D2.4 Applied circular construction skills qualification framework

Compiling a task-based qualification framework for circular construction skills applied to multifunctional green roofs, façades, and interior elements

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Lead partner	ISSO
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Produced by	ISSO
Main author	Carmen Poort, ISSO
Co-authors	Jan Cromwijk, ISSO
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Reviewed by	Bojan Milovanovic (UZ-FCE) , Károly Matolcsy (EMI)
Approved by	Jan Cromwijk (ISSO)
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Publishable executive summary

Within the BUS-GoCircular project, a **general task-based qualification framework** was developed for **circular skills in construction**, meaning a set of tasks and corresponding learning outcomes were mapped and connected to relevant professions throughout the construction value chain. By doing so, the project offers a practical interpretation of the *Key Elements of the Circular Economy*, made applicable to the construction sector.

The methodology that was employed to establish these results, has been developed and validated throughout several previous (and ongoing) large-scale European projects. It has several advantages, one of which is the practical perspective it offers on required skills in the value chain, and required overlaps between actors.

Based on the general qualification framework for circular construction skills a context specific application is made for addressing skills needed to realise, maintain and reuse multifunctional green roofs, façades and inner wall elements. This is done to prove that the qualification framework for circular construction skills is flexible enough to address different challenges while sustaining the built environment.

The qualification framework consists of two tables. The first contains tasks and subtasks; the 9 tasks are the practical equivalents of the *Key Elements*, while the 71 subtasks further specify strategies to implement circular “multifunctional green roofs, façades, and interior elements” in construction. The subtasks are connected to professions on the one hand, and to so-called Units of Learning Outcomes (ULOs) on the other. The second table specifies the 84 ULOs. This segment of the results states the specific learning outcomes one should reach if circular strategies are to be implemented. They are broken up into competencies, skills, and knowledge components.

A next step is validation by market stakeholders. Then, the qualification framework will be used within the BUS-GoCircular project to develop train-the-trainer and mentoring programmes for circular construction skills in Europe (On the generic framework, yet in several cases at national level also on the multifunctional green roofs, façades, and interior elements context). The learning outcomes from the framework will also be added to the BUILD UP Skills Advisor app, to further increase skills recognition for professionals and craftspeople. In our quest for sustainable exploitation, several activities will be undertaken to

enable application in other contexts. By addressing circular ventilation system applications, for example.

List of acronyms and abbreviations

ULO: Unit of Learning Outcome

EQF: European Qualification Framework

KE: Key Elements

BIM: Building Information Modelling

RFID: Radio Frequency Identification

VOC: Volatile organic compound (emissions)

Definitions

Building stages & RIBA: A building life-cycle consists of several stages. The RIBA Plan of Work is the definitive UK model for the building design and construction process.

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.

Competence: The ability of an individual/organisation to do something effectively.

It consists of a cluster of attitude, related abilities, commitments, knowledge, and skills that enable a person (or an organisation) to act effectively in a job or situation.

The competence description is always worded as a result somebody can take responsibility for. Competence addresses 'responsibility and autonomy'. It is the ability of the learner to apply knowledge and skills autonomously and with responsibility.

European Qualification Framework (EQF): Common European reference framework with the purpose of making qualifications more readable and understandable across different countries and systems. (COUNCIL RECOMMENDATION of 22 May 2017 (2017/C 189/03))

Key elements framework: The Circle Economy Key Elements (KE) framework is a conceptual framework of eight elements of circularity that can be applied at different intervention levels (for example, national, regional, sector, business, product, process, or material) towards a circular economy. The KE framework consists of three core elements and five enabling elements. Core elements deal with physical flows directly, whilst enabling elements deal with creating the conditions or removing barriers, for a circular transition[1].

The three **core key elements** are:

1. **Prioritise regenerative resources:** Ensuring that renewable, reusable, non-toxic resources are used in the manufacturing of built environment. Ensuring that all resources are used in an efficient way.

[1] Circle Economy, 2021. https://www.circle-economy.com/resources/the-key-elements-of-the-circular-economy-framework

2. Preserve and extend what is already made / Stretch the lifetime: 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.

3. Use waste as a resource: Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.

The five **enabling key elements** are:

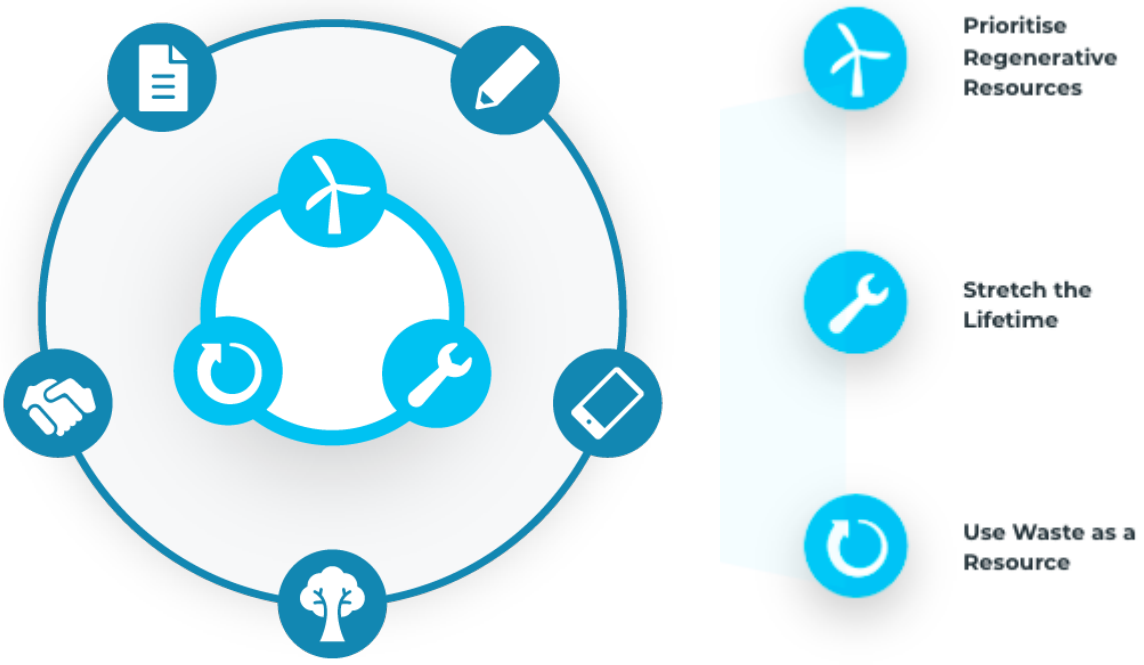
1. Design for the future: Account for the systems perspective during the design process, to use the right materials, to design for appropriate lifetime and to design for extended future use.

2. 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.

3. Rethink the business model: Consider opportunities to create greater value and align incentives that build on the interaction between products and services.

4. Incorporate digital technology: Track and optimise resource use and strengthen connections between supply chain actors through digital, online platforms and technologies that provide insights.

5. Strengthen and advance knowledge: Develop research, structure knowledge, encourage innovation networks and disseminate findings with integrity.



Knowledge: 'Knowledge' is the body of facts, principles, theories, and practices that is related to a field of work or study.

Know-how you need to know by 'head' in order to perform a task as efficiently and effectively as possible.

In the context of the EQF, knowledge is described as theoretical and/or factual.

Multifunctional green roofs, façades, and interior elements: Roofs, façades, or interior elements (e.g. walls) that carry vegetation systems and are potentially combined with additional functions. For example, green roofs can assist in storing rainwater, generating renewable energy with the help of solar panels, or creating extra space for people. Façades can also have multiple functionalities: One can install both solar panels for generating energy and plants for biodiversity.

Profession: A profession is a specialised occupation characterised by profession specific education and training.

Qualification: A pass of an examination or an official completion of a course, especially one conferring status as a recognized practitioner of a profession or activity.

Skill: Something a person needs to be able to do/perform in order to reach a certain result.

To have a 'skill' or to be 'skillful' signifies the ability to use know-how to complete tasks and solve problems. These can be cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the EQF, skills are described as cognitive (involving the use of logical, intuitive and

creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Subtask: An activity that is part of a certain task at a subordinate level. Individual subtasks can be linked to multiple tasks.

Task: A piece of work / an activity to be done or undertaken.

Task-based qualifications A qualification framework in which tasks and subtasks are set up and connected to a) relevant professions and b) learning outcomes in the specific form of Unit of Learning Outcomes

Unit of Learning Outcome (ULO): The 2008 EQF recommendation defines learning outcomes as '…statements of what an individual should know, understand and/or be able to do at the end of a learning process'. ULO's are statements regarding what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and attitude (reflected in responsibility and autonomy).

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1. Introduction

In the built environment, a lot can be done about the major contributions of the sector to environmental degradation. A circular approach to construction, from planning and design to end-of-life, can reduce much of the energy consumption, greenhouse gas emissions, use of extracted materials, and the amount of waste generated by the built environment. By carrying out circular economy interventions throughout each stage of the construction value chain, environmental impact and life cycle costs can be lowered, and resource depletion can be prevented.[2] In addition, local environmental impacts can be reduced, such as nitrogen surpluses, stress on nature and biodiversity, and pollution.[3]

Figure 1. The *Key Elements of the Circular Economy* in the context of BUS-GoCircular.

[2] BUS-GoCircular D2.1 Framework for circular interventions in the construction value chain. https://busgocircular.eu/framework-for-circular-interventions-in-the-construction-value-chain/

[3] Trinomics, 2018. Quantifying the benefits of circular economy actions on the decarbonisation of EU economy: Final report. http://trinomics.eu/wp-content/uploads/2020/04/Trinomics-2018-Quantifying-the-benefits-of-circular-economy-actions-on-the-decarbonisation-of-EU-economy_final-report.pdf
Circle Economy, 2021. Three ways circular construction can strengthen biodiversity efforts. https://medium.com/circleeconomy/three-ways-circular-construction-can-strengthen-biodiversity-efforts-bfc632061715

Within BUS-GoCircular, a *general circular construction skills qualification framework* has been developed. Project deliverable D2.3, explained the results of this development. In the framework, tasks that are required for ensuring circularity in construction were mapped and connected to a) corresponding professions and b) corresponding learning outcomes. This gave hands-on insight into who needs to develop which competences, to be able to create a circular built environment together in the value chain.

In order to test the applicability of the qualification framework to specific fields in construction, the framework was applied to the context of multifunctional green roofs, façades, and interior elements. This will prove the practical value of the developed framework at both national and EU levels.

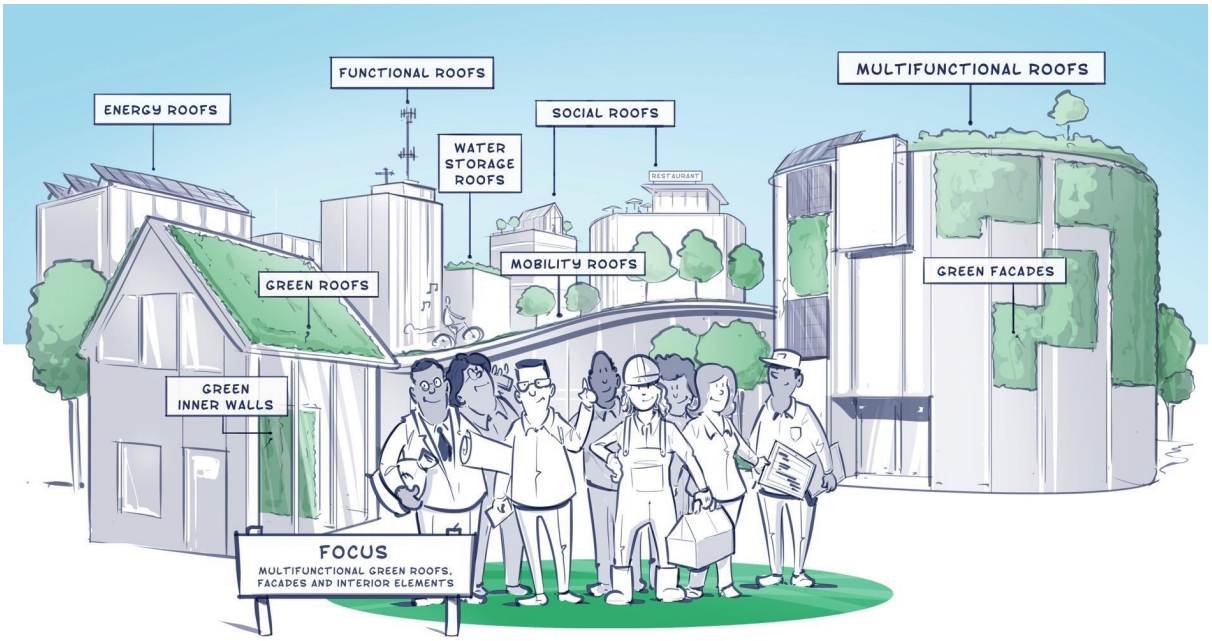

Figure 2. Visualisation of a group of professionals and craftspeople in an environment where multifunctional green roofs, façades, and interior elements are realised.

Earlier in the BUS-GoCircular project, the consortium established a *Framework for circular interventions in the construction value chain*.[4] This was a research and gathering of opportunities for circular approaches that can be applied to the built environment. The *Key*

[4]BUS-GoCircular D2.1 Framework for circular interventions in the construction value chain. https://busgocircular.eu/framework-for-circular-interventions-in-the-construction-value-chain/

Elements of the Circular Economy framework[5] has guided that investigation, with its three 'core elements' and five ‘enabling elements' (See Figure 1). Both the framework for circular interventions, and the key elements framework, have guided the work that is to be elaborated upon in the current deliverable.

First, the BUS-GoCircular *applied circular construction skills qualification framework* will be presented in two tables. Second, the differences between the general and the applied qualification frameworks will be explained. Lastly, the deliverable mentions future developments and applications of the *applied circular construction skills qualification framework*. For more information about the methodology of task-based qualifications, including a more detailed explanation, previous applications and added value, see Deliverable 2.3.

[5] Circle Economy. Key elements of the circular economy. https://knowledge-hub.circle-lab.com/circular-jobs-initiative/frameworks/9?n=Key-elements-of-the-circular-economy

2. Results

By using the methodology of developing task-based qualifications, the *general circular construction skills qualification framework* was adjusted to the applied context. The resulting qualification framework consists of a list of 9 tasks with subtasks. Each subtask is linked to corresponding Unit of Learning Outcome (ULO) numbers and relevant professions. This information can be found in Table 1. The 84 Units of Learning Outcomes (ULOs) are written up in Table 2. The structure of the full framework is depicted in Figure 3 and 4. ULOs, then, consist of a set of competences, skills, and knowledge components (See Figure 5). The full names of professions that are referred to in Table 1 can be found in Appendix I.

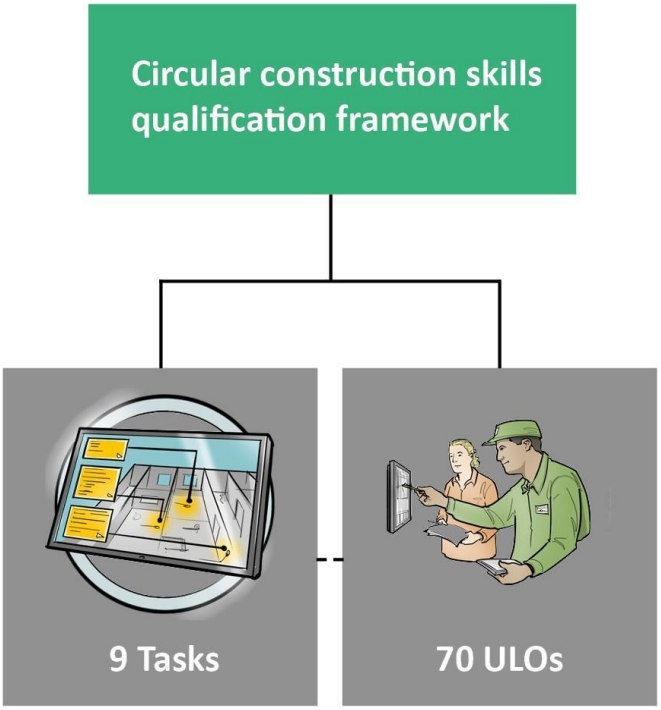

Figure 3. Overview of the main elements of the circular construction skills qualification framework. *Note:* There are 84 ULOs in the applied framework, instead of 70.

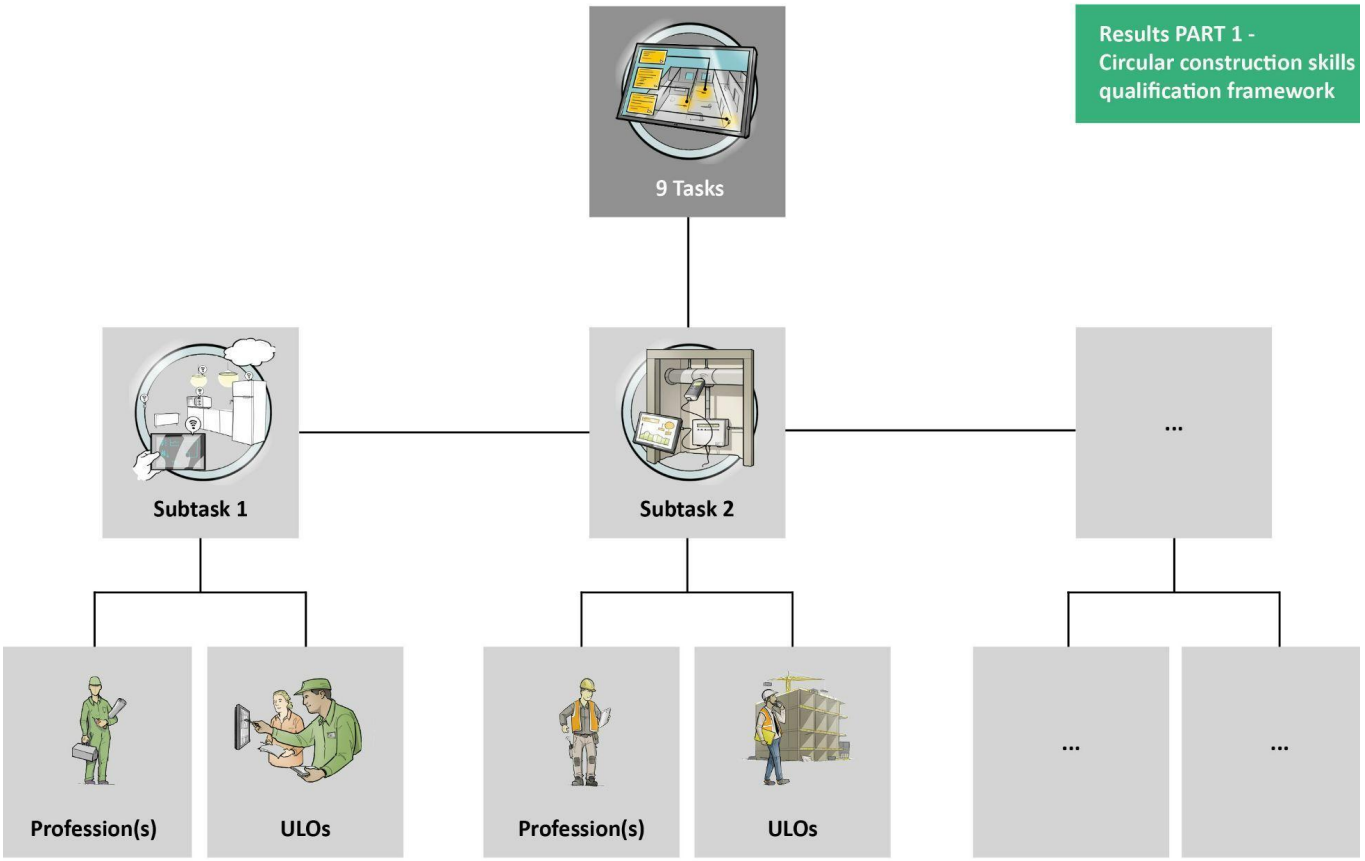

Figure 4. Overview of the results of circular construction skills qualification framework - Part 1, 9 tasks.

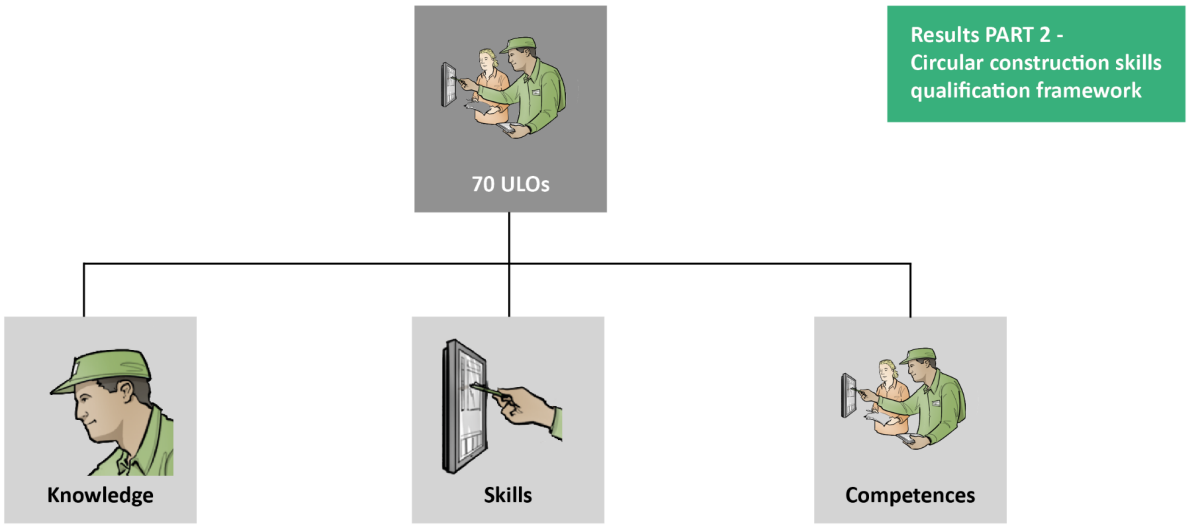

Figure 5. Overview of the results of circular construction skills qualification framework - Part 2, ULOs. *Note:* There are 84 ULOs in the applied framework instead of 70.

Table 1: List of Tasks and subtasks, including corresponding ULO numbers and professions

#	Task	Subtask	ULO Nr.	Profession(s)
1	Prioritise regenerative and efficient use of resources		81	
1.1		Design roofs and façades with bio-based, non-toxic and/or non-critical materials	1, 2, 3, 4	LA, FDE, AR, MS, ME, CE, EE, UP, AM, C
1.2		Replace energy sources with less impactful alternatives	8	AR, EE, EL, MS, PM
1.3		Apply suitable energy efficiency measures to roofs and façades (taking into account building purpose and climate)	9	LA, FDE, AR, EE, EL
1.4		Generate energy from renewable sources - e.g. solar panels on roofs and façades	10	LA, FDE, AR, EE, EL
1.5		Apply measures on roofs and façades that replace freshwater with less impactful alternatives	6	LA, FDE, P, Gd, R, EI
1.6		Enact water efficiency measures with help of roof and façade functions	7, 15	LA, FDE, P, Gd, R, EI
1.7		Source bio-based, reusable, non-toxic and non-critical materials for roofs, façades, and interior elements	1, 2, 3, 4, 5, 36	MS, PM, LA, FDE, AR,ME, CE, EE, UP, AM, C
1.8		Source local and lightweight materials for roofs, façades, and interior elements	74	MS, PM, LA, FDE, AR,ME, CE, EE, UP, AM, C
2	Design for the future		81	
2.1		Design to reduce waste during production and use of multifunctional green roofs, façades, and interior elements	2, 26, 27, 28	CE, EL, AR, LA, FDE
2.2		Design with materials that enable multiple uses after the service lifetime of the roof, façade, or interior element	5	CE, EL, AR, BS, HS, LA, FDE
2.3		Design multifunctional green roofs, façades, or interior elements that are made to last and to ensure longer use (to contribute to multiple uses and lifecycles of a building)	31	CE, EL, AR, LA, FDE
2.4		Design roofs and façade structures to enable reuse and recycling	29	CE, EL, AR, BS, HS, LA, FDE

2.5		Design roofs and façades that make repair accessible	30	CE, EL, AR, BS, HS, LA, FDE
2.6		Design with use of pre-fabricated roof, façade and interior element components	26	CE, EL, AR, LA, FDE
2.7		Design modular solutions for roofs, façades, and interior elements	28	CE, EL, AR, BS, HS, LA, FDE
2.8		Design using secondary materials not initially intended for reuse	1, 14, 20, 23, 55, 78	AR, MS, CE, EE, UP, AM, C, LA, FDE
2.9		Design to use and store energy more efficiently in roofs and façades	67, 24	AR, LA, EE, EL, FDE
2.10		Integrate multi-functionality into buildings by making use of roofs and façades	54	CE, EL, AR, BS, HS, LA, FDE
2.11		Compile and provide deconstruction/demolition specifications and other relevant documentation at commissioning	59, 75	ME, CE, EL, AR, BS, HS, LA, FDE
3	Assemble / construct for the future		15	
3.1		Install energy efficiency measures on roofs, façades, and interior elements	56	RESI, RWT, II, HPI, EI, VI, WI
3.2		Install renewable energy systems on roofs and façades	63	RESI, RWT, II, HPI, EI, VI, WI
3.3		Install measures to use and store energy more efficiently in buildings	67	RESI, RWT, II, HPI, EI
3.4		Reduce waste during production and construction of roofs and façades	58	Br, II, FM, FW, R, WI, BA, FD, R
3.5		Build modular structures for roofs, façades, and interior elements	60	FM, P, FW, R, BA, Br, II, WI, FD, R, BA
3.6		Build roofs and façades with bio-based, reusable, non-toxic and non-critical materials	68	C, CE, SS, Br, II, FM, BA, FD, R, BA
3.7		Construct multifunctional green roofs, façades, or interior elements	69	P, FD, R, Gd, WI, BA
4	Rethink the business model			
4.1		Construct multifunctional green roofs, façades, and interior elements according to service business model	15, 60, 62	C, CE, ME, BS, Br, II, FM, FW, R, WI, BA, FD, R
4.2		Offer construction maintenance and repair services for multifunctional green roofs, façades, and interior elements	15, 43, 64	RM, FDE, R, FaM
4.3		Provide multifunctional green roofs, façades, and interior elements as a	42	PD, RM, FD, R

		service		
4.4		Offer different leasing and rental models to provide access to multifunctional green roofs, façades, and interior elements rather than ownership	44	PD, RM, FD, R, AM
4.5		Incentivise the renovation of un- or under-used buildings with use of multifunctional green roofs, façades, and interior elements	45	C, BS, FaM, PA, AM
5	Stretch the lifetime		81	
5.1		Manage and preserve biological products as part of green roofs, façades, or interior elements	15, 17	C, CO, RM, FW, R, Gd, AM
5.2		Maximise lifetime of products in-use	11, 12, 13, 57	AR, RM, DA, BO, RM, R, FW
5.3		Repair (active maintenance) roofs, façades and interior elements	15, 64	RM, EI, FM, FW, PHI, II, P, RESI, RM, RWT, VI, WI, R
5.4		Operate the building in a clever and adaptive manner that optimises sustainability and circularity	76, 77	FaM, EL, BO
5.5		Maximise lifetime of materials and products after use	14, 16, 79	DeA, DeL, RM
5.6		Adaptive reuse of existing buildings for a new purpose	66	DeA, DeL, AR, CE
5.7		Renovate with the use of multifunctional green roofs, façades, or interior elements to extend lifetime of current building stock	54, 61, 72	AR, LA, C, PD, BO, FW, R
6	Use secondary resources			
6.1		Reuse, repurpose or recycle secondary materials/components/resources from the same industry for the construction of multifunctional roofs, façades, or interior elements	18, 20	PM, PD, MS
6.2		Reuse, repurpose or recycle secondary materials/components/resources from other industries for the construction of multifunctional roofs, façades, or interior elements	21, 23	PM, PD, MS
6.3		Organise logistics and storage of secondary materials for the construction of multifunctional roofs, façades, or interior elements	46, 48, 73	C, PM, HS, DeA

6.4		Assess quality of materials to be reused for the construction of multifunctional roofs, façades, or interior elements (audit of waste)	78	DeA, MS
6.5		Transform waste streams from multifunctional roofs, façades, or interior elements for reuse, repurpose, or recycle waste streams within the same industry (closed loop)	19	DeA, DeL, CE, SC, AR
6.6		Transform waste streams from multifunctional roofs, façades, or interior elements for reuse, repurpose, or recycle waste streams within other industries (open loop)	22	DeA, DeL
6.7		Organise and provide guarantees for reused materials from multifunctional roofs, façades, or interior elements	47, 73, 82	C, CE, ME, EE, FdE
6.8		Disassemble modular components of multifunctional roofs, façades, or interior elements	15, 65	LA, AR, DeA, DeL, HS, FW, R
7	Incorporate digital technology			
7.1		Employ digital marketplaces for products or components of the green roof, façade, or interior element	48	DA, R, FDE
7.2		Employ material passports throughout each phase of the building/project	46, 47	LA, AR, CE, C, DA, FM, BS, MS
7.3		Employ technologies to gather and analyse data to provide and gain insights on resource use (procure, operate, end of service life)	46, 47, 57	DA
7.4		Trade secondary materials for multifunctional green roofs, façades, and interior elements on digital marketplaces	16, 48, 79	DeA, MS, PM, PD
7.5		Use drones and imaging technologies to collect data about multifunctional roof or façade for renovation	84	DS, HS, BO
7.6		Apply BIM modelling practices to building projects in order to aid circular applications of multifunctional green roofs, façades, and interior elements	57	LA, AR, CE, C, DA, BS, HS
7.7		Apply sensor technology to green roofs and façades (e.g. for predicting maintenance, to facilitate water flow from roof when needed)	70	DA, EL
8	Collaborate to create joint value			

8.1		Put in place purchasing guidelines for green roofs and façades for procurement departments	34	PA, PM, GPPAt, R, FDE
8.2		Engage internally to guide employees and facilitate greater knowledge sharing about circular multifunctional roofs and façades between internal divisions	32, 33	Senior management of company in construction value chain
8.3		Collaborate with industry peers to create joint value and identify synergies	34, 35	ME, CE, AR, PM, HS, R, FDE
8.4		Engage and guide customers and users to ensure circular use of multifunctional roofs and façades	37, 38	PD, PA, II, HPI, AR, BEC, RESI, RWT, VI, P, EI, FM, SC
8.5		Engage with local communities to find solutions for installing multifunctional green roofs or façades	12, 41	LA, AR, PA, AM, PD
8.6		Engage with governments to establish criteria for green roofs and façades and to incentivise its use with different programs and subsidies	39, 40	AM, LA, AR, FaM, PA, PM, PD, GPPA
8.7		Redefine building regulations to incentivise circular use of multifunctional roofs and façades	80	PA, GPPA, AR, FED, R
9	Strengthen and advance knowledge			
9.1		Educate building users on the benefits of installing multifunctional green roofs, façades, and interior elements (e.g. as a renovation option)	38	PA, BEC, FaM, BO, AM, AR, LA, FDE, R
9.2		Engage and guide customers and users to ensure circular use of buildings and products	37, 38, 75	PA, BEC, FaM, BO, AM, AR, LA, FDE, R
9.3		Raise awareness about secondary construction components and materials for multifunctional green roofs, façades, and interior elements	53, 55	PA, BEC, FaM, BO, AM, AR, LA
9.4		Integrate principles of circularity into school curricula	49	PA, GPPA, AR, FED, R
9.5		Conduct workplace trainings on circular multifunctional green roofs, façades, and interior elements	49, 50	LA, AR, CE, C, ME, EE, PM etc.
9.6		Solidify definitions and create frameworks to support understanding of circular strategies in multifunctional green roofs, façades, and interior elements (incl. common language)	39, 51	PA, BEC, FaM, BO, AM, AR, LA

9.7		Develop and conduct research about circular construction strategies for multifunctional green roofs, façades, and interior elements	52, 82	LA, AR, PA, EL, ME, CE, EE, FDE
9.8		Conduct post occupancy survey and analysis	77	BO, HS, FaM
9.9		Increase (access to) understanding of non-conventional construction materials for multifunctional green roofs, façades, and interior elements	34, 47, 82, 83	LA, AR, MS, ME, CE, EE, UP, AM, C
9.10		Evaluate and assess life cycle impacts of multifunctional green roofs, façades, and interior elements on the environment (emissions, soils, water, biodiversity, etc.)	25, 53	LA, AR, EE, SC, BEC, CO, GPPA
9.11		Conduct a feasibility study for the new built or renovation project at hand	61	AM, LA, AR, C, PD, SC

Table 2: Unit of Learning Outcomes, consisting of competences, skills, and knowledge components

ULO Nr.	Competence	Skills	Knowledge
1	Design roofs, façades, and interior elements with bio-based materials as an alternative for conventional construction materials	Select bio-based materials for the roof, façade or inner wall Consider the purpose of the building and the context of the entire building solution, as well as construction requirements When biobased materials are not an option, select proper low impact materials Integrate use of the Material Circularity Indicator (make sure it is not higher than X) Ensure use of materials that have little to no volatile organic compounds (VOC) emissions	Types of bio-based materials suitable for roofs, façades, and inner walls (such as hemp, straw, bamboo, sustainably sourced wood, agricultural residues) Advantages and disadvantages of biobased materials Seven functional requirements of building walls Alternative forms of concrete Wood or thatch/straw panels for rainscreen cladding and insulation on façades
2	Enact measures that optimise material use to strive for material efficacy	Apply measures that optimise material use to multifunctional green roofs, façades, and interior	General knowledge about measures that optimise material use in construction, such as 3D

		elements Combat underutilisation or surplus of materials by sharing products or assets and optimising their use	printing or accurate structural design/industrialized prefabricated products (keep design lightweight)
3	Design with non-critical raw materials as defined by EU	Avoid, insofar as possible, use of critical raw materials as defined by EU while selecting materials for multifunctional green roofs, façades, and interior elements	Types of non-critical raw materials as defined by EU
4	Design with non-toxic materials as defined by EU	Avoid, insofar as possible, use of chemicals as defined by EU while selecting materials for multifunctional green roofs, façades, and interior elements	Types of non-toxic construction materials, such as alternatives to anti-flame retardants used on wood
5	Design with products and materials that can be easily reused or recycled after use	Recognise and select materials that can be easily reused or recycled after the building's end-of-lifetime Recognise and avoid composites or other mixed materials that are then hard to recycle/repurpose	Reusable and/or recyclable materials, such as glass, plasterboard, steel, gravel (aggregates), rammed earth walls Recycling requirements for specific products and materials for safety and functionality (and regional/local infrastructure capacity)
6	Replace freshwater use with alternative water sources	Use alternative water source applications that are suitable for the project at hand Harvest greywater and rainwater on roofs or façades for certain applications Design sustainable drainage systems Stimulate the cooling of the city/building by slowly releasing rain water	Alternative water sources such as rainwater, fogwater, seawater, grey water etc. When are roofs and façades suitable for applying alternative water sources Sustainable drainage systems
7	Enact measures that optimise water use for water efficiency	Apply plant-based biofilters/ phytopurification in green roofs, façades, or interior plant walls Create water cascading systems	Sustainable water technology Plant-based biofilters to purify wastewater Criteria for reuse of water

		Stimulate the sponge function of green roofs and façades for peak moments of water Harvest greywater and rainwater for certain applications	Cascading water for efficiency Innovative measures, such as using recycled textiles as roofing materials to catch water
8	Select sources with less impact to apply to operations in buildings	Select best energy solution that is less impactful based on current situation in country (e.g. convert fossil fuel based operations to electric)	Fossil fuel based operations vs. electric operations Renewable fuels, such as biomass How circular economy works with regards to materials and sources, renewability Current state of affairs and regulations with regards to energy sources Options like waste heat/district heating
9	Enact measures that reduce and optimise energy use through solutions on roofs and facades whilst taking into account building purpose and climate	Include energy efficiency measures in design of roofs, façades, and interior elements (e.g. insulation of roofs, roof ventilation) Include passive design techniques in design of roofs, façades, and interior elements (e.g. solar orientation, skylight windows, shading)	Smart solutions to spread demand throughout the day Measures such as draught-proofing, airtightness, insulation, ventilation Materials with lower thermal conductivity (e.g. sheep's wool, cellulose, earthwool)
10	Generate energy or heat/cold from renewable sources in design of multifunctional green roofs, façades, and interior elements	Incude renewable energy technologies in building design	Options for renewable energy, e.g. solar/PV panels, solar thermal collectors, heat pumpts, waste water heat recovery Systems that generate power or heat/cold
11	Provide repair services or maintenance services for multifunctional green roofs, façades, and interior elements	Renovate buildings or parts of buildings to maximise their lifetime Conduct regular checks and repairs for multifunctional green roofs, façades, and interior elements	Renovation techniques Renovation of bio-based, non-critical and non-toxic materials
12	Provide upgrade programmes or upgrade	Educate home-owners and facility managers on	Which (local) organisation can help upgrade

	services for roofs and façades	the possibilities of upgrading roofs and façades Provide upgrade services	roofs and façades Upgradeability of roofs and façades at hand
13	Provide DIY repair kits or spare part programmes for enabling self-repair of roofs, façades or inner walls.	Describe information to building users and facility managers about how to repair and maintain green roofs, façades, and interior elements (e.g. maintenance of greenery, cleaning solar panels)	DIY techniques for repair and maintenance
14	Extract and reuse parts from end-of-life roofs, façades, or interior elements for use in new buildings	Dismantle built structures whilst maintaining value of products and materials Read construction details for detachability of building components	Dismantling for re-use Detachable construction details
15	Arrange a safe working environment and continuously consider health and safety requirements, especially for working on roofs and facades	Arrange a safe working environment at the construction site Consider health and safety requirements Assure sufficient environmental air quality Arrange the right measures to ensure safety for roof and façade workers	Health and safety requirements specific to biobased and secondary materials (construction) Requirements specific to renewable energy technologies and smart solutions (installation) Hazards of certain materials and their compositions Safety and hazards for rooftops and working at heights
16	Enable second hand sale of multifunctional roof/façade products through marketplaces or services	Make use of (digital) marketplaces to find a new use for disassembled materials (construction) Make use of (digital) marketplaces to find a new use for disassembled products and parts of products (installation)	Potential new purposes for construction materials and products
17	Manage and preserve biological products on the construction site to stretch the lifetime materials	Preserve and manage biological products Keep green roofs and living walls in a healthy state maximising green / biodiversity impact	Preservation and management of biological products on site Periodic treatment and maintenance of wood, straw and other bio-based materials used for the building.

18	Collect products and materials for reuse or recycling in roofs, façades or interior elements from the construction industry	Source demolition materials for construction of new multifunctional green roofs, façades, or interior elements Select waste products and materials for construction of new structures Prioritise local demolition materials to save resources Use digital marketplaces to collect products and materials	Usable and suitable waste products and materials Allocation of local demolition materials Collection programmes that process materials for reuse or recycling within the construction sector Closed loop waste streams
19	Transform waste products and materials from multifunctional roofs, façades or interior elements for reuse, or as a last resort into lower value products in the same industry	Transform demolition materials into products that can be used in new built projects Conduct activities to clean and restore products back to working condition for original or new purposes	Upcycling methods Closed loop waste streams Cleaning, documentation, refurbishment or any physical/chemical treatment to allow reuse Strategies to clean and restore products and materials
20	Use waste products and materials from construction demolition projects that have been processed and recycled	Reuse demolition materials as a resource for new multifunctional green roofs, façades, or interior elements	Different functions for waste materials in new roof, façade, or interior element application Closed loop waste streams
21	Collect products and materials for reuse or recycling in roofs, façades or interior elements from outside construction	Source demolition materials for construction of new multifunctional green roofs, façades, or interior elements Select waste products and materials for construction of new structures Prioritise local materials to save resources Use digital marketplaces to collect products and materials	Usable and suitable waste products and materials Allocation of local demolition materials Collection programmes that process materials for reuse or recycling outside the construction sector Open loop waste streams
22	Transform waste products and materials from multifunctional roofs, façades or	Transform demolition materials into products that can be used in other ways outside construction	Open loop waste streams Strategies to clean and restore products and

	interior elements for reuse outside construction, or as a last resort into lower value products outside construction	Separate waste created during construction Conduct activities to clean and restore products back to working condition for original or new purposes	materials
23	Use waste products and materials from outside construction that have been processed and recycled	Reuse materials as a resource for new multifunctional green roofs, façades, or interior elements	Open loop waste streams
24	Enact measures to use and store energy more efficiently in buildings	Employ batteries for storing renewable electricity produced Utilise a thermal tank to store excess hot water stored on site Make use of phase change materials to store excess heat or cold.	Storage of heat and cold, storage of excess power
25	Evaluate and assess life cycle impacts of buildings, construction products and materials on the environment (emissions, soils, water, biodiversity, etc.)	Apply a lifecycle assessment tool to evaluate the embodied energy and carbon footprint of a new building or the renovation upgrade of an existing building	e.g. One ClickLCA tool Awareness of new circular economy legislation as is currently passing through Irish parliament
26	Design multifunctional green roofs, façades, and interior elements for prefabrication so that as little waste as possible is produced during construction	Design prefabricated solutions If applicable, 3D print building components Use CNC and/or robotics for prefabrication	Prefabrication (incl. relevant software) Alternative prefabrication methods such as 3D printing (incl. digital rendering) Sustainable insulation materials in prefabricated walls
27	Design products so they use as little materials, water, energy, etc. as possible during use phase	Reduce the consumption of total raw materials needed for construction Consider resource efficiency for design of all life cycle stages (e.g. minimum energy consumption during use phase)	How to minimise raw material use for roof, façade, or inner wall construction project
28	Design modular structures for	Design modular structures	Why custom made structures should be avoided

	multifunctional green roofs, façades, and interior elements, so that the components can be disassembled and reused after end of service life	Write and interpret detachable construction details Prioritise standardised solutions and systems to increase possibilities of reuse	(more difficult to reuse after disassembly) Detachable construction details
29	Design multifunctional green roofs, façades, and interior elements to enable reuse and recycling	Design multifunctional green roofs, façades, and interior elements that consist of multiple parts that can be easily disassembled Enable easy recyclability for the designed building component Design with reuse for the same or different purposes in mind 'Legolise' the construction of multifunctional green roofs, façades, and interior elements	Material passports Modularity to enable easy disassembly
30	Design multifunctional green roofs, façades, and interior elements that make repair accessible	Design multifunctional green roofs, façades, and interior elements so that they are easy to repair by home owners or facility managers	Modularity to enable exchange of (parts of) products or materials Design strategies to allow for easy repair Material passports
31	Design multifunctional green roofs, façades, and interior elements that can serve a long and useful life, as well as stay relevant to residents and users	Select materials and technologies that resist damage and wear (e.g. natural slate) Design for flexible use to adapt to changing needs of occupants (e.g. partition walls and systems, change function of multifunctional roof after time)	Design strategies for flexible use of multifunctional green roofs, façades, and interior elements Materials that ensure longevity of buildings
32	Facilitate discussions and meetings between internal team members to identify circular opportunities multifunctional roofs and façades	Apply circular strategies within the firm to serve as an example Provide internal training about circularity topics (e.g. about circular procurement) Facilitate open discussions about circularity	Circular strategies Training strategies (Group) conversation strategies for circularity
33	Integrate circular economy thinking into	Integrate circular economy thinking into employee	Circular economy thinking for employee

	employee evaluations that are linked to professional compensation	evaluations Link circular employee skills to professional compensation	evaluations
34	Collaborate to apply and improve circular procurement processes of multifunctional green roofs, façades, and interior elements	Evaluate material suppliers on circular economy principles and guidelines Setting up purchasing guidelines for procurement departments Improve procurement further by acting regionally Include other lifecycle phases, such as renovation or dismantling works	Circular procurement/GPP Energy Performance Contracting and other performance-based servitization models
35	Collaborate with industry stakeholders to share best practices in circular multifunctional roofs and façades, and act together	Engage in discussions with industry stakeholders to share circular roofs and façades best practices Push stakeholders towards greater circularity Identify potential synergies Engage in activities or projects that advance circularity together Establish regional construction networks	Strategies for promoting greater circularity
36	Make choice of materials between different tender options for multifunctional green roofs, façades, and interior elements	Require Environmental Product Declarations (EPDs) Interpret EPDs	Tender options like bio-based (timber) versus secondary (recycled concrete or steel) Sustainable or circular tender options for roofs and façades
37	Work together with residents and users to jointly create multifunctional green roofs, façades, and interior elements fit for them	Organise feedback from consumers in order to improve roofs and façades in next applications	Co-creation strategies
38	Engage in discussions with construction customers to raise awareness of the circular economy and explore circular opportunities for multifunctional green	Educate residents on circular multifunctional green roofs, façades, and interior elements as construction or renovation solution Provide consumers with reliable data on the	Ecolabelling Renovation options for roofs and façades Benefits of multifunctional roofs and façades (per function, plus increased benefits when

	roofs, façades, and interior elements together	environmental footprint of their choices Provide programmes for home owners and users to help people apply more circular principles	functions are combined)
39	Engage in discussions with government bodies and policy makers to push for regulations that support the application of circular multifunctional green roofs, façades, and interior elements	Establish circular construction and demolition criteria for multifunctional green roofs, façades, and interior elements Open and engage in discussions with government bodies and policy makers Connect public (regional innovation bodies) and private parties to deepen knowledge and incentivise practical collaboration on circular applications on multifunctional green roofs, façades, and interior elements	Public private partnerships Which government bodies and policy makers are relevant to interact with
40	Participate in government programmes that support and advance circular multifunctional green roofs, façades, and interior elements	Select relevant government programmes Contribute to government programmes for circularity or for multifunctional green roofs, façades, and interior elements	Government programmes that support and advance circular economy
41	Work together with the (local) community and engaging them in the company operations	Develop high-value, circular applications of multifunctional green roofs, façades, and interior elements through community collaboration Engage with environmentally conscious inhabitants of buildings to find solutions for installing a multifunctional green roof or façade	Strategies to engage people in local communities with company projects
42	Provide building components (e.g. façades, technical installations on roof, partition walls) as a service instead of as a product	Set up a product business model for building components Provide building components as a service Provide services through a subscription plan with	Strategies for providing building components as a service (e.g. installation company ensures good indoor climate and remains owner of installations)

		regular payment schemes Employ take-back schemes	Subscription plans
43	Offer maintenance and repair services for multifunctional green roofs, façades, and interior elements with help of service business models	Provide maintenance and repair services to buildings as a service Emphasise a locally skilled workforce to provide services	Service business models
44	Offer different leasing and rental models to provide access rather than ownership	Provide leasing or rental models for multifunctional green roofs, façades, and interior elements Recognise and prevent under-use of existing built space Organise multi-use or sharing of spaces (e.g. use office social roof for events during evenings and weekends)	Leasing models Rental models Options for multi-use, sharing of spaces
45	Incentivise the renovation of roofs with a potential of applying multifunctionality	Provide reasonable incentives to firms or individuals who choose to renovate an unused roof Set up projects for incentivisation	What incentives are suitable Models for incentivisation
46	Apply digital tracking of materials to optimise maintenance, demolition, and recovery of multifunctional green roofs, façades, and interior elements	Apply digital tracking of materials used in the construction project Provide and gain insights into the materials used	Digital material tracking software Methods to track materials Use of BIM On site tracking ID's / RFID identification
47	Develop and apply material and building passports	Develop and apply material and building passports Ensure availability of material and building passports to everyone	Material passports Buildings passports Use of BIM Software options (e.g. Cirlinq platform)
48	Employ a regional construction digital marketplace for construction resources	Set up a regional construction digital marketplace Utilise existing online platforms to enable digital marketplace	Digital marketplaces Methods for setting up a digital marketplace Peer-to-peer exchange of materials and

		Persuade and incentivise use of digital construction marketplace by stakeholders	products Use of BIM
49	Incorporate circular strategies, archetypal circular interventions and case studies into educational programmes (in the construction value chain)	Incorporate circular strategies into educational programmes Incorporate archetypal circular interventions into educational programmes Incorporate case studies into educational programmes	Suitable approaches for primary, secondary and tertiary education curricula Suitable approaches for lifelong learning and workplace training Distinguish between types of professions in training
50	Provide internal training about navigating in the value chain for circular multifunctional green roofs, façades, and interior elements	Set up circularity training Provide circular workplace training Provide guidance to trainees Set up a training agreement	Strategies and methods for circularity How to engage trainees with regards to procurement
51	Solidify definitions of circular construction by being consistent and using circularity frameworks	Explain what circularity means in construction	Key Elements of the circular economy Circularity definitions and which to maintain
52	Conduct research about circular construction strategies applied to multifunctional green roofs, façades, and interior elements	Generate knowledge on applied circular strategies by case studies and meta studies Analyse effectivity, barriers and successes of applied circular strategies Give informed advice for future applied strategies	Case studies and meta studies Suitable applied strategies for research
53	Follow developments in the field of environmental costing models and CO2 taxes	Distinguish and interpret environmental costing models and CO2 taxes by following the right sources to remain familiar	Environmental costing models CO2 taxes
54	Integrate multi-functionality into buildings by making use of roofs and façades	Apply functions of multifunctional roofs (e.g. social roofs, green roofs, energy roofs, water roofs) Create vertical gardens as part of façades or interior walls Connect green roofs to sewage systems to avoid	Types of multifunctional roofs and how to combine functions in design

		flooding them	
55	Raise awareness about recycled construction materials and reconstructed buildings	Raise the awareness of stakeholders about reconstruction of buildings and recycled construction materials Explain the value of reconstruction of buildings and recycled construction materials Motivate stakeholders and break unwillingness to use new construction materials or build new	Recycled construction materials Reconstruction of buildings
56	Install energy efficiency measures on roofs, façades, and interior elements	Apply smart solutions to installations Conduct draught-proofing in buildings Conduct air tightness testing Apply suitable method for creating airtightness Build with passive design techniques	Energy efficiency solutions, e.g. ventilated roofs, air quality, insulation, airtightness. Draught-proofing for efficient use of thermal energy Passive design techniques (e.g. passive solar heating, solar collectors like atriums, crossed ventilation, inertia)
57	Employ BIM modelling to get insight into the effects and changes affiliated with upkeep, repair, or improvement of buildings	Make use of BIM modelling for upkeep and repair purposes	BIM modelling for repair information
58	Reduce waste as much as possible during production of multifunctional green roofs, façades, and interior elements	Reduce waste as much as possible during construction Incentivise building crew to avoid waste (=don't reward haste) Collect multiple separated waste streams on site	Strategies to reduce waste
59	Compile demolition specifications for multifunctional green roofs, façades, and interior elements and provide them at final commissioning of the building	Compile clear demolition specifications of the roof, façade, or inner wall at hand	Demolition specifications / detachable construction details

60	Assemble modular structures for multifunctional green roofs, façades, and interior elements	Modular construction systems and their procedures for assembly Apply removable joints Apply sealants that allow for disassembly (e.g. not glueing them or using PUR or KIT for mounting) Ensure that connections made are accessible	Modular construction systems and their procedures for assembly (incl. prefabricated modules) Removable joints (incl. those made from non-conventional materials, whilst maintaining quality of joints) Wall panels, dowels, slot systems etc.
61	Conduct a feasibility study to, if applicable, prioritise renovation, minimise used surface, and minimise the total mass of materials to be used	Conduct a feasibility study to explore possibilities of renovation in order to avoid building new when buildings can be reused Conduct a feasibility study to scan possibilities to minimise the amount of surface used for new built/renovation project Conduct a feasibility study to scan possibilities to minimise total mass of materials used in the project Ensure that results of feasibility study comply with statutory requirements	Feasibility studies in construction projects Statutory requirements for feasibility study Multifunctional green roofs as a possibility to reduce surface use of buildings
62	Construct multifunctional green roofs, façades, and interior elements according to service business model	Assemble multifunctional green roofs, façades, and interior elements properly Ensure that building components are properly assembled as components (e.g. not glueing them or using PUR or KIT for mounting)	Roofs and façades as a service not as a property Modular construction systems and prefabricated modules
63	Install renewable energy technologies in buildings to generate power or heat/cold	Install solar PV panels Install heat pumps	Renewable energy technologies, such as solar panels, heat pumps, waste water heat recovery
64	Maintain and repair multifunctional green roofs, façades, and interior elements in order to maximise lifetime	Maintain and repair multifunctional green roofs, façades, and interior elements (incl. installations and technologies)	Repair techniques for buildings and installations Renovation techniques Renovation of bio-based materials and greenery

		Renovate multifunctional green roofs, façades, and interior elements to maximise their lifetime	
65	Disassemble modular structures from multifunctional green roofs, façades, and interior elements for reuse	Disassemble modular construction systems Write and interpret detachable construction details	Modular construction systems Detachable construction details
66	Rebuild existing (parts of) multifunctional green roofs, façades, and interior elements for a new purpose	Rebuild disassembled buildings Adaptive reuse of existing buildings for a new purpose	Modular construction systems
67	Install measures to use and store energy more efficiently in buildings	Connect elements of systems where heat/electricity is harvested on the roof and stored elsewhere in the building Ensure continuity of insulation in building envelope and pipes.	Types of connected elements in systems for energy storage
68	Apply bio-based, non-critical, non-toxic, and/or reusable products on site whilst maintaining material efficacy	Apply bio-based, reusable, non-critical and/or non-toxic materials at the construction site Enact measures that optimise material use to strive for material efficacy Collect leftover materials	Applications and characteristics of different bio-based materials, what to consider while applying them Alternative forms of concrete Applications of reusable and/or recyclable materials General knowledge about measures that optimise material use in construction, such as 3D printing
69	Construct multifunctional green roofs, façades, or interior elements on site	Apply techniques for constructing green roofs, facades, or interior elements	Soil-bound vs. non-soil bound facades Types of planting (e.g. sedum)
70	Apply sensor technology to green roofs and façades (e.g. for predicting maintenance, to facilitate water flow from roof when needed)	Apply sensor technology to green roofs and façades design Capture the right information with technology (e.g. local weather patterns, moisture levels)	Sensor technology for buildings Green roof monitoring

71	Explain the benefits of green and/or multifunctional green roofs, façades, and interior elements in different contexts and situations (e.g. public/private, to building users, industry, or local community)	Explain the benefits of green and/or multifunctional green roofs, façades, and interior elements	Benefits of multifunctional roofs and façades (per function, plus increased benefits when functions are combined)
72	Renovate buildings with the use of multifunctional green roofs, façades, or interior elements to extend lifetime of current building stock	Examine opportunities for applying multifunctional green roofs, façades, or interior elements Apply design of multifunctional green roofs, façades, or interior elements to renovation projects	Types of multifunctional roofs and how to combine functions in design
73	Organise logistics and storage of secondary materials, whilst aiming to reduce waste	Collaborate with resource hub(s) Include data and knowledge about materials in passports Prioritise local storage and distribution Prepare detailed planning of materials Order materials just in time Avoid overlong on site storage of materials	Resource hubs/ material banks
74	Source local and lightweight materials for multifunctional green roofs, façades, and interior elements if possible	Source local and lightweight materials	How to work with resource hubs or materials banks
75	Provide documentation as guideline to use the multifunctional green roofs, façades, and interior elements properly in order to stretch its lifetime	Provide information about how and when to maintain the roof, facade, or inner wall Create guide for building users Explain the importance of maintenance of greenery	When and how built structure at hand needs regular checks and repair Any kind of documentation as guideline for users
76	Operate multifunctional roofs in a clever manner that suits the current situation	Operate multifunctional roofs while considering post occupancy evaluation, changes in use, and	Post Occupancy evaluation (incl. evaluation during use phase of building)

	best, looking further than solely the original design to optimise sustainability and circularity	the search for energy and material savings during operation Adapt operation of roof to changes in use and context	Options for energy and material savings during operation
77	Conduct post occupancy survey and analysis for building with multifunctional green roof, façades, or interior element	Conduct post occupancy survey and analysis	The importance of post occupancy survey and analysis (also during operation) The purpose of post occupancy survey and analysis (to provide feedback to design practices of design professions)
78	Assess quality of materials to be reused from multifunctional green roofs, façades, and interior elements (audit of waste)	Conduct effective end-of-life assessment about used materials Make decision about reuse of materials Share feedback about quality to constructor and architect Distinguish between high-quality and lower-quality reuse	If applicable, connect end-of-life assessment to purpose of the building the materials are to be used for
79	Trade secondary materials and products on digital marketplaces	Employ (regional) digital marketplace to trade used construction materials that have been selected for reuse Use and apply the data and insights from multifunctional green roofs, façades, and interior elements material passports	How to use digital marketplaces to sell (transformed) used materials
80	Redefine building regulations to incentivise circular approaches to multifunctional green roofs, façades, and interior elements	Redefine building regulations to incentivise circular approaches to multifunctional green roofs, façades, and interior elements	How existing building regulations interact with circular approaches
81	Comply design of multifunctional green roofs, façades, and interior elements with	Comply with applicable legal requirements	What are the relevant legal requirements (e.g. CPR, functional requirements of building walls)

	applicable (national/local/EU) legal requirements		National and regional legal requirements
82	Organise and provide insurance and guarantees for reused materials to buyers	Organise insurance and guarantees for reused materials Provide insurance and guarantees for reused materials	Material passports and digital marketplaces
83	Increase (access to) understanding of biobased construction materials for applications to multifunctional green roofs, façades, and interior elements	Conduct research about quality and characteristics of biobased materials Feedback material research results to established construction requirements Experiment with materials to innovate and discover new sustainable methods of construction Develop new prototypes of multifunctional roofs and facades Improve tailored solutions for multifunctional roofs and facades with the focus on effectivity, multifunctionality and circularity	Construction requirements
84	Use drones and imaging technologies to collect data about roofs or facades for renovation purposes	Use drones and imaging technologies to collect data about building and analyse roofs and facades for required renovation	Drones and imaging technologies for collecting data in construction projects

3. General versus Applied framework

The fundamentals of the applied circular construction skills qualification framework are shared with those of the general framework. The Key elements of the circular economy and the current project's deliverable Framework for circular interventions in the construction value chain have been used to establish the tasks, subtasks, ULOs and connections to professions. The difference between the applied and the general qualifications framework is that in the applied version, the translation has been made to the context of multifunctional green roofs, façades, and interior elements. For example:

2.5	Design products and building structures that make repair accessible

↓

2.5	Design roofs and façades that make repair accessible

Here, the context of roofs and façades replaces that of the more general 'products and building structures. Another example:

6.7	Organise and provide guarantees for reused materials

↓

6.7	Organise and provide guarantees for reused materials from multifunctional roofs, façades, or interior elements

Here, the context is simply added. For some tasks, subtasks and corresponding ULOs were added to the qualification framework. In total, five new subtasks were added to the applied version.

Table 3. Additional subtasks that apply uniquely to the applied qualification framework.

No.	**Subtask**
2.10	Integrate multi-functionality into buildings by making use of roofs and façades
3.3	Install measures to use and store energy more efficiently in buildings

3.7	Construct multifunctional green roofs, façades, or interior elements
5.7	Renovate with the use of multifunctional green roofs, façades, or interior elements to extend lifetime of current building stock
7.7	Apply sensor technology to green roofs and façades (e.g. for predicting maintenance, to facilitate water flow from roof when needed)

The applied qualification framework can be used in the same way as the general framework: to guide upskilling in order to move towards a circular construction sector, and to inspire professionals and companies in what a next, concrete step can be in their journey towards circularity. The applied framework can help in finding or developing the right training for professionals and craftspeople who (want to) work with roofs, façades, and interior elements specifically.

The applied framework has given insight into the replicability of the general framework to a context that represents a highly complex line of work. If, through market validation, its practical usability proves to be high, the circular construction skills qualification framework is likely to also be replicable to other domains.

4. Future applications and replication

Figure 6. Objectives of the BUS-GoCircular project.

Both the general and applied circular construction skills qualification frameworks will be used in future activities of the BUS-GoCircular project. That is to say, the frameworks will guide the design and content of the mentoring programme and the train-the-trainer programme (See Figure 6). In order to “replicate on other domains”, instructions on how to use the framework to address other (new) technologies will be developed.

Furthermore, the applied qualification framework will be added to the Build Up Skills application depository, so that the qualifications become accessible to all. This will also aid professionals’ search for the right learning path in upskilling.

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Appendix I - Professions acronyms

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**
	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	**SS**

	Land surveyor	
	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 / ecologist	**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 Demolition / deconstruction supervisor	**DeL**

	Site analyst Deconstruction auditor Urban miner	**DeA**

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Colophon