eu/publications/markets - EN, DE,

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
http://www.transparense.eu/eu/home/welcome-to-transparense-project SEVEn, e7 Energie Markt Analyse, Factor4, BSERC, ECNet, BEA, REACM, GDI, DTTN, Ekodoma, LEI, ECN, NEE, KAPE, ISR-UC, ECB, IJS, ESCAN, IVL, EEVS	Contracting	http://www.transparense.eu/eu/trainings/training-modules		BG, CZ, DK, IT, SK, …
MEnS - Meeting of Energy Professional Skills, towards NZEB **http://www.mens-nzeb.eu/**	training programs for building professionals in 11 EU countries provide NZEB skills of building managers such as engineers and architects through a series of accredited training activities	training courses related to NZEB to empower professionals with energy efficiency and renewable´s integration skills: *Energy analysis techniques and practices for NZEB implementation**		**available in the educational plan for 2015-2016 of The Technical University in Cluj-Napoca, Romania*
Nearly Zero Energy Hotels (neZEH) **http://www.nezeh.eu/**	providing technical advice to committed hoteliers; demonstrating flagship nZEB projects in the European hospitality sector; undertaking training and capacity building activities.	Training programs: Towards neZEH hotels - Benefits, Steps, and Guidelines (for hoteliers) Designing a nearly Zero Energy renovation project in hotels, neZEH (for building professionals)	European network http://hotelenergysolutions.net/ RETScreen software www.retscreen.net	*Available online:* *http://www.nezeh.eu/main_menu/library/training/index.html* in English, Croatian, French, Greek, Italian, Romanian, Spanish, Swedish

2. Training programmes from other EU-financed projects

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
POWERHOUSE resources database http://www.powerhouseeurope.eu/cases_resources/resources/	Energy efficiency and RES in all areas	Case studies, tools, methodologies, guidelines, brochures, booklets, presentations, etc.	A broad database of training materials with well developed search engine allowing selection by multiple categories	Available online EN
INTENT http://www.intendesign.com/	Integrated energy design (IED)	A set of guidelines on IED + case studies		Available on DropboxEN, DE, DK, NO, GR, PL
COHERENO http://www.cohereno.eu/	Proposals and concepts for promising cross-sector and company business models for high efficiency refurbishment of single-family houses to nearly zero-energy housing	Hands-on recommendations and "striking facts" for several EU countries		Available on DropboxEN
Shelter	Cooperation between different stakeholders for energy renovation of the social housing stock.	Guidelines, incl. to public authorities "Innovate to Renovate guideline"	No website available	Available on DropboxEN
EDUCATE http://www.educate-sustainability.eu/home	Environmental Design in University Curricula and Architectural Training in Europe	Frameworks for curriculum development, Results of course and curriculum development, Criteria for professional education, etc	Targeted to architectural training in universities	Available on DropboxEN
LEAF	Improving the energy efficiency of apartment	Guide for building managers of mixed-tenure housing	Technical toolkit and case studies available	Available on Dropbox and

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
http://www.lowenergyapartments.eu/about-leaf/project-overview/	blocks	Technical toolkit 24 case studies	online http://www.leaftechnicaltoolkit.de/Default.aspx?lang=GB http://www.lowenergyapartments.eu/case-studies/	online EN, DE, FR, HU, SW
PROF/TRAC http://proftrac.eu/open-training-platform-for-nzeb-professionals.html	Training on energy efficiency and RES	A database of training materials developed by EU projects and other sources	A Horizon 2020 project; opportunities for cooperation	Available online EN, etc
nZEB training in the Southern EU countries – Maintaining building traditions (SOUTHZEB) http://www.southzeb.eu/	NZEB trainings for architects, engineers, building technicians and municipal experts	10 training modules: nZEB Basic module, nZEB Advanced module, Thermal bridging, Thermal Comfort, SouthZEB framework module and local architectural regulations, nZEB simulation and design software module, Low carbon technology and automation for nZEB, Retrofitting towards nZEB, Construction management and field supervision of nZEB, Preparation of funding schemes and other incentives for nZEB	No training available for download; possible exchange and cooperation. TTT course on offer. Project certification scheme (2 mandatory + 2 optional lead to "certified NZEB designer).	Available online – after registration/fee
CONSTRUCTION21- A EUROPEAN GREEN BUILDING EXCHANGE (CONSTRUCTION21)	Green building cooperation and exchange platform	Database of educational institutions and courses, best practices, case studies	No training materials as such; possible channel for promotion of T2NZEB trainings	Available online

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
http://www.construction21.eu/		– buildings and cities, social media		
Training for Rebuilding Europe (TRAINREBUILD) http://www.trainrebuild.eu	Trainings for renovation	Training materials for owners, financiers, municipalities and trainers municipalities	Available (.ppt) at http://trainrebuild.eu/project-results	Available on Dropbox EN
Continuous, practice-oriented implementation and dissemination of the EPBD 2002 and energy end-use efficiency and energy services 2006 by training craftsmen and trainers in the construction trade (TRAINENERGY) http://tea.ie/projects/train-energy/	Training for low-energy buildings	Training course consisting of 15 modules / 9 days.	4 video clips in YouTube https://www.youtube.com/user/Trainenergy	Available on Dropbox EN
Renovation through Quality supply chains and Energy Performance Certification Standards (REQUEST) http://www.building-request.eu	Quality assurance in renovation projects	Standards and frameworks for QA in renovations; case studies and EPC requirements		Available on Dropbox
Quality certification & accreditation for installers of small-scale renewable energy systems (QUALICERT) http://www.qualicert-project.eu/	Trainings for RES installers	Guidebook for installer (EN)		Available on Dropbox
School of the Future – Towards Zero Emission with High Performance Indoor Environment http://www.school-of-the-future.eu/	Retrofitting of schools with high comfort requirements	Indoor environmental quality in schools Retrofit of building construction elements Retrofit of building service	▪ An information tool presenting the 4 demonstration buildings, a benchmarking system and a database with measured data from various school buildings ▪ 4 retrofitted energy efficient school	Available online, EN

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
		systems Solution sets for zero emission/energy surplus schools http://www.school-of-the-future.eu/index.php/project-results	buildings with high indoor environment quality ▪ A report of the design phase of the 4 school building retrofits. ▪ A building diary on the website (already available: Germany / Denmark / Italy / Norway) ▪ A report of the design, realisation, commissioning and monitoring of the 4 school building retrofits ▪ A simple energy performance calculation tool for the use in school lectures in the four languages of the School of the Future partners: Danish, German, Italian and Norwegian. ▪ 3 sets of training material for pupils, teachers and technical service personnel ▪ Various dissemination activities including publications such as conference papers, journal articles, a project brochure and an information and discussion platform on the portal BUILD UP.	
Affordable and Adaptable Public Buildings through Energy Efficient Retrofitting http://www.a2pbeer.eu/	Energy Efficient Retrofits	Retrofitting strategies, technologies reviews, online training after registration (restricted)	Downloadable Project Reports D2-1_Public-Building-and-District-Characterization D2-2_Technologies and strategies_ D2-3_Best-Practices-on-Public-Building-	Available online, EN

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
			and-District-Retrofitting_ D2-4_Financial-assessment_ D2-5_Graphics for Systemic Public Building and District Retrofitting Methodology D3-1_Analysis of the Different Existing Envelopes of Public Buildings_ D4-1_Analysis-of-Lighting-Needs_ D5-1_Conceptualization	
CertCraft ISO & ECVET - Future Certification of Crafts(wo)men for Lowest Energy Buildings following the Energy Efficience Directive 2012/27/EU based on ISO 17024:2012 and ECVET www.certcraft.eu	Passive House Tradesperson training	Passive House Tradesperson training course Development of a training module for thermal renovation of existing buildings	No materials available for download Possible connection to find out if the materials are available	DE
Development and implementation of multi-lingual educational video clips applied by craftsmen and site supervisors to gain further skills for the construction of passive houses / ConClip www.conclip.eu	Videos for training construction workers for passive buildings	Insulation – mounting of wall insulation boards Airtightness – window installation in exterior brick wall with insulation Insulation – installation of a window sill Insulation – correct insulation of fascia brickwork Airtightness – sealing around cables, ducts Insulation – correct	Project coordinator contacted	Available online, EN, DE

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
		insulation of cavity walls Insulation – foundation skirting without basement AIRTIGHTNESS – SEALING OF THRESHOLD AREA http://conclip.eu/en		
JUBILEE: New skills for new job for equipment and building with high energy efficiency *Project Number* 2013-1-FR1-LEO05-49037 http://www.jubilee-project.eu/	Training frameworks – energy efficiency in buildings	TC1 : Technical equipments and systems : Module 1 : Regulatory Module 2 : Energy storage Module 3 : Micro CHP (Cogeneration Heat and Power) Module 4 : Thermal solar energy Module 5 : Domestic hot water Module 6 : Heatpump Module 7 : MVC Mechanical Ventilation Controlled Module 8 : Solar PV Module 9 : Heating systems Module 10 : Cooling systems TC2 : Building envelopp Module 11 : Building tightness Module 12 : Lighting Module 13 : Architecture of buildings Module 14 : Thermal insulation Building intelligence and automation Module 15 : Building energy management systems	No training materials as such; learning outcomes and structure of courses described.	Available online, EN

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
		Module 16 : Energy management		
Transferring Open Content on Energy-efficient Buildings www.toceb.eu	Open content learning platform on energy efficiency in buildings	The topics covered are "Energy-efficient building", "Insulation materials", "Thermal renovation" and "Façade systems". http://www.e-genius.at/themenuebersicht	Convenient to use and well-developed pool of training materials, designed for teachers and students in vocational schools	Available online, Austria, the Czech Republic, Italy, Lithuania and Poland
TRAINING TOOLS FOR SUSTAINABLE BUILDINGS www.construction-durable.org	Sustainable buildings:	Network of training providers with online platform for creating and delivering courses: The Concept of Sustainability, Renewable Energy, Energy Efficiency, Air Quality, Water management, Materials, Waste,	After registration for network members	Available online, EN DE GR FR IT RO
Common Learning Outcomes for European Managers in Construction III www.leonardo.il.pw.edu.pl/ldv10	Learning Outcomes for trainings on construction management	Guidelines for construction managers - paid		Available online, EN
COMPetences for Sustainable ENERgy – COMPENER www.compener.enea.it	Qualification schemes for EE and ES	Video Lessons + presentations Requirements for acquiring of qualification for different	Biomass Installers, HEAT PUMPS Installers, Energy Manager, Photovoltaic Installers, Experts in building energy efficiency, Geothermal Installers, Wind Energy	Available online, EN, IT, ES, RO

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
		specialties	Installers, SOLAR THERMAL Installers, Trainer of RES plants installers	
NaSaBau - Transfer of innovative curricula of consulting building owners (KOMBAU) in the area of sustainable renovation http://www.nasabau.de	Renovation	2 TTT schedules		
Skills Alliance Energy Saving and Sustainable Construction in Baltic Sea Region www.skills-energy.eu	Innovative training programmes	Module contents and descriptions: Description Curriculum Vocational Training Specialist for Building Insulation Module Map Curriculum Vocational Training Specialist for Building Insulation 1st module content Preparing Object for Insulation 1st module description Preparing Object for Insulation 2nd module contents Preparing surfaces for insulation 2nd module description Preparing surfaces for	Specific country concepts for the Baltic region Modules for SMEs and TTT Materials of the advanced training for SMEs and Train-the-Trainer: in English: Curriculum Advanced Training for SMEs Energy efficiency Curriculum Advanced Training for SMEs Solar Energy Curriculum Advanced Training for SMEs Waste and Water Management Curriculum Advanced Training for SMEs Energy Efficient Construction Curriculum Advanced Training Train the Trainer Eneergy Sector	Available on Dropbox Available online EN,DE

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
		insulation 3rd module contents Assembling thermal insulation 3rd module description Assembling thermal insulation 4th module contents Application of finish layers 4th module description Application of finish layers		
Training on Renewable Energy solutions and energy Efficiency in reTROFITting (REE_TROFIT) http://www.reetrofit.eu	Trainings on EE and RES in renovations	Training courses – abstracts Basic presentations		Available online: EN, BG, GR, DK, FR, IT, HU Available on Dropbox in BG
From Estonia till Croatia: Intelligent Energy Saving Measures for Municipal housing in Central and Eastern European Countries (INTENSE) http://www.intense-energy.eu	The role of the building design for achieving energy efficiency	Guidebook „Holistic energy efficient design and construction" (EN); brochures for households (BG)		Available on Dropbox
Training courses for installers of small-scale renewable energy systems in buildings (INSTALL+RES)	RES installers in the building sector	Courses on PV, Solar Thermal, Thermal Pumps, Biomass	Free training materials available on request	German, English, Italian,

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
http://www.resinstaller.eu/				Polish, Slovenian, Bulgarian and Greek
Training of Photovoltaic Installers (PVTRIN) http://www.pvtrin.eu	OV installers	Training course and certification scheme	Textbook and additional materials available only online http://pvcert.gr/en/training_material_for_pvtrin_trainees/index.html	Other materials available on Dropbox, BG, EN
ECVET for recognition of qualifications in construction sector http://con-vet.eu/	Web-based application containing modules that can be used to compare existing qualifications with the ECVET.	N/A		EN, BG, GR, PL, ES
ISO 17024:2003 certification: Qualified Construction Worker ISO 17024:2003 www.iso-construct.eu	Validation of competences of unskilled workers in the construction sector applying ISO 17024 standards	Checklists, appraisal sheets, examination programmes, certification schemes, etc.	Qualification level 1 and 2	Available online, EN, DE, SL, FI, ES
SOLARIS PLUS - Innovative modular training as the specialist for renewable energies www.solaris-plus.eu	Modular training for RES	N/A	Possible contacts with project partners	BG, RO, EN, DE, etc
Free online training courses: https://www.futurelearn.com/			Energy: Thermodynamics in Everyday Life Greening the Economy: Sustainable Cities The Age of Sustainable Development	

Name/Website/partners	Topic	Type of training materials	Notes	Availability/ languages
			Introduction to Sustainability Introduction to Sustainable Development Energy 101: The Big Picture Wind, Waves and Tides: Alternative Energy Systems How Green Is That Product? An Introduction to Life Cycle Environmental Assessment Leadership for Engineers Introduction to Project Management Thermodynamics Solar Energy	

3. Training outcomes for the Passive House Tradesperson course

Catalogue of Learning Objectives "Certified Passive House Tradesperson"

This catalogue of learning objectives is based on the assumption that tradespeople already possess the relevant skills required for construction work due to their basic training. The content is therefore restricted to essential additional knowledge relating to the Passive House. These learning objectives form the primary basis of the "Certified Passive House Tradesperson" examination.

Passive House – Interdisciplinary principles

Formatting conventions: **green** text indicates knowledge to be gained, **orange** text highlights skills to be developed, **red** text summarises competencies.

The overarching goal is to develop the competency of building a part of a Passive House as defined by the scope of the respective trade or business with a greater understanding not limited to the own part. To purposefully interact with the architect/Passive House Designer/site supervisor, identify issues where such interaction must be sought. Furthermore to identify critical parts of the building/building process both geometrically, practically and temporally and to gain an idea of which colleague tradespeople to contact for resolving any issue. Last but not least the competency to explain the Passive House concept, benefits and implementation as well as the role of the own trade in the process to other people, particularly customers.

1.1 Passive House Definition

Knowledge of the climate-independent functional definition of a Passive House and the principles it is based on:

"A Passive House is a building, in which thermal comfort (ISO 7730) can be provided solely by postheating or postcooling of the fresh air flow which is required for good indoor air quality (DIN 1946) - without the additional use of recirculated air." *{Definition}*

1.2 Passive House Criteria

Heating load	$p_{Max,heat} \leq p_{Fresh\ air,max}$ (10 W/m²)	{generally}
Cooling load	$p_{Max,cool} \leq p_{supply,max}$ (10 W/m²)	{generally}
Annual space heating demand	$q_{max,heat} \leq$ 15 kWh/(m²a)	{climate- dependent, this value applies for Central Europe}

Annual space cooling demand $q_{Max,cool} \leq 15$ kWh/(m²a) {climate-dependent, this value applies for Central Europe }

Airtightness $n_{50} \leq 0.6\ h^{-1}$ {generally}

Annual primary energy demand $e_{Max,prim} \leq 120$ kWh/(m²a) {generally}

Frequency of overheating $t_{Max,\vartheta}>25°C \leq 10\%\ t_{Use}$ {generally}

Ability to explain the meaning and main rationale of the individual criteria.

1.3 The 5 Passive House principles

Highly insulating envelope

Thermal bridge free construction

Airtightness

Windows and solar gains

Ventilation with heat recovery

Ability to identify Passive House components and their main characteristics

Identify the five principles and related components and design features in drawings and reals buildings

1.4 Ecology and comfort

- Energy consumption and climate, CO_2, energy saving potential

Living comfort and a healthy indoor climate

Ability to explain the challenge to limit climate change, Passive Houses as the adequate and proven answer in the building sector. Added benefits in terms of comfort and health

1.5 PHPP and other planning principles

Impact of orientation of buildings

Influence of Building compactness

The Passive House as a building standard and not an architectural style

Passive House Planning Package (PHPP) and its main features

Overall energy balance of the building

Ability to explain the constituents of either half of the energy balance

Qualitatively estimate the impact of design or construction changes on the energy balance

Main Results of the PHPP calculation

1.6 Economic efficiency

Current cost of energy and energy price development theories

- Sustainable economic development with reference to buildings, long-term yields

Comparison of capital costs - saved energy costs

- Life cycle costs of a Passive House in comparison with a standard building, assuming an average energy price for the period under consideration (20 years), residual value of a building at the end of the period under consideration
- Explain the life cycle cost approach for economic efficiency of buildings and its importance
- Costs incurred in any case and costs of energy conservation measures the principle "if it has to be done, then properly"
- Explain the rationale and benefits of deep retrofits even with stepwise implementation
- Economic efficiency of individual measures:
  Thermal insulation, windows, airtightness, ventilation system in new Passive House constructions and refurbishment with Passive House components (EnerPHit)
- Economic efficiency of a set of measures, documentation based on the costs charged (new Passive House construction and refurbishment with Passive House components (EnerPHit))
- Explain the economic efficiency for the implementation of each Passive House principle and for the whole set of measures
- Relate the life-cycle cost approach to a particular building for entire building retrofit and step-by-step implementation

1.7 Construction process and quality assurance

- Differences in the construction process of Passive Houses and conventional constructions, allocation to particular disciplines of work relating to Passive House features
- Factual and economic sequence of steps for Passive House relevant work
- Interdependence of disciplines involved in terms of time, space and content
- Quality of work that is necessary and methods for achieving this quality
- Practical quality assurance, on site
- Certificates and their advantages
- Explain the differences in the construction process of a Passive House compared to conventional practices under particular consideration of the scope of the own trade or business
- Explain the importance and methodology of quality assurance for Passive Houses and the existing aids and methodologies
- Identify the points of interaction of different trades/contractors for a given project.

Develop an adequate approach to tackle those points in order to achieve a high-quality Passive House building.

- Identify needs for temporal coordination.
- Find inconsistencies of the design and questions to the designer/site supervisor.
- Evaluate which questions can be resolved by interaction and coordination of the trades and which are more fundamental and require referring to the designer

1.8 User information and user support

- What information should be provided to Passive House occupants?
- Opening windows: influence under cold and warm conditions
- Temporary shading: influence under cold and warm conditions
- Ventilation unit, special features, maintenance
- Prevention of dry air in cold conditions
- Prevention of overheating in warm conditions
- Information sources
- Introduce users/owners to their Passive House building and explain the above
- Answer questions from users/owners regarding the use and operation of a Passive House in warm and cold conditions

1.9 Basic principles: Thermal insulation in the Passive House

- The principle of the unbroken thermal envelope
- Explain the necessity, relevance and implementation of the unbroken thermal envelope
- overview of the insulating materials available on the market and their properties
- Thermal conductivity as a characteristic value
- simple calculation of U-values
- Typical U-values for Passive Houses in cool-temperate climate and the typical insulation thicknesses resulting from these
- Correct installation of insulation materials
- Check compliance of a given product with specifications from the PHPP/Passive House design
- Identify the thermal envelope and its constituents in drawings and buldings.

1.10 Basic principles: thermal bridge free construction

- What is a thermal bridge?
- Surface temperatures at thermal bridges
- Moisture related building damage due to thermal bridges
- Thermal conductivities of various building materials that can cause thermal bridging

- Rank heat losses through various thermal bridge situations
- Fundamental rules for prevention of thermal bridges
- Fundamental strategies to minimise thermal bridging where avoiding them is not entirely possible
- Thermal bridge optimised window installation
- Quality assured products available to avoid or minimise thermal bridging
- Identify interactions with the thermal envelope as relevant regarding thermal bridging
- Identify need to refer to the designer/site supervisor
- Identify a thermal bridge in drawings and buldings.

1.11 Basic principles. Passive House windows

- Function of windows in general, and in relation to the Passive House: view towards the outside, thermal protection, solar gains, ventilation during day and during night
- Thermal comfort in the Passive House and the resultant requirements for windows, temperatures at the window
- Ability to explain the relation of window quality and thermal comfort
- Requirements for windows in general, and for the Passive House in particular: airtight, thermally insulating (U-value), transparent, possibility for opening and providing shade when necessary, installed in a thermal bridge minimised/free manner, installed in an airtight manner
- Glazing and glazing edge, overview of requirements, g-value
- Qualitative energy balance of a window
- Explain qualitatively the energy balance of a window depending on component quality and geometric properties
- Identify a Passive House window and optimised installation in drawings and buildings.

1.12 Basic principles. Airtightness

- Necessity of airtightness in a building
- Ability to explain the importance of airtightness in buildings
- The principle of an airtight layer (red pencil method and single airtight layer)
- Difference between airtightness and wind resistance
- Typical weak points in case of poor airtightness
- Test procedures for airtightness measurement (preparation, execution, magnitudes of error), typical measurement results, methods of detecting weak points
- Explain the principle of the pressurisation test method
- Assessment of different leaks

- Suitable and unsuitable materials for airtight surfaces and connections (for different construction methods such as solid, lightweight and mixed constructions), suitable airtightness measures for penetrations, special products
- Procedure/sequence of work with reference to airtightness
- Durability of solutions for airtightness
- Identify the airtight layer and its constituent parts in drawings and buildings and ensure its continuity.

1.13 Basic principles: Ventilation

- Relationship between airtightness, ventilation, air humidity, air hygiene and the necessity for ventilation systems
- Air quality and comfort
- The principle of cross-ventilation – directed air flow
- Build-up of a ventilation system – main components (interdisciplinary)
    - Central unit with heat exchanger
    - Ductwork and insulation of cold ducts, diffusion-impermeable materials
    - Fresh air inlets/extract air outlets
    - Transferred air elements: understanding the necessity and types
    - Outdoor air intake and exhaust air outlet and their positioning
- The principle of heat recovery
- Building envelope interface: airtight and thermal bridge free connection of penetrations for outdoor air and exhaust air ducts
- Necessity and possibilities for installation of ventilation systems in existing buildings
- Service requirements, filter changes, recommended filter grades
- Explain the importance of ventilation for air quality, comfort and energy efficiency
- Explain the constituents and operation of a ventilation system with heat recovery
- Identify and name the components of a balanced ventilation system with heat recovery in drawings and buildings.

1.14 Basic principles: Heat supply

- Heating demand vs. heating power required in Passive Houses
- Explain the heating demand in contrast to required peak heating power
- Introducing the required space heating via fresh air
- Explain the limits imposed on heating power by supply air heating and possible economic benefits thus obtained
- Positioning of heaters in the Passive House

- Explain the degrees of freedom for space heating systems in Passive Houses
- Generation of domestic hot water as the main power demand
- Characteristics of energy efficient domestic hot water systems
- Explain the demands on a domestic hot water system suitable for a Passive House
- Conventional heat generators in the Passive House
- The use of renewable energy sources in the Passive House and PER rating
- Explain the PER rating principle
- Uncontrolled dissipation of heat from heat generators/pipes
- Airtight house connection
- Wood stoves in the Passive House
- Utilisation of old heat generators in retrofit scenarios
- Pipes, heaters in refurbishments of existing buildings
- Explain dependencies between fabric quality and heating system in the process of (step-by-step) refurbishment
-

Specialisation according to discipline - Building Envelope

- **Thermal insulation in the Passive House**

The following subject content is of importance in addition to Section 1.9:

- Moisture transport through diffusion (vapour retarders, vapour barriers, moisture-adaptive vapour retarders)
- Explain the importance of vapour control layers and required levels of qualiy
- In-depth information regarding thermal insulation materials available on the market and their properties
- Explain pros and cons of conventional cheap vs. high performance expensive materials
- Passive House suitable wall constructions and their build-ups, thermal bridge free/minimised attachment, connections:
    - Solid construction with EIFS
    - Monolithic construction methods
    - Lightweight constructions: airtightness, moisture protection
    - Ventilated facades
    - Thermal insulation of building components in contact with the ground
- Passive House suitable roof constructions:
    - Suitable materials and structures
    - Possible roof superstructures
    - Pitched roofs, flat roofs in solid constructions, flat roofs in lightweight constructions
    - Insulation between rafters, on rafters, combined constructions
- Passive House suitable constructions of floor slab / basement ceiling:
    - Thermal insulation of the basement ceiling
    - Thermal insulation of the floor slab
    - Possible structures
    - Fire safety, building approval, liability in individual cases
- Explain the different construction types and their characteristics, most notably suitable details and connections at joints, corners and openings
- Sketch Passive House details for a given construction type
- Evaluate the impact of work carried out interfering with the thermal envelope

1.15 Thermal bridge free construction

The following subject content is of importance in addition to Section 1.10:

- Constructive vs. geometric thermal bridges

- Point and linear thermal bridges, the terms χ-value and ψ-value
- Thermal bridge free design: principle and criterion
- Explain what information is provided by the ψ-value,
- Explain what is meant by "thermal bridge free" in relation to the Passive House
- Assessment of the extent of thermal conductivities of different materials
- estimation of the extent of heat losses through thermal bridges
- Effects of thermal bridges on the Passive House Standard
- Avoiding thermal bridges in solid and timber constructions
- Knowledge of solutions for the foundation, plinth, ceilings, eaves, verge, parapets, penetrations of the insulation layer of compound insulation systems and curtain-wall facades and prevention of projections
- Rank thermal bridges to their order of magnitude/impact on the overall energy balance
- Develop details to avoid to minimise thermal bridging respectively

1.16 Windows and other transparent exterior components

The following subject content is of importance in addition to Section 1.11:

- Insulating characteristics of windows: U-value, various influences on the overall U-value of a window, determination of the window U-value with the tool provided
- Window frame: frame u-value, build-up of Passive House suitable window frames, influence of frame width
- Thermal bridge free installation: frames covered with insulation, shading of the window by the reveal, airtightness of the window, airtight installation, glazing, glazing edge
- Interaction of different influences: optimisation of the glazing U-value and the g-value, frame proportion and solar gains
- Elements of window U-value calculation
- Roof windows and skylights, installation tools for roof surface windows, inclined glazing (change in the U-value)
- Classification and certification of windows, Passive House energy efficiency classes for transparent building components, certification of Passive House windows, certificate uses
- Properties of Passive House doors
- Explain the requirements for Passive House windows and the individual component qualities involved
- Check compliance of a window/door/glazing/glass edge with the specifications in the PHPP/Passive House design
- Evaluate the suitability of a given window and window installation for a Passive House
- Develop a detail for a thermally optimised installation of a window.

1.17 Thermal comfort in warm conditions

- Criteria for thermal comfort in warm conditions
- Influences on summer comfort, IHG and solar loads
- Influences on air exchange for passive cooling
- Solar load: significance, dependence on orientation, on the size of the transparent surfaces, shading, temporary shading, effectiveness of shading equipment on the inside and on the outside
- Influence of the internal heat sources: how can these be reduced? Influence of the colour of the facade, the thermal insulation, and the thermal mass
- Explain the prerequisites for high thermal comfort in warm conditions
- Explain effective solar shading devices and give hints for their usage
- Assess the likelihood of good thermal comfort in warm conditions based on drawings or a given building

1.18 Refurbishment of existing buildings using Passive House components

- Advantages of refurbishment of existing buildings using Passive House components in relation to problems of old buildings: condensation and mould, inadequate thermal comfort, poor air quality, high heating costs, environmental pollution
- Explain the difficulties typically encountered in existing buildings when striving for Passive House standard
- EnerPHit standard, basic requirements and advantages, required standard of thermal protection for all measures
- EnerPHit: Potential for saving energy
- Strategies and solutions to handle with specific problems arising in existing buildings:

  Wall, basement ceiling/floor slab, roof, top floor ceiling, thermal bridges, windows (window installation position, daylight provision), airtightness, interior insulation (risks and disadvantages as well as saving potentials, diffusion-impermeable and diffusion-permeable superstructures)
- Explain the advantages and specific challenges of Step-by-step refurbishment
- Develop a rough refurbishment plan for a given building, pointing out the challenges and appropriate answers to them, including possible successions of measures.

Specialisation according to discipline – Building Services

1.19 Passive House ventilation

The following subject content is of importance in addition to Section 1.13:

- 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 by recuperation of regeneration, moisture/energy recovery
    - Different ventilation concepts (centralised and decentralised ventilation systems)
    - Basic knowledge regarding dimensioning, selection, and setup of units
    - Adequate measuring equipment for commissioning/flow adjustment
- Individual components of ventilation systems and their specifications
    - airtight and thermal bridge free penetration of outdoor air and exhaust air ducts
    - filter grades and types, area and filter wear, recommended filter location
    - heat recovery
    - condensate drain and its connection
    - duct materials
    - minimised pressure loss of duct network, basic principles for dimensioning of ducts
    - airtight duct network
    - choice of extract air outlets and fresh air inlets, transferred air elements,
- Important protective measures for a ventilation system and its correct implementation
    - Reduction of cross-talk transmission and structure-borne sound
    - Different types of frost protection
    - Fire safety and smoke protection
- operating ventilation systems in hot conditions, bypassing
    - Ventilation system in existing buildings, prerequisites and advantages, space-saving devices and duct installation
- Commissioning of a ventilation system (absolute flows per set point, balance at all set points, distribution of air according to design specifications, measuring pressure drop).
- Duct layout including attenuators etc. and rough dimensioning of ventilation system for a house

- Heating via fresh air in Passive Houses:
    - Prerequisites
    - Correct installation of fresh air heating coils
    - Insulation requirements for ductwork in case of air heating
- Verify the suitability of an air heating coil for the given air flow, required heating power and heating system flow temperature

- **Heating in the Passive House**

The following subject content is of importance in addition to Section 1.14:

- Heat generation and heat distribution in the Passive House
    - Prerequisites, setup and functioning of supply air heating
    - Challenges of a conventional heating system used in the Passive House
    - Heating demand and necessary heating output for provision of domestic hot water and heating
    - Hot water storage: coordination with heat generator, insulation of hot water storage tanks, avoiding thermal bridges, measures for prevention of legionella
    - Heat generation and hot water provision in detached houses and multi-storey buildings
    - Integration of solar thermal and PV renewable energy sources
    - Evaluate different heat generators for use in the Passive House in practical and PER perspective
    - Typical setup of a system in a detached Passive House
    - Explain the principle of a heat pump systems and name the main factors influencing its efficiency
    - Setup, function and evaluation of compact heat pump units
    - Setup and function of a ground-coupled compact heat pump unit
    - Safety measures and dependence of combustion processes on outdoor air in the Passive House
    - Gas-based compact units
    - Setup and function of a primary wood-pellet stove, required safety measures
    - Typical installation layout with an integrated pellet stove
- Implementation-relevant details
    - Thermal insulation of pipes and fixtures, useable and non-useable distribution heat losses, installation space required for insulation
    - Fundamental principles for planning of pipe systems for heating/DHW
    - Penetration of the airtight level by heating system pipes
    - Reduction of the energy consumption of circulating pumps
    - Reduction of the pressure losses in duct systems
    - Purpose and procedures for hydraulic balancing
- Refurbishment of existing buildings

    - Modernisation of the heating system within the context of overall refurbishment
    - Power and modulation ranges for DHW generation and heating during refurbishment
    - Suitability of existing heaters after the refurbishment
    - Retrofitting buildings with exhaust air systems
- Explain the demands posed on a heat supply system in a Passive House and name suitable and cost-effective implementations.
- Identify a heating system for a Passive House in drawings and buildings and estimate its suitablility/economic optimisation
- Identify a domestic hot water system for a Passive House in drawings and buildings and estimate its energy efficiency.

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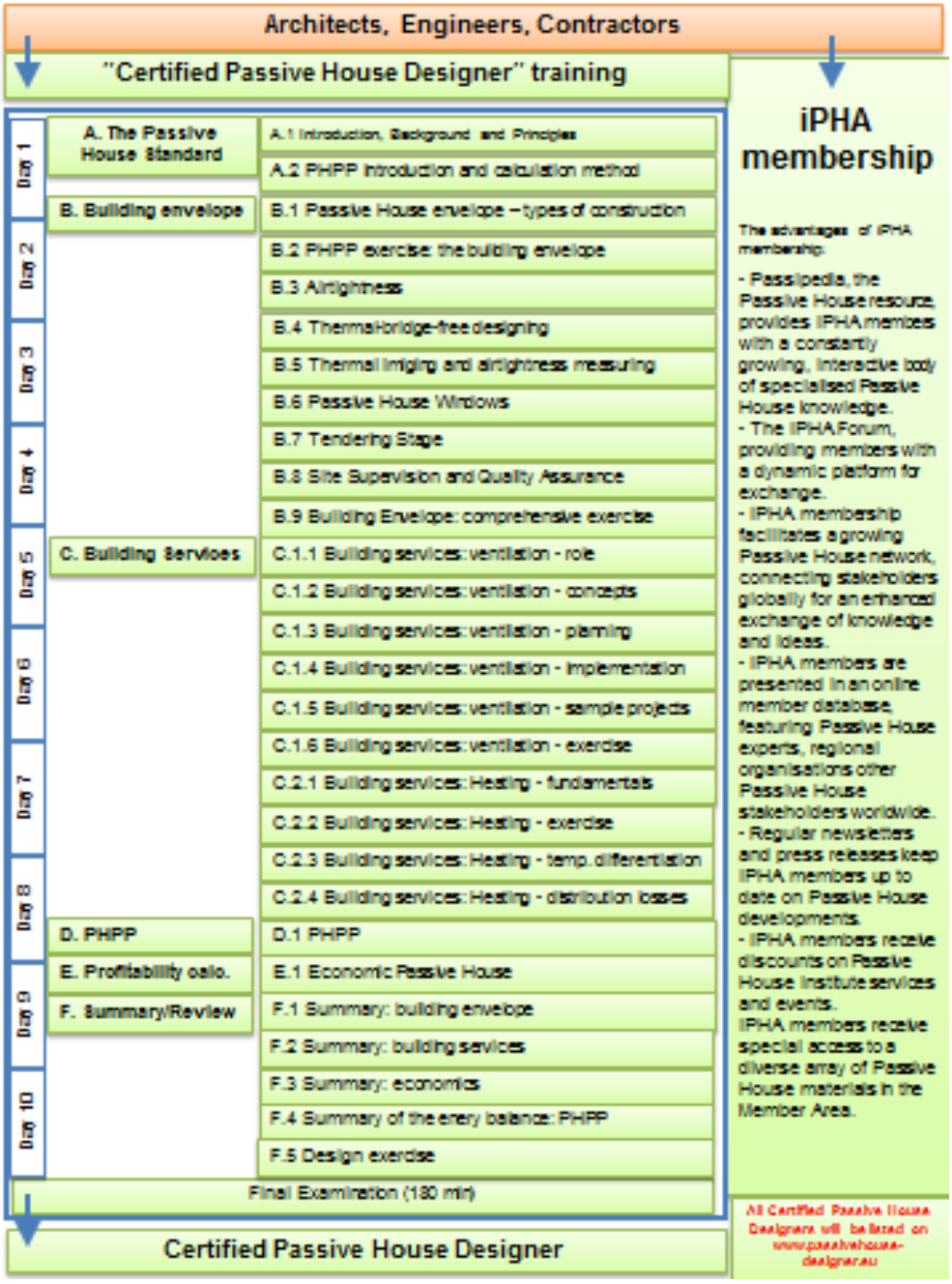
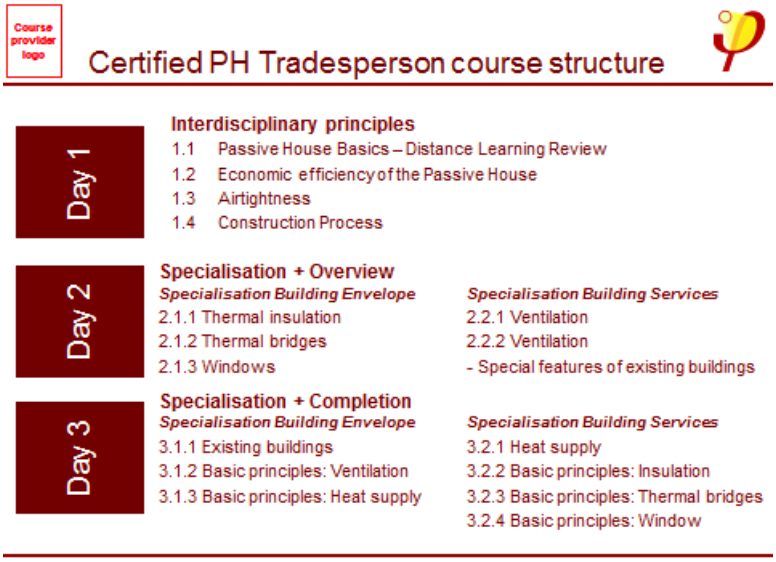
Other short reports and technical literature about the Passive House published on the internet can be found at: http://www.passiv.de/

Appx. 1. Certified Passive House Designer course structure



Appx. 2. Certified Passive House Designer tradesperson course structure



4. List of programmes to be used in the BKHs

4.1. Country: Bulgaria

Categ./ No.	Training program / Occupation	No. hours	Short description / reference
A	**On-site Construction Crafts & Professions**		
1	Building Envelope (BUS EnerPro)	40	Online course + 2 days (theory and practice).
2	Building Systems (BUS EnerPro)	40	Online course + 2 days (theory and practice).
3	Building Market, Products and Technologies (BUS EnerPro)	40	Online course + 2 days (theory and practice).
4	PVs (BUS EnerPro)	40-60	Modular structure, up to 60% practice, each student is stimulated to attend more than 1 course
5	Solar thermal (BUS EnerPro)	40-60	Same as above
6	Biomass (BUS EnerPro)	40-60	Same as above
7	Mini-wind (BUS EnerPro)	40-60	Same as above
8	Thermal pumps (BUS EnerPro)	40-60	Same as above
9	Heating, ventilation and AC (BUS EnerPro)	40-60	Same as above

10	Hybrid systems (BUS EnerPro)	40-60	Same as above
11	Certified PH Tradesperson (envelope/systems)	2.5 days	Following the PH scheme
12	Airtightness	16	Theory + practical
13	Ventilation systems with heat recovery	16-24	Theory + practical
14	Insulation systems + thermal bridges	16-24	Theory + practical
B	**Designers, consultants, building managers (specialists)**		
1	Certified PH Designer / Consultant	7-10 days	Following the PH scheme
2	NZEB design basics	24 hours	Online training + theory + demonstrations
3	Airtightness	16	Online training + practical
4	Ventilation systems with heat recovery	24	Online training + theory + practical
5	Insulation systems + thermal bridges	24	Online training + theory + practical
6	RES in NZEBs	24	theory + practical
C	**Non-specialists**		
1	PH/NZEB economics	8	theory + demonstrations
2	PH/NZEB design basics	8	theory + demonstrations/ practical
3	Airtightness	8	theory + demonstrations/ practical
4	Ventilation systems with heat recovery	8	theory + demonstrations/ practical
5	Insulation, PH windows & thermal bridges	8	theory + demonstrations/ practical
6	RES in NZEBs	8	theory + demonstrations/ practical

4.2 Country: Romania

Nearly zero energy buildings training courses have been structured for 3 categories of target groups (A – On-site Construction Crafts & Professions, B – Specialists, C – Non-specialists) based on individual modules, which could be used in different courses, in order to facilitate the access to single or multiple courses with equalization possibility and tailor-made skills and competences linked to qualification level and/or basic occupation.

It is assumed that participants in this process are familiar with the conventional practices in the building sector and already possess the relevant skills for the design of conventional buildings and / or to assess the energy performance of buildings, according to current practice, obtained during the preparation of their basic or specialization programs and / or following a long life learning training. Therefore, the content is limited to essential additional knowledge related to nZEB.

The general structure of the training courses is presented in the following tables including the allocation of each module for the defined courses in each target group category. The detailed description of each module is presented in Annex 1 of this report.

Categ./ No.	Training program / Occupation	No. hours	Short description / reference
A	**On-site Construction Crafts & Professions**		
1	Building Envelope in nZEBs (Insulation systems + windows)	36	6 days (theory and practice)
2	Building Envelope in nZEBs (Thermal bridges)	27	4,5 days (theory and practice)
3	Building Systems (HVAC) in nZEBs	36	6 days (theory and practice)
4	Solar thermal systems	18	3 days (theory and practice)
5	Biomass systems for space heating and DHW preparation	18	3 days (theory and practice)
6	Heat pump systems	18	3 days (theory and practice)
7	Mini-wind systems for buildings	18	3 days (theory and practice)
8	Airtightness in nZEB	18	3 days (theory and practice)
9	Ventilation systems with heat recovery in nZEB	18	3 days (theory and practice)
10	PV systems (PVTRIN)	114-144	20-24 days (1/3 theory and 2/3 practice), modular structure, prerequisite qualification as electrician
B	**Designers, consultants, building managers (specialists)**		
1	Concepts and buildings design principles of nearly zero energy buildings (nZEB)	32	5.5 days (theory, practice and demonstrations)

2	nZEB energy performance rating (integrated design and energy efficiency)	32	5.5 days (theory, practice and demonstrations)
3	RES systems for nZEBs	54	9 days (theory, practice and demonstrations)
4	Building services in nZEB. Heating and mechanical ventilation with heat recovery	34	6 days (theory, practice and demonstrations)
5	Building envelope (insulation principles and systems, thermal bridges, airtightness) for nZEB	42	7 days (theory, practice and demonstrations)
C	**Non-specialists**		
1	Legal framework and concepts for nZEBs	6	theory + demonstrations
2	Economic efficiency principles for nZEBs (cost optimality)	6	theory + demonstrations
3	Building envelope in nZEBs (insulation, windows, thermal bridges and airtightness)	6	theory + demonstrations
4	Building services in nZEBs (Heating/cooling, ventilation with heat recovery, monitoring)	6	theory + demonstrations
5	RES systems in NZEBs	6	theory + demonstrations
6	nZEB in the context of green buildings	6	theory + demonstrations

Modules and correlation matrix for the definition of training courses related to On-site Construction Crafts & Professions

No.	Module	Hours	Building Envelope in nZEBs (Insulation systems + windows)		Building Envelope in nZEBs (Thermal bridges)		Airtightness in nZEB		Ventilation systems with heat recovery in nZEB		Building Systems (HVAC) in nZEBs		Solar thermal systems		Biomass systems for space heating and DHW preparation		Heat pump systems		Mini-wind systems for buildings	
			Module	hours	Module	hours	Module	hours	Module	hours	Module	hours	Module	hours	Module	hours	Module	hours	Module	hours
1	Nearly zero energy buildings (nZEB) – general specifications	3		3		3		3		3		3								
2	NZEB principles of envelope insulation. Thermal bridges	6		6		6														
3	Airtightness in nZEBs	6		6				6												
4	Windows and other transparent external elements	6		6		6														
5	Renovation of existing buildings using nZEB components	3		3		3		3		3		3								
6	Ventilation for buildings - basic principles	3								3		3								
7	Ventilation in a passive house / nZEB	3								3		3								
8	Heating via fresh air	3										3								
9	Basic principles: thermal energy supply	3										3								
10	Space heating in a passive house / nZEB	3										3								
11	Heating systems - execution details	3										3								
12	Heating systems - Renovation of existing buildings	3										3								

No.	Module	Hours	Building Envelope in nZEBs (Insulation systems + windows)		Building Envelope in nZEBs (Thermal bridges)		Airtightness in nZEB		Ventilation systems with heat recovery in nZEB		Building Systems (HVAC) in nZEBs		Solar thermal systems		Biomass systems for space heating and DHW preparation		Heat pump systems		Mini-wind systems for buildings	
			Module	hours	Module	hours	Module	hours	Module	hours	Module	hours	Module	hours	Module	hours	Module	hours	Module	hours
13	**Integration of RES systems in buildings**	**6**												6		6		6		6
14	**Economic efficiency - nZEB**	**2**		2		2		2		2		2		2		2		2		2
15	**Process of construction and quality assurance**	**2**		2		2		2		2		2		2		2		2		2
16	**Information and support for nZEB users**	**1**		1		1		1		1		1		1		1		1		1
17	**Summer comfort. Shading Systems**	**3**		3		3														
18	**Legal framework and concepts for nZEB realisation**	**1**		1		1		1		1		1		1		1		1		1
19	**Nearly zero energy building in the concept of green building**	**3**		3								3								
20	**Heating and DHW systems operating on biomass**	**6**														6				
21	**Heat pump systems**	**6**																6		
22	**Mini-Wind systems for buildings**	**6**																		6
23	**Thermal solar systems**	**6**												6						
TOTAL HOURS		**87**		**36**		**27**		**18**		**18**		**36**		**18**		**18**		**18**		**18**

Modules and correlation matrix for the definition of training courses related to Designers, consultants, building managers (specialists)

No.	Module	No. of hours	Concept and design principles of nearly zero energy buildings		nZEB energy performance rating (integrated design and energy efficiency)		RES systems for nZEBs		Building services in nZEB. Heating and mechanical ventilation with heat recovery		Building envelope (insulation principles and systems, thermal bridges, airtightness) for nZEB	
			Module	hours	Module	hours	Module	hours	Module	hours	Module	hours
1	**Nzeb buildings – general specifications**	**3**		3		3		3		3		3
2	**NZEB principles insulation envelope. Thermal bridges**	**6**		2		0		0		0		6
	M2-1.1	**0,5**		0,5								0,5
	M2-2.1	**0,5**		0,5								0,5
	M2-2.2	**0,5**		0,5								0,5
	M2-4.1	**0,5**		0,5								0,5
	M2-2.3	**1**										1
	M2-3.1	**0,5**										0,5
	M2-3.2	**0,5**										0,5
	M2-4.2	**1**										1
	M2-5.1	**0,5**										0,5
	M2-5.2	**0,5**										0,5
3	**Airtightness in nZEB buildings type**	**6**		2		0		0		2		6
	M3-1.1	**1**		1						1		1
	M3-1.5	**0,5**		0,5						0,5		0,5
	M3-2.1	**0,5**		0,5						0,5		0,5
	M3-1.2	**0,5**										0,5
	M3-1.3	**0,5**										0,5
	M3-2.2	**1**										1
	M3-3.1	**0,5**										0,5
	M3-3.2	**0,5**										0,5
	M3-4.1	**0,5**										0,5
	M3-4.2	**0,5**										0,5

No.	Module	No. of hours	Concept and design principles of nearly zero energy buildings		nZEB energy performance rating (integrated design and energy efficiency)		RES systems for nZEBs		Building services in nZEB. Heating and mechanical ventilation with heat recovery		Building envelope (insulation principles and systems, thermal bridges, airtightness) for nZEB	
			Module	hours	Module	hours	Module	hours	Module	hours	Module	hours
4	**Windows and other transparent exterior elements . U values for windows**	**6**		2		0		0		0		6
	M4-1.1	**1**		1								1
	M4-2.1	**0,5**		0,5								0,5
	M4-3.1	**0,5**		0,5								0,5
	M4-1.2	**0,5**										0,5
	M4-3.2	**0,5**										0,5
	M4-4.1	**1**										1
	M4-4.2	**0,5**										0,5
	M4-5.1	**0,5**										0,5
	M4-5.2	**1**										1
5	**Heat gain through windows and other exterior transparent elements**	**6**		2		0		0		0		6
	M5-1.1	**0,5**		0,5								0,5
	M5-2.1	**0,5**		0,5								0,5
	M5-3.1	**0,5**		0,5								0,5
	M5-4.1	**0,5**		0,5								0,5
	M5-1.2	**0,5**										0,5
	M5-2.2	**0,5**										0,5
	M5-3.2	**1**										1
	M5-4.2	**0,5**										0,5
	M5-4.3	**1,5**										1,5
6	**Ventilation for Nzeb**	**9**		2		0		0		9		0
	6.1 Ventilation for nZEB - basic principles	**2**		2						2		
	6.2 Natural ventilation	**1**								1		
	6.3 Exhaust ventilation systems	**1**								1		

No.	Module	No. of hours	Concept and design principles of nearly zero energy buildings		nZEB energy performance rating (integrated design and energy efficiency)		RES systems for nZEBs		Building services in nZEB. Heating and mechanical ventilation with heat recovery		Building envelope (insulation principles and systems, thermal bridges, airtightness) for nZEB	
			Module	hours	Module	hours	Module	hours	Module	hours	Module	hours
	6.4 Balanced supply and exhaust ventilation systems with heat recovery	**5**								5		
7	**Heating principlesof spaces in passive houses/nZEB**	**3**		3						3		
8	**Solar shading and summer comfort**	**4**		4						4		4
9	**Electricity consumption**	**2**				2				2		
10	**Principles for achieving energy balance**	**4**				4		4				
11	**Principles for calculating economic efficiency**	**6**				6		6				
12	**Elaboration of specifications for procurements**	**3**								3		3
13	**On-site execution management and quality assurance**	**3**				3		3		3		3
14	**Refurbishments using nZEB components**	**3**		3		3				3		3
15	**Information and support for nZEB occupants**	**2**				2		2		2		2
16	**Principles and overall solutions for the use of renewable energy in nZEB**	**6**		6		6		6				
17	**Heating and DHW operating on biomass**	**6**						6				
18	**Heating equipment with heat pumps**	**6**						6				
19	**Mini-Wind systems for buildings**	**6**						6				
20	**Solar electricity generation - PV systems**	**6**						6				
21	**Thermal solar systems**	**6**						6				
22	**Nearly zero energy building in the concept of green building**	**3**		3		3						
	Total hours	105		32		32		54		34		42

Modules and correlation matrix for the definition of training courses related to non-specialists

MODULE	Hours	Theory, laboratory	Practical applications
1. Legal framework and concepts for nZEBs	**6**	**3**	**3**
2. Economic efficiency principles for nZEBs (cost optimality)	**6**	**3**	**3**
3. Building envelope in nZEBs (insulation, windows, thermal bridges and airtightness)	**6**	**2**	**4**
4. Building services in nZEBs (Heating/cooling, ventilation with heat recovery, monitoring)	**6**	**2**	**4**
5. RES systems in NZEBs	**6**	**3**	**3**
6. nZEB in the context of green buildings	**6**	**3**	**3**
Total hours	**36**	**16**	**20**

4.3 Country: Czech Republic

Categ./ No.	Training program/ Occupation	No. hours			No. of test Questions		Short description/ reference
		In class	Practical training	Self study	Teoretic.	Practic.	
A	**On-site Construction Crafts & Professions**						
1	Non-residential and high performance building systems (IngREeS)	12	8	4	10	5	Presentations + Excursion (site visit) + Self study
2	Construction design 4 (IngREeS)	10	2	12	10	5	In class + Practical training + Self study
3	Lifecycle and Quality control 2 (IngREeS)	10	2	12	10	5	In class + Practical training + Self study
4	Lifecycle and Quality control 4	10	2	12	10	5	In class + Practical training + Self

	(IngREeS)						study
5	Principles revised Normal Quality (Project INTENT)	8	8	8	10	5	In class + Practical training + Self study
6	Awareness of energy efficiency (IDES-EDU)	6	2	16	10	5	In class + Practical training + Self study
7	Interdisciplinary skills (IDES-EDU)	6	2	16	10	5	In class + Practical training + Self study
B	**Designers, consultants, building managers (specialists)**						
1	Integrated building systems (IngREeS)	16	4	4	10	5	Presentations + Group exercise + In class + Practical training + Self study
2	Renewable energy technologies (IngREeS)	16	4	4	10	5	Presentations + Group exercise + In class + Practical training + Self study
3	Advanced building methods and tools (IngREeS)	4	12	8	10	5	Presentation + Exercise on software tool + In class + Practical training + Self study
4	Basic climate adaptive design (IngREeS)	8	12	4	10	5	Presentations + Excursion (site visit) + Group exercise + In class + Practical training + Self study
5	Advanced climate adaptive design (IngREeS)	16	4	4	10	5	Presentations + Group exercise + In class + Practical training + Self study
6	Construction design 3 (IngREeS)	6	6	12	10	5	In class + Practical training + Self

							study
7	Construction design 5 (IngREeS)	6	6	12	10	5	In class + Practical training + Self study
8	Assessment measures 1 (IngREeS)	8	4	12	10	5	In class + Practical training + Self study
9	Assessment measures 2 (IngREeS)	6	6	12	10	5	In class + Practical training + Self study
10	Integrated energy design (Project INTENT)	6	6	12	10	5	In class + Practical training + Self study
11	Housing comfort (IDES-EDU)	6	6	12	10	5	In class + Practical training + Self study
12	Integrated Design Approach (IDES-EDU)	6	6	12	10	5	In class + Practical training + Self study
13	Energy production (IDES-EDU)	10	2	12	10	5	In class + Practical training + Self study
14	Energy management, production, reduction (IDES-EDU)	6	6	12	10	5	In class + Practical training + Self study
15	Energy Performance Contracting (Transparense)	6	6	12	10	5	In class + Practical training + Self study
C	**Non-specialists**						
1	Train rebuild technical manual (Project TRB)	7	1	4	10	5	In class + Practical training + Self study
2	Assessment of existing nZEB technologies	7	1	4	10	5	In class + Practical training + Self study

	(Project neZEH)						
3	Principles revised Normal Quality (Project INTENT)	6	2	4	10	5	In class + Practical training + Self study

Equipment:

In class: Tables, chairs, notebook, projector, flip chart, pencils, pens and papers.

Practical training: Tools, tables, 4 training models of construction, 4 practical models for testing.

Facilities:

BKH with classes and training room (Building of Architecture and building foundation, ABF)

4.4. Country: Turkey

Table 1. Basic structure of training programme

MODULES		Module 1 nZEB Basic	Module 2 nZEB Advanced	Module 3 Retrofitting towards nZEB	Module 4 nZEB simulation	Module 5 Preparation of funding schemes	Module 6 Automation in nZEB	Total duration
Duration		14 hours	14 hours	8 hours	6 hours	6 hours	6 hours	
TARGET	Designers	x	x	x	x		x	48 hours
	Construction workers	x		x				22 hours
	Non-specialists	x				x		20 hours

Table 2. Content of training programme

	Module 1	Short description / reference
1	Definition of nZEB	Theory
2	National legislation, standards and regulations related to energy efficiency in buildings, passive house and nZEB	Theory
3	Basic building physics	Theory
4	Heat transfer mechanisms	Theory
5	Thermal bridge in buildings	Same as above
6	Thermal insulation materials	Same as above
7	Construction techniques for thermal insulation	Practical + demonstrations
8	Solar control	Theory

9	Ventilation and airtightness	Theory + Practical
10	Thermal comfort	Theory
11	Introduction to RES	Theory + demonstrations + practical
	Module 2	**Short description / reference**
1	Principles of bioclimatic design	Theory
2	Introduction to passive house concept	Theory
3	Passive and active solar systems for heating and cooling	Theory + demonstrations
4	Energy efficient HVAC systems	Theory + demonstrations
5	RES	Theory + demonstrations
6	Energy efficient building materials	Theory + demonstrations
7	Natural lighting	Theory
	Module 3	**Short description / reference**
1	Energy audit techniques	Theory
2	Definition of renovation strategies	Theory
3	Passive and active renovation solutions	Theory + practical
4	Application of renewable energy solutions	Theory
5	Energy efficient building components: windows and doors	Theory + demonstrations
6	Life cycle cost assessment	Theory
	Module 4	**Short description / reference**
1	Introduction to building energy simulation	Theory
2	Current simulation tools	Theory
3	Practical application of simulation tools	Theory
4	Understanding simulation results and errors	Theory
	Module 5	**Short description / reference**
1	Available funding mechanisms and incentives	Theory
2	Practical investment / calculation exercise	Theory
	Module 6	**Short description / reference**
1	Major components in building automation systems	Theory
2	Monitoring systems	Theory
3	Building energy management systems	Theory

4.5. Country: Ukraine

Train-to-NZEB: The Building Knowledge Hubs

TRAINING PROGRAMS

Prepared by Municipal Development Institute, Train-to-NZEB Project implementer in Ukraine, jointly Kyiv National University of Construction and Architecture, Project Partner (2016)

(A) TRAINING PROGRAM FOR THE CONSTRUCTION INDUSTRY WORKERS (MASTERS, JOB FOREMASTERS AND FOREMEN, ENGINEERING SUPERVISION STAFF)

44 hours, including 16 hours of lectures and 28 hours of practice; knowledge checks (1 hour); 10 minutes/person for knowledge verification

1. Physical processes in the building envelope during heat, humidity and air transfer (2 hours).

1.1 Heat transfer.

1.2 Humidity transfer.

1.3 Air transfer.

1.4 Heat resistance.

2. Normative requirements to heat insulating jacket (2 hours).

2.1 Thermal physic requirements to structures.

2.2 Requirements to energy efficiency of buildings.

2.3 Requirements to heat reliability of the building envelope.

2.4 Engineering and physical-mechanical requirements to the insulating jacket.

3. Modern heat insulating materials (2 hours).

3.1 Groups of heat insulating materials, their properties and application:

3.1.1 Heat-insulating materials: construction.

3.1.2 Heat-insulating materials: assembly works.

3.2 Selection of insulating materials: feasibility study.

3.3 Use of heat-insulating materials in the new energy efficient buildings.

3.4 Blown-out concrete. Improving heat insulation features of self-bearing frame filling by using gas concrete and foam concrete.

3.5 Self-bearing ceramic envelope heat insulating framing.

Practical task on chapters 1, 2 and 3 - To develop a project on thermal modernization of the existing wall structure.

Workshop on “Practical aspects regarding insulation of inclined roofs of frame wall structures” (to be conducted by URSA) (1 hour).

Workshop on “Energy efficient design solutions providing for the use of wall ceramic blocks and ceramic tiles” (to be conducted by Wienerberger) (3 hours).

4. Constructive energy efficient solutions in the building sector (3 hours).

4.1 Classification of façade systems:

4.1.1 Prefabricated facade systems covered with plaster or pieces of decoration elements.

4.1.2 Prefabricated facade systems covered with bricks or wall stones.

4.1.3 Prefabricated facade systems covered with transparent elements.

4.2 Coating. Improving heat insulation features of the coating:

4.2.1 Selecting coating materials.

4.2.2 Specificities about energy efficient coating.

4.3 Windows and other translucent structures. Design of translucent envelope:

4.3.1 Thermal physical processes in the translucent structures.

4.3.2 Selecting energy efficient translucent structures. Modernization of the structures.

4.3.3 Assembly of the modern translucent structures.

4.4 Reducing losses of energy by means of optimization/modernization of the foundation structures and wall structures of basements.

4.5 Constructive energy efficient solutions for door apertures.

4.6 Energy efficient solutions for overlap structures.

Practical tasks on chapter 4:

1. Find errors in the constructive structural assemblies of the façade system and propose corresponding adjustment.

2. Find errors in the way the translucent structures were assembled and propose corresponding adjustment.

3. Prepare a basement insulation design project.

Workshop on “Practical aspects regarding façade systems. Prefabricated façade systems covered with stucco or small decorative elements” (to be conducted by Henkel Bautechnik Ukraina (3 hours).

Workshop on “Energy efficient window and other translucent structures” (to be conducted by REHAU) (4 hours).

Workshop on “Practical aspects regarding aluminum façade systems for nearly-zero energy buildings” (to be conducted by Techno-Alliance) (1 hour).

5. Licensing in the building sector. Concurrence of design documentation in the context of energy efficient buildings and structures with relevant authorities (1 hour).

5.1 Structure and contents of design documentation. Complicacy categories and types of consequences.

5.2 Licenses and certificates for design and construction activities in Ukraine:

5.2.1 Concurrence of design documentation with relevant expertise authorities.

5.2.2 Procedures on the start of construction of complexes and engineering networks and putting facilities into operation.

5.3 Norms governing preparation of estimation documentation on nearly zero energy buildings.

6. Selecting a source of heat supply (1 hour).

6.1 Energy indicators of a source of heat supply.

6.1.1 Types of heat loads, calculation of the annual consumption of the organic fuel.

6.1.2 Daily and seasonal schedules on heat energy consumption by heating systems.

6.1.3 Qualitative and quantitative regulation of heat energy carrier and its effective use.

6.1.4 Diversification and decentralization of energy sources.

6.1.5 Cogeneration as a combined production of heat and electric energy. Trigeneration as a combined production of heat (heating + cooling) and electric energy.

6.2 Heat schemes of the sources of heat supply:

6.2.1 Heating substations:

- Types of connections of internal building heating networks to the main heating network that is operated in Ukraine since 1950-1960. Temperature schedules for elevator systems and temperature control systems.
- Modern heat schemes and possibilities for the regulation of heat in Individual heating substations. Feasible energy and economic effect from weatherization (comparing calculations and statistical data).
- Specificities regarding selection of regulators for modern heating substations.

6.2.2 Modern heat schemes and possibilities for the regulation of heat in boiler houses.

6.2.3 Use of alternative energy sources. Alternative fuels and specificities of Ukraine’s climate.

6.3 Energy losses during heat energy generation, transportation, and consumption.

6.4 Environmental requirements to energy sources, including alternative energy sources, as set by relevant EU Directives which are currently harmonized with Ukrainian laws. Definition of green house gas emission.

Practical tasks on chapter 6:

1. Analyze operation of a heating substation depending on outside temperature and changing loads in the heating system and centralized hot water supply system.

2. Propose heat schemes for a source of heat energy, with energy to be produced from alternative energy sources.

3. Calculate technical and economic indicators for the reconstruction of a rayon boiler house and use of the locally available alternative energy fuels.

Presentation by Aclima on chapter 6.2.3:

- Use of various types of heat pumps in various climate zones in Ukraine.
- Demonstration of relevant video materials.
- Case-studies presented by professionals.
- Use of energy efficient equipment: step-by-step concepts and schemes.
- Presentation on the implemented schemes (approaches).
- Analysis of ready-made concepts by Aclima.

7. Selection, design, and assembly of energy saving heat supply and hot water supply systems (2 hours).

7.1 Normative requirements to heating and hot (tap) water supply systems. Key changes in the requirements after State Building Norms DBN B.2.5-67:2013 and DBN B.2.5-64:2012 were adopted.

7.2 Regulation of heat supply to a building from the angle of heat regime regulation on the level of an individual apartment and the building in whole.

7.3 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.

7.4 Energy efficient heating systems. Changing quantitative and qualitative values of the systems depending on the proposed approach:

7.4.1 Selecting a heater and connection types.

7.4.2 Design of devices of the heating systems depending on the temperature levels of the heat energy source.

7.4.3 Heating systems: modern assembly technologies.

7.5 Calculating and monitoring of the use of heat energy sources. Local and centralized monitoring of heat loss.

7.6 Relevant software for the heating systems (for example, Audytor C.O.).

Presentation by Aclima on chapter 7.4:

- Calculating a payback period for heat pumps.
- Special software for selecting a heat pump (MYCOND, Hitachi).
- Case-study analysis.
- Demonstration of relevant video materials.

8. Design and installation of the energy efficient ventilation systems for a building (1 hour).

8.1 Energy efficient ventilation systems with natural circulation of the air.

8.2 Energy efficient ventilation systems with forced ventilation of premises:

8.2.1 Mechanical exhaust ventilation with natural air intake.

8.2.2 Mechanical inlet and exhaust ventilation.

8.2.3 Centralized ventilation systems, systems with individual fans and mixed systems.

8.2.4 Combination of various ventilation systems for having the energy efficient air exchange regime.

8.3 Utilization of ventilated air (recuperating, regenerating and use of transitional heat carrier).

8.4 Alternative energy sources used for heating fresh air.

Practical tasks on chapters 7-8:

1. Calculate the hydraulic regimes with the special software Aydutor C.O. (Danfoss, Herz, Romstal, etc.).

2. Calculate the indicators of the heating system and specify the changes in the indicators while comparing high-temperature and low-temperature energy sources.

Workshop on “Equipment of internal engineering systems of nearly-zero energy buildings” (to be conducted by REHAU) (4 hours).

Workshop on “Energy saving ventilation, air conditioning, heating, and hot (tap) water supply systems: how it works?” (to be conducted by Aclima) (4 hours).

Workshop on “Design and assembly of alternative energy sources” (to be conducted by Vaillant) (6 hours).

9. Cooling systems in buildings and facilities (1 hour).

9.1 Passive cooling systems of buildings and structures.

9.2 Active cooling systems of buildings and structures.

9.3 Cooling systems in buildings and structures when trigeneration - combined cooling, heat and power generation - system is in place.

10. A nearly-zero energy building as a combination of effective solutions on the building envelope, engineering networks, utilization of the secondary resources within the intellectual system for micro-climate control and monitoring (1 hour).

(B) TRAINING PROGRAM FOR THE BUILDING INDUSTRY PROFESSIONALS (DESIGNERS, ARCHITECTS, ENGINEERS, CONSTRUCTION WORKS COORDINATORS, DESIGN AND CONSTRUCTION CONSULTANTS)

44 hours, including 24 hours of lectures and 20 hours of practice; knowledge checks (1 hour); 10 minutes/person for knowledge verification

1. Design of energy efficient buildings: Methodology (2 hours).

1.1 Climatic analysis of a construction site: temperature, relative humidity, wind speed, solar radiation, precipitation. Determining the impact of climate on urban planning and design of the energy efficient buildings.

1.2 Comprehensive approach to the integrated energy efficient technologies in design, construction and maintenance of buildings and facilities in different climate and environmental conditions.

1.3 Complex criteria pertinent to optimization of the engineering networks: ventilation, air conditioning, heating, hot water supply, electricity supply, cold water supply and sanitation. Automatic control of micro-climate. Automatic control of the technological (if necessary) processes.

1.4 Recommendations on the economic and environmental feasibility for various approaches regarding the use of the alternative energy sources for different facilities in the specific natural and climatic conditions.

Practical task on chapter 1:

Propose a design of a micro-rayon of the specified buildings. Take into consideration the climate of the construction area and propose appropriate alternative energy sources.

Presentation by Aclima on chapter 1.3:

- Specificities of design of energy efficient ventilation, air conditioning and heating systems.
- Presentation of implemented solutions.
- Analysis of ready-made concepts by Aclima.

2. Design of energy efficient buildings (4 hours).

2.1 Design of residential buildings. Rating buildings, systems, equipment, building envelope and energy resources by the degree of energy efficiency.

2.2 General principles regarding design of energy efficient buildings:

2.2.1 Space and planning parameters.

2.2.2 Constructive solutions.

2.2.3 Engineering and technical solutions.

2.3 Passive houses:

2.3.1 Space and planning parameters.

2.3.2 Constructive solutions.

2.3.3 Engineering and technical solutions.

2.4 Zero-energy buildings:

2.4.1 Space and planning parameters.

2.4.2 Constructive solutions.

2.4.3 Engineering and technical solutions.

2.5 Buildings with positive energy balance:

2.5.1 Space and planning parameters.

2.5.2 Constructive solutions.

2.5.3 Engineering and technical solutions.

Workshop on “Practical aspects regarding façade systems. Prefabricated façade systems covered with stucco or small decorative elements” (to be conducted by Henkel Bautechnik Ukraina) (2 hours).

Workshop on “Practical aspects regarding aluminum façade systems for nearly-zero energy buildings” (to be conducted by Techno-Alliance) (1 hour).

3. Engineering calculations of energy efficient structures (4 hours).

3.1 Lighting in buildings: calculation methodology; modernization:

3.1.1 Norms and requirements.

3.1.2 Natural lighting: design and calculations. Side, overhead, combined, transportable and accumulated lighting.

3.1.3 Artificial lighting: design and calculations.

3.1.4 Combined lighting: design and calculations.

3.2 Use of solar irradiation in a building:

3.2.1 Norms and requirements.

3.2.2 Methods for calculating the duration of solar irradiation.

3.2.3 Sun protection: design and optimization.

3.3 Sound insulation in energy efficient buildings:

3.3.1 Norms and requirements.

3.3.2 Calculating sound insulation indicators for the modern energy efficient building envelope.

3.3.3 Design of sound insulation of light external structures and translucent structures.

3.4 Design of the heat insulated building jacket:

3.4.1 Norms and requirements.

3.4.2 Calculation of heat transfer resistance.

3.6.3 Calculation of heat and humidity condition of the building envelope.

3.4.4 Calculation of heat resistance of building envelopes and premises.

3.4.5 Systemic methods for optimization of building envelopes by a reliability indicator.

3.5 Energy efficiency class of the building:

3.5.1 Energy consumption for heating.

3.5.2 Energy consumption for cooling.

3.5.3 Energy consumption for ventilation.

3.5.4 Energy consumption for lighting.

3.5.5 Energy consumption for hot water supply.

3.5.6 Optimization of the heating, electricity, water supply and sanitation systems with the aim of achieving the best possible efficiency of consumption of the energy resources.

Practical tasks on chapter 3:

1. Prepare design of a sunshield based on the following parameters: specific location of the building, forms and sizes of windows in a specified part of the building.

2. Prepare design of a project on heat insulation of a wall. Define the heat and humidity conditions of the wall.

Workshop on “Practical aspects regarding insulation of inclined roofs of frame wall structures” (to be conducted by URSA) (1 hour).

Workshop on “Energy efficient windows and other translucent building envelope” (to be conducted by REHAU) (2 hours).

Workshop on “Energy efficient wall ceramic blocks and ceramic tiles” (to be conducted by Wienerberger) (3 hours).

4. Automated design of energy efficient buildings: software and computer systems

(4 hours).

4.1 Design of two- and three-dimensional warm floors: Term, Windows, Ansys, SolidWorks, etc. Design of geometric models, calculation algorithms, data entry, identification of errors, analysis of calculation results:

4.1.1 Analysis of the constructive assemblies of buildings and identification of “cold (heat) bridges”. Recommendations regarding improvement of the poor heat insulation.

4.1.2 Developing a temperature field model in the assembly of a building structure.

4.1.3 Modeling of the humidity field in the assembly of a building structure.

4.2 Design systems for the energy efficient buildings: EnergyPlus, PHPP, Autodesk Ecotect Analysis, etc. Design of geometric models, calculation algorithms, data entry, identification of errors, analysis of calculation results.

Practical task on chapter 4:

Design the temperature field for a specific construction unit. Determine heat resistance and temperature in the most risky part of the unit.

5. Licensing in the building sector. Concurrence of design documentation in the context of energy efficient buildings and structures (1 hour).

5.1 Structure and content of the design documentation. Complicacy categories and types of consequences.

5.2 Licenses and certificates for design and construction activities in Ukraine:

5.2.1 Concurrence of design documentation with relevant expertise authorities.

5.2.2 Start of construction of complexes and engineering networks and putting facilities into operation.

5.3 Norms governing preparation of estimation documentation on nearly-zero energy buildings.

6. Selection of a source of heat supply (3 hours).

6.1 Energy indicators of a source of heat supply.

6.1.1 Types of heat loads, calculation of the annual consumption of the organic fuel.

6.1.2 Daily and seasonal schedules on heat energy consumption by heating systems.

6.1.3 Qualitative and quantitative regulation of heat energy carrier and its effective use.

6.1.4 Diversification and decentralization of energy sources.

6.2 Heat schemes of heat supply sources:

6.2.1. Heating substations:

- Types of connections of internal building heating networks to the main heating network that is operated in Ukraine since 1950-1960. Temperature schedules for elevator systems and temperature control systems.

- Modern heat schemes and regulating possibilities for heating substations. Feasible energy and economic effect from weatherization (comparing calculations and statistical data).

- Specificities regarding selection of regulators for modern heating substations.

6.2.2 Modern heat schemes. Heat regulation at boiler houses.

6.3 Specific energy losses at heat energy generation, transportation and consumption.

7. Alternative energy sources and design of the modern building and facilities (3 hours).

7.1 Wind energy in design of electric networks of modern buildings:

7.1.1 Design of wind electric generators. Key issues about installation and operation of wind electric generators in the modern buildings.

7.1.2 Adaptation of the electric network of a building to use and accumulate wind energy.

7.2 Solar energy in the heating systems of the modern buildings:

7.2.1 Solar collectors in autonomous or mixed (partly autonomous) hot water supply systems.

7.2.2 Types of solar collectors. Selecting a solar collector.

7.2.3 Design of structural components for installation of solar collectors and supplementary equipment. Recommendations on the location of the solar collectors.

7.2.4 Heat schemes of centralized hot water supply systems in a building when centralized water supply system and/or organic fuels and solar collectors are used in the building.

7.3 Photoelectric elements:

7.3.1 Design of structural components for the photoelectric elements and supplementary equipment. Key issues about locations for the photoelectric elements.

7.3.2 Specific issues regarding the combination of photoelectric elements and centralized electricity supply.

7.4 Heat pumps in modern buildings:

7.4.1 Effectiveness of a heat pump: definition.

7.4.2 Impact of the low-potential environment on the effectiveness of a heat pump.

7.4.3 Modern elements of a heat pump. Inverter and spiral compressors. Types of refrigerants. Selecting a refrigerant. Cascade heat pump systems.

7.4.4 Low emission energy sources (wind, soil, water) and heat pumps.

7.4.5 Wastewater and other secondary energy sources and heat pumps.

7.4.6 Heating and hot water supply systems and energy produced by heat pumps, changing temperature schedules of the heating system.

7.4.7 Specific features about the buildings where heat pumps will be installed.

Presentation by Aclima on chapter 7:

- Heat pumps. Specificities about design of engineering systems with heat pumps.
- Case-studies analysis.
- Typical mistakes about design of heat pumps.
- Special software (MYCOND, Hitachi).
- Demonstration of relevant training video materials.

8. Selection, design and assembly of energy saving heating and hot water supply systems

(2 hours).

8.1 Regulating heat supply inside the building from the perspective of regulating the heating regime by apartment and in the building in whole.

8.2 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.

8.3 Energy efficient heating systems. Varying quantitative and qualitative indicators when a specific approach is applied:

8.3.1 Heaters and system connection types.

8.3.2 Calculations on the parameters of the heaters depending on the temperature of a heat supply source.

8.3.3 Modern technologies for assembly of the heating systems.

8.4 Systems used for estimating and monitoring of heat resources consumption. Local and centralized monitoring of heat losses.

8.5 Software used for heating systems modeling (on the example of Audytor C.O.).

Presentation by Aclima on chapter 8:

- Use of heat pumps to supply hot (tap) water: effectiveness and difficulties.

- Comparative analysis of energy consumption in a private house when various energy sources are use for hot water supply.
- Demonstration of relevant training video materials.

Workshop on “Equipment for internal engineering systems in nearly-zero energy buildings” (to be conducted by REHAU) (2 hours).

9. Design and installation of the energy efficient ventilation system inside the building (1 hour).

9.1 Energy efficient ventilation systems with natural circulation of air.

9.2 Energy efficient ventilation systems with compulsory ventilation:

9.2.1 Mechanical exhaust ventilation with natural air intake.

9.2.2 Mechanical supply-and-exhaust ventilation.

9.2.3 Centralized ventilation systems, systems with individual ventilators and systems with combination of several types of the ventilation systems.

9.2.4 Best combination of different types of ventilation systems with the aim of having the energy saving air exchange regime.

9.3 Use of recuperators.

9.4 Use of the alternative energy sources for heating of the supply air.

Workshop on “Energy saving ventilation, air conditioning, heating, and hot water supply systems: how it works?” (to be conducted by Aclima) (4 hours).

Workshop on “Design and assembly of alternative energy sources” (to be conducted by Vaillant) (4 hours).

10. A nearly-zero energy building as the inclusive combination of the effective engineering solutions on the building envelope, engineering networks, utilization of the secondary energy resources – all working under the intellectual system for micro-climate monitoring and management (1 hour).

(C) TRAINING PROGRAM FOR NON-PROFESSIONAL DECISION-MAKERS (KEY EXECUTIVES AND REPRESENTATIVES OF GOVERNMENT INSTITUTIONS)

32 hours, including 16 hours of lectures and 16 hours of practice; knowledge checks (1 hour); 10 minutes/person for knowledge verification

LECTURE COURSE

1. Legislation governing energy efficiency in the building industry (2 hours).

1.1 Background on the requirements to energy efficiency in Ukraine.

1.2 Current national norms vs relevant international norms.

1.3 Improvement of the energy efficiency norms in Ukraine from the perspective of the environmental issues worldwide.

1.4 Engineering and technical issues, management, financial and other issues pertinent to energy efficient buildings.

2. Design and installation of energy efficient heating and heat supply systems (2 hours).

2.1 Regulating heat supply to the building. Heat regime regulation on the level of an individual apartment and in the building in whole.

2.2 Energy efficient heating systems.

2.3 Systems used for estimating and monitoring of heat resources consumption. Local and centralized monitoring of heat energy consumption. Installation of thermostats and heat meters with convectors and heaters.

Presentation by Aclima on chapter 2:

- Comparative analysis of ways to heat buildings.
- Demonstration of training video materials.

3. Energy efficient design of electricity supply systems (1 hour).

3.1 Optimization of the electricity supply system for working in the autonomous energy saving operation modes.

3.2 Adaptation of the electricity supply system to the modern energy saving equipment as well as the alternative electric energy sources.

3.3 Systems used for monitoring and control of consumption of electric energy. Local and centralized monitoring of electric energy consumption. Installation of meters and local on-off automated electricity supply systems.

4. Energy efficiency measures in the gas supply and water supply systems in the modern buildings (1 hour).

4.1 Efficient consumption of natural gas. Systems used to estimate and monitor and regulate natural gas consumption.

4.2 Reduction of water consumption. Systems used to estimate and monitor water consumption.

5. Improving effectiveness of maintenance of buildings and facilities. (4 hours)

5.1 Thermal modernization of buildings:

5.1.1 Standard requirements to thermal modernization.

5.1.2. Examination and energy audit of buildings and engineering systems of buildings.

5.1.3. Heat safety of building envelope: heat failures of the seal course of the buildings. Classification of heat failures. Methodology for examination of heat safety of building envelope and energy efficiency of buildings.

5.1.4. Energy passports of buildings. Data/information in the energy passport. Estimation of heat losses through the heat retention jacket of the building and ventilation. Estimation on solar irradiation. Estimation on the net heat loss of the building. Energy efficiency rating of the buildings.

5.1.5. Thermal modernization of the building: scenarios.

5.1.6. Technical and economic assessment of the thermal modernization scenarios.

5.2 Thermal sanation (deep retrofit) of housing stock:

5.2.1 Mandatory energy efficiency improvements in buildings and facilities.

5.2.2 Voluntary energy efficiency improvements in the framework of the thermal modernization of buildings and facilities.

Presentation by Aclima on chapter 5:

- Increasing energy efficiency of buildings.
- Analysis of case studies: thermal modernization programs; implementation of thermal modernization programs,

6. Automated systems for regulation of energy consumption and micro-climate control in the building (1 hour).

6.1 Regulation and monitoring of heat energy consumption.

6.2 Regulation and monitoring of water consumption.

6.3 Regulation and monitoring of electric energy consumption.

6.4 Regulation and monitoring of the micro-climate in the building.

6.5 Regulation and monitoring of air exchange in the building.

6.6 Software used for monitoring and regulation of energy resources consumption.

7. Certification of buildings (1 hour).

7.1 Modern systems for the green certification of buildings.

7.2 Energy certification of buildings.

7.3 Estimation of energy indicators in the course of certification of buildings.

8. Energy audit of buildings (1 hour).

8.1 Screening and selecting of facilities for energy audit.

8.2 Equipment and devices used by energy auditors.

8.3 Phases of energy audit.

8.4 Estimation of energy consumption of a building.

8.5 Analysis of energy consumption and recommendations on improving the energy parameters of a building.

Practical task:

To develop a plan of measures for improving energy efficiency of buildings (within the competence of training participants).

9. Investments into energy efficient new construction. State support to construction of energy efficient buildings (1 hour).

9.1 Banks.

9.2 Private investors.

9.3 State programs.

10. Heat supply sources, diversification and decentralization of energy sources. Alternative energy sources (1 hour).

Presentation by Aclima on chapter 9:

- Heat pump as the alternative heating technology.
- Selecting a heat pump. Effective operation of a heat pump.
- Estimating payback period for heat pumps.

11. A nearly-zero energy building as the inclusive combination of the effective engineering solutions on the building envelope, engineering networks, utilization of the secondary energy resources – all working under the intellectual system for micro-climate monitoring and management (1 hour).

WORKSHOPS

1. Workshop on "Practical aspects regarding façade systems. Prefabricated façade systems to be covered with stucco or small decorative elements" (to be conducted by Henkel Bautechnik Ukraina) (2 hours).

2. Workshop on "Practical aspects regarding insulation of inclined roofs of frame wall structures" (to be conducted by URSA) (1 hour).

3. Workshop on "Energy efficient design solutions providing for the use of wall ceramic blocks and ceramic tiles" (to be conducted by Wienerberger) (1 hour).

4. Workshop on "Energy saving ventilation, cooling (air conditioning), heating and hot water supply systems: how it works?" (to be conducted by Aclima) (3 hours).

5. Workshop on "Practical aspects regarding assembly of aluminum façade systems for nearly-zero energy buildings" (to be conducted by Techno-Alliance) (1 hour).

6. Workshop on "Translucent building envelope and equipment of internal engineering networks in nearly-zero energy buildings" (to be conducted by REHAU) (4 hours).

7. Workshop on "Design and assembly of alternative energy sources" (to be conducted by Vaillant) (3 hours).

(1) WORKSHOP ON "PRACTICAL ASPECTS REGARDING FAÇADE SYSTEMS. PREFABRICATED FAÇADE SYSTEMS TO BE COVERED WITH STUCCO OR SMALL DECORATIVE ELEMENTS" FOR NON-PROFESSIONAL DECISION-MAKERS (KEY EXECUTIVES AND REPRESENTATIVES OF GOVERNMENT INSTITUTIONS)

2 hours of training

1. Welcome remarks.

2. Norms and requirements to nearly-zero energy buildings.

2.1. Trends in Europe and worldwide.

2.2. Requirements in Ukraine.

2.3. "Green" buildings philosophy.

3. Energy efficient solutions for new buildings.

3.1. Energy efficient solutions for new buildings.

3.2. Solution selection criteria.

3.3. Case studies on ready-for-use projects.

4. Coffee break.

5. Practical training at the Training Technological Centre.

5.1. Classification of façade systems.

5.2. Types of insulation material.

5.3. Examples of use of insulation materials.

6. Practical training at the Laboratory of Internal Engineering Networks.

(2) WORKSHOP ON "PRACTICAL ASPECTS REGARDING INSULATION OF INCLINED ROOFS OF FRAME WALL STRUCTURES" FOR NON-PROFESSIONAL DECISION-MAKERS (KEY EXECUTIVES AND REPRESENTATIVES OF GOVERNMENT INSTITUTIONS)

1 hour of training

1. Welcome remarks.

2. Presentation on main types of insulation materials (structure and application area).

2.1 Staple glass fibre insulation.

2.2 Extruded polystyrene foam insulation.

3. Specificities about assemblage of insulation materials. Indexing and fastening of insulation materials.

3.1 Working with staple glass fibre insulation.

3.2 Working with extruded polystyrene foam insulation.

4. Hydro and steam barriers.

4.1 Vapour seal.

4.2 Hydraulic seal (water proofing).

(3) WORKSHOP “ENERGY EFFICIENT DESIGN SOLUTIONS PROVIDING FOR THE USE OF CERAMIC WALL BLOCKS AND CERAMIC TILES” FOR NON-PROFESSIONAL DECISION-MAKERS (KEY EXECUTIVES AND REPRESENTATIVES OF GOVERNMENT INSTITUTIONS)

3 hours of training

1. Welcome remarks

2. Characteristics and assortment of energy efficient ceramic wall blocks

2.1. Blocks used for external non-insulated wall structures

2.2. Blocks used for internal wall structures

2.3. Blocks for division panels

3. Normative requirements to ceramic wall items

3.1. Requirements of State Standards and Technical Conditions (DSTU) Б В.2.7-61-97 for bricks and stones. Technical conditions

3.2. Requirements of State Building Norms (DBN) В.2.6-162:2010 for stone and reinforced masonry structures

3.3. Requirements of State Building Norms (DBN) В.2.6-31:2006 for thermal insulation of buildings

3.4. Requirements of State Building Norms (DBN) В.1.1.7–2002 for fire safety of building projects

4. Design solutions and specificities about the use of energy efficient ceramic wall items

4.1. External building envelope

4.1.1. Basement unit

4.1.2. Seals

4.1.3. Floor bearings

4.1.4. Roof bearings

4.2. Internal walls

4.3. Special design solutions for external building envelope

4.3.1.Bows

4.3.2. Wall rounding

5. Energy efficient ceramic wall items

5.1. Wall bounding and filling seals with mortar

5.2. Video presentation on “Cementation of ceramic blocks”. Cementation technique

5.3. Monolithic reinforced concrete structures in walls

5.4. Thin-seal brick-work technology

5.4.1. First line cementation

5.4.2. Cementation on mineral glue

5.4.3. Cementation on polyurethane glue

6. Typical mistakes during execution of works

7. Specificities about the use of ceramic tiles

8. Knowledge test

(4) WORKSHOP “ENERGY SAVING VENTILATION, AIR CONDITIONING, HEATING, AND HOT (TAP) WATER SUPPLY SYSTEMS: HOW IT WORKS?” FOR NON-PROFESSIONAL DECISION-MAKERS (KEY EXECUTIVES AND REPRESENTATIVES OF GOVERNMENT INSTITUTIONS)

3 hours of training

1. Welcome remarks.

2. Energy saving ventilation. Free cooling technology.

2.1 Energy saving in recuperation systems.

2.2 Free cooling technology. Specificities regarding the use of free cooling technology.

2.3 Energy efficient ventilation for various building projects.

2.4 Demonstration: balanced (supply-and-exhaust) plant Weger.

3. Coffee break.

4. Alternative heating technologies: heat pumps.

4.1 Feasibility study on the use of heat pumps.

4.2 Comparative analysis of traditional and alternative heating types and their economic feasibility.

4.3 Demonstration: “air - water” heat pumps (Hitachi, MYCOND).

(5) WORKSHOP ON “PRACTICAL ASPECTS REGARDING ALUMINUM FAÇADE SYSTEMS FOR NEARLY-ZERO ENERGY BUILDINGS” FOR NON-PROFESSIONAL DECISION-MAKERS (KEY EXECUTIVES AND REPRESENTATIVES OF GOVERNMENT INSTITUTIONS)

1 hour of training

1. Welcome remarks.

2. Classification of translucent ventilated façade systems. Use of the systems.

2.1 Classification of the systems.

2.2 Types of infilling of façade systems.

2.3 Use of aluminum façade systems.

3. Impact of certain elements and materials used for ventilated façade systems on their resultant heating qualities.

3.1 Methods for improving heating qualities of translucent façade systems: use of different design solutions.

3.2 Analysis of the impact of certain elements of translucent façade systems on their resultant heating qualities.

3.3 Requirements of heat-insulating materials.

3.4 Attainable heat-transfer resistance.

4. Impact of certain elements and materials used for ventilated façade systems on their resultant heating qualities.

4.1 Methods for increasing heating qualities of ventilated façade systems: use of different design solutions.

4.2 Analysis of impact of certain elements and materials used for ventilated façade systems on their resultant heating qualities.

4.3 Requirement to heat-insulating materials.

4.4 Attainable heat-transfer resistance.

5. Translucent ventilated façade systems: typical mistakes.

6. Practical tasks – samples of nodal solutions.

(6) WORKSHOP ON “ENERGY EFFICIENT ASPECTS REGARDING DESIGN AND ASSEMBLY OF TRANSLUCENT FILLER STRUCTURES” FOR NON-PROFESSIONAL DECISION-MAKERS (KEY EXECUTIVES AND REPRESENTATIVES OF GOVERNMENT INSTITUTIONS)

3 hours of training

1. Welcome remarks

2. Norms and requirements to nearly-zero energy buildings

2.1. Trends in Europe and worldwide

2.2. Requirements in Ukraine

2.3. Philosophy of “green” buildings

3. Coffee break

4. Energy efficient solutions in the building sector

4.1. Energy efficient solutions in the building sector

4.2. Criteria for selecting of design solutions

4.3. Case studies on ready-to-use projects

5. Coffee break

6. Practical training in the Training Technological Centre

6.1. Specificities about production of polyvinylchloride windows

6.2. Materials used for assembly of polyvinylchloride windows

6.3. Testing windows at the stand

7. Heating systems. Water supply systems.

7.1 Selecting of heating and water supply systems.

Examples of using of heating and water supply systems.

7.2 Automatic management of a heating system.

8. Practical training in the laboratory of internal engineering networks

(7) WORKSHOP “DESIGN AND ASSEMBLY OF ALTERNATIVE ENERGY SOURCES” FOR NON-PROFESSIONAL DECISION-MAKERS (KEY EXECUTIVES AND REPRESENTATIVES OF GOVERNMENT INSTITUTIONS)

3 hours of training

1. Welcome remarks.

2. Specificities about design of solar collectors.

2.1 Quantitative and qualitative features of solar energy. Potential and its assessment, conditions under which solar collectors can be used.

2.2 Description of Vaillant solar panels.

2.3 Main economic indicators, payback period and calculation of main economic indicators.

2.4 Questions and answers.

3. Solar helio systems (DrainBack, auroTHERM).

3.1 Classification of helio systems (pressure, non-boiling).

3.2 auroSTEP as a system for warming water

3.3 Heat supply in the building with the help of the auroFLOW plus system.

3.4 Capacity of the auroTHERM pressure systems.

3.5 Schemes and solutions for using several energy sources in the building simultaneously.

3.6 Questions and answers.

4. Break.

5. Heat pumps (classification, types of primary heat energy sources).

5.1 Practical aspects of the heat pumps theory.

5.2 Description of COP of a heat pump.

5.3 Use of water as of a heat energy source.

5.4 Soil and its features in the heat intake for the heat pump.

5.5 How heat pumps work with air.

5.6 Selecting of capacity of a heat pump based on its operation regime (monovalent, divalent, etc.). The triVAI system and function of a divalent point – advantages and specificities.

5.7 Questions and answers.

TRAINING SCHEME

Training audience	(A)	(B)	(C)
Trainer ↓ No of hours per a tr.course →	44	44	32
University (KNUCA) (lectures), hours	16	24	16

REHAU (workshop), hours	8	4	4
HENKEL (workshop), hours	3	2	2
VAILLANT (workshop), hours	6	4	3
URSA (workshop), hours	1	1	1
WIENERBERGER (workshop), hours	3	3	1
A-CLIMA (workshop), hours	4	4	3
TechnoNIKOL (workshop), hours	2	1	1
Techno-Aliance (workshop), hours	1	1	1
Total duration, hours	44	44	32

(A) - Construction industry workers
(B) - Building industry professionals
(C) - Non-professional decision-makers

Training audience (A) →	Mon	Tue	Wed	Thu	Fri	Sat	Total hours
Trainer ↓ No of hrs a day →	8	8	8	8	8	4	
University (lectures), hrs	8	8					16
REHAU (workshop), hrs			8				8
HENKEL (workshop), hrs				3			3
VAILLANT (workshop), hrs					6		6
URSA (workshop), hrs				1			1
WIENERBERGER (workshop), hrs				3			3
A-CLIMA (workshop), hrs						4	4
TechnoNIKOL (workshop), hrs					2		2
Techno-Alliance (workshop), hrs				1			1
Total duration (workshop), hrs	8	8	8	8	8	4	44

Training audience (B) →	Mon	Tue	Wed	Thu	Fri	Sat	Total hrs
Trainer ↓ No of hrs a day →	8	8	8	8	8	4	
University (lectures), hrs	8	8	8				24
REHAU (workshop), hrs					4		4
HENKEL (workshop), hrs				2			2
VAILLANT (workshop), hrs					4		4
URSA (workshop), hrs				1			1
WIENERBERGER (workshop), hrs				3			3
A-CLIMA (workshop), hrs						4	4
TechnoNIKOL (workshop), hrs				1			1
Techno-Alliance (workshop), hrs				1			1
Total duration (workshop), hrs	8	8	8	8	8	4	44

Training audience (C) →	Mon	Tue	Wed	Thu	Fri	Sat	Total hrs
Trainer ↓ No of hrs a day →	8	8	8	8	0	0	
University (lectures), hrs	8	8					16
REHAU (workshop), hrs				4			4
HENKEL (workshop), hrs			2				2
VAILLANT (workshop), hrs				3			3
URSA (workshop), hrs			1				1
WIENERBERGER (workshop), hrs			1				1
A-CLIMA (workshop), hrs			3				3
TechnoNIKOL (workshop), hrs			1				1
Techno-Alliance (workshop), hrs				1			1
Total duration (workshop), hrs	8	8	8	8	0	0	32

Annex – Detailed content of training programs
Romania

A – Definition of training modules for Designers, consultants, building managers (specialists)

Module 1 – Nearly Zero Energy Buildings (nZEB). General specifications

- ✓ **No. of hours:** 3
- ✓ **Knowledge, skills**
  - International measurement unit system (SI):
    - base units, measuring instruments,
    - derived units.
  - SI derived units with special names and symbols (Watt, Joule, Pascal, lux, lumen etc.);
  - Units related to energy consumption in buildings (exercises for calculation and conversion);
  - The principles of thermodynamics; Basics of heat transfer,
  - Defining nZEB: concept, performance levels and general requirements for the building envelope and related technical systems;
  - Very low energy required for heating / cooling (e.g. passive house), climate independent: the ratio between heat load for space heating and heat flow that can be supplied to the building using the flow of fresh air required to ensure the indoor air quality requirements;
  - The indoor microclimate:
    - Hygiene criteria, fresh air requirements for a person, extracted airflows and minimum air exchange rates,
    - The relationship between the indoor relative humidity and efficient air exchange; for temperate to cold climates, especially in cold conditions.
  - The low energy building required characteristics: passive house, specific energy use.
- ✓ **Acquired Competence:**
  - ➢ Definition of nZEB: concept, principles, criteria and levels of performance.
- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Use the system of units of measurement,
- Explain the principles of thermodynamics and basics of heat transfer,
- Present the concept of nZEB,
- Identify critical features for a building with nearly zero energy consumption,
- Define the indoor climate of nZEB,
- Understand the interdependence of the characteristic parameters of the indoor climate,
- Present the criteria for defining a passive house / nZEB.

- ✓ **Teaching materials:** manual, PowerPoint presentation, specific legislation, worksheets, specialty drawings.
- ✓ **Evaluation** - formative evaluation, direct observation, test (case study).

Module2 - NZEB principles of envelope insulation. Thermal bridges

- ✓ **No. of hours: 6**
- ✓ **Knowledge, skills**

Unit	Content	No. of hours
M2-1.1	NZEB envelope; the influence of the thickness and properties of materials used for insulating layer in order to achieve a complex and performance envelope	0,5
M2-2.1	Suitable thermal insulating materials available on the market and their properties	0,5
M2-2.2	The relationship between U-value (coefficient that characterizes the specific heat loss) and indoor surface temperatures of building elements	0,5
M2-4.1	Qualitative analysis of a building envelope for assessing the thermal bridges potential (examples of calculation)	0,5
M2-2.3	U-value coefficients for the opaque components of the nZEB envelope in climatic conditions specific to Romania and insulation thicknesses typical for these values (examples of calculation)	1,0
M2-3.1	Lightweight or massive constructive solutions for nZEB in climatic conditions specific to Romania	0,5
M2-3.2	Thermal bridges related heat transfer coefficients (interior and exterior dimensions)	0,5
M2-4.2	Principle for thermal bridges free construction, quantitative assessment of practical situations of thermal bridges	1,0
M2-5.1	Analysis of thermal bridges to design the building envelope	0,5
M2-5.2	Develop solutions for balcony in order to avoid / reduce thermal bridges.	0,5

- ✓ **Acquired competence:**
  - ➢ Check the principle of thermal insulation and nZEB opaque envelope to avoid thermal bridges
- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Understand the principle of high thermal performance building envelope,
- Understand the relationship between U-values and temperature values of the indoor surfaces of the construction elements,
- Become familiar with U-values and indoor surfaces temperatures of the construction elements,
- Calculate U-value coefficients for opaque components of the nZEB envelope,
- Present design solutions for buildings specifics to Romania,
- List the related heat transfer coefficients of thermal bridges,
- Understand the principle of building envelope without thermal bridges,
- Assess in quantity and quality the building envelope.

- ✓ **Teaching materials:** manual, PowerPoint presentation, data sheets for materials, worksheets, specialty drawings, demonstration materials
- ✓ **Evaluation** - formative evaluation, direct observation, test (case study).

Module 3 - Airtightness of the nZEB

- ✓ **No. of hours: 6**
- ✓ **Knowledge, skills**

Unit	Content	No. of hours
M3-1.1	Building envelope, ensuring the airtightness of buildings, its influence on obtaining nearly-zero energy consumption	1,0
M3-1.5	Planning principles regarding the airtightness of the building envelope	0,5
M3-2.1	General methods for the evaluation of airtightness and requirements	0,5
M3-1.2	Lightweight or massive constructive solutions for securing the airtightness in a building; criteria for selecting appropriate solutions for achieving tight joints	0,5
M3-1.3	Measures for sealing / air sealing in case of leaks; Typical weak points in case of poor airtightness	0,5
M3-2.2	Test procedures to measure airtightness and requirements	1,0
M3-3.1	Typical spots that generate air leakage (e.g. nail holes, power sockets, window connection joints , unrendered external walls surfaces, loose foil, unsealed penetrations and openings, unsealed downpipes)	0,5
M3-3.2	Permanent solutions for the airtight of typical air leaks	0,5
M3-4.1	Evaluation methods in difficult cases of leaks (timber floors in massive buildings, unrendered external walls behind interior finishes (e.g. stairs), the usual penetrations (e.g. continuous rafters)	0,5
M3-4.2	Avoiding problematic air leaks	0,5

- ✓ **Acquired competence:**
  - ➢ Check the airtightness of a thermal envelope of nZEB.
- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- 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,
- Use evaluation methods for air leakage identification,
- Provide solutions for challenging air leaks.

- ✓ **Teaching materials:** manual, PowerPoint presentation, data sheets for materials, worksheets, specialty drawings, models and demonstration materials
- ✓ **Evaluation** - formative evaluation, direct observation, test, practical examination (case study)

Module 4 - Transparent building elements. U-values of the windows

- ✓ **No. of hours:** 6
- ✓ **Knowledge, skills**

Unit	Content	No. of hours
M4-1.1	The composition of the windows systems for passive house / nZEB: ▪ required specifications for a window in a house passive / nZEB (knowledge of specific values), ▪ influence of geometrical frame / edge system, ▪ Ug, Uf and Ψg values and heat transfer coefficients of installation thermal bridges Ψmont	1,0
M4-2.1	The difference between the windows certification for passive house / nZEB and the approval of windows installation details	0,5
M4-3.1	Indoor comfort criteria (temperatures of external surfaces of windows suitable for passive houses / nZEBs)	0,5
M4-1.2	Thermal performance parameters for curtain wall systems	0,5
M4-3.2	Estimation and evaluation of a window frame ratio	0,5
M4-4.1	Glazing systems with three layers and low emissivity (low-e), the main mechanisms of heat transfer in windows (heat conduction through layers filled with gas, heat radiation from glazed surfaces including low-e treated surfaces, convection)	1,0
M4-4.2	The purpose of a system that produces an insulating glazing (e.g. spacers), optimizing the closing system (warm edge)	0,5
M4-5.1	Solutions for reducing heat transfer coefficient of thermal bridges at the outline of a glazing (warm edge, frame ratio for a window)	0,5
M4-5.2	Automatic calculation tools used to determine the U-value of a window	1,0

- ✓ **Acquired competence:**
  - ➢ Evaluate the performance of windows / external glazing elements adequate for nZEB.
- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Describe the characteristic elements of windows systems for nZEB / passive house,
- Describe the technical performance parameters for curtain wall systems,
- Understand the difference between certification and approval for nZEB windows details installation,
- Describe indoor comfort criteria,
- Determine the ratio of the window frame,
- Describe the 3 layers glazing structure with low emissivity,
- List the mechanisms of heat transfer in low-e windows,
- Explain the purpose of making an insulation system,
- Present solutions for reducing the heat transfer coefficient on the windows,
- Use automated tools for the calculation of U value.

- ✓ **Teaching materials:** manual, PowerPoint presentation, data sheets, low-e windows, worksheets, specialty drawings, models and demonstration materials
- ✓ **Evaluation** - formative evaluation, direct observation, test, practical examination (case study)

Module 5 - Heat gain through windows and other external transparent elements

- ✓ **No. of hours:** 6
- ✓ **Knowledge, skills:**

Unit	Content	No. of hours
M5-1.1	Determination of light and sound glazing properties (SR EN 410-2011), g values expressed by two significant figures	0,5
M5-2.1	Factors that reduce solar gains (angle of incidence, dirt, frame ratio, shading, reflection)	0,5
M5-3.1	Typical examples of energy transmission through windows (day winter cold, winter day, average summer day)	0,5
M5-4.1	Influence of building orientation on solar energy supply	0,5
M5-1.2	The difference between the g value and the luminous transmittance (ISO 9050). Usual values for different types of glazing	0,5
M5-2.2	Estimation and evaluation of window frame ratio;	0,5
M5-3.2	Energy balance for glazing Ug - 1.6 W/(m²K) • g ≤ 0 and its implementation	1,0
M5-4.2	Influence of temporary building shading (self-shading) on the provision of solar energy	0,5
M5-4.3	Automatic calculation tools used to assess window shading	1,5

- ✓ **Acquired competence:**
  - ➢ Evaluate heat gains through the building envelope in nZEB.
- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Define luminous and solar characteristics of glazing,
- Submit typical values for different glazing,
- Identify factors that can reduce solar gains,
- Determine the ratio of the window frame,
- Use the results of an energy balance for glazing
- Describe the factors that influence the supply of solar energy in buildings,
- Use automatic calculation tools for assessment the window shading.

- ✓ **Teaching materials:** manual, PowerPoint presentation, SR EN 410 standard, data sheets for low-e windows, worksheets, specialty drawings, models and demonstration materials, software
- ✓ **Evaluation** - test, practical examination (case study)

Module 6 - Ventilation for nZEB

Module 6.1 - Ventilation - General

- ✓ **No. of hours:** 2
- ✓ **Knowledge, skills**
  - The main indoor air pollutants;
  - CO_2 concentration criteria for buildings;
  - The relationship between indoor air humidity and moisture sources inside buildings;
  - Fresh air flow for proper ventilation;
  - Determining the flow of fresh air and outdoor temperature;
  - Reasons for limitation of the air flow even in winter;
  - How can the ventilation flow be increase when required in special (urgent) cases?
- ✓ **Acquired competence:**
  - ➢ Identify pollution factors and ventilation rates in nZEB.
- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Present the indoor air pollutants,
- Explain the relationship between parameters and sources of moisture / nZEB,
- Determine the fresh air flow for ventilation,
- Explain situations when ventilation airflow can be limited / increased.

- ✓ **Teaching materials:** manual, presentation PowerPoint, worksheets for calculating airflow, specialty drawings, models and demonstration materials
- ✓ **Evaluation** - formative evaluation, direct observation test

Module 6.2 – Natural ventilation

- ✓ **No. of hours:** 1
- ✓ **Knowledge, skills**
  - The driving force of natural ventilation / without mechanical drive;
  - Natural ventilation organized / unorganized. Joints and openings/cracks, tilted windows, space ventilation by windows opening;
  - Factors affecting natural ventilation; ventilating rate / air exchange (qualitative aspects);
  - Why natural ventilation of nZEB / passive houses is not adequate in areas characterized by very high heating degree days (unreliability, heat losses).
- ✓ **Acquired competence:**
  - ➢ Evaluate the operating conditions of a natural ventilation system.
- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Describe factors that influence a ventilation system,
- Describe the natural ventilation systems,
- Explain the link between the number of degree days and the choice of natural ventilation system.

- ✓ **Teaching materials:** manual, PowerPoint presentation, specialty drawings - buildings, material demonstration.
- ✓ **Evaluation** - formative evaluation, direct observation, test

Module 6.3 – Exhaust ventilation systems

- ✓ **No. of hours:** 2
- ✓ **Knowledge, skills**
  - Ventilation system by extraction (exhaust systems): air supply areas, air transfer and air extraction (identifying the areas on a building plan);
  - Structure of the exhaust ventilation system: air inlets and exhaust air fans, filters;
  - The advantages of air exhaust equipment vs natural ventilation;
  - Failure to use the exhaust ventilation systems in nZEB / passive houses located in areas characterized by very high number of degree days (heat loss).
- ✓ **Acquired competence:**
  - ➢ Evaluate the operating conditions of a exhaust ventilation system.
- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Explain the principle of achieving an exhaust ventilation system,
- List the components of the exhaust ventilation system,
- Identify the advantages of air exhaust equipment compared to natural ventilation
- Present the elements of the exhaust ventilation system,
- Explain the reasons why in areas with high heat losses this system of ventilation is not used,
- Explain the link between the number of degree days and the choice of natural ventilation.

- ✓ **Teaching materials:** manual, PowerPoint presentation, specialty drawings - buildings, exhaust ventilation drawings, demonstration materials, standard SR 4839: 2014
- ✓ **Evaluation** - formative assessment, direct observation, test

Module 6.4 – Balanced supply and exhaust ventilation systems with heat recovery

- ✓ **No. of hours: 5**
- ✓ **Knowledge, skills-**
  - The general scheme of a balanced supply and exhaust air system (occupied buildings): areas for air supply, air transfer and air extraction (the ability to identify the areas on a building plan);
  - Main components: supply air inlets, supply air ducts, openings for air transfer, extraction air outlets, extract air ducts, silencers, fresh air and exhaust air filters, AHU (and its components), typical dimensions of ventilation devices;
  - Effects of air circulation, the Coanda effect;
  - The potential and the limits of decentralized ventilation systems; Common solutions; introduction and extraction points on the building plans;

- The characteristics of required filters and their necessity;
- Hygiene requirements for ventilation systems in nZEB / passive houses (without cooling, without drying and active humidification, continuous functioning / dry, clean air filter upstream EU-class F7 or better) and explain the reasons therefor;
- Outdoor air inlets: factors to be taken into account (filters, hygiene requirements (location of fresh air inlets), weather, protection against condensation and frost, sound insulation);
- Basic information regarding designing the air duct network (short length, smooth surfaces, fittings, typical cross sections, airtightness);
- Conditions that require air duct insulation and how to properly execute it (generally: cold ducts in warm spaces in case of recooling or reheating, additional protection against condensation);
- Central ventilation units suitable for nZEB / passive houses;
- Calculation for heat recovery efficiency (dry system); how to calculate the specific electricity consumption (significance and importance of the calculation);
- Construction of the central unit, basic knowledge on the principles of protection against noise;
- The appropriate manner of inserting the ventilation units parameters in automatic calculation tools for evaluating nZEB / passive houses;
- Adjusting initial flow in ventilation systems; importance of ventilation balance; setting mode / setting the ventilation systems.

✓ **Acquired competence:**

- Evaluate the operating conditions of a balanced supply and exhaust ventilation system with heat recovery.

✓ **Learning outcomes**

On completion of the module participants should be able to:

- Describe a balanced supply and exhaust air system (occupied buildings),
- Identify the air inlet and outlet points,
- Present the main components of the system,
- Explain the effects of air flow in the building,
- Present the potential and limits of decentralized ventilation systems,
- Explain the role of filters in the system,
- List the hygiene requirements for ventilation systems for various situations,
- Identify factors influencing air hygiene requirements,
- Apply the basics of sizing the duct network,
- Explain when it is necessary the insulation of ducts,
- Describe the manner of air ducts insulation,
- Calculate the heat recovery efficiency and specific energy consumption,
- Describe the components of central ventilation units,
- Present the noise protection principles,
- Describe the process of adjusting the flow for ventilation systems,
- Use computational tools to evaluate ventilation performance in nZEB.

✓ **Teaching materials:** manual, PowerPoint presentation, specialty plates - buildings, dual flow ventilation scheme with heat recovery, demonstration materials, data sheets, equipment / materials for double flow ventilation systems, demonstration materials for dimensioning, layout

✓ **Evaluation** - formative assessment, direct observation, test, practical test (case study)

Module 7 – Heating principles in passive houses / nZEB

- ✓ **No. of hours: 3**
- ✓ **Knowledge, skills**
  - Thermal comfort requirements (ISO SR 7730);
  - Thermal heating load and the difference between "heating load" and "space heating demand";
  - Indoor thermodynamic parameters in buildings "operative temperature", "design indoor temperature", "air temperature", "average radiant temperature";
  - Draughts and their significance;
  - Calculation of the maximum difference between the indoor air temperature and average temperature of interior surfaces in a passive house / nZEB (performing qualitative estimates);
  - The influence of heating / cooling distribution to achieve thermal comfort in a passive house / nZEB;
  - Typical heating loads;
  - Classification of typical heat distribution systems suitable for nZEB / passive house, factors to be taken into account in consideration of space heating appliances (effective heating capacity based on air flow rate);
  - Heat distribution systems in nZEB / passive house:
    - factors to be considered when designing the heat distribution system and central heat generating equipment (total load),
    - conditions in which the positioning of radiators is required under exterior windows.
  - Schematic representation of a heat distribution system on nZEB building plan / passive house,
  - Factors that should be considered when designing heat distribution system and central heat generating equipment (total load),
  - Limitations to increase the air flow introduced into the conditioned space,
  - Factors that may influence the maximum heat load for heating: significant air leaks, opened windows for limited periods of time, opening of the entrance door,
  - Limitations of heating systems with warm air distribution (independent rooms, extraction rooms) solutions for these situations, the importance of correct placement of the thermostat in a dwelling unit.
- ✓ **Acquired competence:**
  - ➢ Choose appropriate systems for space heating in a passive house / nZEB.
- ✓ **Learning outcomes**

  On completion of the module participants should be able to:
  - List the thermal comfort requirements - SR ISO 7730,
  - Explain the difference between “heating load” and "space heating demand",
  - Present the indoor thermodynamic parameters of buildings,
  - Perform simple calculations for finding the maximum temperature difference,
  - Present factors that influence thermal comfort in buildings,
  - Present typical thermal loads,
  - Classify heat distribution systems for nZEB,
  - Present factors to be taken into account in designing the heat distribution,
  - Represents schematically a system for heat distribution,

- Present limitations for warm air distribution systems,
- Correct positioning of a thermostat in a dwelling unit.

✓ **Teaching materials:** manual, PowerPoint presentation, SR ISO 7730 standard, specialty drawings - buildings, scheme with heating systems, data sheets, equipment / materials for heating systems, equipment demonstration models

✓ **Evaluation** - formative assessment, direct observation, test, practical test (case study)

Module 8 - Solar shading and summer comfort

✓ **No. of hours:** 4

✓ **Knowledge, skills**

- Heat gains in summer, the explanation of their high values, the relationship between building orientation and heat gains in summer (qualitative understanding);
- Effective solutions avoid overheating due to solar gains in summer (qualitative analysis), limitations on transparent surfaces without temporary shading devices;
- Differences between internal and external temporary shading;
- Automatic calculation tools used to assess shading in summer;
- Thermal comfort standards [SR EN ISO 7730, CR SR 1752, SR EN 15251];
- Factors influencing indoor comfort during summer (qualitative understanding):
  - Air exchange - assessment methods; how can the airflow be increased?
  - Solar loads: significance, importance of building orientation and transparent surfaces, shading, temporary shading, effectiveness of indoor and outdoor blinds,
  - Impact of indoor heat sources; how can they be reduced?
  - Impact of exterior colours,
  - Impact of thermal insulation,
  - Impact of thermal masses inside the building; what happens in the case of strongly fluctuating internal loads?

✓ **Acquired competence:**

➢ Provides shading solutions for summer comfort.

✓ **Learning outcomes**

On completion of the module participants should be able to:

- Explain the link between the orientation of the building and heat gains in summer,
- Provide solutions which avoid overheating in summer,
- Explain the differences between the indoor and outdoor temporary shading,
- Apply the standards of thermal comfort,
- Describe the factors that influence thermal comfort.

✓ **Teaching materials**: Manual, PowerPoint presentation, standards, data sheets for shading elements, worksheets, specialty boards, models and demonstration materials, computer programs

✓ **Evaluation** - test

Module 9 - Electricity consumption

- ✓ **No. of hours:** 2

- ✓ **Knowledge, skills**

  - Characteristics of electrical energy (versatile and effective, high primary energy input associated with its generation);
  - Why is energy efficiency especially important when it comes to electrical energy?
  - Typical electrical consumption of a Passive House's building services (auxiliary electricity) ;
  - Energy efficiency requirements for auxiliary power consumption;
  - Typical electrical appliances in homes;
  - Improving the energy efficiency of domestic appliances;
  - Typical electrical appliances in offices (interior lighting, IT);
  - Improving energy efficiency in offices; why is it such an important issue?

- ✓ **Acquired competence:**

  - ➢ Evaluate solutions for reducing electricity consumption in nZEB.

- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Present the characteristics of electricity consumption in buildings,
- Define energy efficiency in buildings,
- Show typical power consumptions for various buildings,
- Describe solutions to improve energy efficiency in buildings.

- ✓ **Teaching materials:** manual, PowerPoint presentation, demonstration materials

- ✓ **Evaluation** - formative assessment, direct observation, test, practical examination (case study)

Module 10 - Principles of energy balancing

- ✓ **No. of hours:** 4

- ✓ **Knowledge, skills**

  - Principles of energy balancing: volumes and limit conditions (envelope, dimensions) for energy balance, energy balance equations;
  - Heat losses, dissipated energy: transmission, ventilation;
  - Energy gains: internal heat sources, passive solar gains, space heating;
  - Calculation of transmission and ventilation losses; estimating their significance;
  - Calculation of a window's U-value; calculation of solar heat gains, especially taking into account shading;
  - Significance of internal heat sources;
  - Calculation of the heating load; degree days;
  - Determining the required capacity of a ventilation system;
  - Heat dissipation of hot water pipes and storage tanks;
  - Compact building services units in passive houses;
  - How to deal with products that are not certified (guarantee of accuracy of specified values, plausibility check).

- ✓ **Acquired competence:**

  - ➢ Performs nZEB energy balance.

- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- List the principles of energy balance,
- Perform calculations for energy balance,
- Describe the factors that influence the energy balance,

- ✓ **Teaching materials:** PowerPoint presentation, manual, spreadsheets, specific standards, building plans

- ✓ **Evaluation** - formative assessment, direct observation, test, practical examination (case study)

Module 11 - Basics of economic efficiency calculation

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Payback period, net present value method, annuity method;
  - Correct determination of excess investment;
  - Life cycle assessment;
  - Cost-effective insulation levels; applications;
  - Energy cost savings compared to the cost and the unit of consumed energy.

- ✓ **Acquired competence:**

  - ➢ Apply the principles for calculating the economic efficiency of buildings to optimize the global cost during the life service of a building.

- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- To assess the key economic parameters: payback period, net present value,
- Establish effective thermal insulation levels in economically feasibility conditions,
- To compare the cost of saved energy with the unit cost of consumed energy.

- ✓ **Teaching materials:** manual, presentation PowerPoint, investment calculation sheets, demonstration materials calculation of investment efficiency

- ✓ **Evaluation** - test, case study

Module 12 - Develop specifications for procurements

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Detailed specifications for all products and services (specific values) and defining categories of products / services;
  - The allocation of responsibilities;
  - Clarify boundaries between specialties in complex cases; factors to be taken into account;
  - Liability, for example on the airtightness of the building envelope and systems (cross-specialties).

- ✓ **Acquired competence:**

  - ➢ Define performance criteria for nZEB in preparing specifications for procurement.

- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Identify specifications for specific products and services,
- Identify the factors to be taken into account when completing specifications,
- Clarify responsibilities in the execution of works.

- ✓ **Teaching materials:** Manual, PowerPoint presentation, model specifications, specialized projects

- ✓ **Evaluation** - formative assessment, direct observation, test, practical test (case study)

Module 13 – Construction site management and quality assurance

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Involved trade sectors for construction site management and quality assurance;
  - Initial instructions for craftsmen;
  - Materials and services to be inspected and quality assurance methods;
  - Airtightness of surfaces and connection details / intersections;
  - Thermal bridge free design, avoiding penetrations that do not figure in the plans;
  - Window installation; frame and glazing qualities;
  - Thermal insulation, thermal conductivity of insulation materials, elimination of joints, application without air gaps;
  - Air ducts: no leakages, layout / dimensions in accordance with plans, insulation, prevention of condensation and protection against construction dirt, antistatic;
  - Space heating system: installation according to plans, complete insulation of heated pipes (including fixtures, pumps etc.), running times of pumps, test run;
  - Hot water system: installation according to plans, complete insulation of heated pipes (including fixtures, pumps etc.), running times of pumps, test run;
  - Required quality assurance procedures (pressure test [appropriate timing], specific dates for the quality assurance for the window installation, airtight layer, insulation, air ducts, inspection of the ventilation unit);
  - Handing over the building at an appropriate interior temperature (warm in winter and cool in summer periods).

- ✓ **Acquired competence:**

  - ➢ Ensure quality procedures by type of work performed - particularities for nZEB.

- ✓ **Learning results**

On completion of the module participants should be able to:

- Identify the specialties involved in the construction activity,
- To provide quality assurance methods for materials,
- List the elements that ensure the quality of execution of airtightness,
- List the elements that ensure the quality of execution of ventilation,
- Describe the quality assurance procedures according to the stages of assembly of building elements and systems.

- ✓ **Teaching materials:** Manual, PowerPoint presentation, project execution installation of ventilation, heating, execution details, models of quality procedures (minutes, sheets of material)

- ✓ **Evaluation** - formative assessment, direct observation, test, practical test (case study)

Module 14 - Refurbishments using nZEB components

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Minimum requirements (reference levels) for energetic rehabilitation in terms of nZEB/passive house:
    - Annual space heating demand: $q_{max,\ heat} \leq 15\ kWh/(m^2a)$,
    - OR: Components according to the cost optimum (life cycle based), standard values,
    - Airtightness: target value: $n_{50} \leq 0.6\ h^{-1}$ | required value: $n_{50} \leq 1.0\ h^{-1}$.
  - Advantages of using Passive House/nZEB components;
  - Examples of completed Passive House/nZEB renovation projects;
  - Typical thermal bridges and effective solutions;
  - Special challenges concerning interior insulation (humidity).

- ✓ **Acquired competence:**

  - ➢ Identify the nZEB elements to rehabilitate existing buildings.

- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Identify the minimum requirements for the reference levels nZEB type buildings,
- Describe the particularities of the nZEB refurbishment.

- ✓ **Teaching materials:** Manual, PowerPoint presentation, renovated houses projects, demonstration materials

- ✓ **Evaluation** - direct observation, test, practical test (case study)

Module 15 - Information and support for nZEB occupants

- ✓ **No. of hours:** 2

- ✓ **Knowledge, skills**

  - What kind of information do occupants of Passive Houses/nZEB need?
  - Opening windows: effect during winter and summer periods;
  - Temporary shading: effect during winter and summer periods;
  - Ventilation unit: it is not an air conditioning system; maintenance requirements: changing filters;
  - Permanent use or shutdown with dry filters;
  - How to avoid dry air in winter;
  - Information sources.

- ✓ **Acquired competence:**

  - ➢ Provides support to nZEB users.

- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- To present simple elements that can positively influence energy consumption;
- Present recommended equipment for building and their mode of operation nZEB.

- ✓ **Teaching materials:** manual, PowerPoint presentations, flyers concept, worksheets, demonstration materials, specialized data sheets

- ✓ **Evaluation** - test (case study)

Module 16 - Principles and overall solutions for the use of renewable energy sources in nZEB

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Functional schemes for use of equipment using renewable sources;
  - Using solar energy - solar collectors for DHW and space heating;
  - Using photovoltaic systems for electricity use;
  - The use of biomass in heating plants;
  - The use of heat pumps;
  - Hybrid heating system;
  - Using wind energy and related facilities;
  - Integration of renewables for heating, ventilation and domestic hot water in buildings.

- ✓ **Acquired competence:**

  - ➢ Apply the principles of integration of renewable energy in nZEB.

- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Understand the importance of using RES sources for heating, ventilation and DHW,
- Interpret technical diagrams that use renewable energy sources systems,
- Understand the role and importance of integrating solar energy, heat pumps, biomass in buildings,
- Check the integration of RES installations to the electricity grid connections.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, models, data sheets, specialty boards - plans and details assembly operation schemes

- ✓ **Evaluation** - formative assessment, direct observation, written test, practical test (case study)

Module 17 - Heating and DHW operating on biomass

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - The definition of biomass produced in a sustainable manner for use in energy applications;
  - Biomass and sustainability: CO_2 emissions;
  - Types of biomass, classification, advantages, disadvantages, storage;
  - Composition and functioning of a compact combustion wood / pellet;
  - Configuration of typical installation with an integrated pellet burning appliance;
  - Connection of burning appliances in hot water installations;
  - Connection of combustion appliances in space heating mode;
  - Basic requirements for safety, occupational health and fire protection in facilities with biomass.

- ✓ **Acquired competence:**

  - ➢ Analyse systems operating on biomass for space heating and DHW preparation.

- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- Identify the resources related to biomass,
- List the advantages / disadvantages of using biomass as an energy source,
- Describe a compact combustion wood / pellet,
- To provide basic requirements for the safety, occupational health and fire protection equipment for burning pellets,
- Interpret technical documentation for connecting burning appliances,
- Identify the steps for connecting burning appliances.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, data sheets, specialty drawing boards - Operating scheme

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

Module 18 - Heating equipment with heat pumps

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Heat pump-use areas, the role of the heat pump, classification;
  - Composition, operation and evaluation of compact heat pump units;
  - Principles of heat pump systems and configuration;
  - The composition and operation of a heat pump unit connected to a ground source heat exchanger ;
  - The composition and operation of a heat pump unit connected to an aquifer heat source;
  - Space heating / cooling;
  - Connecting the pump to the technical system of a building - DHW preparation;
  - Installation of heat pumps;
  - Basic requirements for safety, occupational health and fire protection.

- ✓ **Acquired competence:**

  - ➢ Analyse the functioning of the heating / cooling heat pump.

- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- Classify heat pumps according to several criteria,
- Describe the operation of a heat pump units connected to different heat sources,
- Describe the composition and functionality of a heat pump.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials and models, specialized data sheets, drawings - operating scheme

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

Module 19 - Mini-Wind systems for buildings

- ✓ **No. of hours: 6**
- ✓ **Knowledge, skills**
  - Wind energy - general concepts;
  - Wind power stations and wind turbines, classification, description, operation, advantages and disadvantages;
  - The wind turbine: technical and functional parameters;
  - Wind turbines for small power;
  - Integration into the power grid system.
- ✓ **Acquired competence:**
  - ➢ Analyse the performance and operation of wind turbines.
- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- List the components of the wind turbine / system,
- Describe the function of the wind turbine / system,
- Specify the functional and technical parameters of the wind turbine,
- Identify solutions for deploying, using the wind turbine to obtain electric energy.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, models, data sheets, drawings with details of fitting
- ✓ **Evaluation** - formative assessment, direct observation, written test, practical test (case study).

MODULE 20 - Solar electricity generation - PV systems

- ✓ **No. of hours: 6**
- ✓ **Knowledge, skills**
  - Sunlight, solar radiation;
  - Converting solar energy into other forms of energy;
  - Components of a photovoltaic system; solar system operation;
  - Solar panels, classification, construction, operation;
  - Technical solutions for carrying solar installations to produce electricity
  - Technical solutions for connecting the plant to the electricity consumers;
  - Installation of solar panels;
  - Connection of existing installations of solar panels, operation and maintenance of photovoltaic panels.
- ✓ **Acquired competence:**
  - ➢ Analyse PV systems for nZEB.
- ✓ **Learning outcomes:**
  - On completion of the module the participants should be able to:
  - To 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,
  - Describe the operating principle of a PV system,
  - Read the specialized technical documentation
  - Describe the facility for producing electricity using solar systems,
  - Identify stages of fitting a PV system,
  - Comply with the maintenance and operation stages of photovoltaic panels.
- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, models, data sheets, drawings with fitting details
- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

Module 21 – Thermal solar systems

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Sunlight as heat energy, solar radiation;
  - Converting solar energy into other forms of energy;
  - Components of a solar thermal installations; Solar system operation;
  - Solar collectors, classification, construction, operation;
  - Technical solutions for carrying solar installations for water heating;
  - Technical solutions for the preparation of DHW and heating;
  - Installation of solar collectors; tight and free of thermal bridges connection of the penetrations of a pipes installation;
  - Connection of existing systems of solar panels, commissioning of solar system.

- ✓ **Acquired competence:**

  - ➢ Analyse solar thermal systems for nZEB.

Learning outcomes:

On completion of the module the participants should be able to:

- 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 systems,
- Describe the facility for preparing energy carrier for space heating using solar systems,
- Identify key phases for installation of a solar system,
- Present steps to connect the collectors to the interior system.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, models, data sheets, drawings with fitting details

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

Module 22 – Nearly zero energy building in the concept of green building

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Green Building: concept, elements, characteristic of green buildings;
  - Characteristics of green buildings with low energy demand;
  - Requirements for suitable materials for green building; available materials (on the market) used for green buildings;
  - Principle of realization of the building envelope from thermal point of view;
  - Alternative energy sources: heat pumps, solar collectors, photovoltaic panels,
  - Green building certification;
  - Benefits of Green Buildings: lifetime costs of green buildings compared to a usual building, insulation, windows, airtightness;
  - The legal framework of green building certification and nearly zero energy buildings.

- ✓ **Acquired competence:**

  - ➢ Define the concept of green building and relationship with nearly zero energy building.

- ✓ **Learning outcomes**

On completion of the module participants should be able to:

- Define a green building,
- Present materials available that can be used in the construction of green buildings,
- Identify the typical values of thermal performance of materials,
- Identify the stages of realisation of a green building envelope,
- Presenting technical solutions to eliminate thermal bridges in green buildings,
- Identify sources of alternative energy for green buildings,
- Understand technical documentation for RES systems,
- Provide the legal framework for the certification of green buildings,
- List the economic benefits that can be achieved by building a green house.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, data sheets, specialty boards - execution details, functioning schemes of the installations

- ✓ **Evaluation** - test (case study)

B – Definition of training modules for On-site Construction Crafts & Professions

MODULE 1– Nearly Zero Energy Buildings (nZEB) – general specifications

- ✓ **No. of hours:** 3
- ✓ **Knowledge, skills**
  - Defining the nearly zero energy building: concept, performance levels and general requirements for the building envelope and the building related services/systems;
  - The characteristics of a building with low energy demand: Passive house; Specific energy consumption;
  - The principles for achieving nZEB performance:
    - very well insulated building envelope,
    - thermal bridges free construction,
    - airtightness,
    - solar energy contribution through windows,
    - ventilation with heat recovery,
    - use of renewable energy sources.
  - The benchmarking values for passive house;
  - Ecology and comfort:
    - Energy use, climate, CO_2, energy saving potential,
    - Comfort of living and healthy indoor climate.
  - nZEB advantages: costs during the lifetime of an nZEB building type compared with a typical building, insulation, windows, airtightness.
- ✓ **Acquired competence:**
  - ➢ Define nZEB: concept, criteria and performance.
- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- 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,
- To identify requirements for comfort in passive house / nZEB,
- To identify the performances that define nZEB.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, plans, details of execution of a building
- ✓ **Evaluation** - test

✓

MODULE 2 – NZEB principle of envelope insulation. Thermal bridges

- ✓ **No. of hours: 6**
- ✓ **Knowledge, skills**
  - The principle of thermal building envelope;
  - Overview of commercially available insulating materials and their properties; properties of different construction materials;
  - Thermal conductivity, U-value simplified calculation;
  - Typical U-values for nZEB climatic conditions specific to Romania and typical insulation thicknesses to achieve these values;
  - What is a thermal bridge?
  - Damage to the building due to thermal bridges, envelope surface temperatures;
  - Basic rules to avoid thermal bridges;
  - Installing windows with minimal thermal bridges;
  - Evaluation of heat losses by transmission through thermal bridges for different situations;
  - Basic requirements for safety, occupational health and fire protection.
- ✓ **Acquired competence:**
  - ➢ Verify the nZEB opaque envelope thermal insulation and thermal bridges avoidance principles.
- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- Understand the principle of achieving high thermal performance envelopes,
- Understand how to evaluate the performance of an envelope element and know the typical values and the effects of thermal bridges,
- Apply proper thermal insulation and avoid thermal bridges and their negative effects,
- Read technical documentation of a building,
- Apply basic requirements for safety, occupational health and fire protection,
- Organize the work.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials and mock-ups, technical data sheets for materials; Thermography camera; plans with execution details
- ✓ **Evaluation** - test, practical application(case study)

MODULE 3 – Airtightness in nZEB

- ✓ **No. of hours:** 6
- ✓ **Knowledge, skills**
  - The need to ensure the airtightness in a building;
  - The principle of an airtight layer (red pencil method and sealed single layer);
  - The difference between airtightness and wind resistance;
  - Typical weak points in case of poor airtightness;
  - Methods for measuring airtightness: blower door test, alone and coupled with thermal imaging;
  - Procedures for measuring airtightness test (preparation, execution, the order of magnitude of errors), typical measurement results, methods of detecting weaknesses;
  - Evaluation of different types of leaks;
  - Suitable materials and unsuitable materials for airtight surfaces and connections (for different construction methods, such as massive, lightweight and mixed buildings), suitable airtightness measures for penetrations, special products;
  - Procedures / work flow sequence with reference to airtightness;
  - Stability of solutions for airtightness.

- ✓ **Acquired competence:**
  - ➢ Verify the application of principle for building envelope airtightness in nZEB.
- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- List the methods used to measure airtightness,
- Provide procedures which can be used for measuring the airtightness,
- Avoid / eliminate successfully heat loss areas,
- Identify suitable materials to ensure airtightness,
- Identify solutions to achieve the correct airtightness.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, technical data sheets for materials; airtight room, blower door testing equipment, working benches, Thermography camera; plans with execution details, tightness measuring device, plans, execution details of a building

- ✓ **Evaluation** - test, direct observation(case study)

MODULE 4 - Windows and other transparent exterior elements

- ✓ **No. of hours:** 6
- ✓ **Knowledge, skills**
  - The general function of a window, and in relation to the passive house / nZEB: visibility from the outside, thermal protection, solar gains, ventilation during the day and night;
  - Thermal comfort in a passive house / nZEB and requirements for windows, the windows temperatures;
  - General requirements for windows and requirements for passive house / nZEB: airtightness, insulation (U-value), transparency, the possibility of opening and shading when necessary, way of installing minimized / without thermal bridges, ensuring airtight installation;
  - Glazing and insulating profiles, overview of requirements, g value;
  - Insulation characteristics of the windows: U-value, diverse influences on overall U value of a window, a window U value determination using automatic calculation tools;
  - Joinery / carpentry in windows systems: U value of the frame, making an appropriate passive house carpentry / nZEB influence width frame / edge;
  - Assembly without thermal bridges: carpentry covered by insulation, shading the window by the reveal, air-tightness of the window, airtight installation, glazing, the glazing edge;
  - The interaction of various influences: optimizing U-value and the Ug value for the glazing to window frame ratio a solar gains;
  - Skylights, roof windows installation, inclined glazing (U value changes);
  - Classification and certification of windows, energy efficiency classes for transparent building elements suitable for passive house / nZEB certification for use in passive house windows / nZEB, the use of certificate.

- ✓ **Acquired competence:**
  - ➢ Analyse the external windows / glazing elements that meet the nZEB conditions.
- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Provide the functions of the window to ensure thermal comfort in the building,
- Know the general and specific requirements for windows that are installed in a passive house/nZEB,
- Know the characteristics of thermal insulation of windows,
- Submit stages of windows installation with no thermal bridges,
- Explain the role of energy certificates for glazed components.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, models, working benches, technical data sheets for windows, drawings - plans and specialized installation details

- ✓ **Evaluation** - direct observation, test, practical application (case study)

MODULE 5 - Renovation of existing buildings using nZEB components

- ✓ **No. of hours:** 3
- ✓ **Knowledge, skills**
  - Advantages of renovating existing buildings using passive house/ nZEB suitable components with reference to the specific problems of old buildings: condensation and dampness, inadequate thermal comfort, poor air quality, high heating costs, environmental pollution;
  - Why it is not often possible to renovate buildings at passive house / nZEB standards?
  - Certification of energy performance for passive house / nZEB buildings, basic requirements and benefits;
  - Reference levels of thermal protection for all measures;
  - Potential for energy savings;
  - Addressing specific problems occurring in existing buildings:
    - Wall, basement ceiling/floor slab, roof, top floor ceiling, thermal bridges, windows (window installation position, daylight provision), airtightness, interior insulation (risks and disadvantages as well as saving potentials, diffusion-impermeable and diffusion-permeable superstructures);
  - Renovation in successive phases (step by step).

- ✓ **Acquired competence:**
  - ➢ Introduce nZEB solutions for the energy renovation of existing buildings.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Present the advantages of renovating a building,
- Interpret the energy audit certificate,
- Identify opportunities for energy savings.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, models, drawings - construction plans, technical data sheets for insulation materials, windows

- ✓ **Evaluation** - direct observation, test, practical application(case study)

MODULE 6 – Ventilation for buildings - basic principles

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Ventilation system in new nZEB buildings and renovated buildings with nZEB performance.
  - The relationship between airtightness, ventilation, humidity, air hygiene and the need for ventilation systems;
  - Indoor Air Quality;
  - The principle of cross ventilation - directed air flow;
  - Key components for achieving a ventilation system:
    - Central unit with heat exchanger,
    - Air ducts and cold pipe insulation, waterproof materials to diffusion,
    - Fresh air intakes and extraction / exhaust air,
    - Air transfer elements: understanding the need and types,
    - Outdoor air intakes and exhaust polluted air and their positioning.
  - The principle of heat recovery;
  - Interface of the building envelope: tight connections free of thermal bridges and penetrations for introduction of pipes for fresh air and exhaust air;
  - The need and possibilities for installation of ventilation systems in existing buildings.

- ✓ **Acquired competence:**

  - ➢ Analyse the structure and influence of a ventilation system in nZEB.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Submit features a ventilation system parameters,
- Describe the principle of cross ventilation,
- List the components of a ventilation system,
- Describe key components operation belonging to a ventilation system,
- Identify critical elements in the installation of the ventilation so as not to affect the building envelope.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, technical data sheets, drawings - operation schemes for ventilation systems, plans and mounting detail, airtight room, compact mechanical ventilation system with heat recovery

- ✓ **Evaluation** - Formative evaluation, direct observation test (case study)

MODULE 7 – Ventilation in a passive house / nZEB

- ✓ **No. of hours:** 3
- ✓ **Knowledge, skills**
  - Why it is essential the ventilation of the building?
    - Indoor air contaminants,
    - The relationship between relative humidity and sources of indoor moisture inside the building, the flow of fresh air and outdoor temperature,
    - Preventing mold formation,
    - Ventilation system in new nZEB buildings and renovated buildings with nZEB performance.
  - Controlled ventilation with heat recovery in residential buildings:
    - Heat recovery principle of cross ventilation;
    - Various concepts of ventilation systems (centralized and decentralized ventilation);
    - Basic knowledge regarding sizing, selection and adjustment of ventilation systems;
  - The individual components of ventilation systems:
    - Input plugs and exhaust air filters, heat recovery, condensate drain, materials for air ducts,
    - Basic principles for air duct sizing,
    - Tight network of air ducts, reduced load loss in the air ducts network ,
    - Choosing extract air intakes and exhaust vents, fresh air supply, air transfer elements,
    - Tight puncturing and free of thermal bridges ducts for fresh air and exhaust air.
  - Important protective measures for the ventilation system and proper implementation:
    - Reducing the transmission of airborne and structure-borne sound,
    - Various types of frost protection,
    - Protection against fire and smoke.
  - Ventilation systems in existing buildings, prerequisites and benefits, space-saving devices and mounting air ducts.
- ✓ **Acquired competence:**
  - ➢ Explains the functioning of a ventilation system for nZEB / passive house.
- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Present the importance of ventilation in a passive house / nZEB,
- List the advantages of passive house / nZEB ventilation,
- Specify the basic elements that influence sizing, selection and adjustment of ventilation systems,
- Classify ventilation systems,
- Provide methods that can ensure ventilation heat recovery,
- Apply basic requirements for safety, occupational health and fire protection,
- Identify the basic principles for sizing, selection and adjustment of ventilation systems,
- List the elements that make up for the ventilation system,
- Identify basic principles for air duct sizing and selecting air intakes,
- Present the advantages of using the ventilation system in existing buildings.

- ✓ **Teaching materials:** manual, power-point presentation, worksheets, demonstration materials, models, technical data sheets and specialty catalogues, drawings - plans and details, assembly operation schemes for ventilation installations
- ✓ **Evaluation** - Formative evaluation, direct observation, test, practical application (case study)

MODULE 8 - Fresh air heating

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Fresh air heating in passive houses / nZEB
  - Prerequisites
  - The correct installation of fresh air heating batteries;
  - Initial conditions, installation and operation of the fresh air heating;
  - Reducing the transmission of airborne and structure-borne sound;
  - Various types of frost protection;
  - Protection against fire and smoke;
  - Commissioning:
    - The need for initial adjustment,
    - Making the initial adjustment.

- ✓ **Acquired competence:**
  - ➢ Describe the fresh air heating system

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Provide technical characteristic of fresh air heating of buildings,
- Identify the steps of system / fresh air heating coil installation ,
- Describe how the system operates,
- Identify frost and cold protective equipment,
- Identify stages of system/plant commissioning.

- ✓ **Teaching materials:** manual, power-point presentation, worksheets, demonstration materials, models, technical data sheets, installation materials catalogues, drawings - drawings and mounting details for heating fresh air

- ✓ **Evaluation** - Formative evaluation, direct observation, test (Case study)

MODULE 9 - Basic principles: supply of thermal energy

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Heat requirement for heating and necessary thermal power in a passive house / nZEB
  - The introduction of heat for space heating by fresh air;
  - Positioning of heating appliances in a passive house / nZEB;
  - Conventional heat generators in a passive house / nZEB;- Production of hot water for domestic consumption;
  - Renewable energy in a passive house / nZEB;
  - Uncontrolled heat dissipation from the pipes / heat generators;
  - Connection to an airtight building ;
  - Burning appliances in a passive house / nZEB;
  - Use old heat generators;
  - Pipes, heaters in case of renovating existing buildings.

- ✓ **Acquired competence:**
  - ➢ Analyse the equipment that can supply heating energy to a passive house / nZEB.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

  - Estimate the energy demand for space heating in a passive house,
  - Understand the basic principles underlying the choice and positioning of the heat source,
  - Identify the sources of renewable energy that can be used in a passive house: heating, DHW production,
  - Determine the critical elements which may determine heat loss,
  - Identify devices and components of the plant that can provide heat in passive houses / nZEB and renovated houses.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, models, drawings - drawings and installation details of a building

- ✓ **Evaluation** - Formative evaluation, direct observation, test (Case study)

MODULE 10 - Space heating in a passive house / nZEB

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Accumulation of hot water: coordination with heat generator, thermal insulation of hot water storage tanks, measures to prevent the development of Legionella;
  - Heat generation and hot water supply in individual residential buildings and multi storey buildings;
  - Unsuitability of conventional heat generators for passive house / nZEB;
  - Suitability of renewable energy sources;
  - Accumulation of heat and heat-generating regulations for small size;
  - Evaluation using various generating heat in a passive house / nZEB;
  - Typical configuration of a system in a passive house building individual / nZEB;
  - Composition, operation and Evaluation of compact heat pump units;
  - Principles of heat pump systems and configuration;
  - Set-up and operation of a heat pump units connected to a ground coupled heat exchanger;
  - Security measures and dependence of combustion processes on outside air in a passive house / nZEB;
  - Gas functioning compact units;
  - Composition and functioning of a compact combustion wood / pellet;
  - Configuration of typical installation with an integrated pellet burning appliance.

- ✓ **Acquired competence:**

  - ➢ Describes heat generator systems for nZEB.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Identify the possibilities of thermal insulation for appliances / equipment used for hot water preparation and heating agent,
- Present the facilities that generate heat and provide hot water in individual buildings and with multiple floors,
- Present the controls for heat generators,
- Determine the suitability of heat generators in a passive house / nZEB,
- Identify components of a heat pump system heat,
- Describe the functioning of a heat pump unit connected to a ground-coupled heat exchanger.

- ✓ **Teaching materials:** manual, power-point presentation, worksheets, demonstration materials, models, specialized data sheets for heat pumps, drawings - drawings and mounting details for installation, operation schemes

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

MODULE 11 - Heating systems - execution details

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Thermal insulation of pipelines and their attachments, usable and unusable heat losses in heat distribution, installation space required for thermal insulation;
  - Basic principles for planning pipe systems for heating / domestic hot water / ventilation;
  - Penetrating airtightness layer through pipes for the heating system;
  - Reducing energy consumption of circulation pumps;
  - Reduced load loss in piping systems;
  - Purpose and procedures for hydraulic balance.

- ✓ **Acquired competence:**
  - ➢ Provides assembling / thermal insulation of the heating pipes.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Identify stages of the operations of thermal insulation of pipes,
- Comply with the conditions of pipeline system installation,
- Interpret technical documentation of the studied system,
- Establish principles for planning pipe systems for heating / domestic hot water / ventilation,
- Identify solutions to reduce the energy consumption of pumps,
- Apply the procedures for hydraulic balance in heating systems.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, models, data sheets, specialty boards - plans and details assembly operation schemes

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

MODULE 12 – Heating systems – Renovation of existing buildings

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Upgrading a heating system in the context of a complex/major renovation;
  - Power and control ranges for BMS in renovation;
  - Ensure airtightness during construction of new heating and ventilation systems;
  - Adequacy of existing heating appliances after renovating the building;
  - Renovation with air exhaust systems.

- ✓ **Acquired competence:**
  - ➢ Propose solutions to upgrade the heating system in existing buildings.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Identify the possibilities of upgrading an existing building,
- Ensure airtightness of renovated buildings,
- To choose appropriate heating devices, after renovating the building,
- Identify the modernization possibilities of buildings with air extraction systems.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, models, data sheets, specialty boards - Plans and mounting details

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

MODULE 13 - RES systems integration in buildings

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Use of photovoltaic systems;
  - Using wind energy and related facilities;
  - Working drawings for the use of equipment using renewable sources;
  - Using solar energy - solar collectors;
  - The use of biomass in plants;
  - Use of heat pumps;
  - Hybrid heating system;
  - Integration of renewable heating, ventilation and hot water in buildings.

- ✓ **Acquired competence:**
  - ➢ Analyse the possibilities for integration of building services systems that work with renewable energy.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- List the renewable energy sources that can be used,
- Interpret technical documentation of installations / RES schemes,
- Provide technical solutions for heating the buildings with renewable sources,
- Interpret technical documentation for RES heating systems.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, models, data sheets, specialty boards - plans and details assembly operation schemes

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

MODULE 14 – Economic efficiency - nZEB

- ✓ **No. of hours:** 2

- ✓ **Knowledge, skills**

  - The current energy cost and estimation models of energy and energy price developments;
  - Sustainable economic development with reference to buildings, long-term benefits;
  - Comparison of investment costs to costs for energy savings;
  - Costs over the service life of a nZEB building compared with an usual building, assuming an average price of energy for the period considered (20 years), the residual value of a building at the end of the period under consideration;
    - General costs and costs relating to all cases of energy saving measures, the "if it has to be done, then do it properly" principle,
    - Economic efficiency of the individual measures.
  - Thermal insulation, windows, airtightness, ventilation system in new buildings and renovated buildings with nZEB performance;
  - Economic efficiency of a package of measures, documentation based on current costs (new nZEB buildings and renovated buildings with nZEB performance).

- ✓ **Acquired competence:**

  - ➢ Evaluate the achieving costs of nZEB.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Understand the difference between investment costs and energy saving costs,
- Identify the factors that may positively influence the economic efficiency of a building,
- Understand the relationship between capital costs and costs relating to all types of energy saving measures,
- Understand the economic efficiency based on current costs for new nZEB buildings and renovated buildings with nZEB performance,
- Explain the economic efficiency of a package of measures (operating costs for new nZEB buildings and renovated buildings with nZEB performance).

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, specialized data sheets

- ✓ **Evaluation:** Formative evaluation, direct observation, written test, practical application (Case study)

MODULE 15 – Process of construction and quality assurance

- ✓ **No. of hours:** 2

- ✓ **Knowledge, skills**

  - Differences in the process of constructing a passive house / building with nearly zero energy consumption and conventional buildings;
  - Sequence of factual and economic stages relevant for related nZEB works;
  - The interdependence between the disciplines involved in terms of time, space and content;
  - Quality of work, which is required for nZEB performance and methods for achieving this quality;
  - The practice of quality assurance on site;
  - Certificates and their advantages.

- ✓ **Acquired competence:**
  - ➢ Apply quality assurance principles and procedures in the nZEB execution process.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Identify the advantages and disadvantages in the process of constructing a building with nearly zero energy consumption and conventional buildings,
- Submit the relevant economic issues related to nZEB works,
- Ensure quality of work to achieve an nZEB building,
- Provide quality assurance methods for site activities.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, materials, demonstration, legislation (electronic format)

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

MODULE 16 – Information and support for nZEB users

- ✓ **No. of hours:** 1

- ✓ **Knowledge, skills**

  - What information should be provided for the nZEB occupants?
  - Opening windows: influence in winter and summer;
  - Temporary shading: influence in winter and summer;
  - Equipment / ventilation system, special features, maintenance;
  - Prevention of air drying in winter;
  - Information sources.

- ✓ **Acquired competence:**
  - ➢ Provides support to nZEB users.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Provide simple elements that can positively influence energy consumption,
- Present the recommended equipment for an nZEB building and their mode of operation.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, specialized data sheets

- ✓ **Evaluation** - test (case study)

MODULE 17 – Summer comfort. Shading Systems

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Criteria for thermal comfort;
  - Influences on the comfort during the summer;
  - How to estimate the flow of fresh air / number of air changes, which are possibilities for increasing the flow of fresh air?
  - Solar thermal load: significance, dependence on orientation, dependence on the size of transparent surfaces, shading, temporary shading, effectiveness of the shading systems/devices located inside and outside;
  - Influence of internal heat sources: how can they be reduced? The influence of colour façade, insulation and thermal mass.

- ✓ **Acquired competence:**
  - ➢ Describe shading systems that can provide thermal comfort.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Understand the role of air changes in obtaining thermal comfort during summer,
- Present the criteria for thermal comfort in summer,
- Define the solar heat load,
- Identify internal heat sources that can maintain thermal comfort in a building.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, materials demonstration

- ✓ **Evaluation** - test, (case study)

MODULE 18 – Legal framework and concepts for achieving nearly zero energy buildings

- ✓ **No. of hours: 1**

- ✓ **Knowledge, skills**

  - The legal framework in the field of energy performance of buildings - EU (European directives);
  - The national legislation for the implementation of nearly zero energy buildings with : the energy performance of buildings, efficient use of energy, use of renewable energy sources;
  - Passive house concept in the context of current legal framework and policies;
  - The concept of nearly zero energy building;
  - The legal certification for passive houses / nZEB buildings.

- ✓ **Acquired competence:**
  - ➢ Analyse the legal framework for carrying nZEB.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Interpret the legal framework for achieving nZEB buildings,
- Define the energy performance of buildings,
- Present the features of a passive house and for nZEB,
- Identify legal steps for the certification of nZEB buildings.

- ✓ **Teaching materials:** manual, PowerPoint presentation, legal documents (electronic format), worksheets

- ✓ **Evaluation** - test, (case study)

MODULE 19 – Nearly zero energy building in the concept of green building

- ✓ **No. of hours:** 3

- ✓ **Knowledge, skills**

  - Green buildings: concept, characteristic elements of green buildings;
  - Characteristics of green buildings with low energy demand; commercially available materials used to realise green buildings;
  - Principle of realization of the thermal building envelope;
  - Alternative sources for energy: heat pumps, solar panels, photovoltaic panels,
  - Green building certification;
  - Benefits of Green Buildings: lifetime costs of green buildings compared to a typical building, insulation, windows, airtightness;
  - The framework for the certification of green buildings and nearly zero energy buildings.

- ✓ **Acquired competence:**
  - ➢ Describe the building with nearly zero energy consumption in relation to green building.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

  - Define a green building.
  - Present the materials available that can be used in the construction of the green buildings.
  - Identify the typical values of the thermal performance of materials,
  - Identify the stages of execution of a green building envelope,
  - Present technical solutions to mitigate thermal bridges in green buildings,
  - Identify sources of alternative energy for the green building,
  - Interpret technical documentation for the RES systems,
  - To provide the legal framework for certifying green buildings,
  - List the economic benefits that can be achieved by a green building.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, data sheets, specialty boards - execution details, functioning schemes of the installations

- ✓ **Evaluation** - test, (case study)

MODULE 20 – Heating and DHW operating on biomass

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - The definition of biomass produced in a sustainable manner for use in energy applications;
  - Biomass and sustainability: CO_2 emissions;
  - Types of biomass, classification, advantages, disadvantages, storage;
  - Composition and functioning of a compact combustion wood / pellet;
  - Configuration of typical installation with an integrated pellet burning appliance;
  - Connection of burning appliances in hot water installations;
  - Connection of combustion appliances in heating;
  - Basic requirements for safety, occupational health and fire protection in facilities with biomass.

- ✓ **Acquired competence:**
  - ➢ Describes operating biomass systems for space heating and DHW preparation.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Identify the resources needed to obtain biomass,
- List the advantages / disadvantages of using biomass as an energy source,
- Describe a compact combustion wood / pellet,
- Provide basic requirements for the safety, occupational health and fire protection equipment for burning pellets,
- Interpret technical documentation for connecting appliances burning,
- Identify the steps for connecting burning appliances.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, data sheets, specialty drawing boards - Operating scheme.

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

MODULE 21 – Heating equipment with heat pumps

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Heat pump-use areas, the role of the heat pump, classification;
  - Composition, operation and evaluation of compact heat pump units;
  - Principles of heat pump systems and configuration;
  - The composition and operation of a heat pump unit connected to a ground source heat exchanger;
  - The composition and operation of a heat pump unit connected to an aquifer source;
  - Space heating / cooling;
  - Connecting the pump to the technical systems of a building - DHW preparation;
  - Installation of heat pumps;
  - Basic requirements for safety, occupational health and fire protection.

- ✓ **Acquired competence:**
  - ➢ Describe the composition and functioning of the heating / cooling heat pump.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Explain the functioning of heat pumps,
- Present a compact heat pump unit,
- Classify heat pumps according to several criteria,
- Describe the operation of a heat pump units connected to a ground source heat exchanger / aquifer,
- Present the heating / cooling systems with heat pump,
- Interpret specific technical documentation,
- Identify the stages of heat pumps installation ,
- Apply the basic requirements for safety, occupational health and fire protection.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, demonstration materials, specialized data sheets, drawings - Operating scheme

- ✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

MODULE 22 - Mini-Wind systems for buildings

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Wind energy - general concepts;
  - Wind power stations and wind turbines, classification, description, operation, advantages and disadvantages;
  - The wind turbine: the technical parameters and functional;
  - Wind turbines for small power;
  - Integration into the power grid system.

- ✓ **Acquired competence:**
  - ➢ Describe mini-wind systems / turbines.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- Define the wind power,
- Present the advantages / disadvantages of wind power,
- Identify the components of a wind power plant,
- List the technical parameters and functional of a wind turbine,
- Interpret technical documentation of a wind power plant,
- Present the benefits of using wind energy,
- Apply legislation on wind power.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, models, data sheets, drawings with fitting details

- ✓ **Evaluation** -Formative evaluation, direct observation, written test, practical application (Case study)

✓

MODULE 23 - Thermal solar systems

✓ **No. of hours:** 6

✓ **Knowledge, skills**

- Sunlight as heat energy, solar radiation;
- Converting solar energy into other forms of energy;
- Components of a solar thermal installations; Solar system operation;
- Solar collectors, classification, construction, operation;
- Technical solutions for carrying solar installations for water heating;
- Technical solutions for the preparation of DHW and heating;
- Installation of solar collectors ; tight and free of thermal bridges connection of the penetrations of a pipes installation;
- Connection of existing installations of solar panels, commissioning of solar systems.

✓ **Acquired competence:**

- Analyse solar thermal installations for nZEB.

✓ **Learning outcomes**

On completion of the module the participants should be able to:

- 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,
- Describe the facility for preparing heating water using solar installations,
- Identify key phases for installation of a solar system,
- Present steps to connect the collectors to the interior installations.

✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, models, data sheets, drawings with fitting details

✓ **Evaluation** - Formative evaluation, direct observation, written test, practical application (Case study)

C – Definition of training modules for Non-specialists

Module 1 Legal frame and concepts for nearly zero energy buildings

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

- The legal framework in the field of energy performance of buildings - EU (European directives) and national regulatory frameworks;
- Energy performance of buildings, energy efficiency, use of renewable sources;
- nZEB principles:
  - Well insulated building envelope,
  - Construction without thermal bridges,
  - Airtightness,
  - Solar gains through windows,
  - Ventilation with heat recovery,
  - The use renewable energy.
- Certification of the energy performance of a building: What is the building' energy performance certificate (EPC) – where to use and when EPC is required;
- The energy audit of a building: what is it, when must it be elaborated, differences and relationship with the EPC;
- Minimum energy performance requirements for new and existing buildings:
  - for components,
  - for the buildings,
  - features for new buildings and existing buildings,
  - financial incentives.
- Certification of nZEB / passive houses - the legal frame for passive houses / nZEB certification.

- ✓ **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.

Teaching materials: manual, PowerPoint presentation, specific legislation, worksheets

Evaluation - formative assessment, direct observation, test (case study).

Module 2 Principles of economic efficiency for nearly zero energy buildings (principles of optimizing total costs)

- ✓ **No. of hours:** 6

- ✓ **Knowledge, skills**

  - Payback period, net present value, annuity;
  - The correct additional investment costs;
  - Evaluation during the lifetime / during the service lifetime of building;
  - Economically feasible levels of thermal insulation;
  - Cost of saved energy compared to the cost of consumed energy;
  - The current cost estimation models of energy and energy price developments;
  - Sustainable economic development with reference to buildings, long-term benefits;
  - Comparing investment costs - costs for the energy savings;
  - Costs over the life of nZEB compared with an usual building, assuming an average price of energy for the period considered (20 years), the residual value of a building at the end of the period considered;
  - Existent costs in all cases and costs relating to energy saving measures, the principle "if it has to be done, do it properly";
  - Economic efficiency of the individual measures:
    - Thermal insulation, windows, airtightness, ventilation system in new buildings and renovated buildings with nZEB performance.
  - Economic efficiency of a package of measures, documentation based on current costs (new nZEB buildings and renovated buildings with nZEB performance).

- ✓ **Acquired competence:**

  - ➢ Applying the principles of economic efficiency calculation for buildings to optimize the global cost during the service of a building,
  - ➢ Evaluate the costs for achievement of nZEB.

- ✓ **Learning outcomes:**

On completion of the module the participants should be able to:

- To assess the payback period,
- Establish effective thermal insulation levels in terms of economic efficiency,
- Compare the cost of saved energy unit with the cost of consumed energy unit,
- Understand the difference between investment costs and energy saving costs,
- Identify factors that can positively influence the economic efficiency of a building,
- Understand the relationship that exists between costs and costs relating to all cases of energy saving measures,
- Define economic efficiency based on current costs for new buildings and refurbished buildings with nZEB performance,
- To present the economic efficiency of a package of measures (operating costs for new buildings and renovated buildings nZEB performance nZEB).

- ✓ **Teaching materials:** manual, PowerPoint presentation, specific legislation, worksheets

- ✓ **Evaluation** - formative assessment, direct observation, test (case study).

Module 3 Building envelope (insulation, windows, thermal bridges, airtightness) for nZEB

- ✓ **No. of hours:** 6
- ✓ **Knowledge, skills:**
  - NZEB building envelope; influence of the thickness and properties of materials for the insulating layer to achieve a complex and performance envelope;
  - Suitable insulating materials and their properties, taking into account the products that are not certified (guarantee of performance characteristics plausibility checks);
  - The relationship between U (coefficient characterizing the specific heat loss) and indoor surfaces temperatures of construction elements;
  - Envelope of the building, airtightness of buildings, envelope influence on achieving near-zero energy consumption;
  - Task planning regarding the airtightness of the envelope;
  - General methods of evaluation the airtightness and requirements;
  - Lightweight or massive constructive solutions for airtightness in a building; criteria for selecting appropriate solutions for achieving airtight joints;
  - Composition for the passive house / nZEB carpentry:
    - properties required for a window in a passive house / nZEB (knowledge of specific values)
    - the influence of geometrical frame / carpentry.
  - The difference between the windows for the passive house/nZEB certification and approval of details for window installation;
  - Criteria for interior comfort (temperatures of the indoor surfaces of windows suitable for passive houses / nZEB).

- ✓ **Acquired competence:**

  - ➢ Application of nZEB principles of high thermal insulation of the building envelope, to avoid thermal bridges, insulated windows performance and solar gains in winter.

- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- Understand the principle of high performance thermal building envelope,
- Present commercially available insulation materials and their properties,
- Define the airtightness of a building envelope,
- Understand the importance of checking the airtightness of buildings,
- Differentiating a window system for nZEB from a classic one,
- Understand the difference between certification of nZEB windows and approval of windows installation details.

- ✓ **Teaching materials:** manual, PowerPoint presentation, specific legislation, worksheets

- ✓ **Evaluation** - Formative assessment, direct observation, test (case study).

Module 4 Building services for nZEB (heating / cooling, ventilation with heat recovery, energy performance monitoring)

- ✓ **No. of hours:** 6
- ✓ **Knowledge, skills**
  - Thermal comfort requirements (ISO SR 7730);
  - Air draught, their role;
  - Specific systems for nZEB / passive house:
    - Heating / cooling in nZEB,
    - Ventilation - general concepts.
  - Accumulation of domestic hot water: thermal insulation of hot water storage tanks, prevention of Legionella development;
  - Generating heat and hot water supply in individual residential buildings and multi-storey buildings, elements of economic efficiency, certified equipment;
  - Why is ventilation of the building essential?
    - indoor air pollutants,
    - The relationship between relative humidity and sources of indoor air humidity inside the building, the flow of fresh air and outdoor temperature,
    - Preventing mold formation.
  - Ventilation system in new buildings and renovated buildings with nZEB performance;
  - Controlled ventilation with heat recovery in residential buildings:
    - Heat recovery: the heat to be recovered, the benefits of heat recovery,
    - Different ventilation concepts (centralized and decentralized ventilation systems).
  - Measuring devices - the primary components of energy monitoring system;
  - Data records obtained by monitoring energy consumption.
- ✓ **Acquired competence:**
  - ➢ Identify specific technical systems for nZEB ,
  - ➢ Presents general notions for monitoring the energy consumption in buildings.
- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- Present the factors that influence thermal comfort and the choice for installations of the building
- Enumerate the nZEB related technical systems / services
- Identify possible thermal insulation for appliances / equipment used for heating and DHW,
- Understand the importance of ventilation in a passive house / nZEB,
- List the advantages of passive house / nZEB ventilation,
- Explain the importance of monitoring the energy consumption in high performance buildings.

- ✓ **Teaching materials:** manual, PowerPoint presentation, data sheets for installation materials, worksheets, standards, models and demonstration materials
- ✓ **Evaluation** - Formative assessment, direct observation, test, practical test (case study)

Module 5 Renewable energy sources systems in nearly zero energy buildings

- ✓ **No. of hours:** 6
- ✓ **Knowledge, skills**
  - The definition of biomass, produced in a sustainable manner for use in energy applications;
  - Biomass and Sustainability: CO_2 emissions;
  - Connection of combustion appliances to heating and hot water installations;
  - Heat pump-use areas, the role of the heat pump, advantages / disadvantages;
  - Compact heat pump units: possibilities of acquiring, operating and maintenance costs of the systems;
  - Wind power stations and wind turbines, advantages and disadvantages, wind energy costs;
  - Converting solar energy into other forms of energy;
  - Elements components of a solar thermal installations;
  - Solar collectors, classification, installing and advantages of their use in buildings nZEB;
  - Technical solutions of solar systems for water heating;
  - Advantages of using nZEB / passive house certified components;
  - Examples of completed buildings at nZEB / passive house specific legislation.
- ✓ **Acquired competence:**
  - ➢ Identify opportunities to use renewable energy systems in new and rehabilitated buildings.
- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- Identify the resources needed to obtain biomass,
- List the advantages / disadvantages of using biomass as an energy source,
- Identify possibilities of using heat pumps,
- Familiarize with heating / cooling with heat pumps,
- Implement legislation on wind power,
- List the forms of energy obtained through solar energy conversion,
- Present the advantages and fields of solar energy,
- Become familiar with solar installations for DWH preparation,
- Provide information about the benefits of using RES in buildings.

- ✓ **Teaching materials:** manual, PowerPoint presentation, data sheets for installation elements, worksheets, specialty boards, models and demonstration materials
- ✓ **Evaluation** - Formative assessment, direct observation, test, practical test (case study)

Module 6 Nearly zero energy building in the concept of green building

- ✓ **No. of hours:** 6
- ✓ **Knowledge, skills**
  - Green building: concept, characteristic elements;
  - Characteristics of green buildings with low energy demand;
  - Commercially available materials used to develop green building;
  - Principle of realization of the high performance thermal building envelope;
  - Alternative sources for energy: heat pumps, solar panels, photovoltaic panels,
  - Green building certification;
  - Benefits of green buildings: lifetime costs of green buildings compared to a usual building, insulation, windows, airtightness;
  - The legal certification of the green buildings and nearly zero energy buildings.
- ✓ **Acquired competence:**
  - ➢ Understand concept of green building and relationship with nearly zero energy buildings.
- ✓ **Learning outcomes**

On completion of the module the participants should be able to:

- Define a green building,
- Present available materials that can be used in the construction green building,
- Identify the typical values of thermal performance of materials used,
- To identify the elements the ensure a quality executions of the green building envelope,
- Understand the importance of eliminating thermal bridges in green buildings,
- Identify sources of alternative energy for green building,
- To provide the legal framework for certifying a green building,
- List the economic benefits that can be achieved by building a green building.

- ✓ **Teaching materials:** manual, PowerPoint presentations, worksheets, data sheets for materials, equipment, quality standards

- ✓ **Evaluation** - Formative assessment, test (case study)