D3.1 Structural assessment of available training materials and methodologies

Circular construction

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Lead partner	Circle Economy
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Main authors	Ola Bąkowska (CE), Joel Marsden (CE), Nanna Morgenroth (CE)
Co-authors	Carmen Poort (ISSO), Martin Breen (TUS), Benny McDonagh (TUS), Bojan Milovanovic (UZ-FCE), Dr. Károly Matolcsy (ÉMI), Daniela Blazejova (INCIEN), Laura Reus Losa (FEVEC), María Lladró (FEVEC), Dragomir Tzanev (Eneffect)
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Reviewed by	Carmen Poort (ISSO), Gloria Callinan (TUS)
Approved by	Jan Cromwijk - ISSO
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Revision and history chart

Version	Date	Editors	Comment Description
0.1	24.06.22	Ola Bakowska, Joel Marsden, Nanna Morgenroth (CE)	First draft version
0.2	27.06.22	Carmen Poort (ISSO), Gloria Callinan (TUS)	Feedback on first draft, and gaps identified.
0.3	31.07.22	Joel Marsden (CE)	Final version, feedback from reviews has been processed.
1.0	31.08.22	Jan Cromwijk (ISSO)	Final version approved

Executive Summary

The overall aim of BUS-GoCircular is to address and overcome the challenges of the stimulation of demand for green energy skilled workforce, along with hands-on capacity building to increase the number of skilled workforces across the value chain. Based on the different circular strategies and interventions that are being applied in practice we have mapped which occupations are involved within the implementation of these interventions. Based on this work, different skills required for these different interventions were mapped (T2.2), and the tasks to carry out circular construction activities were mapped onto corresponding learning outcomes for the affected professions and trades workers into a circular skills qualification framework (T2.3).

In the Work Package 3 we are aiming to design the train the trainer and mentoring programmes to develop the mindset and skill set needed to enable the transition to circular procurement and construction in the Netherlands, Bulgaria, Czechia, Spain, Croatia, Hungary and Ireland, as well as materials that have been disseminated by internationally renowned organisations within the EU.

The Work Package 3 starts with Task 3.1 - mapping of the current state when it comes to training materials available to professionals in the sector. Circle Economy, with the support of consortium partners has created a structural assessment framework to compare the available training materials and methodologies as inventoried in Task 2.2, and collected complimentary training materials, on the topics of:

- Circular economy, including introductory, background and general course and training materials;
- Circular construction techniques, including theoretical and applied course and training materials, both on general construction techniques and specifically oriented towards multifunctional green roofs, green facades and interior elements;
- Digitization needs for implementing circularity;
- Transversal circular economy skills, including systems thinking and entrepreneurial skills.

As a result, consortium partners led by Circle Economy, have assessed 26 courses against: modality, audience, content, learning outcomes and skills. To provide the depth needed,

consortium partners have provided examples of learning materials for some of the courses assessed. Based on the review of the collected courses and materials, a decision can be made to obtain further materials from providers or translate the materials collected, to support the design of the trainer course.

List of acronyms and abbreviations

BIM: Building Information Model

BUS: Build-Up Skills

CPD: Continued Professional Development

DER: Deep Energy Retrofit

EPD: Environmental Product Declarations

EQF: European Qualification Framework

LCA: Life Cycle Assessment

MGRFIE: Multi-functional Green Roofs, Façades and Interior Elements

MOOC: Massive Open Online Course

nZEB: nearly Zero Energy Buildings

TtT: Train the Trainer

ULO: Unit of Learning Outcome

WP: Work Package

Definitions

Circular economy: The circular economy offers the next progressive step in our economic model, taking over from the current linear 'take-make-waste' economy by seeking to extract the maximum value from resources in use and keep materials in circulation for as long as possible through processes like reuse, repair, remanufacture and recycling. The ultimate goal of a circular economy is to establish an ecologically safe and socially just operating space for humankind.

Competencies: describe the desired knowledge, skills and behaviours a training may aim to build, whereas learning outcomes describe what a learner will be able to do in some measurable way. Competencies, Skills and Knowledge are assigned to Units of Learning Outcomes (ULOs) in Circular Construction Skills Qualification Framework (T3.2).

European Qualifications Framework (EQF): is a translation tool to make national qualifications easier to understand and more comparable. The EQF seeks to support cross-border mobility of learners and workers, promote lifelong learning and professional development across Europe. The EQF is an 8-level, learning outcomes-based framework for all types of qualifications that serves as a translation tool between different national qualifications frameworks.

Learning Outcomes: Set of knowledge, skills and/or competences an individual has acquired and/or is able to demonstrate after completion of a learning process, either formal, non-formal or informal. Competencies, Skills and Knowledge are assigned to Units of Learning Outcomes in Circular Construction Skills Qualification Framework (T3.2).

Modalities: The different delivery modes of learning through which learners' knowledge, skills and competencies are developed.

Multi-functional Green Roofs, façades and Interior Elements: combine multiple functions in order to maximise the return of a roof or façade (the front part or exterior of a building). Interior elements are considered insofar as they support the functions of buildings' roof and façade. Each function can be denoted its own colour[1]:

[1] Building Changes, 2021. https://www.multifunctioneledaken.nl/kleursysteem/;
Rotterdam Municipality, 2021. https://www.rotterdam.nl/wonen-leven/multifunctionele-daken/

- Green roofs or façades incorporate vegetation (such as moss, grass, shrubs, trees, etc.) and offer space for nature and horticulture. This can contribute to cooling and insulating properties, improve local air quality and biodiversity.
- Blue roofs or façades provide water retention and harvesting functions, for example, to delay stormwater runoff, reduce flooding and offer opportunities to reuse rainwater to water interior plants.
- Yellow roofs or façades generate sustainable energy, for example to power or heat the building with solar panels, thermal collectors, or wind turbines.
- Red roofs or façades make use of buildings' exterior space for social functions, such as roof-top playgrounds, bars or cinemas.
- Grey roofs or façades provide technical functions such as inlet-outlet heat recovery ventilation, chimneys and natural light.

Skills: Ability to apply knowledge and use know-how to complete tasks and solve problems. Competencies, Skills and Knowledge are assigned to Units of Learning Outcomes in Circular Construction Skills Qualification Framework (T3.2).

Table of contents

Table of figures

List of tables

1. Introduction

1.1. Purpose

The accelerated and greater adoption of circular economy strategies across the construction value chain is needed to reduce the sector's embodied emissions, waste and pollution, and environmental footprint. Within BUS-GoCircular these strategies have previously been identified and mapped onto the professions and trades workers responsible or involved in implementing these strategies at different stages of the construction life cycle (task 2.1).[2] The skills needed were then analysed (task 2.2),[3] and a set of tasks and corresponding learning outcomes were subsequently mapped to identify the competences and training needed to create a circular built environment (task 2.3).[4]

The purpose of this task 3.1 is to structurally assess a broad selection of openly available training materials and methodologies aimed to develop skills for circular construction within the Netherlands, Bulgaria, Czechia, Spain, Croatia, Hungary and Ireland, as well as materials that have been disseminated by internationally renowned organisations within the EU.

The assessment is primarily focused on topic-specific content and training modalities to further link the materials assessed to the framework for circular economy interventions in the construction value chain (based on the key elements) through the results of the skill mapping (task 2.2), and the circular construction skills qualification framework (task 2.3) to identify gaps and improvement points.

The purpose of this assessment is to support the identification of existing training materials that can serve as the basis for the training materials to be designed during train-the-trainer programmes to be designed in task 3.2, and implemented in task 5.2. It also serves to inform work to develop fundamentals training packs for SMEs in task 3.4.

[2] BUS-GoCircular D2.1 (2021). Framework for circular interventions in the construction value chain. https://busgocircular.eu/framework-for-circular-interventions-in-the-construction-value-chain/
[3] BUS-Go Circular D2.2 (forthcoming). Mapping of required skills and skills gaps.
[4] BUS-GoCircular D2.3 (2022). Circular construction skills qualification framework, available at: https://busgocircular.eu/circular-construction-skills-qualification-framework/

An additional aim is to collect references for trainers to be trained and create a repository of courses on the Build-Up Skills (BUS) advisor app, and when available in English also to the PROF/TRAC platform.

Firstly, the approach to identify, collect and assess relevant training materials is outlined. The results are then presented describing the modalities, content and learning outcomes of the assessed materials. The course target audiences and learning outcomes are then mapped against the reference professions, skills and task-based qualification frameworks, before a qualitative assessment is provided of the openly available materials collected that can be used by trainers and other learning professionals. The final section highlights the challenges and opportunities, and provides recommendations for the design of the Train the Trainer programmes, and the Fundamental Training Packs to be developed in the next phase of the project.

2. Approach

2.1. Identifying and collecting relevant upskilling content

Relevant content has been collected through online desk research and based on the expertise and contributions of consortia partners. Selected partners from the 7 EU member states covered by the BUSGoCircular project (CE, ISSO, EnEffect, CVUT, FEVEC, UZ-FCE, EMI and TUS) have contributed information on 26 courses. Of these, 18 were identified for the skills mapping inventory as part of task 2.2, and 8 of them are new courses added. This includes six courses from outside the countries represented by the consortia, including 4 from outside the EU, which provides access to more English-language content specific to MGRFIE.

Table 1: Trainings / modules identified for assessment

No.	Country	Training title (in English)
1	Spain	*Aplicación de la economía circular a la construcción* (Applying the circular economy to the construction industry)
2	Spain	*Bioconstrucción* (Bio-construction)
3	Spain	*Economía Verde y Circular para empresas y emprendedores* (Green and circular economy for businesses and entrepreneurs)
4	Spain	*Cubiertas ajardinadas* (Green roofs)
5	Croatia	CROSKILLS - Build Up Skills Croatia: Strengthening energy efficiency skills and certification schemes for building workers
6	Croatia	GBPro - Green Buildings Professional
7	Croatia	*Afirmacija zelene gradnje* (Affirmation of green building)
8	Ireland	Introduction to low energy building construction
9	Ireland	nZEB fundamental awareness
10	Ireland	nZEB retrofit
11	Ireland	nZEB ventilation
12	Netherlands	Circular economy for a sustainable built environment
13	Netherlands	Circular economy - sustainable materials management
14	Netherlands	Zero energy design: an approach to make your building sustainable
15	Netherlands	New business models - working together on value creation
16	EU: Hungary, Netherlands,	NEWCOM (flat roofers) - New competence for building professionals and

	Slovakia, Austria	blue collar workers: certified qualification schemes to upgrade the qualification for building nZEBs
17	EU: Hungary, Netherlands, Slovakia, Austria	NEWCOM (building inspectors) - New competence for building professionals and blue collar workers: certified qualification schemes to upgrade the qualification for building ZEBs
18	EU: Ireland, Croatia, Hungary, Spain	BIMzeED - Education for nZEBs using BIM
19	EU: Czechia, Bulgaria, Croatia, Ireland, Austria, Greece, Italy, Romania	Fit-to-nZEB: Innovative training schemes for retrofitting to nZEB-levels
20	EU: Bulgaria, Czechia, Ireland, Germany, Romania, Turkey, Ukraine	Train-to-nZEB: the building knowledge hubs
21	Germany	German Sustainable Building Council (DGNB) training
22	Finland	Decarbonize design
23	United Kingdom	An introduction to green roofs
24	United Kingdom	Green roofs - basic principles and design
25	United States	Green roof professional (GRP) training & accreditation
26	Singapore	Skyrise greenery certification programme - part 1

2.2. Assessment methodology

The assessment form has been created by CE and refined based on partners' input to inform the future process of designing a train-the-trainer programme. The assessment has been conducted by lead partners independently and through four online supporting sessions with CE.

The assessment methodology allows information to be captured about a variety of course types ranging from a full programme of courses (e.g. https://bimzeed.eu/) to a single course or module within a course.

The assessment covers:

- Basic information: about the course, provider and delivery institutions.
- Modality: the cost, timing, duration, language and mode of delivering the course.
- Target Audience: the relevant geography, work fields and type of construction project targeted, by the training course, plus any pre-course requirements
- Course Content: topics covered and certification.

- Learning outcomes specific to Circular Economy and MGRFIE.
- Course skills: the circular construction skills that the course supports, based on circular construction skills mapping in task 2.2.

As a next step, short interviews with selected provider institutions (1 to 2 in each partner country) can be conducted to better understand course effectiveness and potential improvement points based on e.g. trainee feedback surveys and success metrics and to gain access to more training materials.

3. Results

3.1. Assessment results

Based on the collected information on relevant training and the assessment process carried out by the partners, this chapter summarises the results. First, we present the different modalities of courses identified and course content. Second, we assess the course learning outcomes and how these relate to the circular construction skills qualifications framework developed in task 2.3. Finally, for the courses with readily available or open-access materials, we provide a qualitative assessment of their content and mode(s) of delivery.

3.1.1. Course modalities

Of the 26 courses assessed, Figure 1 shows that these were mainly certificated CPD courses (15), or online MOOCs (9).

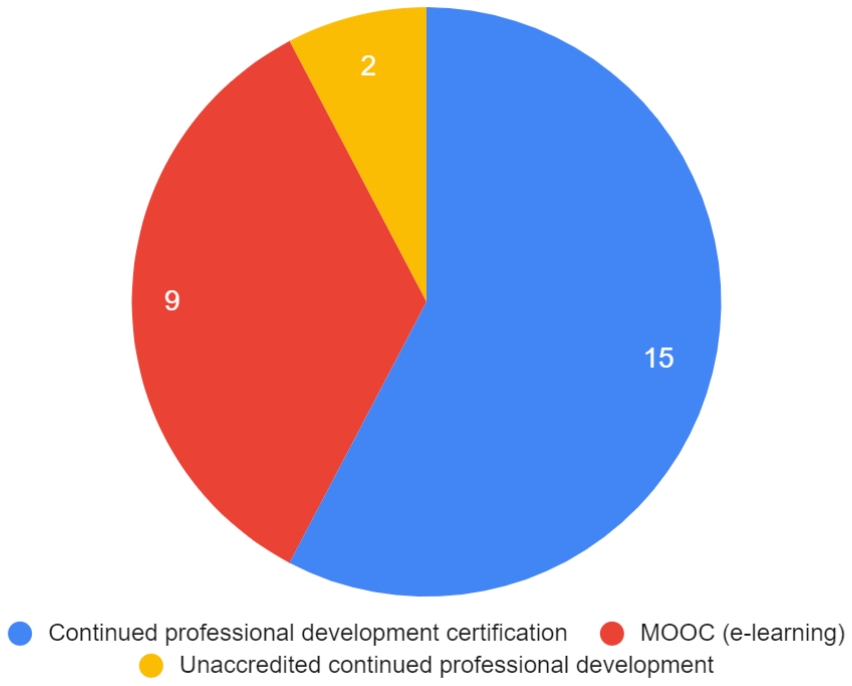

Figure 1: The types of courses assessed: MOOC (e-learning), Continued personal development certification, and Unaccredited continued personal development.

Besides the 9 online MOOCs, 12 of the courses are delivered in a hybrid model - part online and part in person (see Figure 2).

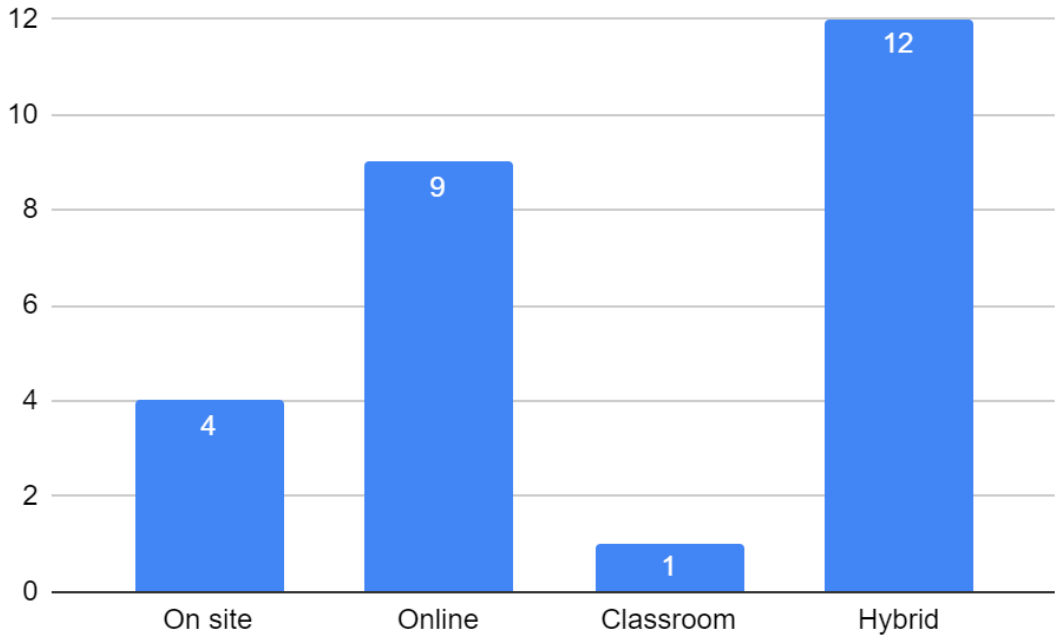

Figure 2: Delivery location: Online, Onsite, Classroom, or Hybrid.

When it comes to the delivery type (Figure 3), the assessed courses are mainly instructor or tutor led (19).

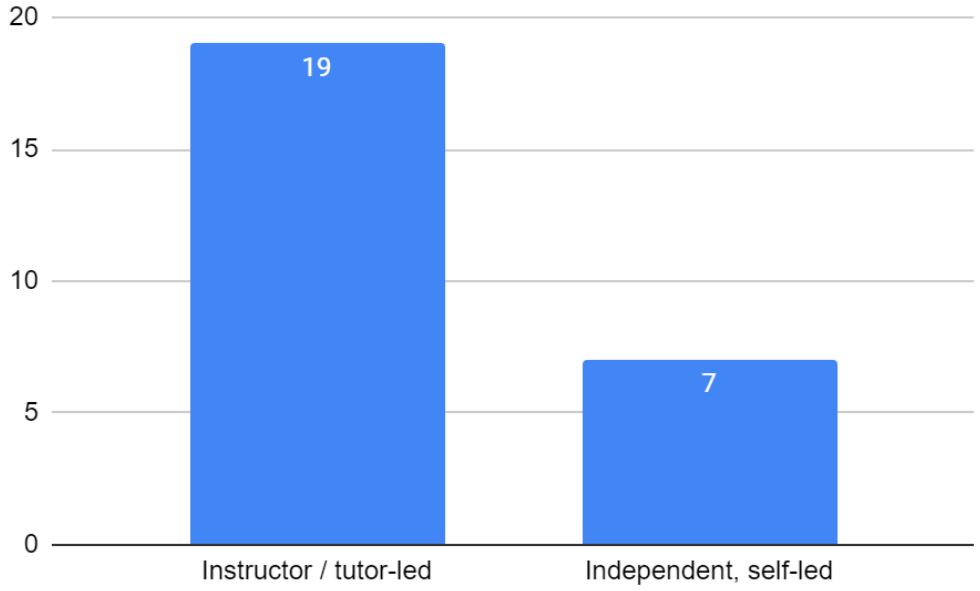

Figure 3: Delivery type: independent/ self-led, Instructor/tutor-led.

3.1.2. Course content

In terms of course content, 12 courses provide a general introduction to the circular economy and 10 train on transversal circular economy skills such as systems thinking. A majority, 17 of the 26 courses, provide training on circular construction techniques. Of these, 12 have been identified that provide learning specific to MGRFIE, including four courses from outside the EU.

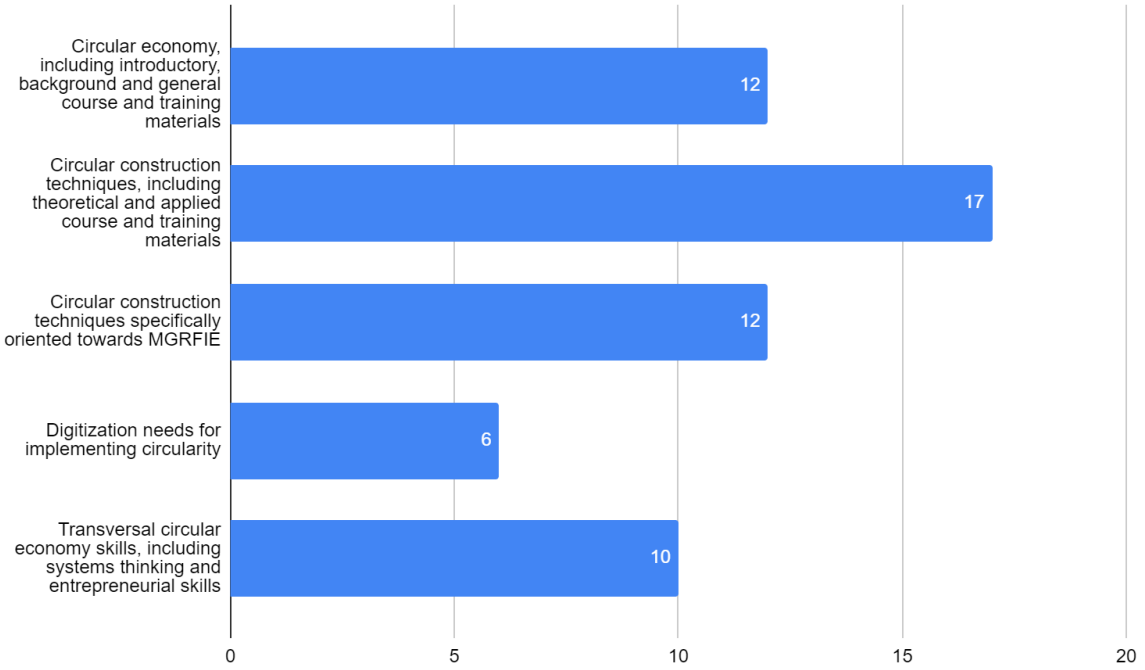

Figure 4: Topics covered by the assessed courses. Note: some courses cover multiple topics.

The courses with a specific focus on MGRFIE include:

- 2. Bio-construction (Spain),
- 4. Green Roofs ("*Cubiertas ajardinadas"*) (Spain),
- 5. CROSKILLS (Croatia)
- 6. GBPro (Croatia)
- 9. NZEB Fundamental awareness (Ireland)
- 16.-17. NEWCOM (Multiple: Hungary, Austria, Slovakia, and the Netherlands)
- 20. Train-to-NZEB: The Building Knowledge Hubs (Multiple: Bulgaria, Czechia, Ireland, Germany, Romania, Turkey, Ukraine),
- 21. DGNB consultant training (Germany)
- 23. An Introduction to Green Roofs (United Kingdom),
- 24. Green roofs - basic principles and design (United Kingdom).
- 25. Green Roof Professional Training & Accreditation (North America).
- 26. Skyrise Greenery Certification Programme - Part 1 (Singapore).

A variety of learning outcomes are provided across the different courses, although not all of the course assessments include detailed learning outcomes of the course, or its specific modules (see table 2).

Table 2: Stated learning outcomes of the assessed courses

#	Course title	Stated learning outcomes of the course
1	*Aplicación de la economía circular a la construcción* (Applying the circular economy to the construction industry)	**Module 1 Economy models in building works:** - Knowledge of the linear economy and the circular economy in products and construction systems. - Knowledge of the linear and circular methodology in a construction system or building process. - Management of the execution of a construction system as established in the applicable regulations on zero emissions. - Organisation of the development of construction works as established in the applicable regulations on zero emissions. - Ability to choose products with the best life cycle for commissioning. - Ability to manage construction projects according to circular economy standards. **Module 2 Construction systems with 4R methodology:** - Application of the construction system or 4R process in the field of architecture and construction. - Projection and control of the execution of the work as established in the systems with 4R methodology. - Management of the works execution project as established in the applicable regulations for systems with 4R methodology. - Rehabilitation of buildings using specific techniques based on life cycle analysis with 4R methodology. **Module 3 Life Cycle in building projects:** - Accreditation of construction processes with LCA methodology. - Control of the construction project with circular methodology and low environmental impact. **Module 4 C2C Cradle to Cradle Certification:** - General management on the C2C certification in building work. - Application of the Cradle to Cradle certification criteria and sustainability characteristics of the materials, products and systems used in the works. **Module 5 Circular economy in architectural design:** - General knowledge about Agenda 2050. - Analysis of the European Union documentation on the design and construction of zero emission buildings. - Determination of the Passivhaus Standard on passive construction in buildings. **Module 6 Environmental management in buildings:** - Carrying out environmental impact studies in buildings. - Knowledge of the energy certification process for buildings. - Evaluation of the energy efficiency of building installations **Module 7 Waste management in building projects:**

		- Design of buildings according to DfD (Design for Disassembly). - Location within the market of catalogued materials according to Shearing Layers and Material Passport. - Development of the Passport of materials from the design phase. - Management of construction waste in a sustainable manner. - Project design of modular, standard, reversible and mechanical buildings.
2	*Bioconstrucción* (Bio-construction)	There is no specific module for circular economy but bioconstruction itself is about building with regenerative, renewable and recycled materials. In the course they show different alternatives and construction solutions, element by element of the building (with practical assessment and with one specific module of green roofs). The topic of circular economy is explained in an introductory way, as a concept, in the initial module.
3	*Economía Verde y Circular para empresas y emprendedores* (Green and circular economy for businesses and entrepreneurs)	Aimed at developing entrepreneurial skills that favour the creation of entrepreneurial initiatives in a green and circular economy. Module I. Principles of the circular economy. Module II. The circular economy as a response. Module III. Circular economy and future trends. Module IV. How to implement the circular economy in companies.
4	*Cubiertas ajardinadas* (Green roofs)	1. Green roofs and their composition. 2. Types of green roofs. 3. Benefits of green roofs. 4. Construction and maintenance.
5	CROSKILLS - Build Up Skills Croatia: Strengthening energy efficiency skills and certification schemes for building workers	Focused on lifelong education of workers in the field of energy efficiency in construction.
6	GBPro - Green Buildings Professional\	To raise generations of multi-disciplinary experts spanning the fields of green building, designing and financing green buildings; use of eco-friendly materials for building, furnishing, and reconstruction of buildings; assessment of building value and life cycle with regard to green building elements; landscaping; energy-efficient light design; achieving of savings through recycling and energy savings; efficient use of water resources; selection of a sustainable site and its management; national regulations and certification.
7	*Afirmacija zelene gradnje* (Affirmation of green building)	The educational programme is aimed at understanding how to draft, build and manage green projects. As part of the course, participants will be presented with key parameters on various sustainable solutions applicable to obtaining internationally recognized green building certificates. It consists of three modules: 1) Green construction - health, well-being and productivity. 2) Environmental Impact Statement - Environmental Product Declarations (EPD) 3) Green construction and landscape architecture / Basic terms
8	Introduction to low energy building construction	1. List and describe the key policies and laws which are creating the requirement for low energy buildings.

		2. Explain the key energy terms and measurement units associated with low energy buildings. 3. List and describe the key principles of the techniques for new build and renovation works which will produce low-energy buildings. These principles include insulation, air-tightness, ventilation and detailing to achieve healthy buildings. 4. Identify best practice in a number of common construction methods relevant to low-energy buildings and be able to recognise work practices which fall below this standard. 5. Understand why there is a need to talk with other construction workers in order to produce low-energy buildings and be able to have such discussions. 6. Describe some key challenges of implementing low energy high quality building projects and how to apply specific solutions to meet those challenges.
9	nZEB fundamental awareness	Understand the principles of NZEB and its role in Energy Efficiency
10	nZEB retrofit	Understand the principles of refitting to NZEB standards. Knowledge of sustainable green products in addition to energy efficiency
11	nZEB ventilation	Understand the design, install, and commissioning of NZEB ventilation systems.
12	Circular economy for a sustainable built environment	At the end of the course you will be able to: Recognize the principles of circularity and their application to the built environment; Identify the scales of the built environment from materials and products to cities and regions; Identify the life-cycle phases of building products and how they can be circular; Discuss design principles in building of products and key aspects such as stakeholders, incentives, timt3.1eframes, business models; Discuss the circular design and development approach for buildings and recognize the impact of a building on society and the environment during its life-cycle; Recognize the flows at different city scales and how they differ depending on the actors and the local context; Reflect on the complexity and variety of possible circular solutions in terms of energy, water and waste management; Analyze and map the different stages and value webs of building materials at the regional level; Reflect on possible environmental impacts of the different building life-cycle stages and activities along the value web; Explore the potential of intervening to steer the value web towards more circularity
13	Circular economy - sustainable materials management	Module 1: Materials. This module explores where materials come from, and builds a rationale for why society needs more circularity. Module 2: Circular Business Models. In this module circular business models are explored in-depth and a range of ways for business to create economic and social value are discussed.

		Module 3: Circular Design, Innovation and Assessment. This module presents topics like functional materials and eco-design as well as methods to assess environmental impacts. Module 4: Policies and Networks. This module explores the role of governments and networks and how policies and sharing best practices can enable the circular economy. Module 5: Circular Societies. This module examines new norms, forms of engagement, social systems, and institutions needed by the circular economy and how we, as individuals, can help society become more circular.
14	Zero energy design: an approach to make your building sustainable	Analyse the energy use of a building; Analyse the local climate and select appropriate measures; Develop an integrated net-zero-energy concept for the building; Apply a stepped approach to find energy reducing measures Week 1 Energy in the built environment Introduction to Zero Energy Design Analyse the energy consumption of a selected building Week 2 REDUCE: Passive measures Analyse the local climate and choose passive measures to reduce the energy demand, like thermal insulation and sun shading. Week 3 REDUCE: Active measures Overview of active measures to reduce the energy demand, like demand-controlled heating and ventilation. Week 4 REUSE Overview of the opportunities to reuse energy flows in buildings, like heat recovery from ventilation air and warm waste water Week 5 PRODUCE Overview of the opportunities to produce heat and electricity in the building, like PV-systems, ground source heat pumps. Week 6 INTEGRATE Apply all the measures from the previous weeks in an integrated net zero energy concept for the selected building Week 7 Wrap up
15	New business models - working together on value creation	The role of business models in a changing economy, against the background of trends and developments. Understand how the economy and society is changing and how to use this as input for your value proposition. How to make an initial design for your new business model. who and what you will need for your NBM and how to design your own NBM.

		How to improve your value proposition, based on three principles of value creation. How to develop a community of people who actively participate in your NBM. How to distinguish and assess the values your NBM is creating. If you successfully complete the course, you will have your own NBM.
16	NEWCOM (flat roofers) - New competence for building professionals and blue collar workers: certified qualification schemes to upgrade the qualification for building nZEBs	51 units of learning outcomes identified. The summary project report is available at: https://www.newcomtraining.com/fileadmin/2_newcomtraining/downloads/project_results/d3_2_summary_report_on_national_certification_strategies_new.pdf
17	NEWCOM (building inspectors) - New competence for building professionals and blue collar workers: certified qualification schemes to upgrade the qualification for building ZEBs	81 units of learning outcomes identified. The summary project report is available at: https://www.newcomtraining.com/fileadmin/2_newcomtraining/downloads/project_results/d4_2_national_certification_strategies_for_bi_final_new.pdf
18	BIMzeED - Education for nZEBs using BIM	**Unit 1- Collaborative BIM To Achieve NZEB** • Create a collaborative workflow between all construction team members using BIM. • Identify the role and responsibilities of each construction team member. • Identify the building regulations applicable and generate all documents to achieve nZEB design. **Unit 2- BIM & NZEB For Workers** • Carry out communication between design and construction teams. • Use the BIM methodology on site to apply problem solving workflow. • Evaluate the situation and apply the necessary prior actions to prevent setbacks using BIM methodology. • Understand and apply the nZEB principles on site. **Unit 3- NZEB Realisation & Commissioning: Building Envelope & Air Tightness** • Use tools for BIM object creation (foundations, walls, roofs...) • Understand the principles that affect an element to be suitable in an nZEB building design. • Guarantee a correct nZEB design through the application of a quality control of the construction model. • Base nZEB building design on suitable BIM objects. **Unit 4- NZEB Realisation & Commissioning: Building Services & Smart Technologies** • Use tools for BIM object creation (energy systems, mechanical ventilation...). • Identify the principles that affect an element to be suitable in an nZEB building design. Guarantee a correct nZEB design through the application of a quality control of the construction model. • Base nZEB building design on suitable BIM objects. • Perform analysis of energy demand calculations for building services design.

		• Compare and contrast different technologies to facilitate selection of an appropriate solution or solutions. **Unit 5- NZEB Realisation & Commissioning: Quality Assurance** • Guarantee energy saving systems and sustainable materials quality. • Determine different quality controls and verify their good implementation. • Coordinate the project team to ensure the quality control in the construction site. **Unit 6- BIM Model Uses During Construction** • Implement and design a digital twin of the building. • Optimise the BIM model and create models with zero clashes. • Implement an active working methodology in the use of BIM for constructive design. • Generate structure and systems calculations from the BIM model. • Audit the BIM model project provided by the client (Clash detection, technical issues, LOD) **Unit 7- BIM Model Uses For Specification & Quantification** • Design construction models based on the effectiveness and efficiency provided by the BIM methodology. • Analyse model data to minimise costs, time and clashes in site planning. • Conceptualise and apply the BIM dimensions (4D, 5D and 6D). **Unit 8- BIM Model Standardisation For NZEB Design** • Standardise the BIM model data structure to accomplish NZEB goals based on European directives and national requirements. • Generate the required documentation for nZEB validation. • Optimise the design workflow based on the standardised BIM model. **Unit 9- Building Energy Modelling (BEM) Design & Export** • Generate a Building Energy Model (BEM) and evaluate its positive impact on the workflow of nZEB design. • Design and export a Building Energy Model (BEM) considering nZEB requirements and parameters. • Generate a Building Energy Model (BEM) of existing buildings to rehab them into nZEB buildings. **Unit 10- Energy Simulation With BIM Tools** • Analyse a Building Energy Model (BEM). • Make economic feasibility studies and apply solutions. • Verify and evaluate the parameters needed to accomplish a nZEB building. **Unit 11- NZEB Facility Management** • Diagnose and improve energy efficiency during the facility management. • Implement tools and techniques for communication with users to collect suggestions. • Validate and carry out preventive efficiency controls. **Unit 12- BIM In Facility Management Software** • Structure model data for a correct facility management implementation with BIM. • Classify BIM objects, spaces and other BIM parameters to be compatible with facility management software. • Generate a model considering maintenance parameters
19	Fit-to-nZEB: Innovative training schemes for	The course is divided into four major parts. 1) General knowledge of building physics, requirements in terms of health,

	retrofitting to nZEB-levels	comfort and safety in buildings and general retrofit approach including notions about ecology and sustainability. 2) Deep energy retrofit (DER) in connection to the building envelope with particular attention being paid to the design and construction of the distinct building components, underlining the role of the comprehensive design to the DER and examining its key renovation principles. The basic renovation design principles are being introduced, emphasising on what makes a retrofit 'a deep energy retrofit' and what are the most common faults in the standard building renovation practices. The students get to grasp not only the theoretical knowledge behind the DER practices, but the insight on why it is advantageous and preferred to the standard energy renovation. Special and particular attention is paid to the step-by-step renovation. 3) Building services and deals with the ventilation, heating and cooling, DHW and RES in retrofitting. 4) Project management and planning and design instruments as well as to the assurance of high quality building design and construction. The basics of the economic efficiency and cost-effectiveness of the renovation of existing buildings is covered. The main sustainability indicators, the involvement of stakeholders, and energy management at community level are also briefly mentioned.
20	Train-to-nZEB: the building knowledge hubs	1. Development of publicly available Terms of Reference for the setting up of the training and consultation centres (BKHs); 2. Adaptation of existing and development of new training programs; 3. Actual setting up of 4 BKHs according to the Terms of Reference; 4. Building of internal capacity through train-the-trainer activities, targeting at least 90 qualified trainers; 5. Actual training courses according to annual training plans, resulting in: (a) 120 training courses for construction workers, targeting additional qualification of 2400 trainees; (b) 24 training courses for highly-qualified building specialists, targeting additional qualification of 480 trainees; (c) 36 training courses for non-specialists, targeting additional qualification of 720 trainees; 6. Strict monitoring and evaluation for constant improvement of the offered services. 7. Setting up of a web-based networking platform providing facilities for knowledge sharing and exchange between the BKHs; 8. Conduction of a targeted dissemination and communication campaign to increase the market demand for NZEB projects
21	German Sustainable Building Council (DGNB) consultant training	Become an expert for sustainable building by participating in this digital training. During 8 online sessions, participants will learn about the international application of the DGNB Certification System for sustainable buildings and districts.
22	Decarbonize design	- Comprehensive understanding of the role of Carbon in built environment - Theoretical and practical understanding of circular analysis methodologies for the built environment sector with respect to life cycle assessment - Practical experience in implementing circular design methodologies and best practices from legislative, regulatory, and industrial policy aspects

		- Design and build experience in developing a mock-up building or infrastructure unit with specific focus on circular economic strategies, including recycled, regenerate, and biogenic building assemblies, renewable energy sources, rainwater collection and storage, and minimal operating energy.
23	An introduction to green roofs	Understand the background, history and potential future of green roofs; Identify different types of green roof and their associated benefits; Consider roof design and structural requirements; Understand the processes involved in the safe installation of green roofs; Appreciate the need to maintain green roofs following installation
24	Green roofs - basic principles and design	Knowledge and skills to plan, design and manage green roofs in accordance with best practice guidance and relevant regulatory framework
25	Green roof professional (GRP) training & accreditation	The full range of system types and components available to designers Essential qualifications for project teams How to integrate green roofs with other building systems for maximum client benefit Implementation issues for new and retrofit buildings (including staging, scheduling, conveyance methods, and coordination of trades) Contracts and construction administration Quality assurance, warranties, and liability issues
26	Skyrise greenery certification programme - part 1	- Comprehensive understanding of green roof systems and components - Waterproofing principles and materials along with drainage implementation for green roofs - Design and installation of vegetation substrate for the green roofs

3.2. Mapping courses against job roles and the skills framework

During the preliminary work to identify relevant courses, courses were mapped against the professions or trades workers targeted. This mapping is provided in table 4. Full details of the acronyms of reference professions are provided in Appendix 1.

The courses target a wide range of professions and trades workers, including roles specifically relevant to MGRFIE such as green roofers, landscape architects, renewable energy installers and facade workers. The Fit-to-nZEB course notably offers different levels of training to different types of profession, with levels indicated by the European Qualifications Framework (see Appendix 4).

Table 4: Professions and trades workers targeted by the assessed courses

#	Course title	Reference professions / trades

1	*Aplicación de la economía circular a la construcción* (Applying the circular economy to the construction industry)	AR, CE, EE, MS, C, PD, LA, DeA, DeL, BEC
2	*Bioconstrucción* (Bio-construction)	AR, CE, EE, MS, C, FW, R, Gd, BA, BEC, FM, WI, Br
3	*Economía Verde y Circular para empresas y emprendedores* (Green and circular economy for businesses and entrepreneurs)	Potential relevance to all professions and trades workers
4	*Cubiertas ajardinadas* (Green roofs)	LA, Gd, R
5	CROSKILLS - Build Up Skills Croatia: Strengthening energy efficiency skills and certification schemes for building workers	II, FW, R, Gd, BEC, PA FM, WI, Br
6	GBPro - Green Buildings Professional	AR, CE, EL, ME, EE, AM, FaM, LA, FDE, PM, PD, BEC, SC, GPPA
7	*Afirmacija zelene gradnje* (Affirmation of green building)	AR, CE, BEC, SC, LA, PM, PD
8	Introduction to low energy building construction	All professions and trades workers
9	nZEB fundamental awareness	All professions and trades workers
10	nZEB retrofit	AR, CE, MS, PD, BO, FaM, II, FW, R, DeA, DeL, RM, VI, WI,
11	nZEB ventilation	VI
12	Circular economy for a sustainable built environment	AR, CE, EE, LA,
13	Circular economy - sustainable materials management	AR, CE, MS, PM
14	Zero energy design: an approach to make your building sustainable	AR, CE, EE, MS, LA, RESI, RWT, BEC
15	New business models - working together on value creation	Potential relevance to all professions and trades workers
16	NEWCOM (flat roofers) - New competence for building professionals and blue collar workers: certified qualification schemes to upgrade the qualification for building nZEBs	R
17	NEWCOM (building inspectors) - New competence for building professionals and blue collar workers: certified qualification schemes to upgrade the qualification for building nZEBs	HS, BEC
18	BIMzeED - Education for nZEBs using BIM	AR, CE, ME, EL, EE, DA, MS, C, PD, LA, EI, RESI, RWT, HPI, VI, BEC, GPPA, R
19	Fit-to-nZEB: Innovative training schemes for retrofitting to nZEB-levels (EQF level 2)	II, FW, R, P, EI, RM, WI, Br
	Fit-to-nZEB: Innovative training schemes for retrofitting to nZEB-levels (EQF levels 3-5)	II, EI, RESI, RWT, HPI, RM, VI, FM, WI
	Fit-to-nZEB: Innovative training schemes for retrofitting to nZEB-levels (EQF levels 6-7)	AR, CE, C
20	Train-to-nZEB: the building knowledge hubs	AR, CE, ME, EL, C, PD, BO, FaM, BEC, PA
21	German Sustainable Building Council (DGNB) training	AR, CE, ME, EL, EE, C, PD, BO, FaM, PM, LA, PA, GPPA

Partners assessed the courses within their countries against the skills framework developed (Deliverable 2.2), whereby a skills table was developed based on the key elements of the circular economy for the construction industry in general, and applied to MGRFIE. The full results are presented in table 5, and full details of the skills are provided in Appendix 2.

This shows that across the courses assessed, each of the identified skills is covered by two or more of the courses. The skills most frequently covered, in 10 or more of the assessed courses, include:

- DF7: Design/Build for durability
- CCJV1: Collaborate to create joint value (specific to circular economy)
- CCJV2: Collaborate to create joint value (general)
- MF4: Insulation installation

The skills least frequently covered, in less than 5 of the assessed courses, include:

- UWR3: Reclaiming energy
- UWR5: Grey water collection and use
- IDT1: Drone use
- IDT2: 3D printing
- RBM2: Environmental costing models and carbon taxes
- RBM3: Facades as a service
- RBM5: Interior features as a service

Table 5: Skills for circular construction provided by the courses assessed within partner countries

Course no.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Country		**ES**	**ES**	**ES**	**ES**	**HR**	**HR**	**HR**	**IE**	**IE**	**IE**	**IE**	**NL**	**NL**	**NL**	**NL**	**EU**	**EU**	**EU**	**EU**	**EU**
PRR	**Prioritise regenerative resources**	y	y	y	y		y			y	y		y	y			y	y	y		
PRR1	Bio-Based and regenerative material application	y	y		y		y			y	y		y								
PRR2	Reusable material application	y	y				y			y	y		y				y	y			
PE	**Preserve and extend what is already made**					y	y			y	y		y				y	y		y	y
UWR	**Use waste as a resource**	y	y	y		y	y			y	y		y				y	y	y		
UWR1	Deconstruction for reuse	y		y			y				y						y	y			
UWR2	Material innovation		y	y			y	y			y		y								
UWR3	Reclaiming energy											y	y		y						
UWR4	Continuous reuse of energy with little or no waste	y	y						y	y	y	y	y						y		y
DF	**Design/Build for the future**	y		y			y	y	y	y	y	y	y	y			y	y	y		y
DF1	Design/Build for reuse	y		y			y		y	y	y		y	y			y	y			y
DF2	Design/Build for repurpose of materials	y		y			y					y	y				y	y		y	y
DF3	Apply material passports	y		y									y				y	y			
DF4	Design/Build for material impact reduction	y					y	y	y	y	y	y		y							y
DF5	Reduce/Build reliance on critical raw materials		y				y	y					y				y	y	y		
DF6	Design/Build out waste	y						y	y	y	y		y				y	y	y		
DF7	Design/Build for durability	y				y		y	y	y	y			y			y	y	y	y	y

DF8	Design/Build for cyclability	y					y							y			y	y	y		y
CCJV	**Collaborate to create joint value**	y		y			y	y	y	y	y	y	y	y		y	y	y		y	y
CCJV1	Collaboration for Circular Economy	y		y			y	y					y			y	y	y		y	
RBM	**Rethink the business model**			y			y	y		y	y			y		y	y	y			
RBM1	Repairs as a service			y						y	y			y			y	y			
RBM2	Environmental costing models and carbon taxes			y				y													
IDT	**Incorporate digital technology**			y			y	y	y	y	y	y					y	y	y		y
SAK	**Communication, education and information**	y		y			y	y	y	y	y	y							y	y	y
PRR	**Prioritise regenerative resources**	y	y			y	y		y	y	y		y		y		y	y	y	y	y
PRR3	Sustainable sourcing	y	y			y	y		y	y	y		y								
PRR4	Energy storage and distribution	y					y		y				y		y					y	y
PRR5	Production of renewable energy						y		y	y	y	y	y		y		y	y	y	y	y
PRR6	Continuous reuse of water with little or no waste								y	y	y		y						y		
PE	Preserve and extend what is already made					y	y		y	y	y	y		y			y	y	y	y	y
PE1	Maintenance of building components					y	y		y	y	y	y					y	y	y		y
PE2	Upgrade of building components					y	y		y	y	y	y					y	y	y		
UWR	**Use waste as a resource**						y	y	y	y	y		y				y	y			
UWR5	Grey water collection and use								y	y	y		y								
UWR6	Rainwater collection and use						y	y	y	y	y		y		y						
UWR7	Sustainable drainage systems						y	y	y	y	y		y				y	y			
DF	**Design for the future**	y		y			y		y	y	y		y	y			y	y	y		y

DF9	Design for adaptability						y						y	y			y	y	y	y	y
DF10	Modular design	y		y			y		y	y	y		y	y							
CCJV	**Collaborate to create joint value**			y		y	y	y	y	y	y	y		y		y	y	y	y	y	y
CCJV2	Collaboration			y		y	y	y	y	y	y	y		y		y	y	y	y	y	y
RBM	**Rethink the business model**	y							y	y	y	y					y	y	y	y	
RBM3	Facades as a services	y							y	y	y	y					y	y			
RBM4	Technical installation as a service	y															y	y	y	y	
RBM5	Interior features as a service																		y		
IDT	**Incorporate digital technology**	y		y			y		y	y	y	y	y				y	y	y		y
IDT1	Drones Use								y				y				y	y	y		
IDT2	3D Printing												y			y			y		
IDT3	Prefabrication	y		y					y	y	y	y	y				y	y			y
IDT 4	BIM/Digitisation	y		y			y		y	y	y	y	y					y	y		
SAK	**Communication, education and information**	y		y			y	y						y			y	y			y
SAK1	Research and development	y		y			y	y						y							y
MF	**MGRFIE**	y	y		y	y	y		y	y	y	y			y		y	y	y	y	y
MF1	Solar power systems for electricity generation						y		y	y	y	y			y		y	y	y	y	y
MF2	Solar thermal systems for domestic hot water or heating generation	y					y		y	y	y	y			y		y	y	y	y	y
MF3	Heat pump	y					y		y	y	y	y			y			y	y	y	y
MF4	Insulation installation	y	y			y	y		y	y	y	y			y		y	y	y	y	y

MF5	Establishing the cooling and heating function of green roofs		y		y				y	y	y	y			y		y	y			
MF6	Horticulture		y				y	y		y	y						y	y			

Note: A full description of each skill is provided in Appendix 1.

3.3. Assessing courses against the task-based qualifications framework

The circular construction skills qualifications framework consists of two versions, a general framework (G) - applicable to all aspects of the built environment, and an applied framework (A) - specific to the case of MGRFIE. Each framework consists of a list of nine tasks with subtasks that are linked to corresponding ULOs and relevant professions.

Table 6 maps the learning outcomes of the assessed courses against the nine tasks for both the general framework (G1-G9) and applied framework (A1-A9), with descriptions of the tasks provided in Appendix 3.

Of the 20 courses assessed for which training materials are available, 16 include at least some element of '*collaborate to create joint value'* in the general framework (G5). 12 or more of the 20 courses include content relevant to the general circular construction tasks: '*prioritise regenerative and efficient use of resources*' (G1), '*Use secondary resources*' (G3), and '*design/assemble/construct for the future*' (G4).

Relatively few of the assessed courses include specific content that maps onto the applied framework, with just three courses identified as relevant to MGRFIE applied tasks '*rethink the business model*' (A6) and '*strengthen and advance knowledge*' (A8). This may reflect the lesser attention that existing courses providing a specific focus on MGRFIE place on the transversal skills needed to enable circular strategies for construction.

Table 6: Analysis of the courses against the tasks mapped as part of the circular construction skills qualification framework.

#	Course title	Tasks (see table 7, Appendix 3)
1	*Aplicación de la economía circular a la construcción* (Applying the circular economy to the construction industry)	G1, G3, G4, G5, G8, A1
2	*Bioconstrucción* (Bio-construction)	G1, G3, A1, A3
3	*Economía Verde y Circular para empresas y emprendedores* (Green and circular economy for businesses and entrepreneurs)	G1, G3, G4, G5, G6, G7, G8
4	*Cubiertas ajardinadas* (Green roofs)	G1, A1
5	CROSKILLS - Build Up Skills Croatia: Strengthening energy efficiency skills and certification schemes for building workers	G2, G3, A2, A3
6	GBPro - Green Buildings Professional	G1, G2, G3, G4, G5, G6, G7, G8,

#	Course title	Tasks (see table 7, Appendix 3)
		A1, A2, A3, A4, A5, A6, A7, A8
7	*Afirmacija zelene gradnje* (Affirmation of green building)	G4, G5, G6, G7, G8
8	Introduction to low energy building construction	G4, G5, G7, G8
9	nZEB fundamental awareness	G1, G2, G3, G4, G5, G7, G8, A1, A2, A3, A4, A5, A7, A8
10	nZEB retrofit	G1, G2, G3, G4, G5, G7, G8
11	nZEB ventilation	G4, G5, G7, G8
12	Circular economy for a sustainable built environment	G1, G2, G3, G4, G5
13	Circular economy - sustainable materials management	G1, G4, G5, G6
14	Zero energy design: an approach to make your building sustainable	G1, G3
15	New business models - working together on value creation	G5, G6
16	NEWCOM (flat roofers)	G1, G2, G3, G4, G5, G6, G7, A1, A2, A3, A4, A5, A6, A7
17	NEWCOM (building inspectors)	G1, G2, G3, G4, G5, G6, G7, A1, A2, A3, A4, A5, A6, A7
18	BIMzeED - Education for nZEBs using BIM	G1, G2, G3, G4, G5, G7, G8
19	Fit-to-nZEB: Innovative training schemes for retrofitting to nZEB-levels	G2, G5, G8
20	Train-to-nZEB: the building knowledge hubs	G2, G4, G5, G7, G8, A2, A4, A5, A7, A8

3.4. Qualitative analysis of materials collected

Course materials have been collected for 20 of the 26 assessed courses. Training materials for the other courses are not openly available. The materials collected reflect the differences in media used for training delivery across the assessed courses. These include: online videos, case studies, assessment exercises, presentations, guides and manuals (theoretical and practical), ULOs, and journal articles. A full overview is provided in table 7.

Table 7: Course materials per country

MS partner	Czechia (CZ)	Croatia (HR)	Hungary (HU)	Ireland (IE)	The Netherlands (NL)	Spain (ES)
# courses assessed	2	3	2	7	5	4
Course numbers	19, 20	5, 6, 7	16, 17	8, 9, 10, 11, 18	12, 13, 14, 22	1,2,3,4

Content / Topics	- Circular construction techniques; - Circular construction techniques specific for MGRFIE; -Transversal circular economy skills.	- Introductory circular economy; - Circular construction techniques; - Circular construction techniques specific for MGRFIE; - Digitization needs for implementin g circularity	- Circular construction techniques; - Circular construction techniques specific for MGRFIE; - Digitization needs for implementin g circularity; -Transversal circular economy skills.	- Introductory circular economy; - Circular construction techniques; - Circular construction techniques specific for MGRFIE; - Digitization needs for implementing circularity; -Transversal circular economy skills.	- Introductory circular economy; - Circular construction techniques - Digitization needs for implementing circularity -Transversal circular economy skills	- Introductory circular economy; - Circular construction techniques; - Circular construction techniques specific for MGRFIE; - Digitization needs for implementing circularity; -Transversal circular economy skills.
Modality	- CPD certification - Instructor / tutor-led - On site	CPD certification - Instructor / tutor-led - On site, Hybrid and Online	- Unaccredited CPD. - CPD certification - Instructor / tutor-led	- MOOC - Certification - Vocational - Instructor / tutor-led and independent / self-led - Online and hybrid	- MOOC - Independent / self-led - Online	- Tutor led Certification course - MOOC - Instructor / tutor-led and independent / self-led - In class or hybrid
Strengths	Detailed presentations on energy efficiency and the building envelope, plus transversal skills that apply to the circular economy.	Practical manuals for blue collar workers with many images and photos of real life cases	Strong content on different types of green roofs	Learners' handbooks including fundamental, pedagogical approaches and specific applications.	Links, visuals and video guides to introduce concepts, and develop circular economy skills for construction	Articles, reports and guides
Gaps	Lacks introductory content on the circular economy, or course materials related to digitization needs for implementing	Lacks content on Transversal circular economy skills, including systems thinking and entrepreneu rial skills	Lacks content on Circular economy, including introductory, background and general course and training materials	All core topics covered, at least to some extent.	Lacks content on circular construction techniques specifically oriented towards MGRFIE.	All core topics covered, at least to some extent.

	circularity.					
Materials collected	- Training programs for: professional and pedagogic training the trainer; construction professional; electrical engineer and energy sector; - Design of training and demo models for deep energy retrofit. - 17 training presentations across nZEB topics, with accompanying exercises	- 6 theoretical & 6 practical manuals for workers (plasterer, drywall fitter, painter, roofer, bricklayer) in Croatian with visuals. - 1 presentation : EPD in Croatian and English (broader context, link to emissions, materials) - 2-day agenda for GBPro training (in English). - GBPro course brochure in Croatian	- 1 presentation for professionals and trade workers on nZEB, Passivhaus and Autonomous House in Hungarian. - 2 spreadsheets: Tasks, sub tasks and ULOs for building inspector & roofer in English, German and Slovakian - 1 presentation: *Intelligent failure detection systems for roofs* in English. - 3 TtT presentations: Flat roof implementation of nZEB buildings, assisting in diagnostics of existing roof, and solar system installation, health & safety, proactive design (case studies in English and Hungarian).	- 2 national skills specifications for nZEB ventilation & fundamental awareness. - nZEB ventilation flow rate activities. - Webinar / presentations on ventilation, retrofit and nZEB. - Handbooks on low energy construction, nZEB fundamental awareness, building services, pedagogical approaches, building fabric and energy performance. - BIMzeED: Guides for piloting learning units in English, Spanish, Croatian and Hungarian - Reports on delivery and assessment guides for 12 learning units, and available VET and HEI training for nZEBs.	- 20 links to youtube videos (case studies). - articles in English: introduction to LCA of buildings; A holistic sustainability framework for waste management; Design for disassembly in the built environment; LCA of a living building; Resource management in peri-urban areas; Design for disassembly and deconstruction; Life cycle assessment of building materials for a single family house; Overview on bio-based building material made with plant aggregate. - Case study on local waste cooperation (in Dutch) - Passive and active energy reduction measures. - Zero energy design quiz questions. - List of exercises and materials. - Decarbonise design guide.	- 1 course programme in Spanish - articles in Spanish: Water footprint; quality of indoor environment; Strategies for near zero energy buildings; Ecolabelling; Guide to sustainable residential building including topics of waste, water, energy,; Spanish National Energy Efficiency Roadmap 2017-2020; Circular economy for construction sector; Guide to carbon footprint; Guide to sustainability certifications in the construction sector (2021); Current state of Circular Economy in Spain (2021)

4. Future development and applications

4.1. Challenges and opportunities

Task 3.1 together with the tasks in WP2 is an initial enabler for the consortium to design a train-the-trainer programme in WP3 that addresses the application of the frameworks developed. Further on to conduct capacity-building activities in WP4 and the national implementations in WP5.

Opportunities:

- From course assessment we learn what learning methods and modalities are applied, these include mainly: presentations, discussions, case studies, videos and activities.
- A variety of openly available videos in English have been collected.
- Reading materials have been collected in 4 languages (English, Spanish, Hungarian and Croatian).

Challenges:

- Having assessed learning methods, the challenge remains to apply the diversity of most suitable learning methods in the course for a wide range of professionals and tradespersons;
- Some of the materials collected are available only in one language (e.g. practical manuals for blue-collar workers are available in Croatian and Hungarian). In some cases, these materials were developed as part of wider EU projects and as such, English and other language versions may be available. This will need to be further explored by partners in task 3.2 when collating relevant materials for trainers.
- Eight courses have been assessed without providing a list of learning outcomes specific to the circular economy.
- Relevant materials, such as the Level(s) sustainable performance in buildings e-learning[5], were, and will continue to be, made available after the completion of this assessment. While not assessed, such courses will be explored for relevant content and materials to support the next phase of work.

[5] Available at: https://academy.europa.eu/courses/level-s-sustainable-performance-in-buildings

- Subsequent tasks should exercise caution in using materials collected that may be protected or otherwise not be available in the public domain. If in doubt, permission to reuse materials from the training providers should be sought.

4.2. Recommendations for Train the Trainer and the Fundamentals Training Packs

Based on the structural assessment of the materials collected, and discussions with TUS and CVUT, below is a list of recommendations for the design of the train the trainer (TtT) programme and needed materials.

The process needs to start with scoping of initial knowledge levels and inquiry into teaching methods and the experience of trainers. This can be conducted online via surveys and interviews if needed. This task falls into the responsibility of the partner responsible for the recruitment of trainers. Q&A meetings with trainers can be offered online to facilitate the recruitment and outline benefits and requirements to future trainers.

The Proposed TtT delivery method of online webinars and in-person workshops should include the details below.

Suggested outline of online modules for trainers:

1. Introduction and orientation: Getting familiar with the assignment.
2. Presentation: Learning outcomes and skills for circular construction.
3. Meetings in-country groups with consortia partners.
4. Online assignment 1: Trainers to decide the professions and tradespersons that they are designing training for, and the outcomes that they want their course to deliver (work in country groups)
5. Online assignment 2: Trainers to prepare a 15-minute presentation on *MGRFIE and circular interventions in the construction value chain in your region* (work in country groups).

Preparation for the in-person workshops: Review of the online assignments and organisational information.

The aim of the online assignments (above) is to ensure that trainers are familiar with the training pack ahead of intense in-person workshops.

Aim of in person workshops is to facilitate dynamic content work in country groups alongside multinational experience exchange. If possible the in-person workshops shall include shadowing of the workshop delivery from trainers to students/professionals. See the details of the proposed approach. This is intended as an initial concept for inspiration and treated flexibly to adapt to different delivery models and time constraints faced, e.g. some materials / assignments could also be sent in advance.

DAY 1 (half / full day)

- Introduction to BUSGoCircular and consortium partners (IDOARRT[6]).
- Expert presentations on circular interventions in the construction value chain.
- Expert presentations on circular strategies and technologies for MGRFIE.
- Mapping of the current state and knowledge exchange: MGRFIE and circular interventions in the construction value chain in your region - 15 min long presentations from trainers.
- Expert Q&A on circular construction, nZEB and building certifications (differences and similarities, strengths and weaknesses).
- Networking / Speed Dating.

DAY 2 (half / full day)

- Presentation of the Assignment (repetition from online).
- Summary overview of the Trainers Pack (including presentation of the baseline curriculum to be tailored).
- Country groups work on assignment with facilitation from consortium partners.
- Consultation of new course proposal (consultation including: skills, content, learning methods, professions) (consultants need to be assigned per topic).
- Country groups refine their assignment and practice.

[6] IDOARRT stands for Intention, Desired Outcomes, Agenda, Roles, Rules and Time

DAY 3 (half day)

- Trainers deliver the sample workshop to a group of students/professionals under the supervision of consortia partners.
- Feedback, wrap up, next steps.

Recommendations for the Training Pack (to be developed under task 3.4):

- Necessary: include example workshop scenarios (timetables in excel sheet).
- Necessary: include baseline curriculum to be tailored to country specific needs (the baseline can build on PROF/TRAC materials).
- Nice to have: include example scripts (text in document), and real world applications and practical examples.

5. References

No.	Course title	Website / link
1	*Aplicación de la economía circular a la construcción* (Applying the circular economy to the construction industry)	https://sede.sepe.gob.es/es/portaltrabaja/resources/pdf/especialidades/EOCO07.pdf
2	*Bioconstrucción* (Bio-construction)	https://sede.sepe.gob.es/es/portaltrabaja/resources/pdf/especialidades/EOCB01.pdf
3	*Economía Verde y Circular para empresas y emprendedores* (Green and circular economy for businesses and entrepreneurs)	https://mooc-localcir.org/
4	*Cubiertas ajardinadas* (Green roofs)	https://prebolsaapi.construyendoempleo.com/MOOC/HTML-INFORMACION/DOSSIER_MOOCS_ENERO_2022.pdf
5	CROSKILLS - Build Up Skills Croatia: Strengthening energy efficiency skills and certification schemes for building workers	https://projekti.grad.hr/en/projekt/croskills-ii-build-up-skills-croatia-strengthening-energy-efficiency-skills-and-certification-schemes-for-building-workers/
6	GBPro - Green Buildings Professional	https://gbccroatia.org/en/events-and-education
7	*Afirmacija zelene gradnje* (Affirmation of green building)	https://www.hkig.hr/Strucno-usavrsavanje/HKIG-seminari/Seminari/2022/Afirmacija-zelene-gradnje/353
8	Introduction to low energy building construction	https://www.igbc.ie/wp-content/uploads/2016/09/D2.3-QualiBuild-FES-Learners-Handbook-Final_PU.pdf
9	nZEB fundamental awareness	https://waterfordwexford.etb.ie/latest-news/nzeb-fundamentals-course/ https://mountlucas.ie/nzeb-fundamental-awareness/
10	nZEB retrofit	https://waterfordwexford.etb.ie/latest-news/nzeb-fundamentals-course/ https://mountlucas.ie/nzeb/
11	nZEB ventilation	https://waterfordwexford.etb.ie/latest-news/nzeb-fundamentals-course/ https://mountlucas.ie/nzeb/

12	Circular economy for a sustainable built environment	https://learning.edx.org/course/course-v1:DelftX+CESBE1x+2T2021/home
13	Circular economy - sustainable materials management	https://www.coursera.org/learn/circular-economy#about
14	Zero energy design: an approach to make your building sustainable	https://online-learning.tudelft.nl/courses/zero-energy-design/
15	New business models - working together on value creation	https://iversity.org/en/courses/new-business-models Corresponding publication, publicly available: https://repository.ubn.ru.nl/bitstream/handle/2066/198989/198989.pdf
16	NEWCOM (flat roofers) - New competence for building professionals and blue collar workers: certified qualification schemes to upgrade the qualification for building nZEBs	https://host7.ssl-net.net/newcomtraining_eu/
17	NEWCOM (building inspectors) - New competence for building professionals and blue collar workers: certified qualification schemes to upgrade the qualification for building ZEBs	The development of training schemes is supported by a moodle platform available on www.newcomtraining.eu. Interested trainers or training providers can obtain log-in details by sending a request
18	BIMzeED - Education for nZEBs using BIM	https://bimzeed.eu/
19	Fit-to-nZEB: Innovative training schemes for retrofitting to nZEB-levels	https://cordis.europa.eu/project/id/754059/results
20	Train-to-nZEB: the building knowledge hubs	https://cordis.europa.eu/project/id/649810/results
21	German Sustainable Building Council (DGNB) training	https://gbccroatia.org/en/digital-dgnb-consultant-training-22-23-24/ponuda/406
22	Decarbonize design	https://www.decarbonizedesign.com/
23	An introduction to green roofs	https://www.lantra.co.uk/course/introduction-green-roofs-e-learning
24	Green roofs - basic principles and design	https://www.ciria.org//Training/Training_courses/Green_roofs_basic_principles_and_design.aspx
25	Green roof professional (GRP) training & accreditation	https://livingarchitectureacademy.com/p/green-roof-professional-training-complete-3-course-series
26	Skyrise greenery certification programme - part 1	https://www.nparks.gov.sg/cuge/programmes-schemes/programmes/professional-programmes/skyrise-greenery-certification-programme

APPENDIX 1 - Reference professions and trades

Table 5: Workfields, references professions and trades within the work fields with their corresponding reference codes

Work field	Reference professions and trades within the work field	Reference code
Ambition setting and governance	Policymaker / Policy advisor	**PA**
	Green Public Procurement (GPP) advisor	**GPPA**
Asset management	Asset manager; Real estate investor	**AM**
Urban planning	Urban planner	**UP**
Architecture	Architect; Interior architect; Architectural technician; Designer	**AR**
	Landscape architect; Green roof / green façade designer	**LA**
Civil engineering	Civil engineer; Construction engineer; Structural engineer	**CE**
	Façade design engineer	**FDE**
Electrical engineering	Electrical engineer; ICT engineer; Building automation engineer	**EL**
Mechanical engineering	Mechanical engineer; Energy engineer	**ME**
Environmental engineering	Environmental engineer	**EE**
Building management	Facility manager	**FaM**
	Building operator	**BO**
	Data analyst; BIM programmers, BIM designer; Software engineer; 3D image technician / engineer	**DA**
Construction management	Cost engineer; Project manager and coordinator; Quality control and assurance; Quantity surveyor	**C**
	Health and safety (H&S) advisor; H&S inspector; Site supervisor	**HS**
Surveying	Site surveyor; Land surveyor	**SS**
	Building surveyor	**BS**
Financing and procurement	Procurer / purchasing manager; Procurement officer	**PM**
	Project developer	**PD**
	Material scout	**MS**
Energy performance	Building energy consultant; Energy assessor	**BEC**
Sustainable building	Sustainability consultant; Sustainability assessor	**SC**
Conservation	Conservation officer; Conservation scientist	**CO**
Construction - building	Bricklayer Stone-layer, cutter and mason	**Br**
	Insulation installers	**II**
	Carpenter; Joiner	**FM**

	Façade worker; Plasterer	**FW**
	Roofers	**R**
	Gardener (roof and façade); Interior planter / landscaper; Arboriculturalist / Horticulturist	**Gd**
	Window installer / glazer	**WI**
	Wood manufacturer and finisher; Pre-fabricated building assembler; Truss assembler	**BA**
Construction - Technical installations	Plumber	**P**
	Electrical installer and technician	**EI**
	Renewable energy systems installer (electric)	**RESI**
	Renewable energy systems installer (thermal)	**RWT**
	Heat pump installer	**HPI**
	Ventilation installer; Air conditioning installer	**VI**
	Repair and maintenance operative; Maintenance planner; Safety maintenance operative	**RM**
Demolition and deconstruction	Demolition / deconstruction labourer; supervisor	**DeL**
	Site analyst; Deconstruction auditor; Urban miner	**DeA**

APPENDIX 2 - Skills for circular construction

Table 6: Skills for a circular built environment analysed in task 2.2

Orange = Skills relating specifically to Circular Economy and MGRFIE		
PRR	**Prioritise regenerative resources**	**Taking into consideration that renewable, reusable, non-toxic resources are used in the construction and production of the built environment.**
PRR1	Bio-Based and regenerative material application	Design with/for the use of bio-based and regenerative materials such as bio-based concrete, crops, algae. Maximise, preserve and manage biological products for buildings lifecycle. Material Creation and innovation. Knowledge of material impact.
PRR2	Reusable material application	Design for the use of reusable materials. The application of reusable materials such as timber, metal, etc. Including knowledge of material impact.
PE	**Preserve and extend what is already made**	**While resources are in-use, maintain, repair and upgrade them to maximise their lifetime and give them a second life through take back strategies when applicable.**
UWR	**Use waste as a resource**	**Utilise waste streams (Sewage, Trade waste) as a source of secondary resources and recover waste for reuse and recycling.**
UWR1	Deconstruction for reuse	Use demolition materials as a resource for new and retrofitting buildings. Specialism in deconstruction, material recovery and deconstruction material innovation.
UWR2	Material Innovation	Experimentation and innovation with materials to discover new sustainable methods of construction.
UWR3	Reclaiming Energy	Reclaiming energy from waste materials wherever possible.
UWR4	Continuous reuse of energy with little or no waste	Understanding/use of closed and open loop knowledge of waste (Closed loop - all resources created or used are kept within a continuous cycle. Open loop - not all resources created or used are kept within a continuous cycle).
DF	**Design/Build for the future**	**Designing for building adaptability and to design for extended future use.**
DF1	Design/Build for Reuse	Designing for easy dismantling and re-use of built elements, equipment or materials.
DF2	Design/Build for repurpose of materials	The use of Circular materials. Reuse, recycle and repurpose of all materials in construction.
DF3	Apply material passports	Apply material passports to enable more timely upgrading and life-time extension.
DF4	Design/Build for material impact reduction	Reduction of the materials impact on the environment from the design to installation phase.

DF5	Reduce/Build reliance on critical raw materials	Design increased use of renewable and sustainable materials in construction.
DF6	Design/Build out waste	Use design as a tool to reduce or eradicate all waste at design phase.
DF7	Design/Build for Durability	Design so that products and installations are easy to repair. Design for longevity.
DF8	Design/Build for Cyclability	Design/Build for resource efficiency for all life cycle stages, prioritising material reuse and reduction.
CCJV	**Collaborate to create joint value**	**Work together throughout the supply chain, internally within organisations and with the public sector to increase transparency and create joint value (Mutual benefit).**
CCJV1	Collaboration for Circular Economy	To ensure GPP, construction networks, digital marketplace, innovation, Circular Procurement training and application of circular strategies to establish circular construction principles and demolition criteria are incorporated at design stage.
RBM	**Rethink the business model**	**Consider opportunities to create greater value and align incentives that build on the interaction between products and services.**
RBM1	Repairs as a service	Rethinking repairs as a necessary part of the business model rather than replace.
RBM2	Environmental costing models and carbon taxes	Rethinking costing and carbon taxes within construction.
IDT	**Incorporate digital technology**	**Track and optimise resource use and strengthen connections between supply chain actors through digital, online platforms and technologies that provide insights.**
SAK	**Communication, Education and information**	**Develop research, knowledge transfer, encourage innovation networks and disseminate findings with integrity.**
Green = Skills not specific to Circular Economy and MGRFIE		
PRR	**Prioritise regenerative resources**	
PRR3	Sustainable Sourcing	Building with sustainable sourced materials i.e. Wood, Hemp, Seaweed, Cork, Bamboo, Earth, straw, wool etc.
PRR4	Energy storage and distribution	Measures to more efficiently use and store energy in the house.
PRR5	Production of Renewable Energy	The understanding and operation of creating energy from renewable sources
PRR6	Continuous reuse of water with little or no waste	Understanding/use of closed and open loop knowledge of water (Closed loop - all resources created or used are kept within a continuous cycle. Open loop - not all resources created or used are kept within a continuous cycle)
PE	**Preserve and extend what is already made**	

PE1	Maintenance of building components	Share information and knowledge on how to maintain building components e.g. DIY painting. Knowledge specific to maintenance work.
PE2	Upgrade of building components	Use expertise to upgrade elements. Knowledge specific to maintenance work.
UWR	**Use waste as a resource**	
UWR5	Grey Water Collection and Use	Understanding/use of closed and open loop knowledge of water (Closed loop - all resources created or used are kept within a continuous cycle. Open loop - not all resources created or used are kept within a continuous cycle)
UWR6	Rainwater collection and use	Rainwater harvesting to be used for certain applications e.g. washing, toilets, gardening.
UWR7	Sustainable Drainage Systems	Roofs, interiors and walls connected to sewage systems and water recovery systems to avoid flooding them. Sensor technology in green facades to facilitate water flow from the roof when needed.
DF	**Design for the future**	
DF9	Design for Adaptability	Build lifetime extensions, especially through adoption. Specifically in order for spaces to adjust to new conditions depending on need over time (change in family needs, changing needs of public rooms)
DF10	Modular Design	Use of modularity in construction of all elements of the building envelope to facilitate disassembly and reuse.
CCJV	**Collaborate to create joint value**	
CCJV2	Collaboration	Experience and knowledge of internal Collaboration, Customer/Consumer Collaboration, Industry Collaboration, Community Collaboration, Government collaboration. Education, Feedback, logistics and data measuring,
RBM	**Rethink the business model**	
RBM3	Facades as a services	Rethink the use of facades as a service (including services such as Ventilation, heating and cooling Systems).
RBM4	Technical Installation as a service	Electrical products, Boilers, Heat pumps, Solar systems.
RBM5	Interior features as a service	Rethink the use of interior features as a service (material, use and systems)
IDT	**Incorporate digital technology**	
IDT1	Drones Use	To scan/image frontage and roofs of buildings for data collection and analysis for renovation.
IDT2	3D Printing	To avoid material loss and to allow for material innovation and experimentation.
IDT3	Prefabrication	This must include digital rendering leading to a further minimizing of waste from human error.

IDT 4	BIM/Digitisation	Digitally track materials in order to maximise lifetime of products through BIM. Digital tracking and management of building systems and components. Allowing for material and building tracking (building tracking, collaboration and communication).
SAK	**Communication, Education and information**	
SAK1	Research and development	Develop high-value product applications. Analyse effectivity, barriers and successes of applied circular strategies. Analysis of barriers and success factors during operate phase/Operate phase analysis
Red = Skills specifically related to MGRFIE		
MF	**Multi-functional Green Roofs Facades and Interior Elements**	
MF1	Solar power systems for electricity generation	Installation, maintenance and electricity production.
MF2	Solar thermal systems for domestic hot water and/or heating generation	Installation, maintenance and heat production.
MF3	Heat Pump	Installation, maintenance and energy production.
MF4	Insulation Installation	More efficiently use thermal energy e.g. insulation and draught-proofing, The use of building materials with lower thermal conductivity coefficient ideally with reused, recycled, regenerative or bio-based materials.
MF5	Establishing the cooling and heating function of green roofs	In depth understanding of cooling and heating systems (Micro Climate) in regard to MGRFIE.
MF6	Horticulture	Plant and soil understanding and expertise in relation to heating and cooling, insulation, shading, weight distribution, water collection and use.

APPENDIX 3 - Tasks within the circular construction skills qualification framework

Table 7: Tasks within the circular construction skills qualification framework under task 2.3

# task	Circular construction framework tasks - general (G)
G1	Prioritise regenerative and efficient use of resources
G2	Stretch the lifetime
G3	Use secondary resources
G4	Design / assemble / construct for the future
G5	Collaborate to create joint value
G6	Rethink the business model
G7	Incorporate digital technology
G8	Strengthen and advance knowledge
#	Circular construction framework tasks - applied to MGRFIE (A)
A1	Prioritise regenerative and efficient use of resources
A2	Stretch the lifetime
A3	Use secondary resources
A4	Design / Assemble / Construct for the future
A5	Collaborate to create joint value
A6	Rethink the business model
A7	Incorporate digital technology
A8	Strengthen and advance knowledge

APPENDIX 4 - EQF levels

Table 6: EQF levels

EQF Level	Knowledge	Skills	Competence
	In the context of EQF, knowledge is described as *theoretical and/or factual*.	**In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking), and practical (involving manual dexterity and the use of methods, materials, tools and instruments)**	**In the context of EQF, competence is described in terms of *responsibility and autonomy*.**
Level 1	Basic general knowledge	Basic skills required to carry out simple tasks	Work or study under direct supervision in a structured context
Level 2	Basic factual knowledge of a field of work or study	Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools	Work or study under supervision with some autonomy
Level 3	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	Take responsibility for completion of tasks in work or study; adapt own behaviour to circumstances in solving problems
Level 4	Factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
Level 5[1]	Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others
Level 6[2]	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups
Level 7[3]	Highly specialised knowledge,	Specialised problem-solving skills	Manage and transform work or

	some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research	required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields	study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams
	Critical awareness of knowledge issues in a field and at the interface between different fields		
Level 8[4]	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields	The most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice	Demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research

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