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Fit-to-NZEB
Innovative training schemes for retrofitting to nZEB-levels

Catalogue of Learning Outcomes.

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Led by:

SEVEn, the Energy Efficiency Center

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D2.3 Catalogue of Learning Outcomes

Catalogue of learning outcomes consisting of new knowledge, skills and responsibility needed for the different qualification levels, topic-based

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1. Introduction

D2.3 Catalogue of Learning Outcomes includes compendium of knowledge, skills and responsibilities that the learner is supposed to possess after finishing DER training programme at different EQF levels. The catalogue is structured according to 17 topics, chosen by Fit-to-nZEB project partners. Numbers and names of some topics were changed from the preliminary structure indicated in the project proposal in order to cover all fields of DER/nZEB renovation issue and to take into account local conditions of the involved countries. The order of the topics in the Catalogue is not connected with their importance or relevance to the field of DER.

In the report were used the following definitions, introduced in the Council recommendation[1]:

“knowledge” means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the EQF, knowledge is described as theoretical and/or factual;

“skills” means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments);

”responsibility” and autonomy’ means the ability of the learner to apply knowledge and skills autonomously and with responsibility.

The project partners have included in the catalogue possibly fullest collection of learning outcomes related to DER, some of that will be applied in training programmes newly developed within the project.

[1] COUNCIL RECOMMENDATION of 22 May 2017on the European Qualifications Framework for lifelong learning and repealing the recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning (2017/C 189/03)

2. Learning outcomes for DER

2.1. Topic 1: Basics of building physics

Sub-Topic 1.1: Passive house principles

Introduction to building physics necessary for understanding the interrelations of the major principles in deep energy renovation (DER). Introduction to the passive house principles and how they work together

Topic 1	Basics of building physics	
Topic 1.1	Passive house principles	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** on facts, principles, processes and general concepts on the energy balance. - ***knowledge*** on facts, principles, processes and general concepts on building physics characteristics of building materials. - ***knowledge*** on facts, principles, processes and general concepts on the five passive house pillars	- ***cognitive and practical skills*** required to accomplish tasks related to the design process of energy saving buildings and DER. - ***solve*** problems by selecting and applying basic methods	- ***responsibility*** for completion of tasks related to the design process of energy saving building and DER
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on the basics of Building Physics - comprehensive, specialised, ***factual and theoretical knowledge*** on the energy balance in both winter and summer season. - comprehensive, specialised, ***factual and theoretical knowledge*** on the passive house principals - comprehensive, specialised, ***factual and theoretical knowledge*** on the 5 passive house pillars - comprehensive, specialised, ***factual and theoretical knowledge*** on the primary energy demand	comprehensive range of ***cognitive and practical skills*** required to generate solutions to specific problems related to the energy calculation of a building.	- review and develop performance of self and others, taking some ***responsibility*** for the evaluation and improvement of work. - self-management and/or ***management and supervision*** within the guidelines of work related to the design process of energy saving buildings and DER.

EQF	6 - 7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** on Building Physics principles - ***advanced and highly specialised knowledge*** on the energy balance in both winter and summer season. - ***advanced and highly specialised knowledge*** on passive house principals - ***advanced and highly specialised knowledge*** on the 5 passive house pillars: - Properly insulating envelope - Thermal bridge free construction - Airtightness - Windows and solar gains - Ventilation with heat recovery	- Ability to explain the main building physics principles and units in connection to DER (λ, Ψ, μ, etc.) - ***advanced skills***, assessing the influence of each parameter on the energy balance of the building. - ***advanced skills***, carrying out a fine tuning to optimize the building envelope and the building services depending on the climate conditions.	- taking ***responsibility*** for decision-making contributing to professional knowledge during the design process of energy saving buildings and DER. - manage complex technical or professional activities or projects, taking ***responsibility*** for decision-making in the design process.

2.2. Topic 2: Optimal solar gains

Situation and sizes of openings / shading and natural ventilation

Module 2	Optimal solar gains	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** on facts and general concepts of the impact of orientation of buildings - ***knowledge*** on facts of the influence of building compactness - ***knowledge*** on facts, principles and general concepts regarding properties of types of shading systems - ***knowledge*** on facts, principles and general concepts regarding properties of types of permanent and temporary shading	- ***cognitive and practical skills*** required to explain effective solar shading devices and give hints for their usage - ***cognitive and practical skills*** required to explain the importance of shading automatization. - ***cognitive and practical skills*** required to show differences between internal and external shading systems -	- ***responsibility*** for completion of tasks related to installation of shading systems on different types of building elements and different types of systems on the market - ***adaptation*** of own behaviour to circumstances in solving problems
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** of the impact of orientation of buildings - ***factual and theoretical knowledge*** of the influence of building compactness - ***factual and theoretical knowledge*** regarding properties of types of shading systems - ***factual and theoretical knowledge*** on principles and concepts regarding	- comprehensive range of ***cognitive and practical skills*** required to Show differences between internal and external shading systems - comprehensive range of ***cognitive and practical skills*** required to Show differences between direct and indirect passive solar systems	- self-management and/or ***management and supervision*** within the guidelines of work related to assess the likelihood of solar gains based on drawings or a given building - self-management and/or ***management and supervision*** within the guidelines of work related to the design and installation of shading systems

properties of types of permanent and temporary shading - comprehensive, specialised, ***factual and theoretical knowledge*** of Heat Transfer – Principles, mechanisms, thermal conduction, thermal convection, thermal radiation, transfer of energy by phase changes. - comprehensive, specialised, ***factual and theoretical knowledge*** of direct passive solar systems, building envelope – design considerations, heat accumulating mass and transparent elements of the building envelope, limitation of heat losses, prevention of overheating.	- comprehensive range of ***cognitive and practical skills*** required to understand passive solar design in different climates – cold, warm, continental.	on different types of building elements and different types of systems on the market - review and develop performance of self and others, taking some ***responsibility*** for the evaluation and improvement of work.
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** of the impact of orientation of buildings - ***advanced and highly specialised knowledge*** of the influence of building compactness - ***advanced and highly specialised knowledge*** regarding properties of types of shading systems - ***advanced and highly specialised knowledge*** on principles and concepts regarding properties of types of permanent and temporary shading - ***advanced and highly specialised knowledge*** of Heat Transfer – Principles, mechanisms, thermal conduction, thermal convection, thermal radiation, transfer of energy by phase changes. - ***advanced and highly specialised knowledge*** on direct passive solar systems, building envelope – design considerations, heat accumulating mass and transparent elements of the building envelope, limitation of heat losses, prevention of overheating. - ***advanced and highly specialised knowledge*** on solar architecture, passive solar design, light guides, ways to prevent overheating, shape and height of buildings in order to absorb solar radiation.	- ***advanced skills***, demonstrating mastery and innovation, required to solve complex and unpredictable problems related to effective solar shading devices and give hints for their usage - specialised ***problem-solving skills*** required in research and/or innovation in order to develop new knowledge and procedures related to shading automatization. - specialised ***problem-solving skills*** required to show differences between internal and external shading systems - ***advanced skills***, demonstrating mastery and innovation, required to solve complex and unpredictable problems related to shading simulation, taking into account the build of future buildings in the neighbourhood	- manage complex technical or professional activities or projects, taking ***responsibility*** for decision-making in unpredictable work related to optimisation of solar gains in existing buildings - ***manage*** and transform complex and unpredictable work on the design and/or installation of shading systems - taking ***responsibility*** for decision-making contributing to professional knowledge and practice in unpredictable work related to the design and/or installation of optimizing solar gains based on drawings or a given building

2.3. Topic 3: Building Envelope

Sub-Topic 3.1 Thermal insulation

Sub-Topic 3.2 Minimizing thermal bridges

Sub-Topic 3.3 Highly efficient windows

Building envelope: insulation of walls / insulation of roofs / insulation of foundations / division of heated from unheated volumes (blocks of buildings), etc.; interior insulation (risks and disadvantages as well as saving potentials, diffusion-impermeable and diffusion-permeable superstructures). Use of triple glazing / tight and highly efficient window frames / insulating doors / positioning of windows and doors to avoid thermal bridges etc., other ways of minimizing thermal bridges

Topic 3.1	Thermal insulation	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** on facts and general concepts of health and safety issues regarding the installation of thermal insulation - ***Knowledge*** on facts, principles, processes and general concepts on the principle of the unbroken thermal envelope (external, internal insulation; diffusion-impermeable and diffusion-permeable solutions) - ***knowledge*** on facts, principles, processes and general concepts on the insulating materials and their properties - the overview of products available on the market, requirements and possibilities, including advantages and disadvantages - ***knowledge*** on facts, principles and general concepts on hygrothermal and physical properties of materials (thermal conductivity, water vapor diffusion resistance factor, reaction to fire, etc.) as characteristic values - ***knowledge*** on facts, principles and general concepts regarding building elements - ***knowledge*** on facts, principles and general concepts regarding properties of elements comprising building envelope (U-values, water vapor resistance, fire behaviour on different kind of building envelopes, noise protection, etc.) - ***knowledge*** on facts, principles, processes and general concepts	- ***cognitive and practical skills*** required to accomplish tasks related to installation of thermal insulation on different types of building elements and different types of systems on the market - solve problems by selecting and applying basic methods, tools, materials and information to install thermal insulation on different types of building elements and different types of systems on the market - ***cognitive skills*** related to the issues of quality control process - ***cognitive skills*** related to risks and construction damage resulted from poor workmanship cognitive skills related to the concepts of cross-crafting	- ***responsibility*** for completion of tasks related to installation of thermal insulation on different types of building elements and different types of systems on the market - adaptation of own behaviour to circumstances in solving problems

on correct installation of insulation materials - ***knowledge*** on facts, principles, processes and general concepts on risks and construction damage resulted from poor workmanship - ***knowledge*** on facts, principles, processes and general concepts on quality control of thermal insulation - ***knowledge*** on facts, principles, processes and general concepts of cross-crafting		
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on concepts of health and safety issues regarding the installation of thermal insulation - comprehensive, specialised, ***factual and theoretical knowledge*** on the principle of the unbroken thermal envelope (external, internal insulation; diffusion-impermeable and diffusion-permeable solutions) - comprehensive, specialised, ***factual and theoretical knowledge*** on the insulating materials and their properties - the overview of products available on the market; requirements and possibilities, including advantages and disadvantages - comprehensive, specialised, ***factual and theoretical knowledge*** on hygrothermal and physical properties of materials (thermal conductivity, water vapor diffusion resistance factor, reaction to fire, etc.) as characteristic values - comprehensive, specialised, ***factual and theoretical knowledge*** regarding building elements - comprehensive, specialised, ***factual and theoretical knowledge*** regarding properties of elements comprising building envelope (U-values, water vapour	- comprehensive range of ***cognitive and practical skills*** required to generate solutions to specific problems related to installation of thermal insulation on different types of building elements and different types of systems on the market - comprehensive range of ***cognitive and practical skills*** required to generate solutions to specific problems related to the issues of quality control process - comprehensive range of ***cognitive and practical skills*** required to generate solutions to specific problems related to risks and construction damage resulted from poor workmanship - comprehensive range of ***cognitive and practical skills*** required to generate solutions to specific problems related to the concepts of cross-crafting	- self-management and/or ***management and supervision*** within the guidelines of work related to installation of thermal insulation on different types of building elements and different types of systems on the market - self-management and/or ***management and supervision*** within the guidelines of work related to installation of thermal insulation where there is unpredictable change - review and develop performance of self and others, taking some ***responsibility*** for the evaluation and improvement of work (related to cross-crafting issues)

resistance, fire behaviour of different kind of building envelopes, noise protection, etc.) - comprehensive, specialised, ***factual and theoretical knowledge*** on correct installation of insulation materials - comprehensive, specialised, ***factual and theoretical knowledge*** on risks and construction damage resulted from poor workmanship - comprehensive, specialised, ***factual and theoretical knowledge*** on quality control of thermal insulation - comprehensive, specialised, ***factual and theoretical knowledge*** on cross-crafting		
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** on concepts of health and safety issues regarding the installation of thermal insulation, with critical awareness of knowledge issues - ***advanced and highly specialised knowledge*** on the principle of the unbroken thermal envelope (external, internal insulation; diffusion-impermeable and diffusion-permeable solutions); with critical understanding of theories and principles - ***advanced and highly specialised knowledge*** on the insulating materials and their properties - the overview of products available on the market and at the forefront of knowledge; requirements and possibilities, including advantages and disadvantages - ***advanced and highly specialised knowledge*** on hygrothermal and physical properties of materials (thermal conductivity, water vapour diffusion resistance factor, reaction to fire, etc.) as	- ***advanced skills***, demonstrating mastery and innovation, required to solve complex and unpredictable problems related to installation of thermal insulation on different types of building elements and different types of systems on the market - specialised ***problem-solving skills*** required in research and/or innovation in order to develop new knowledge and procedures related to thermal insulation of new and existing buildings - specialised ***problem-solving skills*** required to integrate knowledge from different fields related to thermal insulation of new and existing buildings	- manage complex technical or professional activities or projects, taking ***responsibility*** for decision-making in unpredictable work related to thermal insulation of new and existing buildings - ***manage*** and transform complex and unpredictable work on the design and/or installation of thermal insulation - taking ***responsibility*** for decision-making contributing to professional knowledge and practice in unpredictable work related to the design and/or installation of thermal insulation

characteristic values; with critical understanding of theories and principles - ***advanced and highly specialised knowledge*** regarding building elements; with critical understanding of theories and principles of heat, air and moisture transport mechanisms - ***advanced and highly specialised knowledge*** regarding properties of elements comprising building envelope (U-values, water vapour resistance, fire behaviour of different kind of building envelopes, noise protection, etc.); with critical understanding of theories and principles - ***advanced and highly specialised knowledge*** on correct installation of insulation materials; with critical understanding of theories and principles - ***advanced and highly specialised knowledge*** on risks and construction damage resulted from poor workmanship; with critical understanding of theories and principles - ***advanced and highly specialised knowledge*** on the durability and pathology of insulating materials - ***advanced and highly specialised knowledge*** on quality control of thermal insulation; with critical understanding of theories and principles - comprehensive, specialised, ***factual and theoretical knowledge*** on cross-crafting with critical awareness of knowledge issues at the interface between different fields		

Topic 3.2	Minimizing thermal bridges	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** of facts and principles on thermal bridges - ***knowledge*** of facts, principles processes and general concepts on moisture related building damage due to thermal bridges - ***knowledge*** of facts on the influence of thermal bridges on the heat losses - ***knowledge*** of facts, principles, processes and general concepts on prevention of thermal bridges - ***knowledge*** of facts, principles, processes and general concepts on minimisation of thermal bridging where avoiding them is not entirely possible - ***knowledge*** of principles, processes and general concepts thermal bridge optimised window installation - ***knowledge*** of facts and general concepts on quality assured products available to avoid or minimise thermal bridging - ***knowledge***e on facts, principles, processes and general concepts of cross-crafting	- ***cognitive skills*** needed for recognition different types of thermal bridges - ***cognitive and practical skills*** required to accomplish tasks related to the minimisation of thermal bridges - ***cognitive and practical skills*** required to accomplish tasks related to the thermal bridge optimised window installation - ***cognitive and practical skills*** required to accomplish tasks related to the installation of quality assured products available to avoid or minimise thermal bridging - ***cognitive and practical skills*** required to applying basic methods, tools, materials and information related to thermal bridges - ***communication skills*** to bring co-workers (who might be older and 'more experienced) on-board regarding the importance of dealing appropriately with thermal bridging	- perform routine work regarding installation of materials and systems regarding the minimisation of thermal bridges - take ***responsibility*** for the performed work related to the minimisation of thermal bridges - adapt own behaviour to circumstances in solving problems
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***comprehensive knowledge*** on the classification and types of thermal bridges - ***factual knowledge*** on the surface temperatures at thermal bridges - ***factual and comprehensive knowledge*** on moisture related building damage due to thermal bridges - ***factual and comprehensive knowledge*** on the influence of thermal bridges on the heat losses - comprehensive, ***specialised, factual and theoretical knowledg***e on fundamental	- ***cognitive and practical skills*** in the identification of the interactions within the thermal envelope as relevant regarding thermal bridging - ***cognitive and practical skills*** analysis of thermal bridge performance - ***cognitive and practical skills*** of applying existing solutions to minimize heat flow and optimize surface temperatures on the thermal bridge - ***cognitive and practical skills*** in execution of an assessment of condensation risk analysis in thermal bridges	- identification and qualification of thermal bridges in drawings and buildings under guided supervision - perform an analysis of thermal bridge ***performance*** during the design and/or construction process which is subjected to unpredictable change - perform and/or ***supervise*** routine work of others regarding installation of materials and systems regarding the minimisation of thermal bridges - review performance of others when using materials or details

rules for prevention of thermal bridges - comprehensive, ***specialised, factual and theoretical knowledge*** on fundamental strategies to minimise thermal bridging where avoiding them is not entirely possible - comprehensive, ***specialised, factual and theoretical knowledge*** thermal bridge optimised window installation - comprehensive, ***specialised and factual knowledge*** on quality assured products available to avoid or minimise thermal bridging - ***knowledge*** on facts, principles, processes and general concepts of cross-crafting - ***awareness*** on all the limitations and assumptions made regarding the thermal bridging	- ***cognitive skills*** in identification of limitations of the person and identification of further assistance	which might lead to creating or worsening a thermal bridge
EQF	6 - 7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced knowledge*** on the classification and types of thermal bridges - quantification of thermal bridges (ψ and χ values) - theoretical and practical aspects of modelling of thermal bridges - ***advanced knowledge*** on moisture related building damage due to thermal bridges - Thermal conductivities of various building materials that can cause thermal bridging - ***advanced knowledge*** and critical understanding on the ranking of heat losses through various thermal bridge situations - ***advanced knowledge*** on fundamental rules for prevention of thermal bridges - ***advanced knowledge*** on fundamental strategies to minimise thermal bridging where avoiding them is not entirely possible - ***advanced knowledge*** on measures required to ensure	- ***advanced skills*** in the identification of the interactions within the thermal envelope as relevant regarding thermal bridging - ***advanced skills*** in application of appropriate validated analytical software tools to the assessment and resolution of thermal bridging problems - Ability to carry out a comprehensive analysis of thermal bridge performance - ***specialised problem-solving skills*** in development of design solutions to minimize heat flow and optimize surface temperatures on the thermal bridge (development of novel and innovative solutions) - ***advanced skills*** in execution of an assessment of condensation risk analysis in thermal bridges - ***advanced skills*** in interpretation of and solving problems arising from the legislative framework, codes and standards appropriate to the thermal bridging	- Taking ***responsibility*** for identification and quantification of thermal bridges in drawings and buildings. - Taking ***responsibility*** for minimising the impact of thermal bridges in drawings and buildings - Making critical judgements and decisions based on scientific principles within a changing and ill-defined technological context, with an ability to analyse and measure novel and emerging technological propositions against building performance and energy efficiency design data and metrics. - Ability to record and present project case studies and design proposals regarding thermal bridging using appropriate professional and academic report writing conventions.

that (a) comfort is not compromised and (b) that mould and / or condensation cannot arise, in instances where thermal bridges cannot be avoided - ***advanced knowledge*** on thermal bridge optimised window installation - ***advanced knowledge*** on quality assured products available to avoid or minimise thermal bridging - ***knowledge*** on facts, principles, processes and general concepts of cross-crafting - ***advanced knowledge*** and critical awareness on legislative framework, codes and standards related to thermal bridges	- ***ability to summarise, explain and advise*** a client on what constitutes low risk NZEB construction and determine when risks associated with thermal bridging performance may be adequately assessed by a design practitioner and when a specialist is required. - ***advanced skills*** in using thermographic technology and other diagnostic technology to verify the successful treatment of thermal bridges	
Topic 3.3	Highly efficient windows	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** on facts and appreciate the multiplicity of benefits in using high performance window in deep retrofits - ***knowledge*** on facts, and principles on the importance of the installation detailing for high performance windows	- ***cognitive and practical skills*** required to install windows in the correct position in the thermal envelope, ensuring continuity with the insulation layer - ***cognitive and practical skills*** required to ensure that each window is fitted in the correct location, bearing in mind that windows of similar sizes may have different solar heat gain coefficient values which will not be apparent without reading the window labels - ***cognitive and practical skills*** required to achieve suitable connection of the window to the airtight layer using appropriate materials - ***cognitive and practical skills*** required for micro adjustment of windows during airtightness testing to ensure minimal leakage	- perform routine work regarding installation of high performance windows in deep retrofits - take ***responsibility*** for the performed work related to the installation of high performance windows in deep retrofits
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***specialised knowledge*** on function of windows in general, and in relation to the energy efficiency and comfort: view	- ***cognitive and practical skills*** required to install windows in the correct position in the thermal envelope, ensuring	- perform routine work regarding installation of high performance windows in deep retrofits

towards the outside, thermal protection, solar gains, ventilation during day and during night - ***specialised knowledge*** on the requirements for windows in general: 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 - ***specialised knowledge*** on glazing and glazing edge, overview of requirements, g-value - ***specialised knowledge*** on the qualitative energy balance of a window	continuity with the insulation layer - ***cognitive and practical skills*** required to ensure that each window is fitted in the correct location, bearing in mind that windows of similar sizes may have different solar heat gain coefficient values which will not be apparent without reading the window labels - ***cognitive and practical skills*** required to achieve suitable connection of the window to the airtight layer using appropriate materials – - ***cognitive and practical skills*** required for micro adjustment of windows during airtightness testing to ensure minimal leakage	- taking ***responsibility*** for the performed work related to the installation of high performance windows in deep retrofits
EQF	6 - 7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** on function of windows in general, and in relation to the energy efficiency and comfort: view towards the outside, thermal protection, solar gains, ventilation during day and during night - ***advanced and highly specialised knowledge*** on thermal comfort in the buildings and the resultant requirements for windows, temperatures at the window - ***advanced and highly specialised knowledge*** on the requirements for windows in general: 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 - ***advanced and highly specialised knowledge*** on glazing and glazing edge, overview of requirements, g-value - ***advanced and highly specialised knowledge*** on the qualitative energy balance of a window	- ***Ability to explain*** the relation of window quality and thermal comfort - ***skills*** on explaining qualitatively the energy balance of a window depending on component quality and geometric properties - ***specialised problem-solving skills*** in development of design solutions of suitable window installation detail (for different construction types) for optimised performance - ability to carry out a comprehensive analysis, interpretation of and solving problems arising from the legislative framework, codes and standards appropriate to the windows	- Taking ***responsibility*** for identification of appropriate and high-quality window as well as optimised installation in drawings and buildings. - taking ***responsibility*** for the sketch of suitable window installation detail (for different construction types) for optimised performance - ability to analyse and discuss with project Architect (Make critical judgements and decisions based on scientific principles within a changing and ill-defined technological context), distinguishing key objectives of minimising thermal bridging whilst maximising airtightness - ability to make critical judgements, analyse and take responsibility to query where original insulation or airtightness materials specified in the tender documents have been swapped out for alternative materials (which might not perform as well as intended)

2.4. Topic 4: NZEB Neighbourhoods

Sub-Topic 4.1 Distributed energy production systems and energy management

Sub-Topic 4.2 Energy cooperatives

The topic is based on the understanding and implementation of the Nearly Zero Energy Neighbourhood in deep energy renovation projects, defined as a cluster of residential and/or non-residential units where the overall energy demand is low and is partly met by renewable energy self-produced within the neighbourhood. The learning outcomes are defined taking into account principles for the building system boundary, energy weighting system and Net ZEB balance, temporal energy match characteristics, and measurement and verification of the energy performance of buildings and group of buildings, including imported and exported energy at neighbourhood level.

Specific subtopic is on energy cooperatives, defined as clusters of prosumer buildings and/or decentralized energy production units that may sell the surplus energy for commercial benefit. The cooperatives may activate as isolated business or may be connected to a local smart grid or to the national grid, also based on commercial principles. The energy cooperatives need qualified management and legal status.

Other thematic areas: Energy performance of a cluster of residential and/or non-residential units characterized by low energy consumption as a result of energy produced from renewable resources within the neighbourhood. Distributed energy sources. Microgrid solutions. Configuration and topologies of the district level distribution grids. Impacts and benefits of the grid integration of the distributed energy production. Energy Management Systems (EMS).

Assessment of the extended built boundary and energy balance of the bounded area. Temporal energy match characteristics in the loading curve. Main characteristics of the District Energy Systems. Advanced Distribution Automatization. New cooperatives as EMS and business opportunities and models.

Topic 4	NZEB Neighbourhoods	
Topic 4.1	Distributed energy production systems and energy management	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge on facts, principles, processes and general technical characteristics*** of the different distributed energy production technologies (internal combustion engine, industrial combustion turbine, microturbine, Stirling engine, fuel cell system, micro/small hydroelectric unit, wind turbine, photovoltaic systems, solar thermal unit, biomass unit, geothermal unit). - Possible connection with the equipment placed inside or on/near the buildings.	- ***Ability to identify*** the energy systems within the neighbourhood - ***Assess*** the boundaries of the overall energy system - ***Understand*** and ***quantify*** energy fluxes - ***Analyse*** the pattern of energy use in the selected neighbourhood	- Assume the correct understanding of the physics of defined system - Assume understanding the concepts and express will to learn more.
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Factual and theoretical knowledge on*** assessment of the extended built boundary and ***understanding*** energy balance of the bounded area; - ***Factual and theoretical knowledge*** on temporal energy	- ***Ability to identify*** the energy systems within the neighbourhood - ***Assess*** the boundaries of the overall energy system - ***Understand*** and ***quantify*** energy fluxes	- Assume the correct understanding of the physics a defined system - Taking ***responsibility*** in recommending actions to optimize the functionality of a defined system

match characteristics in the loading curve of different consumers/prosumers in a common neighbourhood; - main characteristics of the ***Factual and theoretical knowledge on*** District Energy Systems, Advanced Distribution Automatization and EMS.	- ***Analyse*** the pattern of energy use in the selected neighbourhood - ***Ability to assess/identify*** the local potential for use of RES	- Assume understanding the concepts and express will to learn more.
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Specialised knowledge*** on the concepts of the Nearly Zero Energy Neighbourhood based on extension of individual building performance to a cluster of building units characterized by low energy consumption and energy supply from renewable sources, within the neighbourhood - principles and methods for extended building system boundary determination and performance evaluation; - ***Specialised knowledge*** on distributed energy generation regarding the basic of smart grid concept, technologies, and systems; smart grid standards; - ***Awareness of*** the principles and technical characteristics of the different distributed energy production technologies (internal combustion engine, industrial combustion turbine, microturbine, Stirling engine, fuel cell system, micro/small hydroelectric unit, wind turbine, photovoltaic systems, solar thermal unit, biomass unit, geothermal unit); - ***Specialised knowledge*** on. structure (generators, storage, controlling) and operating conditions (islanding or grid connected) of the microgrid solutions regarded as a controlled entity which can be operated as a single aggregated load or generator, eventually as power source providing network support and services; - ***Specialised knowledge*** on configuration and topologies of the district level distribution	- ***Ability to identify*** the energy systems within the neighbourhood; - ***Assess*** the boundaries of the overall energy system; - ***Understand*** and ***quantify*** energy fluxes; - ***Ability to assess*** the energy demand of buildings by types of energy (thermal, electrical); - ***Ability to assess/identify*** the local potential for use of RES - ***Analyse*** the pattern of energy use in the selected neighbourhood - ***Optimize/flatten*** the loading curve by adjusting use to simultaneous cheapest energy available - ***Ability to evaluate*** technical specifications for the various smart grid solutions or components (generators, storage, controlling) and to ***provide*** generic solutions for microgrid applications. - ***To understand*** relevant standards and guidelines applicable to distributed generation and energy management systems; - ***Advanced skills***, demonstrating mastery and innovation, required ***to solve*** complex and unpredictable problems related to installation of the various equipment within the energy system. - Specialised ***problem-solving skills*** required in research and/or innovation in order ***to develop new knowledge and procedures*** related to NZEB neighbourhoods concepts. - ***ability to integrate knowledge*** from different fields related to	- Assume the correct understanding of the physics a defined system; - Taking ***responsibility*** in recommending measures/actions to optimize the functionality of a defined system; - Ensure the legal quality of the measures/actions Guarantee the quality of works by proper monitoring and measuring techniques; - Assume ***responsibility*** for the proposed/promised benefits.

grids: electrical distribution system (structure, components, voltage regulation, protection), district heating grids, new concepts of district heating and cooling systems(bidirectional); - ***Specialised knowledge*** on impact (over/under-voltage, voltage fluctuation, phase imbalance, harmonics, unintended islanding etc.) and benefits (reduced distribution loss, supply security, peak power supply, power quality management) of the distributed electrical energy generation grid integration; - ***Specialised knowledge*** on Energy Management Systems (EMS); - ***Awareness of*** connection of the decentralized production units with the equipment placed inside or on/near the buildings; - ***Specialised knowledge*** on how to influence of energy user behaviour and pattern of energy use on the overall performance of the nZEB neighbourhood.	district energy system development. - ***Advanced ability on modelling and simulation*** of energy systems (up to the district level) by using specific informatics tools.	
Topic 4.2	Energy cooperatives	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
Knowledge on general definitions and concepts – technical aspects and business models;	***Identify*** such systems and ***understand*** basic operation and associated benefits (costs, emissions, commercial)	- Assume the correct understanding of the physics of defined system - Assume understanding the concepts and express will to learn more.
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**

Factual and theoretical knowledge of general definitions and concepts – technical aspects and business models; ***Factual and theoretical knowledge of*** legal framework for energy management, tariffs and inter-connection and inter-operability of energy systems;	- ***Identify*** such systems and ***understand*** basic operation and associated benefits (costs, emissions, commercial) - ***Identify*** opportunities to use such systems	- Assume the correct understanding of the physics a defined system - Taking ***responsibility*** in recommending actions to optimize the functionality of a defined system - Assume understanding the concepts and express will to learn more.

EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Awareness*** of legal framework for energy management, tariffs and inter-connection and inter-operability of energy systems; - ***Specialised knowledge*** on the principle of the extended building boundary assessment and energy balance calculation regarding the bounded area; - ***Specialised knowledge*** on temporal energy match characteristics: the temporal match between energy generation on-site and the building load (load match), the temporal match between the energy transferred to a grid and the demands of a grid (grid interaction) and the temporal matching between the types of energy imported and exported (fuel switching); - ***Advanced knowledge*** of informational tools to calculate relevant energy balances or temporal matching indicators; - ***Awareness*** of basic principles and existing technologies in the field of advanced distribution automatization included advanced metering infrastructure (AMI) technologies. - ***Specialised knowledge*** on Main characteristics of the District Energy Systems; - ***Specialised knowledge*** on cooperatives energy management systems and correlation with new business opportunities.	- ***Ability to develop*** a business model for the operation of all energy production units based on the energy consumption patterns. - ***Ability to identify/select*** end-users to ensure the optimum loading curve (ex: residential for evening use with non-residential for day-time use). - ***Ability to educate*** users to optimize their energy use pattern for own benefits derived from lower energy costs and increased energy availability. - ***Ability to measure*** and quantify relevant energy fluxes. - ***Ability to operate*** all equipment - ***Ability to perform*** an economic Analysis of the integrated energy system and make it profitable.	- Assume the correct understanding of the physics a defined system; - Take ***responsibility*** in recommending measures/actions to optimize the functionality of a defined system; - Ensure the legal quality of the measures/actions Guarantee the quality of works by proper monitoring and measuring techniques; - Assume responsibility for the proposed/promised benefits.

2.5. Topic 5: Airtightness, vapour and moisture movement, windtightness

Minimizing heat losses from infiltration and/or exfiltration / key points of buildings / quality assurance and blower door test, etc. Introduction to factors determining how and how much vapour passes into and through the construction fabric, both inwards and outwards, including the relevant properties of different materials and their respective ability to diffuse, absorb and retain moisture

Topic 5	Airtightness, vapour and moisture movement, windtightness	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge*** on facts, principles, processes and general concepts on the necessity of airtightness, vapour control and windtightness in a building and the multitude of benefits they bring - ***Knowledge*** on facts, principles, processes and general concepts on the critical importance of coupling airtightness with ventilation ("*build tight-ventilate right*") - ***Knowledge*** on facts, principles, processes and general concepts on the principle of an airtight layer (red pencil method and single airtight layer) - ***Knowledge*** on facts, principles, processes and general concepts on typical weak points in the case of airtightness, vapour control and windtightness - ***Knowledge*** on facts, principles, processes and general concepts on the difference and relationships between vapour control, airtightness and wind resistance - ***Knowledge*** on facts, principles, processes and general concepts on the role of dew point as a risk factor in determining likelihood of condensation and mould formation - ***Knowledge*** on facts, principles, processes and general concepts regarding the Importance of introducing a vapour control layer to reduce the potential for transfer of vapour from inside, through the envelope towards the exterior - ***Knowledge*** on facts, principles, processes and general concepts relating to the principle of increasing permeability of vapour	- ***cognitive and practical skills*** required to explain the importance of airtightness, windtightness and vapour control in buildings - ***cognitive and practical skills*** required to explain the difference between air-tightness and 'breathability' and distinction between 'airtight' yet 'vapour open' - ***cognitive and practical skills*** required to explain the principle of the pressurisation test method and explain the benefits of completing both positive and negative pressurisation tests - ***cognitive and practical skills*** required to operate fans (such as 'wincon') to create a pressure difference between inside and outside for the purposes of pre-checking airtightness in advance of the official pressurisation tests - ***cognitive and practical skills*** required to identify leaks in a building envelope using a variety of methods including smoke-sticks and thermography where practicable - ***cognitive and practical skills*** required to achieve high levels of airtightness (n50 ≤ 1.0 ac/hr) using a broad variety of materials and methods including specialist skills in dealing with challenging 3-D connections as well as penetrations and transition points in the envelope - ***cognitive and practical skills*** required to identify the airtight layer and its constituent parts in drawings and buildings - ***cognitive and practical skills*** required to seal elements such	- ***responsibility*** for formulating a logical procedure/sequence of work with reference to airtightness - ***responsibility*** for completion of tasks related to correctly prepping surfaces for application of airtight applications (dust removal, priming, applying base layers) in order to ensure long-term maintenance of airtightness and vapour control - ***responsibility*** for completion of tasks related to ensuring absolute continuity of the three key layers providing vapour control, airtightness and windtightness and without tears or unsealed penetrations - ***responsibility*** for and confidence to question the application of bogus airtightness materials proposed by others which might fail in the longer term - ***responsibility*** for and confidence to stop progress on project advancement if necessary if construction details and / or materials being proposed are regarded as being risky - ***responsibility*** for completion of tasks related to identification of when it is best suited to carry out interim airtightness tests, based on the principle of being able to fix leaks before areas are closed up - ***responsibility*** for completion of tasks related to preparation of construction project for arrival of airtightness tester to ensure optimal use of the tester's time. - ***responsibility*** for completion of tasks related to applying tapes, membranes and flexible sealants which do not compromise the

diffuse layers from inside to outside ("drying-out") - ***Knowledge*** on facts, principles, processes and general concepts relating to different approaches that can be used to regulate and control air, vapour and wind movement including materials best-suited to different construction types (membranes versus plasters versus specialist sheeting) - ***Knowledge*** on facts, principles, processes and general concepts relating to the use of appropriate materials for the control of air flow and vapour movement and avoidance of materials (such as impermeable plastics) which could cause significantly adverse effects with respect to vapour trapping	as wooden joists which penetrate the insulation layer into a cold exterior wall and the potential for rot over time arising from mould and condensation - ***cognitive and practical skills*** required to explain the importance of the q50 value in large buildings - ***cognitive, practical and communication skills*** required to bring co-workers (who might be older and 'more experienced') on-board regarding the importance of dealing appropriately with airtightness	quality of aesthetic finishes on exposed surfaces (a common example being too much tape overlapping on window frames which will not be covered later by subsequent finishes) and thus left exposed requiring subsequent removal
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on key principles and relationship between temperature, absolute humidity and relative humidity - comprehensive, specialised, ***factual and theoretical knowledge*** on the direction of both air pressure drive and vapour pressure drive in different climates for the purposes of correctly locating specialist membranes - comprehensive, specialised, ***factual and theoretical knowledge*** on the potential impact of interstitial condensation in terms of structural integrity and occupant health - comprehensive, specialised, ***factual and theoretical knowledge*** on the varying ability of different materials to diffuse, absorb and retain moisture - comprehensive, specialised, ***factual and theoretical knowledge*** on the potential condensation and structural risks associated with placing	- comprehensive range of ***cognitive and practical skills*** required to design and specify an airtightness strategy for different construction types and ability to select appropriate materials required to deal with specific challenges presented in unusual circumstances - comprehensive range of ***cognitive and practical skills*** required to interpret the S_d-values of different materials concerning vapour diffusiveness - comprehensive range of ***cognitive and practical skills*** required to discern between different materials used for vapour control (such as vapour-variable materials, or so-called 'smart-membranes') - comprehensive range of ***cognitive and practical skills*** required to identify critical surface and internal temperatures which indicate likely onset of mould and condensation - comprehensive range of ***cognitive and practical skills*** required to manually calculate the S_d-value in m and know-how on placement of materials such	- self-management and/or ***management and supervision*** related to performing a blower door test in accordance with international norms, including calculating the net volume and building envelope area - self-management and/or ***management and supervision*** related to ensuring that vapour diffusiveness increases from inside to outside and avoiding use of vapour-proof layers towards the exterior - self-management and/or ***management and supervision*** related to reviewing the work of others regarding vapour control and airtightness and make decisions on-site as to appropriate remedies where needed - self-management and/or ***management and supervision*** related to use of a thermographic camera during negative pressurisation testing to identify leaks which might be otherwise difficult to identify - ***self-management and awareness*** to know when it is advisable or necessary to consult with more experienced

internal insulation in older brick buildings - comprehensive, specialised, ***factual and theoretical knowledge*** on the diffusion properties of different plaster types and their influence on indoor humidity - comprehensive, specialised, ***factual and theoretical knowledge*** on the 'water activity' (A_w) concept (risk of mould and condensation)	that the S_d-value of the internal airtight layer should be 6 to 10 times greater than that of the exterior wind tight layer - comprehensive range of ***cognitive and practical skills*** required to appreciate and achieve on-site an appropriate total S_d–value of the building component layers on both the internal and external sides of the insulation material (without air gaps) - comprehensive range of ***cognitive and practical skills*** required to liaise with colleagues and convince them of the importance of managing vapour movement in buildings	colleagues and members of the design team concerning vapour movement detailing
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** on principles of diffusion and convention and how they can impact on heat loss and moisture movement - ***advanced and highly specialised knowledge*** on principles of adsorption, absorption and adhesion and how they impact on vapour and moisture movement - ***advanced and highly specialised knowledge*** on role of capillary action in moisture movement - ***advanced and highly specialised knowledge*** on material porosity values and total pore volume which determines maximum liquid absorption - ***advanced and highly specialised knowledge*** on materials principles of hygroscopic and non-hygroscopic as well as hydrophilic and hydrophobic - ***advanced and highly specialised knowledge*** on isotherms in external envelopes and awareness of norms and standards relating to vapour and moisture movement, including DIN 4108 – 4.	- ***advanced skills***, demonstrating mastery and innovation, required to read and understand psychrometric charts including interrelationship between temperature, relative humidity and the 'absolute' water content (grams/m^3 air) - ***advanced skills***, demonstrating mastery and innovation, required to modelling envelope assemblies using specialist software programmes (such as WUFI and others) to identify risk of mould and condensation over time and across seasons and ability to devise robust insulation and vapour control construction detailing - ***advanced skills***, demonstrating mastery and innovation, required to accounting for water vapour diffusion resistance factors in exterior assemblies (known as µ, or mü) ranging from vapour diffusive to vapour-proof	- ***responsibility*** to publish and share construction details used for vapour control for peer review and improvement - ***manage*** and transform complex and unpredictable work including identifying the possible positions for mould formation / reaching dew point in drawings and buildings

2.6. Topic 6: Building Services

Sub-Topic 6.1 Mechanical Ventilation with Heat Recovery;
Sub-Topic 6.2 Heating and Cooling
Sub-Topic 6.3 DHW
Sub-Topic 6.4 Automation – Regulation
Sub-Topic 6.5 Lighting

Critical points of building / thermal bridges through structural building elements / thermal bridges through windows and doors / thermal bridges through cracks and gaps in building envelope, etc.

Topic 6	Building Services	
Topic 6.1	Mechanical Ventilation with Heat Recovery (MVHR)	
EQF	3	
- ***Knowledge*** on facts, principles, processes and general concepts on the benefits of including a controlled ventilation system in a DER - ***Knowledge*** on facts, principles, processes and general concepts on the principles of heat recovery from exhaust air and tempering of fresh air - ***Knowledge*** on facts, principles, processes and general concepts about use of MVHR's in DER in terms of noise levels, electrical energy requirement for the fans and impact on reduce heating and / or cooling demand - ***Knowledge*** on facts, principles, processes and general concepts on the two most common ducting arrangements used in residential ventilation systems (trunk-and-branch as well as octopus) and the impact these systems will have on the need for sound attenuators - ***Knowledge*** on facts, principles, processes and general concepts on the preferred duct types to ensure smooth air flow and avoiding sagging or kinking - ***Knowledge*** on facts, principles, processes and general concepts on the key components of a balanced ventilation system with heat recovery in drawings and buildings	- ***cognitive and practical skills*** required to sketch a schematic layout of the key components of a home MVHR system - ***cognitive and practical skills*** required to install an MVHR in a home including key components such as heat exchanger, ducting, supply and exhaust registers, condensate drain and post heater - ***cognitive and practical skills*** required to optimise the position of supply and extract registers to ensure optimal flow rates in the spaces in which they serve and to avoid potential annoyance or irritation to occupants due to inappropriate positioning of registers - ***cognitive and practical skills*** required to optimise the position of supply and extract registers such that flow rates are unlikely to be adversely affected by occupants unwittingly placing furniture, storage or other impediments over or close to them - ***cognitive and practical skills*** required to securely fix the routing and positions of ducts and registers so that there is minimal risk of adjustment or movement post-occupancy which would compromise their performance - ***cognitive and practical skills*** required to carefully route ducts through the project to avoid	- ***responsibility*** for suitably locating the MVHR unit considering most especially ease of access for the homeowner for the purposes of changing the filters but also positioning close to the thermal envelope thereby minimising the length of thermal bridges created by the two ducts which connect to the exterior - ***responsibility*** for avoidance of using inappropriate ducting materials which could adversely impact on pressure losses, ease of cleaning and creation of noise and turbulence - ***responsibility*** for full execution of the ventilation system design including provision of all specified ancillary components such as sound attenuators, filters for extract registers and fire and smoke dampers - ***responsibility*** for completion of tasks related to ensuring that all connections are completely airtight and that the two air ducts which penetrate the envelope are entirely and completely insulated with vapour tight insulation - ***responsibility*** for completion of tasks related to ensure excellent hygiene during installation especially preventing soiling of ducts and registers through dust and debris - ***responsibility*** for completion of tasks related to routing of

	excessive pressure losses which would result in increased fan energy use and possible risk of increased noise for occupants arising from the increased turbulence - ***cognitive and practical skills*** required to thoroughly and completely insulate the two air ducts which connect to the exterior through the thermal envelope in order to minimise any adverse thermal bridge effect - ***cognitive and practical skills*** required to secure a completely airtight seal of the two external air ducts at the locations where (a) they connect to the MVHR unit and (b) where they penetrate the thermal envelope - ***cognitive and practical skills*** required to appropriately position the supply and exhaust air grilles where they exit from the conditioned space with special emphasis on avoiding short-circuiting of air flow (and resulting possible contamination) - ***cognitive and practical skills*** required to select appropriately sized mesh coverings for external ducts openings so that they do not clog over time with small particles - ***cognitive and practical skills*** required to measure volumetric flow rates at registers and to adjust supply and extract registers to deliver the required volume flow rate as per the system design	condensate drain to appropriate disposal point - ***responsibility*** for installation of correct filters in the outdoor air side and extract air side - ***responsibility*** for hygienic protection of the filters prior to commissioning the system from risks presented by contaminants and / or moisture / humidity - ***responsibility*** for completion of tasks related to ensuring that the duct network can be easily cleaned in the future should the need arise - ***responsibility*** for ensuring that the homeowner knows why they should replace the MVHR filter at regular intervals and how they can replace them - ***responsibility*** for dealing with queries and concerns from homeowners once they move in and are getting used to the MVHR system (taking the initiative to follow-up with the homeowner to make sure that everything is working well)
Knowledge	**Skills**	**Responsibility and autonomy**
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge*** on facts, principles, processes and general concepts on the role of mechanical ventilation in maintaining high quality indoor air, with special regard for appropriate levels of CO_2 as well as relative humidity - ***Knowledge*** on facts, principles, processes and general concepts on designing appropriate air	- comprehensive range of ***cognitive and practical skills*** in order to design in detail a full whole-house ventilation system including specification of all key components - comprehensive range of ***cognitive and practical skills*** in order to appropriately dimension duct sizes (cross-sectional areas) to minimise	- self-management and/or ***management and supervision*** related to commissioning specialist components (typically found in multi-family projects) in the MVHR system including fire dampers, CAR dampers (constant air-flow), iris dampers, frost protection systems (pre-heaters), post-heaters, summer bypass systems, pressure

flow rates (both supply and extract) for a residential project - ***Knowledge*** on facts, principles, processes and general concepts on cascade ventilation and the need for air to transition from supply room to extract rooms - ***Knowledge*** on facts, principles, processes and general concepts on the principles of heat transfer in an MVH unit and the pros and cons of using an ERV in terms of humidity transfer in both very cold and very humid climates - ***Knowledge*** on facts, principles, processes and general concepts on the relationship between temperature, absolute humidity and relative humidity and appreciation that excessive ventilation in cold weather can result in low indoor relative humidity	pressure losses whilst maintaining modest air speeds to reduce risk of irritating noise for occupants - comprehensive range of ***cognitive and practical skills*** in order to calculate the most appropriate ventilation flow rates for the project, both at normal and 'boost' mode in line with recommendations made by the Passive House Institute and using their PHPP tool - comprehensive range of ***cognitive and practical skills*** in order to select an appropriate MVHR unit for the project considering the key objectives to (a) delivering the required air flow rates, (b) maximising heat recovery rates, (c) minimising electrical fan power required - comprehensive range of cognitive and practical skills in order to size appropriately the transfer openings required in order to minimise pressure drops - comprehensive range of ***cognitive and practical skills*** in order to evaluate the pros and cons of using centralised versus decentralised ventilation approach for multi-family projects - comprehensive range of ***cognitive and practical skills*** in order to commission the ventilation system according to the Passive House requirements including achieving an imbalance of less than 10% between supply and exhaust measured at the two external duct openings - comprehensive range of ***cognitive and practical skills*** in order to measure pressure drops and ability to introduce dampers to the system to regulate and adjust air flow as required - comprehensive range of ***cognitive and practical skills*** in order to design make-up air systems where required, for example where commercial-	differential switches (used to ramp-up ventilation rates where flow rates are curtailed by, for example, dirty filters), make-up air dampers (required for commercial-style kitchen extracts and commercial dryers) and CO_2 and humidity sensors used to regulate air-flow and operate 'slave dampers' - self-management and/or ***management and supervision*** related to ensuring that the MVHR system proactively contributes towards comfortable indoor temperatures and relative humidity in warmer climates - self-management and/or ***management and supervision*** related to measuring noise levels of ventilation system in order to ensure compliance with recommendations for different room occupancy types - self-management and/or ***management and supervision*** related to preparation of bespoke service and maintenance plan for MVHR systems

	style kitchen extract is used, or for commercial clothes dryers	
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- advanced and highly ***specialised knowledge*** on emerging technologies and research innovation in MVHR systems for high performance residential projects - advanced and highly ***specialised knowledge*** on indoor air quality parameters and management of those indicators using mechanical ventilation systems	- comprehensive range of ***cognitive and practical skills*** in order to calculate the likely indoor relatively humidity in a given climate given system flow rates, outdoor air design temperatures and average indoor moisture generation - comprehensive range of ***cognitive and practical skills*** in order to model and simulate using specialist software the air flow paths and air mixing resulting from different positioning of supply and extract air registers with a view of optimal positioning as well as specification of grill-type and to avoid short-circuiting of air flow	- taking ***responsibility*** for decision-making contributing to professional knowledge and practice in unpredictable work related to determining the heat recovery efficiency of MVHR systems where non-certified systems are used requiring on-site measurements of temperature, air flow and electrical fan power usage (ideally at a time of the year when there is a high delta-T between inside and outside) - taking ***responsibility*** for decision-making contributing to professional knowledge and practice through completion of scientific monitoring studies of air quality in DER projects (before and after retrofitting)
Topic 6.2	**Heating and Cooling**	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge*** on facts, principles, processes and general concepts on what constitutes interior 'comfort' in both winter and summer with respect to temperature and relative humidity - ***Knowledge*** on facts, principles, processes and general concepts on the differences between heating and cooling 'demand' and heating and cooling 'load' - ***Knowledge*** on facts, principles, processes and general concepts on the differences in demand and load levels for heating and cooling in older (inefficient) dwellings and those of deep energy retrofit projects - ***Knowledge*** on facts, principles, processes and general concepts on heating high performance homes via the mechanical ventilation with heat recovery using a 'post-heater'	- ***cognitive and practical skills*** required to sketch a schematic layout for a heating and / or cooling system for a single family dwelling - ***cognitive and practical skills*** required to accomplish tasks related to installation of replacement heating and cooling equipment for high performance homes - ***cognitive and practical skills*** required to accomplish tasks related to ensuring continuity of vapour tightness of pipework where required	- ***responsibility*** for completion of tasks related to upgrading of heating and cooling systems - ***responsibility*** for completion of tasks related to thorough and complete insulation of pipework, including all fittings, junctions and values as well as through-envelope penetrations - ***responsibility*** for completion of tasks related to appropriate placement of the thermostat(s) which regulates the operation of the heating and / or cooling system.

- ***Knowledge*** on principles and general concepts on the difference between latent and sensible cooling - ***Knowledge*** on principles and general concepts on what constitutes 'overheating' and what passive measures can be used to reduce risk of overheating - ***Knowledge*** on facts, principles, processes and general concepts on insulation of pipework and the significant influence of this on energy consumption, especially when heating and cooling generators are located outside of the thermal envelope		
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on both latent and sensible cooling, including ability to interpret a psychrometric chart - comprehensive, specialised, ***factual and theoretical knowledge*** on the sizing of heating and cooling systems suitable for DER projects - comprehensive, specialised, ***factual and theoretical knowledge*** on different heating and cooling systems such as boilers, heat pumps, mini-split systems and district heating - comprehensive, specialised, ***factual and theoretical knowledge*** on appropriate sizing of heating and cooling circulation pipes as well as circulation pumps - comprehensive, specialised, ***factual and theoretical knowledge*** on dimensioning of pipework insulation thickness and quantitative understanding of the performance of different insulation types.	- comprehensive range of ***cognitive and practical skills*** in order to model the before and after heating and / or cooling loads for domestic projects using such programmes as the Passive House Planning Package (PHPP) - comprehensive range of ***cognitive and practical skills*** in order to interpret the performance specifications of and test data for heating and / or cooling equipment (including reference to exterior design temperatures) in order to determine their ecoefficiency of performance (COP) and to ensure selection of optimal equipment for the climate and needs of the dwelling - comprehensive range of ***cognitive and practical skills*** in order to design a heating and / or cooling system including the generation and distribution system (whether hydronic or air-based) as well as placement and sizing of emitters. - comprehensive range of ***cognitive and practical skills*** in order to integrate the heating and cooling system into the fresh air (mechanical	- self-management and/or ***management and supervision*** related to the selection of the most optimal heating and cooling system for a project bearing in mind such issues as available services (electricity, gas, wood, oil) and costs - self-management and/or ***management and supervision*** related to commissioning of heating and / or cooling equipment and systems including initial programming (time, temperature, daily operational times) in accordance with the wishes of the homeowner - self-management and/or ***management and supervision*** related to sizing through means of calculations of a post heater (where used) on the mechanical ventilation with heat recovery system to deliver the required heat load - self-management and/or ***management and supervision*** related to integration of the heating system with the domestic hot water system and solar system (where used) - self-management and/or ***management and supervision*** related to use thermographic

	ventilation with heat recovery) system - comprehensive range of ***cognitive and practical skills*** required to train the homeowner and / or tenants to understand how to independently operate the heating and / or cooling system	imagery for the purposes of verifying and commissioning the continuity of insulation on all pipework - self-management and/or ***management and supervision*** related to provision of supplementary heating in spaces such as bathrooms - self-management and/or ***management and supervision*** related to correct placement of supply air registers in living spaces to make the best use of the 'coanda effect' in distributing the heat where it is being distributed via the MVHR
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- advanced and highly ***specialised knowledge*** on the primary energy implications for a project in using different fuels for space conditioning - advanced and highly ***specialised knowledge*** on 'risk rooms' where excessive heat gain or heat losses might occur and where supplementary cooling and / or heating might be required - advanced and highly ***specialised knowledge*** on how to adjust the building envelope specification to reduce heating and cooling loads	- ***advanced skills***, demonstrating mastery and innovation, required to calculate the heat loss through pipework as determined by temperature flow, pipe diameter and insulation type and thickness - ***advanced skills***, demonstrating mastery and innovation, required to interpret the Passive House Planning Package file for a project with respect to designing a heating system and / or cooling system (which covers both latent and sensible loads) - ***specialised problem-solving skills*** required in research and/or innovation in order to develop new knowledge and procedures related to optimised heating and / or cooling systems, sizing and design - ***specialised problem-solving skills*** required in research and/or innovation in order to develop new knowledge and procedures related to modelling heat flow in spaces to ensure that both vertical and horizontal radiant temperature asymmetry is avoided	- taking ***responsibility*** for decision-making contributing to professional knowledge and practice in monitoring the performance of dwellings before, during (for phased projects) and after renovation in order to ascertain the performance, energy efficiency and comfort provided by the heating and cooling system - taking ***responsibility*** for decision-making contributing to professional knowledge and practice in unpredictable work related to use of thermal mass and phase-change materials to modulate temperature fluctuations in the dwelling

Topic 6.3	Domestic Hot Water (DHW)	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge*** on facts, principles, processes and general concepts on the energy demand of DHW production in a typical family home - ***Knowledge*** on facts, principles, processes and general concepts on the most efficient means of producing DHW, whether from a boiler or furnace, heat pump technology, electric resistance, solar thermal, solar electric or hybrid of the above - ***Knowledge*** on facts, principles, processes and general concepts on the significant losses from poorly insulated DHW pipes and that up to 50% of these losses cannot be used as free 'passive' heat gains - ***Knowledge*** on facts, principles, processes and general concepts on clustering rooms which use DHW in an effort to keep pipe-runs short which minimises heat losses - ***Knowledge*** on facts, principles, processes and general concepts regarding impact of using low-flow showerheads in reducing DHW demand - ***Knowledge*** on facts, principles, processes and general concepts on the potential energy contribution of heat recovery from drainwater - ***Knowledge*** on facts, principles, processes and general concepts on the losses from DHW storage tanks and the importance of continuous insulation - ***Knowledge*** on facts, principles, processes and general concepts on the significant contribution potential by solar thermal collectors towards DHW production and the challenges presented by the 'winter gap' in heating dominated climates - ***Knowledge*** on facts, principles, processes and general	- ***cognitive and practical skills*** required to sketch a schematic layout for a DHW system for a single family dwelling - ***cognitive and practical skills*** required to accomplish tasks related to installation of an efficient DHW production, storage and circulation system, including the possible linking with a heating system and / or a solar thermal collector - ***cognitive and practical skills*** required to install a DHW time and temperature control system - ***cognitive and practical skills*** required to accomplish tasks related to full and complete insulation of DHW pipe network and confidence and commitment required to encourage and convince others on the building site to pursue excellence in execution of insulation of pipework - ***cognitive and practical skills*** required to retrofit low-flow showerheads to reduce DHW demand - ***cognitive and practical skills*** required to accomplish tasks related to installation of drainwater heat recovery system	- ***responsibility*** for completion of tasks related to full and complete insulation of the entire network of DHW pipes, including all junctions, connections, valves and awkward parts of the system that are typically left uninsulated - ***responsibility*** for completion of tasks related to full execution of the specification for insulating DHW pipes including thermal conductivity and thickness of insulation materials used. - ***responsibility*** for reporting anomalies in best practice in relation to efficient DHW systems

concepts on the energy consumption of DHW circulation pumps - ***Knowledge*** on facts, principles, processes and general concepts concerning the very real health and safety risks caused by Legionella		
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on the typical DHW consumption per person per day - comprehensive, specialised, ***factual and theoretical knowledge*** on the typical losses from hot water circulation systems, hot water connections to taps and storage tanks. - comprehensive, specialised, ***factual and theoretical knowledge*** on dimensioning insulation thickness for DHW pipes for the purposes of minimising losses - comprehensive, specialised, ***factual and theoretical knowledge*** on dimensioning pipe diameters for DHW pipes for the purposes of minimising losses	- comprehensive range of ***cognitive and practical skills*** required to design a DHW system for a typical single-family dwelling - comprehensive range of ***cognitive and practical skills*** in the interpretation of the DHW sheet in the Passive House Planning Package for the purposes of estimate system requirements and losses - comprehensive range of ***cognitive and practical skills*** in choosing the optimum DHW circulation system for different residential building type scenarios and deciding whether or not it makes sense to include a DHW circulation system - comprehensive range of ***cognitive and practical skills*** in selection of circulation pump(s) and specification of appropriate flow rates - comprehensive range of ***cognitive and practical skills*** on methods to prevent a risk of Legionella - comprehensive range of ***cognitive and practical skills*** required to calculate the energy (and therefore financial) savings potential from a range of DER measures for DHW systems including insulating pipes, insulating the storage tank, installing a drainwater heat recover, installing a solar thermal collector and fitting low-flow showerheads - comprehensive range of ***cognitive and practical skills*** on commissioning a DHW	- self-management and/or ***management and supervision*** related to quality assurance on-site to ensure that all energy saving measures have been executed to the highest standards, most especially the insulation of the entire system - self-management and/or ***management and supervision*** related to verification that the legionella prevention measure(s) have been properly installed and are fully operational - self-management and/or ***management and supervision*** related to use of thermographic imagery for the purposes of verifying and commissioning the continuity of insulation on all pipework - self-management and/or ***management and supervision*** related to ensuring that the occupants are able to operate the DHW system in terms of time and temperature control

	system, including the time and temperature controls	
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- advanced and ***highly specialised knowledge*** on the range of methods that can be used to efficiently provide DHW for residential schemes - advanced and ***highly specialised knowledge*** on emerging technologies used for DHW production - advanced and ***highly specialised knowledge*** on properties of different insulation types and quantification of their impact on reducing the thermal bridge coefficient of DHW circulation pipes	- ***advanced skills*** required to design a DHW system for a multi-family residential scheme - ***advanced skills*** required to calculate the energy required (kW) to deliver a known volume of water (litres) at a defined temperature (Kelvin) in a given time (minutes) - ***advanced skills*** required to calculate the heat loss from DHW storage tanks given temperature difference and tank insulation levels - specialised ***problem-solving skills*** required in relation to pressure losses from DHW circulation systems	- ability to manage and transform complex and unpredictable work on integration of innovative and unfamiliar technologies in DHW systems including drainwater heat recovery. - taking ***responsibility*** for decision-making contributing to professional knowledge and practice in unpredictable work related to energy use in DHW systems through monitoring energy use using flow and temperature metres to identify any performance gaps in the system
Topic 6.4	**Automation - Regulation**	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge*** on facts, principles, processes and general concepts on the advantages of home automation and regulation systems - ***Knowledge*** on facts, principles, processes and general concepts on the risks of overly complicating home automation and regulation systems and the preference to keep such systems as simple to use as possible - ***Knowledge*** on facts, principles, processes and general concepts on the key energy uses which should be governed by home automation and regulation, including DHW and space conditioning as well as CO_2 and humidity levels	- ***cognitive and practical skills*** required to sketch a home automation and regulation system indicating the location of key sensors and highlighting which features they regulate - ***cognitive and practical skills*** required to accomplish tasks related to successful installation of controls and sensors required to provide home automation and regulations - ***cognitive and practical skills*** required to accomplish tasks related to commissioning home automation and regulation systems - ***cognitive and practical skills*** required to train the homeowner to successfully and independently use (and adjust if necessary) the settings on any home automation and regulation system, including making them aware of the risks associated with significant adjustment from the settings established as part of the commissioning process	- ***responsibility*** for completion of tasks related to successful operation of the home automation and regulation system, including suitably positioning sensors which ensures optimal performance of the system(s) - ***responsibility*** for completion of tasks related to setting up systems which reflect the specific thermal comfort and indoor air quality needs of the homeowner (for example, older need might need higher internal temperatures or all-day comfort due to being house-bound) - ***responsibility*** for reporting to superiors if faults in any system are noticed during the commissioning phase

EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on the optimal parameters and home automation settings for thermal comfort, humidity, CO_2 and daylighting - comprehensive, specialised, ***factual and theoretical knowledge*** on the types and kinds of sensors available on the market and the trade-offs between cost-effectiveness, accuracy / responsiveness and ease-of-use for the homeowner - comprehensive, specialised, ***factual and theoretical knowledge*** on the types of automation and regulation systems used on successful projects (case studies) and risks associated with employing systems which are overly complex and which tend to cause problems for homeowners	- comprehensive range of ***cognitive and practical skills*** required to design a home automation and regulation system, including specification of the equipment, wiring and controls - comprehensive range of ***cognitive and practical skills*** required to design and install unusual or bespoke regulation or automation systems to meet specific needs of the homeowner (as a practical example, occupants with heightened sensitivities to specific aspects of indoor air quality) - comprehensive range of ***cognitive and practical skills*** required to commission complex home automation and regulation systems	- self-management and/or ***management and supervision*** related to adjustment and fine tuning of home automation and regulation systems in order to derive the very best energy efficiency for the project - self-management and/or ***management and supervision*** related to adjustment and fine tuning of home automation and regulation systems in order to provide the very best comfort and indoor air quality for the homeowner - self-management and/or ***management and supervision*** related to use of alternative equipment in situations where the originally specified parts are unavailable (without compromising the original design intent)
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- advanced and ***highly specialised knowledge*** on results of theoretical and empirical research into the performance of different types of home automation and regulation systems, most especially concerning indoor air quality (measurement of particle concentration, relative humidity, CO_2, radon and other indoor air pollutants)	- ***advanced skills***, demonstrating mastery and innovation, required to solve complex and unpredictable problems related to the design and specification of automation and regulation systems in large and complex multi-family projects - specialised ***problem-solving skills*** required in research and/or innovation in order to develop new knowledge and procedures related to optimal automation and regulation systems, including carrying out of detailed monitoring studies of DER projects with a view to determining what systems provide superior indoor environments for occupants	- ability to manage and transform complex and unpredictable work on adjustment and rectification of automation and regulation systems that have not operated or delivered as originally intended - taking ***responsibility*** for decision-making contributing to professional knowledge and practice in unpredictable work related to automation and regulation systems which have a significant impact on indoor air quality, including analysis of air change rates, filter grades, humidity control, CO_2 levels, air-borne particle concentrations, VOCs and more besides

Topic 6.5	**Lighting**	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge*** on facts, principles, processes and general concepts on low energy lighting systems, with special focus on use of LED and CFL bulbs ***Knowledge*** on facts, principles, processes and general concepts on use of passive infrared sensors (PIR) in automating lighting in infrequently used spaces and circulation zones	- ***cognitive and practical skills*** required to accomplish tasks related to installation of low energy lighting systems - ***cognitive and practical skills*** required to accomplish tasks related to installation of PIR sensors	- ***responsibility*** for completion of tasks related to installation of low energy lighting systems and PIR sensors
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** relating to lighting levels (lux) required for a range of residential room scenarios - comprehensive, specialised, ***factual and theoretical knowledge*** on range of lighting colours available (cool white versus warm white) - comprehensive, specialised, ***factual and theoretical knowledge*** on the difference between key concepts of lux, lumens and watts - comprehensive, specialised, ***factual and theoretical knowledge*** on expected life of commonly used low energy bulb types	- comprehensive range of ***cognitive and practical skills*** in preparing a lighting design for different residential spaces based on availability of natural daylighting as well as room function and lux levels - comprehensive range of ***cognitive and practical skills in liaising with homeowners to*** identify their needs and aspirations for interior and exterior lighting designs and strategies	- self-management and/or ***management and supervision*** related to commissioning of interior and exterior lighting upgrades including PIR sensors - self-management and/or ***management and supervision*** related to correct use of a lux metre to measure delivered lux levels and comparison of these to the design levels
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- advanced and ***highly specialised knowledge*** on current and emerging technological advances in terms of interior and exterior lighting of residential projects - advanced and ***highly specialised knowledge*** on understanding and interpreting lighting colour temperature charts for the purposes of lighting design	- advanced ***skills***, demonstrating mastery and innovation, required to solve complex and unpredictable problems related to energy efficient lighting design - specialised ***problem-solving skill***s and procedures related to use of daylighting analysis software	- manage and transform complex and unpredictable work on upgrading interior and exterior lighting systems - taking ***responsibility*** for decision-making contributing to professional knowledge and practice in unpredictable work related to energy efficient lighting and use of PIR sensors in domestic DER projects

2.7. Topic 7: Conservation of historic building fabric

Distinction between different levels of conservation, involving the concept of authenticity, and technical concerns where buildings of historic value undergo renovation, including an introduction to materials and techniques suited to sustaining functional and aesthetic integrity

Module 7	Conservation of historic building fabric	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** on facts and general concepts of the importance of conserving the authenticity of historical buildings ('handle-with-care' principle) - ***knowledge*** on facts that in certain circumstances it might not be appropriate to implement a DER in historical buildings due to the need to conserve features of interest - ***knowledge*** on being sensitive to the fact that DER works should, in no way, threaten the historical character of sensitive buildings - ***knowledge*** on facts that many historical buildings have been operating according to some kind of equilibrium (however inefficient from an energy perspective) for perhaps many decades and interventions of any kind can create an imbalance with significant adverse impacts	- ***cognitive and practical skills*** required to understand that working on historical buildings will typically require a more specialised skill-set than working on conventional projects including use of special materials - ***cognitive and practical skills*** required to carefully seal wooden floor joists penetrating both party walls and exterior walls using either tapes or liquid applied membranes - ***cognitive and practical skills*** required to Conceal DER features such as ventilation grilles in order not to detract from historical character.	- ***responsibility*** for completion of tasks related to apply the 'measure twice-cut once' principle in all historical buildings and proceed with caution. - ***responsibility*** for completion of tasks related to sensitive and careful placement of windows in the façade (where permitted) in order to match as close as possible the existing character - ***responsibility*** for completion of tasks related to the sealing of all vapour control layers on the warm side of the assemblies in order to minimise vapour movement towards the exterior and the threat of condensation on the cold interior surface of masonry or brick walls. - ***adaptation*** of own behaviour to circumstances in solving problems
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** of appreciating the importance of conserving the authenticity of historical buildings ('handle-with-care' principle) - comprehensive, specialised, ***factual and theoretical knowledge*** and awareness that high performance windows tends to have bulkier frames	- comprehensive range of ***cognitive and practical skills*** required to careful and close liaising with both design team members and preservation authorities and a proactive manner in problem solving - comprehensive range of ***cognitive and practical skills*** required to devise duct runs and pipe runs in confined spaces and ensure that	- self-management and/or ***management and supervision*** within the guidelines of work related to careful detailing and execution around critical junctions in order not to create severe thermal bridges which might result in mould and / or condensation. - self-management and/or ***management and supervision*** within the guidelines of work

than traditional windows and that this might not be acceptable in terms of character preservation - comprehensive, specialised, ***factual and theoretical knowledge*** that the opening style of windows in historical buildings (such as double-hung sliding sash) is typically not conducive to achieving high levels of airtightness and might require use of internal 'secondary glazing' for the purposes of minimising transmission and ventilation losses	features such as ornate plaster mouldings are not adversely affected - comprehensive range of ***cognitive and practical skills*** required to complete of on-site porosity tests such as the Karsten Tube Penetration Test which can be used to inform the risk of freeze thaw action on internally insulated walls - comprehensive range of ***cognitive and practical skills*** required to select replacement windows and doors which are acceptable to relevant preservation authorities but which also maximise energy efficiency and comfort - comprehensive range of ***cognitive and practical skills*** required to devise strategies for dealing with existing openings in the building fabric (such as chimneys) with a view to reducing unnecessary ventilation losses	related to determine through specific tests the porosity, permeability and absorption levels of bricks in exterior wall assemblies as a means to determining the risk of freeze-thaw action which might arise following introduction of internal insulation. - review and develop performance of self and others, taking some ***responsibility*** for the evaluation and improvement of work.
EQF	6 - 7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** of the importance of conserving the authenticity of historical buildings ('handle-with-care' principle) - ***advanced and highly specialised knowledge*** that in certain circumstances it might not be appropriate to implement a DER in historical buildings due to the need to conserve features of interest - ***advanced and highly specialised knowledge and*** Awareness of standards and norms for testing bricks used in external assemblies, including ASTM C20	- ***advanced skills***, demonstrating mastery and innovation, required to solve complex and unpredictable problems related careful specification of material properties in any hygrothermal studies being carried out in order to ensure that the theoretical model matches as close as possible to the conditions that exist on site. - ***advanced skills*** in interpretation of and solving problems arising from the legislative framework, codes and standards appropriate to the thermal bridging - ***summarise***, ***explain*** and ***advise*** a client on what constitutes low risk NZEB construction and determine when risks associated with thermal bridging performance may be adequately assessed by a design practitioner and when a specialist is required.	- manage complex technical or professional activities or projects, taking ***responsibility*** for decision-making in unpredictable work related to optimisation of the building envelop of historical buildings - ***manage*** and transform complex and unpredictable work on the design and/or installation of windows in historical buildings - taking ***responsibility*** for decision-making contributing to professional knowledge and practice in unpredictable work related to the optimisation the building envelop based on drawings or a given historical building

	- ***advanced skills*** in interpretation of and ***solving problems*** arising from the difficulties typically encountered in existing buildings when striving for NZEB standard	

2.8. Topic 8: RES in building renovation

Sub-Topic 8.1 Long and short term energy storage

Knowledge, skills and responsibilities on installation of RES systems in renovations without interfering with the passive house and nZEB principles and requirements. Ways of long and short-term storage of energy in the building.

Topic 8	RES in building renovation	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***general knowledge*** on existing renewable and non-polluting energy sources - ***specialised knowledge*** on possibilities of integration of renewable energy technologies in buildings - ***knowledge*** on existing HVAC technologies with the use of RES - ***knowledge*** on requirements to drawings for the building equipment with use of renewable sources - ***knowledge*** on existing systems of short term energy storage - ***knowledge*** on existing systems of long term energy storage	- ***skills*** on application of principles of sophisticated design and integrated design to RES building systems; - ***skills*** to list and describe the available tools for design of RES building systems - ***skills*** to assess data on performance of RES systems in buildings - ***cognitive skills*** to explain how building envelope affects possibilities of use of RES - ***practical skills*** to design proper system of energy storage in building	- ***responsibility*** to check the design of RES systems against the guidance and approved documentation
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***specialised knowledge*** on existing renewable and non-polluting energy sources - ***specialised knowledge*** on possibilities of integration of renewable energy technologies in buildings - ***specialised knowledge*** on existing HVAC technologies with the use of RES - ***specialised knowledge*** on building integrated photovoltaic systems	- ***skills*** on application of principles of sophisticated design and integrated design to RES building systems; - ***cognitive and practical skills*** on collection of relevant information to check the design of RES building systems against the guidance and approved documentation - ***cognitive skills*** to list and describe the available tools for design of RES building systems	- ***Responsibility*** to assess the possibilities for integration of technical systems that use renewable energy into building - ***Responsibility*** to check the design of RES systems against the guidance and approved documentation - ***Responsibility*** to design the heat supply of a building in line with n-ZEB standards

- ***general knowledge***/discussion on use of wind energy and related facilities, including small wind turbines in buildings - ***specialised knowledge*** on requirements to drawings for the building equipment with use of renewable sources - ***specialised knowledge*** on solar thermal systems - ***specialised knowledge*** on shallow geothermal energy in buildings - ***specialised knowledge*** on use of heat pumps in buildings - ***specialised knowledge*** on biomass energy in buildings - ***general knowledge*** on district heating and the link to building heat supply system - ***specialised knowledge*** on hybrid heating and DHW systems - ***specialised knowledge*** on renewable energy technologies appropriate to reach nZEB or DER standard - ***specialised knowledge*** on existing systems of short term energy storage - ***specialised knowledge*** on existing systems of long term energy storage	- ***practical skills*** to use respective software tools for including RES systems into calculation/assessment of energy performance of building - ***cognitive and practical skills*** to assess data on performance of RES systems in buildings - ***cognitive and practical skill*** to combine properly thermal properties and use of RES in buildings - ***cognitive skills*** to explain how building envelope and heat distribution systems (inlet temperature) affect possibilities and design of RES use - ***practical skills*** to design heating, cooling and ventilation technologies with the use of RES, including building integrated photovoltaic systems, solar thermal systems, geothermal energy in buildings, biomass energy systems in buildings - ***practical skills*** to design proper system of energy storage in building	
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** on existing renewable and non-polluting energy sources - ***advanced and highly specialised knowledge*** on possibilities of integration of renewable energy technologies in buildings - ***advanced and highly specialised knowledge*** on existing HVAC technologies with the use of RES -- ***advanced and highly specialised knowledge*** on requirements to drawings for the building equipment with use of renewable sources - ***advanced and highly specialised knowledge*** on building integrated photovoltaic systems - ***specialised knowledge*** on use of wind energy and related facilities, including small wind turbines in buildings	- ***advanced skills*** on application of principles of sophisticated design and integrated design to RES building systems; - ***advanced cognitive and practical skills*** on collection of relevant information to check the design of RES building systems against the guidance and approved documentation - ***advanced cognitive skills*** to list and describe the available tools for design of RES building systems - ***advanced cognitive and practical skills*** to assess data on performance of RES systems in buildings - ***advanced cognitive and practical skill*** to combine properly thermal properties and use of RES in buildings	- ***Responsibility*** to assess the possibilities for integration of technical systems that use renewable energy into building - ***Responsibility*** to check the design of RES systems against the guidance and approved documentation - ***Autonomy*** to prioritize on a practical example decision options of RES systems on the basis of effort/output ratio - ***Responsibility*** to design the heat supply and the interaction with the building envelope and heating distribution system in line with n-ZEB standards

- ***advanced and highly specialised knowledge*** on solar thermal systems - ***advanced and highly specialised knowledge*** on shallow geothermal energy in buildings - ***advanced and highly specialised knowledge*** on use of heat pumps in buildings - ***advanced and highly specialised knowledge*** on biomass energy in buildings - ***advanced and highly specialised knowledge*** on hybrid heating and DHW systems - ***advanced and highly specialised knowledge*** on renewable energy technologies appropriate to reach nZEB or DER standard - ***advanced and highly specialised knowledge*** on existing systems of short term energy storage - ***advanced and highly specialised knowledge*** on existing systems of long term energy storage - ***general knowledge*** on the interaction of building with the overall energy system and potentials of demand response - ***specialised knowledge*** on control devices and strategies to operate storage and heating /cooling systems - ***specialised knowledge*** on forecasting of demand and RES generation	- ***advanced cognitive skills*** to explain how building envelope affects possibilities of use of RES - ***advanced cognitive skills*** to explain principles of main support programmes and mechanisms promoting use of RES in buildings - ***advanced practical skills*** to use respective software tools for including RES systems into calculation/assessment of energy performance of building - ***advanced practical skills*** to assess how technical equipment of building influence each other performance - ***advanced practical skills*** to design heating, cooling and ventilation technologies with the use of RES, including building integrated photovoltaic systems, solar thermal systems, geothermal energy in buildings, biomass energy and wind energy systems in buildings - ***advanced practical skills*** to design proper system of energy storage in building - ***practical skills*** to assess and design demand response ready heating and cooling systems	

2.9. Topic 9: Cost effectiveness

Provision of solutions with proven cost effectiveness within the whole life cycle of the building. This topic covers learning outcomes in cost effectiveness, including ability and autonomy of construction specialists with different level of qualification to develop, compare and implement or understand cost effective solutions and measures for DER/nZEB level renovation.

Topic 9	Cost effectiveness	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge*** on definition of cost-effectiveness - ***Knowledge*** on existing methods to assess cost-effectiveness of renovation project	- ***Skill*** to define cost effectiveness - ***Skill*** to understand the results of cost effectiveness assessment	- ***Ability*** to read/understand cost effectiveness analysis with responsibility

EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge*** Definition of cost-effectiveness - ***Specialised knowledge*** on existing methods to assess cost-effectiveness of renovation project - ***Specialised knowledge*** on LCA principles	- ***cognitive skills*** to define cost effectiveness - ***cognitive and practical skills*** to understand the results of cost effectiveness assessment	- ***Ability*** to read the budget properly with regard to cost effectiveness - ***Ability*** to choose building material with optimal cost effectiveness - ***Ability*** to implement recommended cost-effective measures
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***highly specialised knowledge*** on the current energy prices - ***advanced and highly specialised knowledge*** on sustainable economic development with reference to buildings, long-term benefits of DER and nZEBs - ***advanced and highly specialised knowledge*** on LCA methods - ***advanced and highly specialised knowledge*** on costs over the service life of a nZEB building compared with an usual building, assuming an average price of energy for the period considered, the residual value of a building at the end of the period under consideration; - ***advanced and highly specialised knowledge*** on general costs and costs related to energy saving measures, - ***advanced and highly specialised knowledge*** on economic efficiency of the individual measures - ***advanced and highly specialised knowledge*** on economic efficiency of a package of measures, - ***advanced and highly specialised knowledge*** on documentation on investment and operational costs	- ***Cognitive and practical skills*** to understand the difference between investment costs and energy saving costs - ***Cognitive and practical skills*** to identify the factors that may positively influence the economic efficiency of a building, - ***Cognitive and practical skills*** to understand the relationship between capital costs and costs relating to all types of energy saving measures, - ***Practical skills*** on application of LCA methods - ***Cognitive and practical skills*** to understand the economic efficiency based on current costs - ***Practical skills*** on comparison of investment costs to gains from energy savings;	- taking ***responsibility*** for estimation of the budget of nZEB/DER - ***Ability*** to explain criteria for economical quality of the project with autonomy - taking ***responsibility*** for assessment and comparison renovation measures with respect to cost-efficiency - ***Ability*** to explain the economic efficiency of a package of measures - ***Ability*** to explain costs' calculation model

2.10. Topic 10: Planning and design instruments

Nationally recognized software tools / other available software planning tools. BIM tools, solutions and modelling.

Topic 10	Planning and design instruments	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- basic ***knowledge*** of nationally recognised and available software tools for design of DER project - basic ***knowledge*** of available BIM tools - basic ***knowledge*** of possibilities of data exchange between software tools for planning and design	- ***practical skills*** to apply software tools for some parts of design of DER project	- ***responsibility*** for some parts of design of DER project with application of nationally recognised software tools
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- specialised ***factual and theoretical knowledge*** in the field of designing with the help of nationally recognised software tools. - specialised ***factual and theoretical knowledge*** of application of specialised software for design and planning of DER - ***specialised knowledge*** of application of available BIM tools - ***specialised knowledge*** of possibilities of data exchange between software tools for planning and design	- ***cognitive and practical skills*** to apply software tools for specialised parts of design of DER project - ***cognitive and practical skills*** in analysis of design and planning of DER, including suggestions of improvements	- ***responsibility*** for specialised parts of design and planning of DER project with application of nationally recognised software tools
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** on physical properties of building, building envelope, technical systems of buildings, operation and maintenance practices and requirements. - ***advanced and highly specialised knowledge*** on designing with the help of nationally recognised software tools - ***advanced and highly specialised knowledge*** on application of available BIM tools - ***advanced and highly specialised knowledge*** on possibilities of data exchange between software tools for planning and design	- ***advanced practical skills*** in application of nationally recognised software tools to create a model building and it's systems and to use it for control and management of the project. - ***advanced practical skills*** in analysis of design and planning of DER, including suggestions and justification of design improvements. - ***advanced practical skills*** in data exchange between different design tools - ***advanced practical skills*** in application of BIM technology.	- ***responsibility*** for overall design and planning of DER project with application of nationally recognised software tools - ***responsibility*** for fulfilment of national standards and technical requirements within design and planning of DER project

2.13. Topic 11: Comfort, health and safety requirements in buildings, incl. indoor air quality

Sub-Topic 11.1 Summer comfort/ passive cooling strategies

Sub-Topic 11.2 Fire protection

This topic covers learning outcomes in comfort, health and safety requirements in buildings, including indoor air quality, condensation, humidity and mould appearance, CO2 levels, draught elimination, productivity and health impact, other comfort aspects (light, acoustic), general safety requirements and fire protection issues. Summer comfort is a special issue for buildings which are not provided with mechanical systems for cooling during the summer season and the topic includes aspects like passive cooling strategies / shading or night ventilation. The ability and autonomy of professionals with different level of qualification to understand, develop, compare and implement different situations, to communicate with experts having various specialised responsibilities (e.g. fire safety specialist) and to make decisions for the improvement of indoor environment in deep energy renovation projects are included.

Topic 11	Comfort, health and safety requirements in buildings	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Knowledge on facts and principles*** of comfort in buildings and healthy indoor climate, including indoor air quality, thermal comfort, daylight and lighting, noise, connection to the nearby landscape: • Indoor air contaminants and recommended levels for acceptable indoor air quality (including condensation, humidity and mould appearance, CO2 levels, radon, VOCs), • Criteria for thermal comfort and relevant applicable regulation and standards, including adaptive thermal comfort, • Criteria for acoustic indoor environment comfort, including noise and vibration generation and accepted levels, • Criteria for visual comfort, including light and glare conditions; - ***Knowledge on facts and principles*** of key-factors influencing indoor comfort	- ***Ability to explain*** the importance of comfort in buildings and healthy indoor climate, and ***describe*** the main criteria and factors that affect human comfort in buildings: • ***Identify*** sources for air contaminants, ***describe*** performance levels for indoor air quality, ***identify*** main risks related to indoor comfort, building degradation and occupants health, • ***Present*** the criteria for thermal comfort, • ***Understand*** noise generation and present criteria for acoustic comfort, • ***Understand*** visual comfort and present criteria for lighting and glare, • ***Use*** tools and devices for measurement and control to determine the parameters of air quality and comfort of the space environment, • ***Compare*** the results of environmental quality and comfort parameters determined with standard criteria and parameters; - ***Identify*** the main factors influencing indoor comfort during summer and ***describe*** their importance:	- Taking ***responsibility*** for the identification of indoor environment related issues, - Adapt own behaviour to circumstances in solving problems, - Answer questions from users/owners regarding Comfort, health and safety requirements in buildings and DER context, - Complies with health and safety regulations at work, - Taking ***responsibility*** to comply with emergency and fire safety rules, - Assuming teamwork and collaborating with other team members to solve work tasks.

during summer (qualitative understanding): • Understanding key principles and awareness of solar thermal load: significance, dependence on orientation and size of transparent surfaces, permanent / temporary shading, effectiveness of the shading systems/devices located inside and outside, • Understanding key principles and relationship between air exchange and summer comfort, • ***Awareness*** of the influence of internal heat sources: how can they be reduced? The influence of colour façade, insulation and thermal mass. - ***Knowledge*** of facts and principles on passive cooling technologies to avoid overheating / to reduce the cooling demand during summer; - ***Knowledge*** of general concepts regarding safety requirements in buildings and renovation process: • General ***awareness*** of the legal framework structure, the relationship with standards and guidelines applicable to Fire Safety and legal responsibilities in Buildings; • General ***awareness*** of environmental regulations affecting building system design and occupancy health and safety; • General ***awareness*** of the applicable regulations pertaining to safety issues, involving hazardous materials in buildings; • General ***awareness*** of emergency operations and safety plan; • General ***awareness*** of the principles of Passive and Active Fire Protection.	• ***Define*** the solar heat load, • ***Explain*** the link between heat gains in summer and: building orientation and transparent surfaces, shading, effectiveness of indoor and outdoor blinds, • ***Explain*** the role of air changes in obtaining thermal comfort during summer, • ***Identify*** internal heat sources that can maintain thermal comfort in a building • ***Explain*** the importance of external surfaces colours, thermal insulation and internal thermal masses, - ***Understand*** and ***describe*** generic passive cooling techniques, - ***Explain*** how overheating can be avoided or cooling demand reduced using passive techniques and ***provide generic*** technical ***solutions*** for passive cooling; - ***Identify*** key safety requirements in buildings and renovation process and responsible specialists: • ***Ability to identify*** the relevant document type applicable to Fire Safety and ***to identify*** relevant legal responsibilities for safety in Buildings and construction process, • ***Ability to identify*** the main regulation related to occupancy health and safety in renovation process, including specific requirements involving hazardous materials in buildings, • ***Ability to read*** emergency operations and safety plan, • ***Review*** the principles of Passive and Active Fire Protection, ***Ability to identify*** safety (including emergency and fire safety) requirements in buildings in professional activities related to	

General ***awareness*** of the interface / links with various professions in the construction process.	construction, installation, operation and maintenance of buildings and systems.	
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Factual and theoretical knowledge*** of criteria for comfort in buildings and healthy indoor climate, including indoor air quality, thermal comfort, daylight and lighting, noise, connection to the nearby landscape: • Indoor air contaminants and recommended levels for acceptable indoor air quality (including condensation, humidity and mould appearance, CO2 levels, radon, VOCs), • Criteria for thermal comfort and relevant applicable regulation and standards; use of adaptive thermal comfort, • Criteria for acoustic indoor environment comfort, including noise and vibration generation and accepted levels, • Criteria for visual comfort, including light and glare conditions; - ***Factual and theoretical knowledge*** of key-factors influencing indoor comfort during summer (qualitative understanding): • Solar loads: significance/impact, importance of building orientation, architecture, function and vicinity, • Air exchange - assessment methods; how can the airflow be increased? • Impact of indoor heat sources; how can they be reduced? • Impact of exterior colours, of thermal insulation, and of	- ***Explain*** the criteria and added benefits in terms of comfort / healthy indoor climate including aspects of indoor air quality, thermal comfort, daylight and lighting, noise, connection to the nearby landscape: • ***Identify*** sources of main air contaminants, describe the performance levels for indoor air quality and ***explain*** main risks regarding the effects of these pollutants, • Describe criteria and identify the standards of thermal comfort, • ***Describe*** criteria for acoustic indoor environment comfort, identify possible and accepted levels and ***provide generic solutions***, • ***Describe*** criteria for visual comfort, and requirements for lighting and glare; - ***Identify*** the main factors influencing indoor comfort during summer and ***describe*** their influence: • ***Explain*** the link between heat gains in summer and: building orientation and transparent surfaces, shading, effectiveness of indoor and outdoor blinds, • ***Estimate*** air exchange and provide control solutions to improve summer comfort, • ***Explain*** the impact of indoor heat sources and ***provide generic solutions*** how to reduce them,	- Self-management and/or ***management and supervision*** within the guidelines of work related to indoor comfort and health risks issues - Self-management and/or ***management and supervision*** within the guidelines of work related to indoor comfort and health risks issues where there is unpredictable change, - Review and develop performance of self and others, taking some ***responsibilit***y for the evaluation and improvement of work (related to cross-crafting issues) - Answer questions from users/owners regarding Comfort, health and safety requirements in buildings and DER context; - Make judgement and propose decisions regarding specific solutions based on the coordination of own work with other responsible persons, e.g. for safety, fire issues; - Undertaking the initiative in solving some data tasks; - Ensuring the quality of the provided documentation; - Ensuring compliance with health and safety regulation, fire prevention and extinguishing, and environmental protection, - Self-management and/or ***management and supervision*** within the guidelines of work related to health and safety regulations at work.

thermal masses inside the building; • Impact of the dynamics of indoor activities (strongly fluctuating internal loads) • ***Factual and theoretical knowledge*** of simple measuring techniques to assess shading in summer; • ***Factual and theoretical knowledge*** of passive cooling technologies to avoid overheating / to reduce the cooling demand during summer; - Critical ***awareness*** of knowledge issues regarding safety requirements in buildings and the compliance ensured during the renovation process: • ***Awareness*** of the legal framework structure, the relationship with standards and guidelines applicable to Fire Safety and legal responsibilities in Buildings; • ***Awareness*** of environmental regulations affecting building system design and occupancy health and safety; • ***Awareness*** of the applicable regulations pertaining to safety issues, involving hazardous materials in buildings; • ***Awareness*** of emergency operations and safety plan; • ***Awareness*** of the principles of Passive and Active Fire Protection. • ***Awareness*** of the interface / links with various specialties in building design and professions in the construction process.	• ***Explain*** the impact of external surfaces colours, thermal insulation and internal thermal masses, • ***Explain*** the influence of strongly fluctuating internal loads on indoor comfort in summer; - ***Use*** automatic calculation tools to assess shading in summer; - ***Explain*** how overheating can be avoided or cooling demand reduced using passive techniques and ***provide*** common technical ***solutions*** for passive cooling; - ***Describe*** main safety requirements in buildings and renovation process and ***relate*** to key regulation and responsible specialists: • ***Ability to read and understand*** the relevant standards and guidelines applicable to Fire Safety and ***to identify*** relevant legal responsibilities in Buildings, • ***To know*** the technical, regulatory and regulations related to occupancy health and safety in renovation process, including specific requirements involving hazardous materials in buildings, • ***Describe*** the requirements of and provide a sketch of emergency operations and safety plan, • ***Review*** the principles of Passive and Active Fire Protection, • ***Confidence and communication skills to liaise*** with colleagues and convince them of the importance of comfort, health and safety requirements in buildings • ***Elaborating*** a thematic project using and selecting information from the internet	

EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Advanced knowledge*** of criteria for comfort in buildings and healthy indoor climate, including indoor air quality, thermal comfort, daylight and lighting, noise, connection to the nearby landscape: • Indoor air contaminants and performance levels for indoor air quality (including condensation, humidity and mould appearance, CO2 levels, radon, VOCs), • Criteria for thermal comfort and relevant applicable regulation and standards; concept of adaptive thermal comfort, • Criteria for acoustic indoor environment comfort, including noise and vibration generation and accepted levels, • Criteria for visual comfort, including natural light, artificial lighting and glare conditions;	- ***Explain*** the criteria and added benefits in terms of comfort / healthy indoor climate including detailed description of indoor air quality, thermal, visual and acoustic comfort, link to the nearby landscape: • ***Identify*** sources of main air contaminants, ***describe*** the performance levels for indoor air quality, ***explain*** main risks regarding the effects of these pollutants and ***provide solutions*** to reduce their impact, • ***Describe*** criteria and apply the standards of thermal comfort, • ***Describe*** criteria for acoustic indoor environment comfort, identify possible and accepted levels and provide generic solutions, • ***Describe*** criteria for visual comfort, and requirements for lighting and glare;	- Taking ***responsibility*** for identification and quantification indoor environment related issues and to communicate to corresponding specialties proposed impacts and solutions; - Taking ***responsibility*** for minimising the impact of influencing factors on indoor environment, especially on summer comfort; - Make critical judgements and decisions based on scientific principles within a changing and ill-defined technological context, with an ability to analyse and measure novel and emerging technological propositions; - Record and present project case studies and design proposals regarding indoor environment quality and comfort using appropriate professional and academic report writing conventions; - Taking ***responsibility*** for managing professional development of individuals and groups in own supervision; - Answer questions from users/owners regarding Comfort, health and safety requirements in buildings and DER context; - Making decisions regarding specific solutions based on the coordination of own work with other responsible persons, e.g. for safety, fire issues, Responsible for training and compliance with regulations on health and safety at work, by their subordinates.
- ***Advanced knowledge*** of key-factors influencing indoor comfort during summer: • Solar loads: significance/impact, importance of building orientation, architecture, function and vicinity, • Air exchange - assessment methods; how can the airflow be optimized? • Impact of indoor heat sources; how can they be reduced? • Impact of external colours, • Impact of thermal insulation, • Impact of thermal masses inside the building; • Impact of the dynamics of indoor activities; • ***Advanced knowledge*** of automatic calculation tools used to assess shading in summer;	- ***Identify*** the main factors influencing indoor comfort during summer and ***describe*** their influence: • ***Quantify*** the influence on solar heat loads in summer of building orientation and vicinity, transparent envelope surfaces, shading elements, effectiveness of indoor and outdoor blinds, • ***Assess*** air exchange and ***provide*** control ***solutions*** to improve summer comfort, • ***Quantify*** the impact of indoor heat sources and ***provide*** optimization solutions, • ***Quantify/simulate*** the impact of external colours, thermal insulation and internal thermal masses, • ***Quantify/simulate*** the influence of strongly fluctuating internal loads on indoor comfort in summer;	

• ***Advanced knowledge*** of passive cooling technologies to avoid overheating / to reduce the cooling demand during summer; - Critical ***awareness*** of knowledge issues regarding safety requirements in buildings and the compliance ensured during the renovation process: • ***Awareness*** of the legal framework structure, the relationship with standards and guidelines applicable to Fire Safety and legal responsibilities in Buildings; • ***Awareness*** of environmental regulations affecting building system design and occupancy health and safety; • ***Awareness*** of the applicable regulations pertaining to safety issues, involving hazardous materials in buildings; • ***Awareness*** of emergency operations and safety plan; • ***Awareness*** of the principles of Passive and Active Fire Protection. ***Awareness*** of the interface / links with various specialties in building design and professions in the construction process.	• ***Quantify*** shading effects in summer using automatic calculation tools; • ***Assess*** how overheating can be avoided or cooling demand reduced using passive techniques and provide technical solutions for passive cooling; - ***Describe*** main safety requirements in buildings and renovation process and relate to key regulation and responsible specialists: • ***Ability to read*** and understand the relevant standards and guidelines applicable to Fire Safety and ***to identify*** relevant legal responsibilities in Buildings, • ***To know*** the technical, regulatory and regulations related to occupancy health and safety in renovation process, including specific requirements involving hazardous materials in buildings, • ***Describe*** the requirements of and provide a sketch of emergency operations and safety plan, • ***Review*** the principles of Passive and Active Fire Protection, ***Ability to integrate knowledge*** related to safety (including emergency and fire safety) requirements in buildings in professional activities related to design, construction, installation, operation, licensing, and maintenance of buildings and systems, and ***ability to communicate and exchange*** with various specialties.	

2.12. Topic 12: Step-by-step retrofit plans

Economic assessment, energy audit, design and implementation issues. Step-by-step strategies as well as suitable component and alternative solutions

Topic 12	Step-by-step retrofit plans	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** on potential for energy savings in reference to the national and international (e.g. EnerPHit) renovation standards; - ***knowledge*** on defining the purpose of the retrofit: -- Reduced energy consumption -- Reduced energy costs -- Building certification -- Switching to green energy -- Energy autonomous building - ***knowledge*** on reference levels of thermal protection for all measures / building components; - ***knowledge*** on impact of the existing constructive system on the building renovation opportunities; - ***knowledge*** on economic efficiency of the different steps; - ***knowledge*** on the basis of decision-making; - ***knowledge*** on assessment on a case by case basis: tools and instruments; - ***knowledge*** on added cost of DER (based on the different steps and their sequence); - ***knowledge*** on financing tools and support schemes; - ***knowledge*** on Step-by-step retrofit plans; - ***knowledge*** on details and products suitable for SBS DER (at the forefront of knowledge); - ***knowledge*** on integration of RES installations, storage systems and building automation; - ***knowledge*** on multiple benefits and accountability to different stakeholders; - ***knowledge*** on advantages of renovating existing buildings using nZEB suitable components with reference to the specific problems of old buildings;	- ***cognitive skills*** required to explain the advantages and specific challenges of step-by-step refurbishment; - ***cognitive skills*** required to identify opportunities for energy savings; - ***cognitive and practical skills*** required to explain the difficulties typically encountered in existing buildings when striving for ambitious energy standards; - ***cognitive skills*** required to interpret the energy audit certificate;	- ***responsibility*** for installation and usage of details and products suitable for SBS DER (appropriate installation of materials for thermal insulation and airtightness without compromising the measures at the different steps); - ***responsibility*** for ensuring the airtightness during the implementation of different steps and measures -***responsibility*** for providing conditions for correct exploitation of the building heating and ventilation systems

- ***knowledge*** on Commissioning / Facility Management / Monitoring		
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on potential for energy savings in reference to the national and international (e.g. EnerPHit) renovation standards; - comprehensive, specialised, ***factual and theoretical knowledge*** on defining the purpose of the retrofit: -- Reduced energy consumption -- Reduced energy costs -- Building certification -- Switching to green energy -- Energy autonomous building - comprehensive, specialised, ***factual and theoretical knowledge*** on reference levels of thermal protection for all measures / building components; - comprehensive, specialised, ***factual and theoretical knowledge*** on impact of the existing constructive system on the building renovation opportunities; - comprehensive, specialised, ***factual and theoretical knowledge*** on economic efficiency of the different steps; - comprehensive, specialised, ***factual and theoretical knowledge*** on the basis of decision-making; - comprehensive, specialised, ***factual and theoretical knowledge*** on assessment on a case by case basis: tools and instruments; - comprehensive, specialised, ***factual and theoretical knowledge*** on added cost of DER (based on the different steps and their sequence); - comprehensive, specialised, ***factual and theoretical knowledge*** on financing tools and support schemes; - comprehensive, specialised, ***factual and theoretical***	- comprehensive range of ***cognitive and practical skills*** required to explain the advantages and specific challenges of step-by-step refurbishment; - comprehensive range of ***cognitive skills*** required to explain the benefits of renovating to ambitious energy efficiency standards (nZEB / EnerPHit, etc.) - comprehensive range of ***cognitive skills*** required to identify opportunities for energy savings; - comprehensive range of ***cognitive and practical skills*** required to explain the difficulties typically encountered in existing buildings when striving for ambitious energy standards; - comprehensive range of ***cognitive and practical skills*** required to interpret the energy audit certificate; - comprehensive range of ***cognitive and practical skills*** required to consider the correct on-site exercise of DER steps and RES implementation;	- self-management and/or ***management and supervision*** within the identification of the necessary DER steps in drawings and buildings and estimation of their suitability / economic efficiency / comfort benefits and impact; - ***responsibilit***y for communicating the project proposal, the connections between the different measures and steps and the time schedule to the different specialities / stakeholders.

knowledge on Step-by-step retrofit plans; - comprehensive, specialised, ***factual and theoretical knowledge*** on details and products suitable for SBS DER (Know the appropriate materials for thermal insulation and airtightness and their specific usages); Ensuring of airtightness during the implementation of different steps and measures; - comprehensive, specialised, ***factual and theoretical knowledge*** on integration of RES installations, storage systems and building automation; - comprehensive, specialised, ***factual and theoretical knowledge*** on multiple benefits and accountability to different stakeholders; - comprehensive, specialised, ***factual and theoretical knowledge*** on advantages of renovating existing buildings using nZEB suitable components with reference to the specific problems of old buildings; - comprehensive, specialised, ***factual and theoretical knowledge*** on Commissioning / Facility Management / Monitoring		
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** on potential for energy savings in reference to the national and international (e.g. EnerPHit) renovation standards; certification of the energy performance - ***advanced and highly specialised knowledge*** on defining the purpose of the retrofit: -- Reduced energy consumption -- Reduced energy costs -- Building certification -- Switching to green energy -- Energy autonomous building - ***advanced and highly specialised knowledge*** on reference levels of thermal protection for all measures / building components; - ***advanced and highly specialised knowledge*** on impact of the	- ***advanced skills***, demonstrating mastery and innovation, required to explain the advantages and specific challenges of step-by-step refurbishment; - specialised ***problem-solving skills*** required to explain the benefits of renovating to ambitious energy efficiency standards (nZEB / EnerPHit, etc.) on a case-by-case basis; - ***advanced skills*** in explaining the economic efficiency of the different steps within an life-cycle assessment - ***advanced skills*** in explain the difficulties typically encountered in existing buildings when striving for ambitious energy standards; - ***advanced skills*** in identify opportunities for energy savings;	- Taking the ***responsibility*** for autonomously developing a complete Step-by-step retrofit plan and a basic financial analysis within a LCA - taking ***responsibility*** for the management and supervision within the guidelines of work related to the plan implementation, time-schedule and task distribution

existing constructive system on the building renovation opportunities; - ***advanced and highly specialised knowledge*** on economic efficiency of the different steps; Life-cycle assessment; Sensitivity analysis; Financial analysis; - ***advanced and highly specialised knowledge*** on the basis of decision-making; - ***advanced and highly specialised knowledge*** on assessment on a case by case basis: tools and instruments; - ***advanced and highly specialised knowledge*** on added cost of DER (based on the different steps and their sequence); - ***advanced and highly specialised knowledge*** on financing tools and support schemes - ***advanced and highly specialised knowledge*** on Step-by-step retrofit plans: different strategies; time schedule; scope and communication between the different specialties; compatibility of the different measures and steps; - ***advanced and highly specialised knowledge*** on details and products suitable for SBS DER (Know the appropriate materials for thermal insulation and airtightness and their specific usages); Ensuring of airtightness during the implementation of different steps and measures; - ***advanced and highly specialised knowledge*** on integration of RES installations, storage systems and building automation; - ***advanced and highly specialised knowledge*** on multiple benefits and accountability to different stakeholders; - ***advanced and highly specialised knowledge*** on advantages of renovating existing buildings using nZEB suitable components with reference to the specific problems of old buildings: condensation and dampness, inadequate thermal comfort, poor air quality, high heating and cooling costs,	- ***advanced skills***, demonstrating mastery and innovation, required to interpret the energy audit certificate; - ***advanced skills***, displaying professionalism and critical thinking, required to develop a Step-by-step retrofit plan with specific focus on avoiding and eliminating thermal bridges and airtightness problems, - Provide conditions for potential replacement and correct exploitation of the building heating, cooling and ventilation systems related with insulation and airtightness, - specialised problem-solving skills in considering the integration of RES installations, energy storage systems and building automation	

environmental pollution; what is the impact of different steps; - ***advanced and highly specialised knowledge*** on Commissioning / Facility Management / Monitoring		

2.13. Topic 13: Energy efficiency and building renovation policies

National and EU strategic goals; financing schemes and opportunities; relevant legislation acts. The topic includes skills and responsibilities of construction professionals with regard to national energy efficiency policy and financial support schemes in nZEB construction and renovation/ DER.

Topic 13	Energy efficiency and building renovation policies	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***general knowledge*** on EU legislation relevant to energy efficiency policy (EPBD and EED, EcoDesign)	- ***ability*** to identify EU legislation acts related to energy efficiency and explain their main goals - ***ability*** to read and understand energy performance certificate of building	- ***autonomy*** to read/process properly an application for financial support of energy efficient renovation project
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***specialised knowledge*** on EU legislation relevant to energy efficiency policy (EPBD and EED, EcoDesign)	- ***ability*** to identify EU legislation acts related to energy efficiency and explain their main goals - ***ability*** to understand requirements of national programmes supporting energy efficient renovations - ***ability*** to read and understand energy performance certificate of building - ***ability*** to understand the results and recommendations of energy audits of the buildings	- Taking ***responsibility*** for implementation of the recommendations related to energy efficient renovation support - ***autonomy*** to read/process properly an application for financial support of energy efficient renovation project
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and specialised knowledge*** on EU legislation relevant to energy efficiency policy (EPBD and EED, EcoDesign) - ***specialised knowledge*** on legislative proposal "Clean Energy for all Europeans" (Winter package) - ***specialised knowledge*** on national energy efficiency action plan	- ***cognitive skills*** to describe energy efficiency actions being taken at national level - ***cognitive skills*** to list and describe main national programmes supporting energy efficient renovations - ***cognitive and practical skills*** to read and understand details of energy performance certificate calculations - ***practical skills*** to apply software tools to issue energy performance certificate of building	- Taking ***responsibility for*** professional development and submission of full application for financial support of energy efficient renovation project - Taking ***responsibility for*** provision of consultancy on existing support programmes for DER/nZEB renovations

	- ***cognitive and practical skills*** to understand the results and recommendations of energy audits of the buildings	

2.14. Topic 14: Achieving measurable results

Technical requirements for energy audits; required parameters of the building components; issuing of energy performance certificates (EPC). Monitoring and evaluation of the results of the retrofit projects. International retrofitting standards (e.g. EnerPHit).

Topic 14	Achieving measurable results	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Basic knowledge*** on thermal balance calculation, - ***Basic knowledge*** on energy performance certificates and energy audits requirements.	***Skills*** of understanding the principles of issuing energy performance certificate and its results. ***Skills*** to perform calculations for issuing energy performance certificate of building.	***Autonomy*** to read and understand the results of energy audits and energy performance certificates of buildings.
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***Specialised knowledge*** on energy performance certificates and energy audits requirements. - ***Specialised knowledge*** on required parameters of building materials, types of buildings, required parameters of building structures, renovation technologies. - ***specialised knowledge*** on energy use in buildings and building physics, including thermal balance calculation - ***specialised knowledge*** on required parameters of HVAC systems related to achievement of nZEB/DER standard, - ***specialised knowledge*** on related legislation: - Law on energy management; - Local implementing decrees; - Policies, rules regulations and standards. - ***specialised knowledge*** on financial assessment of technical parameters and energy performance measures: - Financial decision-making processes;	***Skills*** of understanding the principles of issuing energy performance certificate and its results. ***Practical skills*** to perform calculations for issuing energy performance certificate of building. ***Cognitive and practical skills*** of understanding and design/implementation of selected solutions for fulfilment of required parameters of building components and systems. ***Practical skills*** of performing comparison of investment costs and related energy cost savings. ***Practical skills*** to apply software tools for calculations related to energy performance certificate or to elaboration of energy audit. ***Practical skills*** of making a measurement plan for the data collecting activities.	***Autonomy*** to read and understand the results of energy audits and energy performance certificates of buildings. ***Responsibility*** for performing comparison of investment costs and related energy cost savings. ***Responsibility*** for performing calculations related to energy performance certificate or to energy audit.

- Economics of energy management. ***- specialised knowledge*** on energy efficiency measures/solutions and related costs. ***- knowledge*** on related software tools: - Nationally recognized tools; - BIM tools		
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
Advanced and specialised knowledge on required parameters of building materials, types of buildings, required parameters of building structures, renovation technologies. ***Advanced and specialised knowledge*** on energy use in buildings and building physics, ***Advanced and specialised knowledge*** on required parameters of HVAC systems related to achievement of nZEB/DER standard, ***Advanced and specialised knowledge*** on related legislation: - Law on energy management; - Local implementing decrees; - Policies, rules regulations and standards. ***Advanced and specialised knowledge*** on financial assessment of technical parameters and energy performance measures: - Financial decision-making processes; - Economics of energy management. ***Advanced and specialised knowledge*** on energy efficiency measures/solutions and related costs. ***Advanced and specialised knowledge*** on related software tools: - Nationally recognized tools; - BIM tools	***Cognitive skills*** of critical thinking: - Using logic and reasoning; - Found strengths and weaknesses; - Choice of solution. ***Practical skills*** of system analysis: - Understanding the building system; - Improving the functionality of the system. ***Cognitive skills*** of understanding and explaining the benefits of selected solutions for fulfilment of required parameters of building components and systems. ***Practical skills*** of performing comparison of investment costs and related energy cost savings. ***Practical skills*** of implementation of principles and methodology of project management. ***Practical skills*** to apply software tools for issuing energy performance certificate and elaboration of energy audit. ***Practical skills*** of making a measurement plan for the data collecting activities and development of technical-economic study.	***Responsibility*** for communication with technical and non-technical decision-makers. - Submission of proposals. - Explaining the benefits of proposed variants. ***Responsibility*** for understanding and application of energy audit principles and methodologies. Experience in the economic assessment. ***Responsibility*** for issuing energy performance certificate and /or energy audit of the building/ group of buildings. ***Responsibility*** for suggestion of energy performance improvement measures within energy advising or energy audit.

2.15. Topic 15: Engaging stakeholders

Explaining the multiple benefits of energy efficiency to different target groups – energy and financial savings, increased thermal comfort, sanitary and health conditions, better indoor air quality, ecological and climate change mitigation impact, broader economic and social benefits, energy security, etc.

Topic 15	Engaging stakeholders	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** on benefits of DER: energy and financial savings, increased thermal comfort, sanitary and health conditions, better indoor air quality, ecological and climate change mitigation impact, broader economic and social benefits, energy security, impact on employment and local economy - ***knowledge*** on demands, needs and requirements of stakeholders' groups in the DER value chain – clients, energy consultants and auditors, designers, construction companies, financing institutions, real estate companies - ***knowledge*** on current national and EU policies in support of DER (at the forefront of knowledge) - ***knowledge*** on current financing instruments for DER (at the forefront of knowledge) - ***knowledge*** on sources of information about DER: best practices	- ***cognitive and practical skills*** required to identify the different stakeholders groups in the DER value chain and their needs and demand - ***cognitive skills*** required to identify and use the right communication argument for each stakeholder group - ***cognitive skills*** required to identify the needs, demands and limitations of the end clients at the level of individual household, based on analysis of the demographic and social status - ***cognitive skills*** required to explain the multiple benefits of energy efficiency to different target groups according to the identified needs, demands and limitations - ***cognitive skills*** required to identify and advice on suitable communication channels and information resources	- ***self-management*** within the guidelines of communication to the different target groups - some ***responsibility*** for providing consultation and advice for the end client on each step of the DER process and the benefits of each measure of the DER plan
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on benefits of DER: energy and financial savings, increased thermal comfort, sanitary and health conditions, better indoor air quality, ecological and climate change mitigation impact, broader economic and social benefits, energy security, impact on employment and local economy - comprehensive, specialised, ***factual and theoretical***	- comprehensive range of ***cognitive and practical skills*** required to identify the different stakeholders groups in the DER value chain and their needs and demand - comprehensive range of ***cognitive and practical skills*** required to identify and use the right communication argument for each stakeholder group - comprehensive range of ***cognitive and practical skills*** required to identify the needs,	- self-management and/or ***management and supervision*** within the guidelines of communication to the different target groups and respective stakeholders - ***responsibility*** for providing consultation and advice for the end client on each step of the DER process and the benefits of each measure of the DER plan

knowledge on demands, needs and requirements of stakeholders' groups in the DER value chain – clients, energy consultants and auditors, designers, construction companies, financing institutions, real estate companies - comprehensive, specialised, ***factual and theoretical knowledge*** on current national and EU policies in support of DER - comprehensive, specialised, ***factual and theoretical knowledge*** on current financing instruments for DER - comprehensive, specialised, ***factual and theoretical knowledge*** on sources of information about DER: best practices and impartial advice	demands and limitations of the end clients at the level of individual household, based on analysis of the demographic and social status - comprehensive range of ***cognitive and practical skills*** required to explain the multiple benefits of energy efficiency to different target groups according to the identified needs, demands and limitations - comprehensive range of ***cognitive skills*** required to identify and advice on suitable communication channels and information resources	
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- advanced and highly specialised knowledge on benefits of DER: energy and financial savings, increased thermal comfort, sanitary and health conditions, better indoor air quality, ecological and climate change mitigation impact, broader economic and social benefits, energy security, impact on employment and local economy ***- advanced and highly specialised knowledge*** on demands, needs and requirements of stakeholders' groups in the DER value chain – clients, energy consultants and auditors, designers, construction companies, financing institutions, real estate companies ***- advanced and highly specialised knowledge*** on current national and EU policies in support of DER ***- advanced and highly specialised knowledge*** on current financing instruments for DER ***- advanced and highly specialised knowledge*** on sources of information about DER: best practices and impartial advice	- ***advanced skills***, displaying professionalism and critical thinking, required to identify the different stakeholders groups in the DER value chain and their needs and demand - specialised ***problem-solving skills*** required to identify and use the right communication argument for each stakeholder group - ***advanced skills***, displaying professionalism and critical thinking, required to identify the needs, demands and limitations of the end clients at the level of individual household, based on analysis of the demographic and social status - ***advanced skills***, displaying professionalism and critical thinking, required to explain the multiple benefits of energy efficiency to different target groups according to the identified needs, demands and limitations - ***advanced skills***, displaying professionalism and critical thinking, required to identify explain the process of SBS renovation and the potential benefits in the view of LCA - specialised ***problem-solving skills*** required to identify and	- self-management and/or ***management and supervision*** within the guidelines of communication to the different target groups and respective stakeholders - taking ***responsibility*** for providing complete guidance and consultation of DER project, incl. SBS renovation

	advice on the use of suitable financing instruments - ***advanced skills***, displaying professionalism and critical thinking, required to identify and advice on suitable communication channels and information resources - ***advanced skills***, displaying professionalism and critical thinking, required to participate in public and political discussion on the implementation of DER-related policies	

2.16. Topic 16: Project management

Sub-Topic 16.1 Quality assurance

Introducing basic principles – Initiating; Planning; Executing; Monitoring; Controlling of project. Deals with the concepts of management in general, definition of project management, energy management, energy efficiency documents of the building. Increase knowledge of investment efficiency, multicriteria assessment, life cycle assessment, energy efficiency legislation used for project management and evaluation.

Topic 16	Project management	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
Basic ***knowledge*** in the field of planning and monitoring project activities. Basic ***knowledge*** on national legislation related to project management. ***Knowledge*** on definition and main principles of project management and energy management Basic ***knowledge*** on definition and main principles of multicriteria assessment and life cycle assessment. General ***knowledge*** on quality assurance systems and their implementation	***Practical skills*** of applying basic methods of project management to fulfilment of time-plan and strategy of DER/nZEB level renovation project.	To read and process project documents with some ***responsibility and autonomy***.
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
Knowledge in the field of planning and monitoring project activities. ***Knowledge*** on national legislation related to project management. ***Specialised knowledge*** on definition and principles of project management and energy management ***Specialised knowledge*** on definition and principles of	***Ability*** to use statistical data for monitoring state of project - Processing of energy statistics; - Balance of object consumption; ***Practical skills*** in monitoring of energy consumption; ***Practical skills*** in application of related software tools for project and energy management.	To read and process project documents with ***responsibility and autonomy***. ***Responsibility*** for monitoring: - project status - technical state of the building - energy consumption of the building. ***Responsibility*** for processing statistical data for making

multicriteria assessment and life cycle assessment. General ***knowledge*** on work with software tools for project management. ***Knowledge*** on use of specialised software for managing and collecting data for project and energy management. ***Specialised knowledge*** on quality assurance systems and their implementation	***Practical skills*** in application of multicriteria assessments.	decisions about project and management strategies. ***Responsibility*** for assurance of technical operability of project management system.
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
Advanced and specialised knowledge on planning and monitoring project activities. ***Advanced and specialised knowledge*** on national legislation related to project and energy management, including: - Laws on energy management; - Local implementing decrees; ***Advanced and specialised knowledge*** on application of principles of project management and energy management. ***Advanced and specialised knowledge*** on application of principles of multicriteria assessment and life cycle assessment. ***Specialised knowledge*** on work with software tools for project management. ***Advanced knowledge*** on use of specialised software for managing and collecting data for project and energy management. ***Advanced and specialised knowledge*** on project financing: - financial decision-making processes; - economics of energy management. - incomes and outcomes of the project ***Advanced and specialised knowledge*** on efficient use of energy in buildings, operation and maintenance practices and requirements. ***Advanced and specialised knowledge*** on quality assurance systems and their implementation	***Practical skills*** in planning and monitoring project activities. ***Practical skills*** in application of software tools to evaluate operational states by comparing actual and required parameters of energy use in buildings. ***Practical skills*** in planning of - energy management concepts; - DER project strategies. ***Practical skills*** in application of statistical data - processing of energy management data; - control the state of project activities. ***Practical skills*** in application of multicriteria assessments. ***Practical skills*** in implementation of quality assurance system for DER projects.	***Responsibility*** for reading, processing and creating project documents and project management strategies. ***Responsibility*** for decisions on energy management system and project management activities. ***Responsibility*** for planning and monitoring project activities. ***Responsibility*** for results of multicriteria assessments. ***Responsibility*** for implementation of quality assurance system for DER projects. ***Responsibility*** for application of specialised software for managing and collecting data for project and energy management. ***Responsibility*** for fulfilment of requirements of national energy efficiency legislation.

2.17. Topic 17: Ecology and Sustainability

Ecology as a starting point for energy efficiency in building; climate change and CO_2 levels; building materials

Topic 17	Ecology and sustainability	
EQF	3	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***knowledge*** on current research on climate change issues, CO_2 and energy saving potential of the building stock, embodied energy and CO_2 and ecology of building materials (incl. recycling and reusing) - ***knowledge*** on the building regulations in connection to the building ecology and sustainability in reference to the national and international building codes (at the forefront of knowledge) - ***knowledge*** on the sustainability and environmental certification schemes and comprehensive benchmarking methods in reference to national and international level (at the forefront of knowledge) - ***knowledge*** on principles of building ecology; methods for the description and evaluation of ecological performance of building elements, components, systems, and structures (at the forefront of knowledge)	- ***cognitive and practical skills*** required to explain the challenge to limit climate change: DER as the adequate and proven answer for the existing building stock. - ***cognitive skills*** required to understand the various environmental conditions and climate zones that characterise the different project sites - ***cognitive skills*** required to respond to site characteristics incl. ecology, climate and environment in the development of the project - ***cognitive and practical skills*** required to understand and explain the impact of building materials, their life-cycle incl. recycling and reusing; and respectively the life-cycle of the building to all aspects of sustainability (economic, environmental, social). - ***cognitive and practical skills*** required to examine and comprehend the fundamental principles of sustainability (social, economic and environmental) in relevant precedents - ***cognitive and practical skills*** required to comprehend and evaluate the embodied energy and embodied CO_2 of different materials and components in connection to the DER.	- taking some ***responsibility*** for work related to evaluation and advice on the possible ecology and sustainability principles that can be integrated into the DER - taking some responsibility for the work related to an analysis of site conditions (including other existing buildings) in regard to the ecology and sustainability, review of the relevant sustainability requirements and an assessment of their implications for the project - ***responsibility*** to read technically clear drawings illustrating and identifying the assembly of materials, systems, and components appropriate for a building design.
EQF	4 - 5	
Knowledge	**Skills**	**Responsibility and autonomy**
- comprehensive, specialised, ***factual and theoretical knowledge*** on current research on climate change issues, CO_2 and energy saving potential of the building stock - ***advanced and highly specialised knowledge*** on main principles of sustainability in relation to the DER: Social, economic and environmental factors and their	- comprehensive range of ***cognitive and practical skills*** required to explain the challenge to limit climate change: DER as the adequate and proven answer for the existing building stock. - comprehensive range of ***cognitive and practical skills*** required to understand the various environmental conditions and climate zones that	- self-management and/or ***management and supervision*** within the guidelines of work related to evaluation and advice on the possible ecology and sustainability principles that can be integrated into the DER - self-management and/or ***management and supervision*** within the guidelines of work related to an analysis of site conditions (including other

interrelation and influence on the project. - comprehensive, specialised, ***factual and theoretical knowledge*** on the building regulations in connection to the building ecology, ecology of building materials and sustainability in reference to the national and international building codes - comprehensive, specialised, ***factual and theoretical knowledge*** on the sustainability and environmental certification schemes and comprehensive benchmarking methods in reference to national and international level - comprehensive, specialised, ***factual and theoretical knowledge*** on embodied energy and embodied CO_2 and their relation to the building ecology and energy saving potential - comprehensive, specialised, ***factual and theoretical knowledge*** on principles of building ecology and ecology of building materials (incl. recycling and reusing); methods for the description and evaluation of ecological performance of building elements, components, systems, and structures including emissions of greenhouse gases and air pollutant; the application of LCA (Life-Cycle Assessment) and EIA (Environmental Impact Analysis) techniques in DER	characterise the different project sites - comprehensive range of ***cognitive and practical skills*** required to respond to site characteristics incl. ecology, climate and environment in the development of the project - comprehensive range of ***cognitive and practical skills*** required to understand and explain the impact of building materials, their life-cycle incl. recycling and reusing; and respectively the life-cycle of the building to all aspects of sustainability (economic, environmental, social). - comprehensive range of ***cognitive and practical skills*** required to examine and comprehend the fundamental principles of sustainability (social, economic and environmental) in relevant precedents and to make informed choices about the incorporation of such principles into architecture and urban design projects. - comprehensive range of ***cognitive and practical skills*** required to comprehend and evaluate the embodied energy and embodied CO_2 of different materials and components in connection to the DER	existing buildings) in regard to the ecology and sustainability, review of the relevant sustainability requirements and an assessment of their implications for the project - ***self-management and/or management, supervision and responsibility*** to make technically clear drawings illustrating and identifying the assembly of materials, systems, and components appropriate for a building design.
EQF	6-7	
Knowledge	**Skills**	**Responsibility and autonomy**
- ***advanced and highly specialised knowledge*** on current research on climate change issues, CO2and energy saving potential of the building stock - ***advanced and highly specialised knowledge*** on main principles of sustainability in relation to the DER: Social, economic and environmental factors and their interrelation and influence on the project. - ***advanced and highly specialised knowledge*** on the building	- ***advanced skills***, displaying professionalism and critical thinking, required to explain the challenge to limit climate change: DER as the adequate and proven answer for the existing building stock. - ***advanced skills***, displaying professionalism and critical thinking, required to understand the various environmental conditions and climate zones that characterise the different project sites	- taking ***responsibility*** for evaluation and advice on the possible ecology and sustainability principles that can be integrated into the DER - taking ***responsibility*** for an analysis of site conditions (including other existing buildings) in regard to the ecology and sustainability, review of the relevant sustainability requirements and an assessment of their implications for the project

regulations in connection to the building ecology, ecology of building materials (incl. recycling and reusing) and sustainability in reference to the national and international building codes - ***advanced and highly specialised knowledge*** on the sustainability and environmental certification schemes and comprehensive benchmarking methods in reference to national and international level - ***advanced and highly specialised knowledge*** on embodied energy and embodied CO_2 and their relation to the building ecology and energy saving potential - ***advanced and highly specialised knowledge*** on principles of building ecology and ecology of building materials (incl. recycling and reusing); methods for the description and evaluation of ecological performance of building elements, components, systems, and structures; the application of LCA (Life-Cycle Assessment) and EIA (Environmental Impact Analysis) techniques in DER - ***specialised knowledge*** on user behaviour and aspects of building usage and how planning can influence the users resulting in sustainability of building operation	- ***advanced skills***, displaying professionalism and critical thinking, required to respond to site characteristics incl. ecology, climate and environment in the development of the project - ***advanced skills***, displaying professionalism and critical thinking, required to understand and explain the impact of building materials, their life-cycle incl. recycling and reusing; and respectively the life-cycle of the building to all aspects of sustainability (economic, environmental, social). - ***advanced skills***, displaying professionalism and critical thinking, required to examine and comprehend the fundamental principles of sustainability (social, economic and environmental) in relevant precedents and to make informed choices about the incorporation of such principles into architecture and urban design projects. - ***advanced skills***, displaying professionalism and critical thinking, required to comprehend and evaluate the embodied energy and embodied CO_2 of different materials and components in connection to the DER - specialised ***problem-solving skills*** required to advise sustainability on DER in all aspects: social, economic and environmental.	- taking ***responsibility*** for making technically clear drawings illustrating and identifying the assembly of materials, systems, and components appropriate for a building design. - ***responsibility*** of guiding the planning to achieving certain certification standards

3. Conclusions and recommendations

There are still many insufficiencies in the vocational education training practices on deep energy retrofit (DER) in the target countries of the project (Bulgaria, Romania, Czech Republic, Italy, Greece, Croatia), which results in a pressing need to develop innovative training programmes and content at all EQF levels. The lack of freely available resources of training programmes and materials was a common issue in the focus countries which was overcome with the help of experience and capacities of project partners.

In order to proceed on the project with the development of new content there was a need to define requirements to the leaner after he/she finished an educational course on DER. These were defined in the form of topic-based catalogue. Each of 17 topics, chosen as most relevant for DER, contains requirements to the knowledge, skills and responsibilities of the learner according to levels EQF 3, EQF 4 - 5 and EQF 6 - 7. The order of the topics in the Catalogue is not relevant to their importance for DER educational materials.

End users of the Catalogue are developers of new training programmes on DER and nZEB renovations, as well as decision makers, involved into educational system, and the trainers. The elaborated learning outcomes can be applied to development of wide range of training programmes of vocational or specialised education for construction specialists. They represent the possible fullest collection of new knowledge, skills and responsibilities related to DER in the involved countries. However, the definition of the learning outcomes is an evolving process and any input from stakeholders during the development of the training programmes and materials will be welcomed and reflected in an updated document at the end of the project.

The developed Catalogue of learning outcomes will serve as a main basis for new training programmes on DER to be elaborated within the project for EQF levels 3-4, 3-5 and 6-7.