



Training module for construction professionals

Using iBRoad2EPC for staged renovation design and construction

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EXECUTIVE SUMMARY

Building Renovation Passports are becoming an integral part of the renovation action around Europe, being one of the direct results of the new legislative developments within the Fit-for-55 legislative package and the national-level adaptation of policy and financial instruments, supporting the increasing EU energy and climate targets. This is exemplified by the recently adopted amendments by the European Parliament on the proposal for a directive of the European Parliament and of the Council on the energy performance of buildings (recast)¹, which, despite stating that building renovation passports are a voluntary tool, clearly indicates the possibility to relate them to financial support measures and instruments.

In this regard, the integration of the Building Renovation Passport in the Energy Performance Certificate, as advocated by the iBRoad2EPC project, provides an excellent opportunity for practical implementation of the policy action, given the fact that it uses an already established service at a key moment of the investment project, minimising costs and involving appropriate expertise in the design and planning of the renovation process. This process has already been guided via a dedicated training scheme for energy auditors developed by the earlier iBRoad project, utilising the existing energy auditors' qualification schemes to provide further the knowledge on energy aspects, technical challenges, economic assessment and the end-user benefits of staged renovation. The scheme is currently further developed by the iBRoad2EPC project, with extended focus on the issuing of the Building Renovation Passport in the framework of the Energy Performance Certificate, and application of the BRoad2EPC electronic tools.

However, the practical implementation of the EPC-integrated renovation passports on the building sites remains a huge challenge, mostly due to the lack of coverage of the topic in the existing qualification frameworks and the lack of practice with specific design details by the construction professionals. In order to address this gap, the current reports provides a framework for developing dedicated training schemes for different types of professionals, taking into consideration the specifics of the national qualification frameworks by using the task-based qualification approach applied by specialised Horizon 2020 projects BUS League and BUS GoCircular. Thus, the report provides, besides a review of the integration of staged renovation content in training projects supported under EU-supported projects and potential cooperation activities, the following components:

- an analysis of the professional occupations relevant for the training action according to the European Skills, Competences, Qualifications and Occupations (ESCO) classification,
- a definition of tasks related to the implementation of EPC-integrated renovation passports,
- a definition of Units of Learning Outcomes related to the implementation of the tasks,
- a generic training curriculum targeted to selected ESCO occupations,
- an example of training curriculum targeting national-level implementation for a specific professional qualification and related occupations, demonstrating the approach for practical adaptation of the generic framework,
- training materials (annotated presentation) in English language.

For the practical application of the training scheme, the iBRoad2EPC team will establish cooperation with ongoing projects supporting professional training and education for construction experts as well as active educational establishments and vocational training

¹ European Parliament (2023) Amendments adopted by the European Parliament on 14 March 2023 on the proposal for a directive of the European Parliament and of the Council on the energy performance of buildings (recast) ([COM\(2021\)0802](#) – C9-0469/2021 – [2021/0426\(COD\)](#)). Available at: https://www.europarl.europa.eu/doceo/document/TA-9-2023-0068_EN.html. Last checked: 02.07.2023.

centres. A special focus will be given to the collaboration with ongoing national BUILD UP Skills projects financed under the LIFE programme of the EU, with the goal to integrate the suggested scheme in the resulting national qualification roadmaps.

1. INTRODUCTION

Building Renovation Passports are gaining more and more visibility as a tool with excellent potential to stimulate renovation action across Europe. In line with the political and expert debate on the topic, this was also acknowledged through the recently adopted by the European Parliament amendment of the proposal for a Directive on the Energy Performance of Buildings, which explicitly confirms the value and importance of Building Renovation Passports, clearly indicating the possibility to relate them to financial support measures and instruments.

The iBRoad2EPC project

On its turn, the iBRoad2EPC project funded by the Horizon 2020 European programme represents the next step in energy performance assessment schemes and certification practices, promoting and showcasing the integration of Building Renovation Passport elements into EPC schemes. Building on the results of the iBRoad project (2017-2020) which developed, tested and delivered a model for the Building Renovation Passport supporting single-family homeowners with personalised advice to facilitate stepwise deep renovation, iBRoad2EPC aims to bridge the Building Renovation Passport with the EPC, and expand, improve and broaden their format and joint scope to consider additional features and become applicable also to multi-family and public buildings. The aim is to improve reliability, usefulness and effectiveness, thereby establishing the next generation of EPCs that will support Europe's decarbonisation ambitions while improving conditions for building occupants. This is done by clustering the project's activities around four main pillars: (1) assess the needs, potential and practicability of merging the EPC with the Building Renovation Passport; (2) adapt the iBRoad concept to become part of EPCs; (3) test and evaluate the applicability of iBRoad2EPC in six countries (Bulgaria, Greece, Poland, Portugal, Romania and Spain), including training for issuers and EPC issuers and (4) facilitate the adoption and exploitation of the iBRoad2EPC model across Europe. Implementing authorities in the six countries are directly involved in the process of conceptualisation, development and testing of iBRoad2EPC to become an integral part of existing relevant schemes. Targeted communication, dissemination and exploitation activities at national and European level support further acceptance and uptake. The project leverages existing knowledge from other projects to expand EPC features and contributes back policy proposals as well as training and capacity building modules.

Objectives of this report

This report presents the concrete concept and methodology for the training activities of the iBRoad2EPC project targeted to building professionals with the aim to understand and apply the recommendations of the iBRoad2EPC in practice. Often quoted as one of the main reasons for underperformance of renovation projects, the availability of qualified services along the value chain of the construction industry is key for creating trust in deep energy building renovation. Due to the lack of proven methodologies, only few projects (e.g. EuroPHit, Fit-to-nZEB) have developed training materials on staged renovation, and the demand for such training services has not been overwhelming. To support further action in this direction, the current report presents complete documentation for a training scheme targeting on-site building professions, aiming at practical implementation of the requirements of the Building Renovation Passport, including through customised recommendations for stepwise deep renovation while avoiding lock-in effects. With the main objective of the report being to support introduction of the topic in existing training programmes and curricula, it is expected that it will serve as foundation for collaboration with specialised EU-financed projects in this area (within the BUILD UP Skills initiative and beyond), as well as with interested training and educational establishments.

2. REVIEW OF EXISTING TRAINING INITIATIVES REGARDING STEP-BY-STEP RENOVATION

Step-by-step or staged renovation has a long history in the actual building renovation practice but has only recently gained the attention of the academic and professional community through the latest amendments of the Energy Performance of Buildings Directive. Its origins are in the need to decrease the investment burden on building owners without compromising the quality and depth of the renovation projects, and to prevent the lock-in effect of either shallow renovation measures or applying individual measures without considering possible next phases of energy efficiency improvement. This concept lies in the foundation of the Building Renovation Passport, which has the potential to become an important element of the future financial system for building renovation. As stated in the Compromise amendment 1 of the EPBD Recast reached by the ITRE Committee at the European Parliament, “Member States and the relevant financial authorities shall review relevant legislation and develop supporting measures to facilitate the uptake of renovation loans and energy efficiency mortgages, and the development of innovative lending products dedicated to the financing of deep renovation and staged deep renovation in line with the steps in renovation passports.” This trend is expected to gain pace further, both because of the increasing EU energy and climate targets, and due to the fact that they are a convenient tool to achieve the minimum performance requirements without compromising deep renovation targets, while also taking into account the market situation and the investment capacities of the building owner(s). Or, as the same document states, “One-step deep and staged deep renovations are both valid options for deep renovations as differing factors need consideration, when determining most suitable solutions for decarbonisation, such as cost-effectiveness, resulting carbon budget, building use, renovation time, existing condition of the building, extent of renovations and primary energy supply of a building”.

The step-by-step renovation concept is considered by the international Passive House Institute as the foundation for minimising investment costs and spreading them over time while reaching the EnerPHit renovation standard. It is a part of the Certified Passive House Tradesperson Course and the Certified Passive House Designer Course, as suitable training materials here have been prepared to address the requirements of these certification-based training schemes. Within this framework, specialised training materials have been prepared under the EuroPHit project financed by the Intelligent Energy Europe programme. A dedicated publication² accompanied by numerous promotional videos are also available as outputs from this project. These materials were afterwards adopted to the conditions of Central and Eastern European countries by the Train-to-nZEB and Fit-to-nZEB projects; however, while the passive house certified tradesperson course and the Train-to-nZEB learning outcomes are simple and mostly targeting a general understanding of the concept, the Fit-to-nZEB project offers a fully-fledged definition of learning outcomes which are distributed according to various European Qualification Framework (EQF) levels. Based on this definition, pilot training courses have been organised for both universities and vocational training facilities in Bulgaria, Romania, Greece, Italy, Croatia, and Ireland. The time allocation of the step-by-step topic in university courses was two hours of lectures and two hours of seminars within a 60-hours academic programme. For professional colleges of architecture and civil engineering, the allocation is an one-hour lecture and two hours of seminars, together with presentations of video materials, in a 60-hours curriculum. While this modest allocation has to be observed within the broader concept of integrated deep

² Passive House Institute (2016) Step-by-step retrofits with Passive House components, http://europhit.eu/sites/europhit.eu/files/EuroPHit_Handbook_final_Optimized.pdf

energy renovation programmes, it is still not considered sufficient in order to deliver in-depth understanding of the concept and the different design and construction approaches, which testifies for the need of a longer upskilling programme focused at various qualification levels. To this end, the iBRoad2EPC project provides the opportunity for development and implementation of longer upskilling courses which can be conducted both within the regular training plans of the educational establishments and as individual offers by vocational training centres accredited to conduct certification courses in the areas of architecture, civil engineering and energy engineering / heating, ventilation and air conditioning.

Even though the pilot courses under Fit-to-nZEB were met with approval by the students in universities and professional high schools/colleges of architecture and civil engineering, few of them remain in the regular curriculum after the pilot implementation. Based on the Fit-to-nZEB legacy, disciplines focused on deep energy renovation featuring step-by-step renovation approach are carried out in the University of Architecture, Civil Engineering and Geodesy in Sofia and in the Faculty of Civil Engineering in the University of Zagreb. However, there is no evidence that the content has sustainably entered the curricula of professional colleges and vocational training centres, with the exception of the Passive House Certified Tradesperson course. In this respect, knowledge, skills and competences of on-site construction workers and site supervisors regarding step-by-step renovation have not been tangibly influenced by the vocational education and training activities which puts into risk the implementation of Building Renovation Passports (BRP). A similar situation is observed as regards the awareness of the end users, who - even if they are naturally inclined to do renovation of their buildings stepwise - rarely understand the importance of using a renovation passport leading them to long-term cost-optimal performance and correct sequence of the renovation measures. This situation is indicative of the major needs for upskilling courses and awareness raising initiatives, which are deemed as the most practical for increasing the understanding of the benefits of the Building Renovation Passports and improving the qualification and skills of the construction workers to deliver quality results on-site. This is especially relevant for on-site supervisors and project managers who are responsible for the right interpretation of the design project and for ensuring correct construction works in the implementation of the specific details.

Certainly, there are multiple other projects focusing on training and educational activities in the area of energy efficiency in the building sector, which are carried out with the support of the Horizon 2020 and LIFE programmes of the EU. In the period 2016-2020, there were 3 topics within the Secure, Clean, and Efficient Energy societal challenge addressed by the Horizon 2020 programme, which specifically addressed the skills and knowledge among construction professionals regarding energy efficiency in buildings. In the period 2016-2017, 10 projects besides the already described Fit-to-nZEB were financed within the Construction Skills topic (EE-14-2016-2017): CraftEdu, PRO-Heritage, Construye2020, BIMcert, BIMplement, BIMEET, NEWCOM, CEN-CE, TRAINEE, and Net-UBIEP. None of these focused on the skills regarding development of EPCs or Building Renovation Passports; however, certain tools and training materials developed under some of them can be employed in the iBRoad2EPC training scheme for construction professionals. Most notably, this includes the common energy efficiency module under CraftEdu and specific practical training under the Austrian NEWCOM project, which applies on-site training during airtightness testing procedures. To a certain, albeit limited extent, implementation of BIM systems in the design and project management phases of staged renovation projects under BIMplement, BIMEET and Net-UBIEP projects can be utilised in broader schemes; however, they advocate the implementation of qualification schemes with a much broader profile, which in theory can integrate the iBRoad2EPC contribution within their practical implementation.

In the period 2019-2020, 9 projects were financed under the topics LC-SC3-EE-3-2019-2020 and LC-SC3-B4E-2-2020 - Stimulating demand for sustainable energy skills in the building

sector. These were the projects INSTRUCT, TRAIN4SUSTAIN, BUSLeague, NZEB Roadshow, HP4All, nZEB Ready, ARISE, BUS GoCircular, and SEEtheSkills. However, while the topic of step-by-step renovation was included in the training schemes and content developed by many of them, it was rarely in the focus. For example, the topic was included in the set of learning outcomes of the INSTRUCT project, targeted at highly-qualified building professionals (architects and civil engineers). The training courses performed in the framework of the nZEB Roadshow project partially included the topics of step-by-step renovation and developing of building renovation roadmaps. Currently, the nZEB READY, SEEtheSkills and ARISE projects offer potential for integration of the iBRoad2EPC learning outcomes and training content both in the development of new training schemes and in their practical implementation.

Another important project that deserves particular attention is the Construction Blueprint project, financed under the Erasmus+ programme of the EU. It develops occupational profiles and qualifications and training materials, and also maintains a platform with existing online training courses, which can integrate iBRoad2EPC content or include dedicated courses in the general offering.

Currently, a number of national BUILD UP Skills 2030 projects (Austria: [ReBUSk](#); Bulgaria: [BUILDUPSkillsBG](#); Croatia: [CRO skills RELOAD](#); Czech Republic + Slovakia: [DoubleDecker](#); France: [BUS2 FRANCE](#); Greece: [REGRoUP](#); Hungary: [ConstructSkills4LIFE](#); Ireland: [BUSI2030](#); Lithuania: [REBOOT-SKILLS-LT](#); The Netherlands: [BUS-NL](#); Poland: [BUPS Poland](#); Romania: [BUS4RoBOOST](#); Spain: [Construye 2030](#)) are being implemented under the LIFE programme of the EU, developing qualification roadmaps for sustainable energy skills until 2030. They offer excellent cooperation potential, given the fact that knowledge skills and competences for development and application of EPC-integrated renovation passports should be integrated in the national educational standards, educational plans and curricula to respond to both the changes of the EU and national legislation and the new market developments.

In the past few years, step-by-step renovation has been included in the qualification framework developed under the BUS League project, which offers task-based definitions of training results compatible to various professions within the construction sector value chain and assigned to applicable qualification levels. This approach, also replicated by the BUS GoCircular project, enables the design of various upskilling, qualification and certification courses targeted to different users and applying various training methods. In practice, both classroom, remote and on-site training can be conducted, depending on the design of the particular investment project. It is considered to be extremely productive, as it allows both the integration of training contents into existing educational curriculum and the design of entirely new training schemes with varying duration and sets of learning outcomes in regards to the entry level of the participants and the desired outcomes of the specific scheme. Following the BUS League approach, a comprehensive analysis of applicable learning outcomes is presented in Chapter 4 below, associated with various tasks along the investment project value chain, each of them assigned to a specific qualification framework. It is expected that within the framework of the iBRoad2EPC project, specific training courses for building site supervisors and project managers would be established and piloted on the basis of the learning outcomes defined within this framework, potentially accompanied by informational sessions for end users based on the demands in each pilot country. The course durations are expected to vary considering the specific needs of the target group and the patterns of integration with existing curricula, but in any case, specific understanding of iBRoad2EPC tools and materials should be integrated in the learning outcomes pursued within the piloting phase. Additionally, the policy context should be considered, as the Building Renovation Passports are expected to become one of the key instruments to achieve minimum energy performance requirements as the first step of an integrated building plan targeting zero-emission performance levels at cost-optimal scenario and investment costs distributed

in a longer period, potentially using the savings achieved in the first steps to finance the implementation of the next ones.

Project	Link	Potential for collaboration	Notes
Fit-to-nZEB	http://www.fit-to-nzeb.com/	Exploiting the learning outcomes and available training materials	
CraftEdu	https://www.craftededu.eu	Exploiting the learning outcomes and available training materials	
NEWCOM	https://cordis.europa.eu/project/id/754148	Reviewing specific training modules	Content available in German only
Construye2020	www.construye2020plus.eu	Exploiting learning outcomes included in the Energy Auditor qualification scheme	Content available in Spanish only
BIMplement, BIMEET, Net-UBIEP	https://www.bimplement-project.eu/ https://www.net-ubiep.eu/	Researching training schemes based on their output with the goal to integrate iBRoad2EPC content	
INSTRUCT	http://instructproject.eu/	Exploiting learning outcomes for specific occupations	
BUSLeague, BUS GoCircular	https://busleague.eu/ , https://cordis.europa.eu/project/id/101033740	Replicating the task-based qualification framework and using specific learning outcomes	
nZEB Roadshow	https://www.nzebreadshow.eu/	Integrating iBRoad2EPC content in training courses	Limited opportunities until the end of the project, but potential for collaboration with involved training centres
nZEB Ready	https://cordis.europa.eu/project/id/101033733	Integrating iBRoad2EPC content in new training schemes and training courses	

Project	Link	Potential for collaboration	Notes
SEetheSkills	https://cordis.europa.eu/project/id/101033743	Integrating iBRoad2EPC content in new training schemes and training courses	Limited information available
ARISE	https://cordis.europa.eu/project/id/101033864	Integrating iBRoad2EPC content in new training schemes and training courses	Limited information available
Construction Blueprint	https://constructionblueprint.eu/	Integrating iBRoad2EPC content in new training schemes and training courses	
National BUILD UP Skills 2030 projects	http://www.buildupskillsbg.eu/	Huge potential for integrating iBRoad2EPC content in national qualification roadmaps	Projects in starting phase

Table 1. Potential for cooperation of iBRoad2EPC with EU-financed Construction Skills projects.

3. TARGET GROUPS FOR iBRoad2EPC TRAINING

Unfortunately, there is no uniform classification of professions and professional occupations among EU countries, which indicates the need of a flexible approach of the proposed training scheme, so that it can apply to different national systems as an upskilling opportunity in continuous professional development systems targeted to relevant qualifications, or as a new component in qualification standards. However, the EU ESCO³ (European Skills, Competences, Qualifications and Occupations) classification provides a standardised system for occupations, skills, and qualifications used across the European Union, which provides an opportunity to identify relevant professional occupations, which can be addressed by the iBRoad2EPC training content. The classification is structured in 9 levels, within each of which professional occupations are defined, corresponding to the International Standard Classification of Occupations⁴ (ISCO) codes. The occupations relevant to the iBRoad2EPC content include:

1 - Managers

1323 - Construction manager

Examples of the occupations classified here:

- Civil engineering project manager
- Construction project manager
- Project builder

2 - Professionals

2142 - Civil Engineer

Examples of the occupations classified here:

- Civil engineer
- Geotechnical engineer
- Structural engineer

2144 - Mechanical engineers

2149.9 - Energy engineers

Examples of occupations classified here:

- Alternative fuels engineer
- Energy systems engineer
- Geothermal engineer
- Nuclear engineer
- Offshore renewable energy engineer
- Onshore wind energy engineer
- Renewable energy engineer
- Solar energy engineer
- Thermal engineer

2151 - Electrical engineer

³ https://esco.ec.europa.eu/en/classification/occupation_main

⁴ <https://www.ilo.org/public/english/bureau/stat/isco/>

Examples of the occupations classified here:

- Electrical engineer
- Electric power generation engineer
- Electromechanical engineer

2151.2 - Smart home engineers

2161 - Building architect

3 - Technicians and associate professionals

3112 - Civil engineering technicians

Examples of the occupations classified here:

- Building inspector
- Building surveyor
- Civil engineering technician
- Clerk of works
- Fire inspector
- Fire prevention specialist
- Geotechnical technician
- Surveying technician

Narrower occupations within professional occupation:

3112.1.3 - construction quality inspector

3112.1.4 - construction quality manager

3112.1.5 - energy assessor

3112.5 - energy analyst

3112.6 - energy conservation officer

3112.7 - energy consultant

3112.8 - engineering assistant

3113 - Electrical engineering technicians

3113.1 - electrical engineering technician

3115 - Mechanical engineering technicians

3115.1.5 - heating, ventilation, air conditioning and refrigeration engineering technician

3115.1.17 - refrigeration air condition and heat pump technician

3119 - Physical and engineering science technicians not elsewhere classified

3119.4 - commissioning technician

3123- Construction supervisors

Examples of the occupations classified here:

- Building construction supervisor
- Site manager (construction)

7 - Craft and related trades workers

711 - Building frame and related trades workers

7111 - House builders

7112 - Bricklayers and related workers

7113 - Stonemasons, stone cutters, splitters and carvers

7114 - Concrete placers, concrete finishers and related workers

7115 - Carpenters and joiners

7119 - Building frame and related trades workers not elsewhere classified

712 - Building finishers and related trades workers

741 - Electrical equipment installers and repairers

7411 - Building and related electricians

9 - Elementary occupations

9313 - Building construction labourers

As mentioned above, these occupations do not match the national classifications of professions and professional occupations, so it is not possible to directly assign sets of learning outcomes to a certain occupation. Moreover, the qualification standards in each of the countries cover different complex sets of learning outcomes, which have to be analysed at national level to identify existing gaps and potential for improvement, if a comprehensive impact on the development of the national qualification system is targeted. However, for the much more focused goals of the iBRoad2EPC professional training scheme, the framework is practically applicable to the extent to which it helps defining the generic occupations, which are crucial for the on-site implementation of the EPC-integrated Building Renovation Passports, while at the same time it allows identification of professional occupations which can be targeted to achieve increased awareness on the issue. In this respect, the target groups of the iBRoad2EPC professional training action are situated at ESCO levels 3 and 7, broadly corresponding to EQF levels 2 to 4 (potentially reaching 5, depending on the national qualification system). The professional occupations requiring higher EQF levels (6-8) and situated at levels 1 and 2 under the ESCO classification are potentially engaged with the design phase of the iBRoad2EPC approach; however, given the fact that there is still little awareness on the methodology and tools, it is conceived that the suggested scheme can also be suitable to increase the basic knowledge of the concept within these groups as well. Certainly, authority to design an EPC-integrated Building Renovation Passport requires additional competences, which are not targeted by the suggested scheme but are already available under the iBRoad2EPC Training Toolkit for energy auditors.

While this distinction seems sufficient at a first glance, in fact it implies possible contradictions, which have to be addressed further. An example for that is the location of specialised energy-related occupations as 3112.1.5 - energy assessor, 3112.5 - energy analyst, 3112.6 - energy conservation officer, 3112.7 - energy consultant, in the third, “technical” level of the ESCO classification. This is most probably a consequence of the different

approaches in the national system for calculation of the energy performance of the buildings and the process of issuing an EPC: while in some countries this can only be done by a highly qualified expert (EQF level 7) with specific additional certification, in others, these activities are performed by experts with a lower qualification level (e.g., EQF level 4). While it is considered that the design of an EPC-integrated Building Renovation Passport requires advanced expert knowledge and the respective qualification, this assessment has to be done per country, so that the learning content will be targeted to the concrete occupation at the right qualification level.

In this respect, the task-based qualification approach applied by the BUS League and BUS GoCircular projects described above is particularly useful for establishing a uniform framework at multi-national level, as it enables the learning outcomes to be targeted to a specific phase of the investment project, rather than to a specific occupation. Within this approach, the tasks related to the goal of the training (in the case of the iBRoad2EPC training scheme this is to ensure quality on-site implementation of the EPC-integrated Building Renovation Passport) are assigned to the respective phase of the investment project. Thus, all occupations involved at this phase - generically defined via the ESCO classification and further specified at national level - become potential targets of the training. To define the phases of the investment project, the well-established phases of the RIBA Plan of Work, being “the definitive model for the design and construction process of buildings”⁵ are used, as follows: Strategic definition / Preparation and briefing / Concept design / Spatial coordination / Technical design / Manufacturing and construction / Handover / Use. In specific cases, certain tasks (usually conceptual, theoretical and terminological knowledge) are applicable for all phases, providing shared understanding for interpretation of the design documentation and implementation of the activities among all specialties at the construction site.

⁵ Royal Institute of British Architects (2020) RIBA Plan for Work. Available at: <https://www.architecture.com/knowledge-and-resources/resources-landing-page/riba-plan-of-work>. Last checked: 03.07.2023

4. iBRoad2EPC TRAINING FRAMEWORK

Following the task-based approach described above, a dedicated training framework, targeting upskilling or awareness raising of building professionals for on-site application of EPC-integrated Building Renovation Passports according to their role in the investment process is prepared. It includes 8 concrete tasks, which are assigned to a specific phase. Within this approach, relevant professional occupations can be related to each of the phases as presented in the examples in Chapter 5 below, according either to the generic ESCO classification or to the national qualification systems. Subsequently, for each of the tasks, Units of Learning Outcomes (ULO) are defined, which serve as the basis for the development of the training plan and the contents of the training materials.

On-site application of iBRoad2EPC renovation passport										
Related ULO	Key tasks	RIBA Plan of Work phases								
		Shared	0	1	2	3	4	5	6	7
1	Identify opportunities for energy savings	X								
2	Interpret the iBRoad2EPC and the underlying documentation	X								
3	Interpret step-by-step recommendations	X								
4	Explain the work to be performed to each involved professional	X								
5	Manage and oversee the project implementation		(x)	(x)	X	(x)	X	X		
6	Install the components of the building envelope, ensuring optimal airtightness and elimination of thermal bridges			(x)	(x)		(x)	X		
7	Install the building heating, cooling, ventilation, and DHW system			(x)	(x)		(x)	X	(x)	
8	Perform replacement of building systems components			(x)	(x)		(x)	X	(x)	(x)

Table 2. Task-based training framework for on-site application of iBRoad2EPC.

Key: X - mandatory tasks for upskilling courses; (x) indicative tasks for awareness raising courses

Phases included in the RIBA Plan of Work: 0 - Strategic definition / 1 - Preparation and briefing / 2 - Concept design / 3 - Spatial coordination / 4 - Technical design / 5 - Manufacturing and construction / 6 - Handover / 7 - Use.

ULO No	Authority and responsibility	Skills	Knowledge
1	Apply national regulations for energy certification of buildings	Understand and explain the requirements for building certification	National building certification requirements, minimum energy requirements, validity, content, certification process and certification tools
	Communicate the project design details to other involved professionals and users, relating them to the benefits of deep renovation of buildings, including comfort, health, and safety requirements	Explain how building renovation influences the indoor environmental quality (IEQ)	Improvement of IEQ through building renovation, benefits for the occupants from different energy efficiency measures. How building envelop and building systems influence IEQ.
	Identify opportunities for energy savings	Explain the difficulties that are typically encountered during renovation of existing buildings which are striving for ambitious energy performance	Common opportunities for energy savings in renovation Energy saving potential of building envelope insulation, airtightness, thermal bridges, changing heating, cooling, ventilation systems, DHW and others.
2	Interpret iBRoad2EPC and the underlying documentation	Understand and explain the iBRoad2EPC and the underlying documentation and recommendations incl. step-by-step recommendations with focus on achieving MEPs at the first renovation step of the staged renovation project	Comprehensive knowledge about the iBRoad2EPC renovation advice and approach and the underlying documentation, energy performance certificates, building energy passports and other instruments for evaluating the energy efficiency measures and step-by-step renovation. Use of online instruments for building renovation and building data collection
	Convey basic knowledge of the SRI and MEPI indicators	Understand and explain what the SRI and MEPI indicators are and how they can be useful to various stakeholders – building owner/tenant, technician, designer, etc.	Understanding and interpreting the different indicators related to the energy performance of the building, i.e., SRI and MEPI, and draw conclusions about the building based on these indicators
3	Read and interpret step-by-step recommendations with focus on achieving MEPs at the first step of the staged renovation project	Develop a step-by-step renovation plan Avoid lock-in effects in step-by-step planning and implementation of energy efficiency measures	Detailed know-how on step-by-step renovation plans (including know-how of gaps in the practical implementation) Good and bad practices related to lock-in effects Building Renovation Passports (BRPs) for renovation in order to increase awareness about the costs, benefits, and the process of renovation
4	Take responsibility for explaining the work to be performed, the connections between the different measures and steps and the time schedule to each involved professional	Communicate properly the specific project designs and plans Explain the advantages and specific challenges of step-by-step renovation Explain the economic efficiency of the different energy efficiency measures in respect to the indicative energy savings lifetimes per measure type	Advantages of renovation with particular focus on stepwise renovation Methods for calculation of the economic efficiency in respect to the indicative lifetimes per energy savings measure type Additional benefits of deep energy efficiency renovations

		Explain the benefits of renovating to ambitious energy efficiency standards Explain how to take into account and avoid lock-in effects	How to take into account and avoid lock-in effects
5	Manage and oversee construction work related to the implementation of construction plans, time schedule and task distribution.	Explain the responsibilities and processes on the construction site and their influence on step-by-step renovation Ensure continuous interaction between the different construction activities on site	Possible step-by-step renovation scenarios The link between different measures in renovations The possible links between the different steps and possible lock-in effects
	Understand requirements for high performance building components used for improvement of the building envelop	Recommend/check/approve the quality and the characteristics of the materials/components to be used	Basic knowledge of thermophysical properties of materials and components used in the building envelope, thermal conductivity, heat transfer, density, moisture permeability, airtightness
	Understand technical specification of high performance building systems	Recommend/check/approve the components and the equipment to be installed	Basic knowledge of the requirements of the building systems, efficiency, efficacy, Seasonal Coefficient of Performance (SCOP), Seasonal Energy Efficiency Ratio (SEER)
6	Provide conditions and perform correct installation of components of the building envelope, ensuring optimal airtightness and elimination of thermal bridges	Proper implementation of energy-saving measures on the building envelope Ensuring a continuous thermal insulation layer and airtight envelope, avoiding thermal bridges	Principles of implementation of thermal insulation on walls, floors, roofs Understanding the flow of water vapour through the structure in cold and warm season Knowledge of materials providing airtightness and vapour control Knowledge of the relationship between airtightness, thermal insulation, thermal bridges, and the possible gaps in the application of energy efficiency measures on the building envelope
7	Provide conditions and perform correct installation and exploitation of the building systems (heating, cooling, ventilation, and DHW)	Provide conditions for installation of new building systems or potential replacement of existing ones	Basic principles for providing heating, ventilation, cooling and DHW in buildings and most common issues arising in renovation projects. The link between envelope renovation and the output of heating and cooling systems. The principles of airtightness and insulation of the building systems. The link between envelope and building systems
8	Provide conditions and perform potential replacement of the building systems related with insulation and airtightness	Identification of specialists who are expected to intervene in the future implementation of building systems. Avoid damage to the building envelope during the future of building systems	Knowledge and understanding of the risks in the future implementation of measures affecting the building envelope

Table 3. Task-based Units of Learning Outcomes for training schemes on on-site application of iBRoad2EPC.

5. CURRICULA FOR DIFFERENT TARGET GROUPS

On the basis of the selected methodological approach, it is possible to design training curricula for different target groups in terms of their professional occupation and qualification levels. This is applicable at both generic level, using the ESCO classification, and also at fine-grained national level, taking into consideration the topic-related competences already acquired within the national qualification system. This is demonstrated by the two examples below, targeting upskilling of building technicians at EQF level 3-4.

GENERIC CURRICULUM FOR BUILDING TECHNICIANS

Name of the programme: **On-site application of iBRoad2EPC**

Course duration: **8.00 teaching hours**

Teaching hour duration: **45 min**

Training institution / professional sponsor: n/a

TARGET GROUP

Technicians and associate professionals at EQF 3-4, considering the following occupational profiles:

3112 - Civil engineering technicians

Examples of the occupations classified here:

- Building inspector
- Building surveyor
- Civil engineering technician
- Surveying technician

Narrower occupations within professional occupation:

3112.1.3 - construction quality inspector

3112.1.4 - construction quality manager

3113 - Electrical engineering technicians

3113.1 - electrical engineering technician

3115 - Mechanical engineering technicians

3115.1.5 - heating, ventilation, air conditioning and refrigeration engineering technician

3115.1.17 - refrigeration air condition and heat pump technician

3119 - Physical and engineering science technicians not elsewhere classified

3119.4 - commissioning technician

3123- Construction supervisors

Examples of the occupations classified here:

- Building construction supervisor
- Site manager (construction)

GRADUATE PROFILE

The graduate is a qualified professional who is capable of independent work and has the required knowledge and skills to oversee the implementation of the construction activities following the working design documentation. He/she has sufficient knowledge and comprehension of reading technical documentations and construction details. He/she is responsible for designing workflows for the manufacture, assembly, disassembly and repair of building envelope components. He/she is able to apply the acquired knowledge and practical skills in problem-solving, and can work both independently and within a team. He/she is manually-skilled in working with both traditional building materials and products and prefabricated building components. He/she wants to continue his/her education, is constantly interested in the development of building concepts, materials and technologies.

TEACHING FRAMEWORK (TO BE ADAPTED AS PER THE TARGET GROUP)

On-site application of iBRoad2EPC	Number of hours	Of which	
		Theory	Practice
↓ Introduction to key principles of step-by-step renovation:	4	3	1
Identify opportunities for energy savings			
Interpret the iBRoad2EPC and the underlying documentation			
Interpret step-by-step recommendations			
Explain the work to be performed to each involved professional (including quality assurance methods, monitoring requirements and financial estimations)			
↓ Specific knowledge regarding building envelope:	3	2	1
- External wall insulation providing continuous insulation layer and minimisation of thermal bridges. Connections with windows and doors. Insulation of balconies - Use of internal Insulation in staged renovation situations. Connections with windows, doors and penetrations - Details and specific products for replacement of windows and doors as a first or as a consecutive step in iBRoad2EPC - Insulation of a pitched roof as a first or as a consecutive step of iBRoad2EPC, providing continuous airtightness, air and vapour permeability - Flat roof insulation as a first or as a consecutive step of the iBRoad2EPC, providing continuous airtightness, air and vapour permeability - Insulation of the basement ceiling and floor slab as a first or as a consecutive step of the iBRoad2EPC providing continuous insulation and airtightness layer - Construction of new balconies with broken thermal bridge			
↓ Specific knowledge regarding building systems:	1	1	0
- Installation of centralised and decentralised ventilation systems as a first or as a consecutive step of the iBRoad2EPC, providing continuous insulation and airtightness - Replacement of heating, cooling and DHW systems as a first or as a consecutive step of the iBRoad2EPC, providing continuous insulation and airtightness - Active utilisation of renewable energy as an integral step of the iBRoad2EPC			
Total	8	6	2

REQUIREMENTS FOR TRAINERS

Knowledge and Experience: Solid understanding of construction principles, techniques, and safety procedures. Substantial hands-on experience working in the construction industry, preferably in various roles and across different projects.

Education: Higher education in architecture, construction management, civil engineering or similar. Relevant industry certifications are an advantage.

Teaching Skills: Having experience or formal education in teaching, instructional design, or adult education can be beneficial.

Continuous Learning: Staying updated with the latest advancements in the industry through continuing education and professional development is important for a trainer. This may involve attending workshops, seminars, and conferences or pursuing advanced certifications.

Personal Qualities: As a trainer, you should possess strong leadership skills, patience, the ability to work with diverse learners, and excellent problem-solving abilities. Good organisational and time management skills are also important to effectively plan and deliver training programmes.

NECESSARY EQUIPMENT AND FACILITIES

Classrooms should have: a workplace for each student (desk and chair), a workplace for the trainer (desk and chair), a study board, cabinets, screens and stands for hanging blackboards, a writing board, other teaching aids and didactic technique; teaching aids - demonstration mock-ups and models, real samples, visualising boards, educational videos, multimedia equipment - computers, projectors and relevant visualisation software products.

FURTHER READING

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EXAMINATION SCHEME

- 1) Written / Computer-assisted test
- 2) Implementation of a practical task/project assignment

Evaluation criteria:

- 1) Demonstrates mastery of theoretical knowledge about the concept, instruments and organisation of the work in the implementation of EPC-integrated Building Renovation Passports
- 2) Self-completed practical task for installation of a specific building component within the preset time limit

NATIONAL EXAMPLE: CURRICULUM FOR UPSKILLING OF BUILDING TECHNICIANS IN BULGARIA

As described above, the key issues regarding the implementation of the iBRoad2EPC training framework for building professionals are expected to appear in the process of adaptation within the national qualification framework, given the different definitions of the professions and the professional occupations among various countries. With the goal to provide better orientation for the potential users, the following paragraphs outline the specific case of adapting the overall framework to the Bulgarian qualification systems. As can be observed, key elements such as the teaching framework, examination procedure and necessary equipment remain the same, while the elements related to the profiling of the users and suppliers of training services are country-specific, compliant to the applicable regulations.

TARGET GROUP

Qualified specialists under specialty 582010 "Construction technician" from the area of education "Architecture and construction" and professional direction 582 "Construction", considering the following occupational profiles:

3112-3004 Technician, civil construction (constructor);

3112-3007 Technician, Investor Control;

3112-3009 Technician, construction and architecture;

3112-3010 Construction technician, design and technical department;

3123-3001 Technical supervisor construction;

GRADUATE PROFILE

The graduate is a qualified professional graduated from the professional high schools of architecture and civil engineering in Bulgaria with professional diploma under specialisation "Construction technician" corresponding to EQF level 3 or above. The training course is also suitable for students or graduates from the "Construction of Buildings and Facilities" specialty in the universities of architecture and civil engineering, as well as for students in other specialties in the professional areas of Architecture and Civil Engineering.

The graduate is capable of independent work and has the required knowledge and skills to oversee the implementation of the construction activities following the working design documentation. He/she has enough knowledge and comprehension of reading technical documentations and construction details. He/she is responsible for designing workflows for the manufacture, assembly, disassembly and repair of building envelope components. He/she is able to apply acquired knowledge and practical skills in problem solving, he can work independently or in a team. He/she has is manually skilled in working with both traditional building materials and products and prefabricated building components. He/she wants to

continue his/her education, is constantly interested in the development of building concepts, materials and technologies.

REQUIREMENTS FOR TRAINERS

Individuals with completed higher education in the relevant specialty can teach a subject or module of professional training.

By subject or module of the professional training, for which there is no corresponding professional direction in the Classifier of the areas of higher education and professional fields, adopted by Resolution No. 125 of 2002 of the Council of Ministers (Government Gazette No. 64 of 2002), persons without higher education and without the professional qualification "teacher" can teach if they have acquired a third degree of professional qualification in the specialty "Construction Technician" under the conditions and in accordance with the Law on Vocational Education and Training.

It is recommended that trainers take a course every three years to update their professional knowledge, skills and competencies.

Available trainers: Zdravko Genchev, Alexander Genchev, Alexander Stankov, Stanislav Andreev, Ralitsa Yordanova

FURTHER READING

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6. AVAILABLE TRAINING MATERIALS

To support the implementation of the iBRoad2EPC training scheme for building professionals, a set of training materials in the form of MS PowerPoint presentations have been prepared, as presented in Annex I to this report. The presentations are available at no cost for interested training providers under the condition of signing a memorandum of understanding with the iBRoad2EPC consortium.

The training materials are organised alongside the eight tasks identified in the report, as follows:

1. Identify opportunities for energy savings
2. Interpret iBRoad2EPC and the underlying documentation
3. Interpret step-by-step recommendations
4. Explain the work to be performed to each involved professional
5. Manage and oversee the project implementation
6. Install the components of the building envelope, ensuring optimal airtightness and elimination of thermal bridges
7. Install the building heating, cooling, ventilation, and DHW system
8. Perform replacement of building systems components

Each presentation covers extensively the Units of Learning Outcomes assigned to the task as described in Table 3 above, and concludes with test questions. Thus, the presentations can be used in training schemes targeted to each of the professional groups active in the respective phase of the construction investment project, prescribed in Table 2 above, as the association of each specific profession or occupation to the separate phases is subject to the appraisal of the respective training institution according to the national specifics. Due to this flexible task-based structure of the iBRoad2EPC training scheme, the training materials can be integrated in practically any existing training scheme/curricula in the systems of formal or informal profession training and education, irrespectively of the possible national differences in the definition of professions and occupations.

In order to pursue actual exploitation within and beyond the duration of the iBRoad2EPC project, the project team is working towards collaboration agreements with educational and training establishments offering qualification services within the national qualification framework in the partner countries. In addition, cooperation activities are initiated with specialised projects operating under the Horizon 2020 and LIFE programmes of the EU, among which a central position is preserved for projects under the flagship BUILD UP Skills initiative. It is expected that under these collaboration activities, specialised individual courses will be piloted within 2023, and the proposed scheme or parts of it will be introduced in the regular practices of partnering training and educational organisations in the period 2024-2025. As stipulated by the contractual terms of the iBRoad2EPC project, at least four memoranda of understanding with different training institutions or initiatives are expected to be agreed and signed by the end of the project activities.

7. ADAPTATION AND INTEGRATION OF THE TRAINING SCHEME

ADAPTING TRAINING MATERIALS TO THE SITUATION IN OTHER COUNTRIES

Each training or educational establishment in EU Member States that adopts the iBRoad2EPC training scheme for building professionals will have at their disposal a large database of presentations that are tailored only to the countries participating in the project, i.e., Bulgaria, Greece, Poland, Portugal, Romania, and Spain. However, the available content can be easily adapted to other countries by replacing the slides referring to the iBRoad2EPC-specific country.

Additionally, the content in the technical parts of the presentations can also be revised in relation to the national regulations considering the organisation of the investment process, and in some cases, the building traditions. The main parts which may need revision when adapting to each country are on topic 1 - Opportunities for energy savings and topic 2 - Interpret the iBRoad2EPC and the underlying documentation.

However, each of the topics are subject to adaptation by changing or adding content. This adaptation should be based on relevant up-to-date information regarding construction products and technologies, on different standards and calculation methodologies applied in the different countries, or on different classification of professions and professional occupations.

INTEGRATION TO EXISTING TRAINING SCHEMES

Integrating the training scheme developed under the iBRoad2EPC project into existing qualification schemes and training courses can enhance the skills and competencies of building professionals in interpreting building renovation roadmaps and new-generation energy performance certificates on the building site. This integration can be achieved through collaboration with educational institutions, professional organisations, and industry stakeholders.

Firstly, the training scheme can be aligned with existing qualification frameworks by mapping its units of learning outcomes to the relevant competencies and knowledge areas in established qualification schemes. This mapping ensures that the skills and knowledge acquired through the iBRoad2EPC training are recognised within the existing educational and professional landscape. For example, specific units of learning outcomes related to energy-efficient building practices can be linked to relevant modules in construction or engineering qualifications.

Secondly, collaboration with educational institutions is crucial for seamless integration. By engaging with universities, technical colleges, and vocational training centres, the training scheme can be incorporated into existing courses or offered as standalone modules. This collaboration may involve adapting the iBRoad2EPC materials to complement the existing curriculum, providing guest lectures, or facilitating joint workshops that allow students to apply their knowledge in practical scenarios.

Thirdly, professional development programmes organised by industry associations and certification bodies can incorporate the iBRoad2EPC training scheme to enhance the skills of practicing building professionals. Recognising the importance of continuous learning in the rapidly evolving field of energy-efficient construction, these organisations can endorse or

require completion of specific iBRoad2EPC modules as part of their certification or recertification processes.

Moreover, the training scheme's adaptability should be highlighted to cater to various educational levels and professional backgrounds. This flexibility ensures that the content can be integrated into diverse training courses, from basic certifications for entry-level professionals to advanced programmes for experienced practitioners.

Finally, to facilitate the integration process, awareness campaigns and promotional activities can be organised to inform stakeholders about the benefits of the iBRoad2EPC training scheme. This can include webinars, conferences, and networking events that bring together educators, industry professionals, and policymakers to discuss the importance of energy-efficient building practices and the role of the iBRoad2EPC training in achieving these goals.

By strategically aligning the iBRoad2EPC training scheme with existing qualification schemes and training courses, a synergistic approach can be achieved, fostering a culture of continuous learning and promoting sustainable building practices within the broader educational and professional community. This has already been achieved by incorporating the iBRoad2EPC training scheme in the training offering of the Bulgarian Building Knowledge Hub situated in the University of Architecture, Construction and Civil Engineering and operated together with the Bulgarian Construction Chamber, and in the joint training programme designed by project partner EnEffect with the specialised training service provider BauAcademy. Additionally, the scheme is presented to the BUILD UP Skills teams of Bulgaria, Croatia and Romania, demonstrating the potential for inclusion in the national roadmaps for improving the qualification of building professionals across Europe to deliver building renovations offering high-energy performance as well as new Nearly Zero-Energy Buildings.

8. CONCLUSIONS AND RECOMMENDATIONS

As evident from the performed analysis, there is still a significant gap in training and educational services covering the topic of staged and deep energy renovation in design and construction practices. Within this perspective, the training scheme for building professionals on the on-site implementation of the iBRoad2EPC can be a valuable asset for multiple training providers across the whole value chain of the construction industry. However, the analysis has revealed that the process may face significant hurdles due to the lack of established patterns and the constantly changing legislative framework and financing landscape. To support the interested training and education service providers, the following recommendations for successful integration of training on the iBRoad2EPC (applicable also to Building Renovation Passports) into the curricula are suggested:

- **Assess current curriculum:** Conduct a thorough review of the existing curriculum to identify gaps in knowledge and skills related to step-by-step renovation. This assessment will help in determining the appropriate areas where the iBRoad2EPC training scheme can be integrated.
- **Develop specialised modules:** Design specialised modules that specifically focus on step-by-step renovation techniques and practices. These modules should cover the learning outcomes from the iBRoad2EPC training scheme that have not been covered by the curriculum so far.
- **Collaborate with industry experts:** Establish partnerships with industry experts, energy consultants, and renovation professionals to ensure that the curriculum reflects current industry practices and standards.
- **Practical training opportunities:** Provide hands-on training opportunities to students by incorporating practical exercises, site visits, and case studies into the curriculum. This will enable students to apply their knowledge in real-world scenarios and develop problem-solving skills.
- **Use simulation and modelling tools:** Integrate the use of energy simulation and building modelling software into the curriculum. These tools can help students understand the energy performance of buildings, evaluate renovation options, and analyse the impact of different measures on energy efficiency.
- **Encourage interdisciplinary collaboration:** Foster collaboration between different disciplines such as architecture, engineering, construction management, and energy management. Renovation projects often require a multidisciplinary approach, and promoting collaboration will help students gain a holistic understanding of the renovation process.
- **Stay updated with emerging technologies:** Energy-efficient technologies and renovation practices are constantly evolving. Ensure that the curriculum includes updates on emerging technologies, energy codes, and regulations related to renovation.
- **Evaluation and feedback:** Regularly evaluate the effectiveness of the training integrated into the curriculum. Seek feedback from students and industry partners to identify areas for improvement and ensure the curriculum remains relevant and up-to-date.

By incorporating these recommendations, specialised training and educational institutions can equip students with the necessary knowledge and skills to become proficient in on-site implementation of the recommendations of the iBRoad2EPC (applicable also for Building Renovation Passports), contributing to a more sustainable and energy-efficient built environment.

ANNEX I – TRAINING MATERIALS

The training presentations are made publicly available along with the present report as PDF files. The corresponding PowerPoint files can be made available to interested training providers at no cost, under the condition of signing a memorandum of understanding with the iBRoad2EPC consortium. Please write to contact@ibroad2epc.eu

1. Identify opportunities for energy savings
2. Interpret iBRoad2EPC and the underlying documentation
3. Interpret step-by-step recommendations
4. Explain the work to be performed to each involved professional
5. Manage and oversee the project implementation
6. Install the components of the building envelope, ensuring optimal airtightness and elimination of thermal bridges
7. Install the building heating, cooling, ventilation, and DHW system
8. Perform replacement of building systems components



iBRoad2EPC

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