D2.2 Mapping of Required Skills and Skill Gaps

And its applications for multifunctional green roofs, façades and interior elements

Issue Date July 13th 2022

Version: 1

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740. The contents of this report reflect only the author's view and the Agency and the Commission are not responsible for any use that may be made of the information it contains.

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And its application for Multi-functional Green Roofs, Façades and Interior elements

Lead partner	ISSO
Issue Date	June 20th 2022
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Version	1
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Approved by	Jan Cromwijk, ISSO
Dissemination level	Public

Revision and history chart

Version	Date	Editors	Comment Description
0.1	22-6-2022	TUS (Martin Breen)	
0.2	29-6-2022	ISSO (Carmen Poort & Jan Cromwijk	Review of draft
1	13-7-2022	ISSO (Jan Cromwijk)	Final review

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 professionals within the workforce across the value chain. Based on the different circular strategies and interventions that are being applied in practice we can map which occupations are involved within the implementation of these interventions. Which will allow us to better understand and design what is required within our train the trainer programmes.

Starting point: A generic framework for Circular Economy interventions

A generic framework for Circular Economy interventions in the construction value chain and its first application has been developed for the BUS-GoCircular project. This framework is based on Circle Economy's Key Elements of the Circular Economy framework. The result of this is a set of archetypical interventions that improve the energy performance of a building while applying circular key elements. The eight Key Elements consist of 25 more specific strategies (tier 2). For these 25 different circular strategy groups (tier 2), the professions, trades and roles that are involved with implementing each strategy have been mapped across five stages of the value chain: Plan, Procure, Construct, Operate, and End of Service Life. This serves as the basis to provide an overview of the different roles that are required to implement such a strategy, from factory operative, over material scout, to material engineers. The framework has then been applied to the circular strategies relating to multifunctional roofs, façades and interior elements, including strategies evolving around energy efficiency. This application has been validated through interviews with relevant external stakeholders and experts from across the BUS-GoCircular project consortium and with External Advisory Boards and Focus groups.

Application for: skills mapping

This generic framework has been used to discover the skills gap existing within the construction industry throughout Europe. Using the elements of this framework a skills table was created relating to circular economy and MGRFIE (Multi Functional Green Roofs, Facades and Interior Elements). Along with this, a list of CPD courses throughout Europe were compiled which can be used to inform the train the trainer programme. Based on our

skills table we began the process of skills mapping, this was carried out by interviewing Professionals working within the construction industry in order to gauge their current and future skills levels on a scale of 0 - not applicable to 5 - experts. The information gained there will be used to help train people within the construction industry by indicating where their level of skill is in relation to where they should be based on our results and therefore assist in upskilling in circular practices.

List of acronyms and abbreviations

BIM: Building Information Model / Management

BUS: Build Up Skills

CRM: Critical Raw Materials

CPD: Continuous Professional Development

EAB: External Advisory Board

EoSL: End of Service Life

GPP: Green Public Procurement

KE: Key Elements

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

ULO's: Units of Learning Outcomes

RES: Renewable Energy Source

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.

Critical raw materials: Those raw materials that are most important economically and have a high supply risk for the EU, as listed by the European Commission.

Focus group: A small subset of experts within the construction industry which have been brought in to assist in verification of the work we have completed.

Key elements framework: The 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.

Skills Mapping: Mapping of skills levels from 0 to 5. This allows us to gauge the skills gap existing within any given profession.

- Current Skills: The skills level at which professionals and experts see their current level of skill.
- Future Skills: The skills level at which professionals and experts see their future level of skill.
- Skills Gap: The gap which exists between the current and future skills levels.

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.

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.

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:

- 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.

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1. Introduction

1.1. Circular approaches to construction and the built environment

The built environment has a significant impact on many sectors of the economy, on jobs, on quality of life and the natural environment. It is responsible for a significant share of environmental degradation: from soaring greenhouse gas emissions, to intensive resource use and biodiversity decline. Buildings are often developed without regard to the ecosystems of which they are a part. And in our civilisation's history, we have built a lot: the mass of human-made things, from pavements to apartments to phones, now outweighs all natural biomass, such as our oceans, trees and animals[1].

During their operational lifetimes, buildings are responsible for 40% of EU final energy consumption, and 36% of greenhouse gas emissions[2]. The embodied emissions from the rest of the building life cycle are estimated to contribute at least a further 10%[3]. More than 50% of all extracted materials are attributed to buildings[4], while construction is responsible for around 2.3 billion tonnes of waste generated per year in the EU, or 36% of the total[5].

Building with, as opposed to over, nature has long been perceived as more of a burden than an opportunity. And this is a shame—because by working smartly together, we can build a better living environment for people, for nature and for the built environment sector itself. A built environment that is less wasteful, more resourceful and that supports nature.

A greater uptake of circular economy approaches means generating less waste, facilitating greater reuse and recycling of products and materials at the end of each service life, and helping to reduce the environmental impacts and life cycle costs.

[1] Elhacham, E., Ben-Uri, L., Grozovski, J. et al. Global human-made mass exceeds all living biomass. Nature 588, 442–444 (2020). https://doi.org/10.1038/s41586-020-3010-5
[2] Impact Assessment for the amendment of the Energy Performance of Buildings Directive, SWD(2016) 414.
[3] IEA, 2019. Material Efficiency in Clean Energy Transitions reports estimates that 10-20% of EU buildings' CO_2 footprint represents the embodied carbon.
[4] DG GROW, 2021. https://ec.europa.eu/growth/industry/sustainability/buildings-and-construction_en
[5] Eurostat, 2018. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics

How can we build on our existing knowledge to ensure that we are utilising circular approaches to construction? Our skills gap analysis will allow us to map the skills gap existing within the construction industry value chain and further will help us to identify where upskilling and knowledge is needed.

2. Approach

2.1. The key elements of the circular economy framework

Based on the approach taken in Task 2.1 'Skills need-analysis and Qualification Development', we are building on the principles of circular economy: Design out waste, regenerative ecosystems and keeping items in use. These principals are highlighted in Figure 1 below and more information on this framework can be seen in the report for Task 2.1.

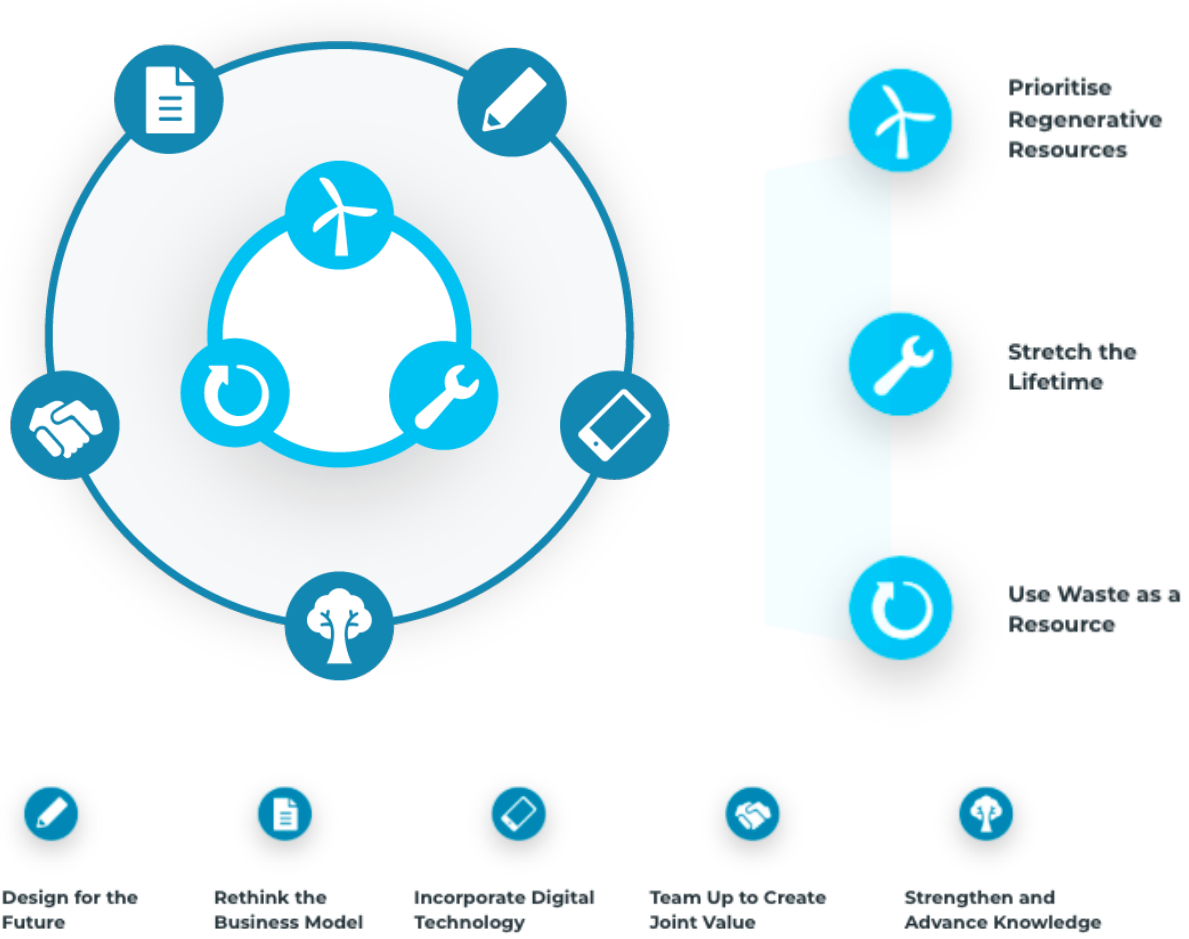

Figure 1: The key elements of the circular economy framework visual

Strategy groups

From a review of 16 projects and strategies developed to implement and accelerate the circular economy for the built environment, this project has identified more than 50 different circular interventions that are specific to the construction value chain, and mapped them onto the Key Element (KE) framework. As a result, the framework now has an extra layer of depth which can help a broad range of stakeholders that work in the built environment to check for inspiration and identify actions to become more circular and thus more sustainable.

Important to note, circularity within the built environment is developing quickly and new technological circular approaches might be developed that are not included within the framework. The approach to circular construction does however provide an in-depth overview of the different circular strategies and interventions that are currently being applied, meaning we are gaining an in-depth overview of circular construction across many sectors.

2.2. Methodology the PROF/TRAC framework for skills gap analysis

PROF/TRAC allowed us to quickly collect a large amount of data from most partner countries across Europe. This methodology is used to identify skills required in any given process and the professions which are related to these (here Circular Economy in relation to MGRFIE). We are then able to map these skills with the help of professions on a scale of 0 (not applicable) to 5 (Expert) to identify current and future skills levels for each profession.

Using the realised Framework for Circular Economy Interventions in construction and building on existing research we utilised the PROF/TRAC methodology to map the skills gap based on the KE within the construction industry. This method carefully maps out how to collect and input the results of our interview with people working in the construction industry which will result in an easy to understand graphics. You can find these results in Figure 3: Future skills - Architect (Page 22) to Figure 38: Future skills - Green Roofers (Page 58).

The key steps in the PROF/TRAC skills gap analysis method are: Mapping Current CPD courses, Mapping Current Professions, Mapping of skills (relating to MGRFIE and Circular

Economy in this case), mapping current skills levels, mapping future skills levels and finally mapping the skills gap. This will be discussed in more detail in the next section.

2.3. Mapping of the required skills needs and skill-gaps

2.3.1: Mapping of current Continuous Professional Development (CPD)

Step 1: The collection of current CPD courses across Europe to indicate what is available and to what level. Each of these courses can provide an indicator of what can be offered to future participants in BUS-GoCircular. Details on this can be found in the Appendix, Table 7: CPD courses throughout Europe (Page 68).

2.3.2: Mapping current professions

Step 2: The collection of professions, builds on the list collated in the Framework for Circular Economy Interventions. We relied heavily on the list that was created within this work, however, as often similar roles may have different names in different geographical areas we had to alter this list slightly and add many sub headings to ensure we accounted for each profession. This list was also tailored to suit the needs associated with MGRFIE and circular economy as this was the boundary of our scope for this project.

As illustrated in Figure 3: MGRFIE focal points (Page 6), we considered all elements of MGRFIE within our project work including green walls, green facades (interior and exterior), multifunctional roofs, Social roofs, water storage (predominantly on roofs), functional roofs and energy collection and storage. These are some of the examples of the areas we are concentrating on, however, this list is constantly expanding and growing as new research is developed. Our list of professions (Table 1: Professions relating to Circular Economy and MGRFIE (Page 10)) is based directly on these areas and our skills table which can be seen in step 3 also arises from these practices.

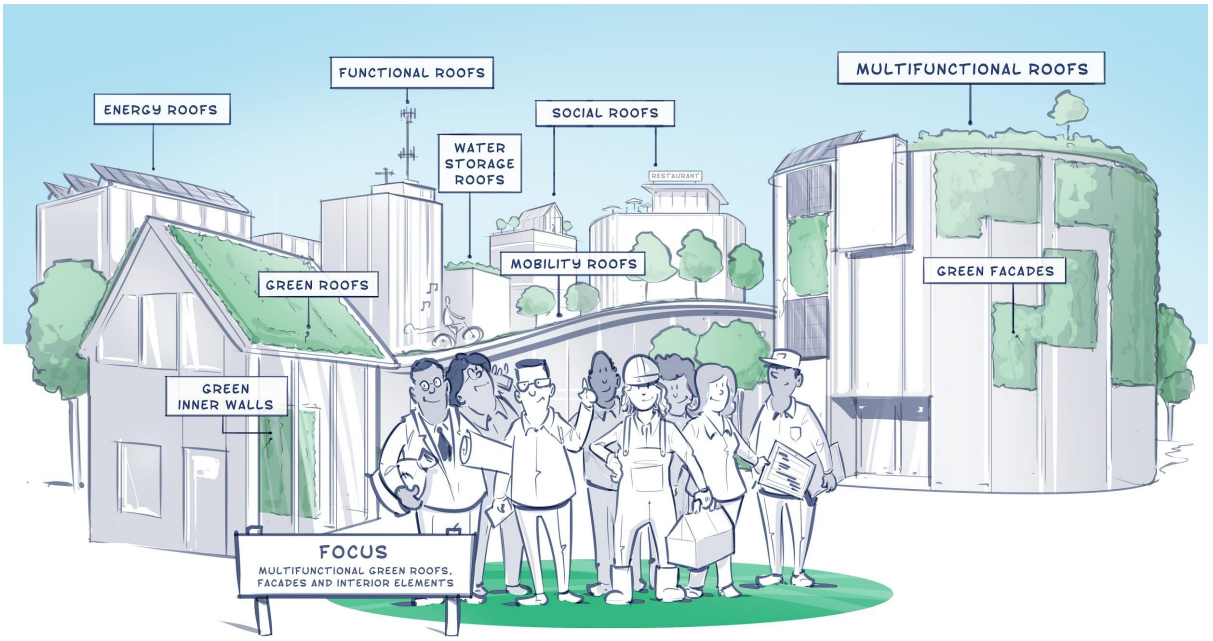

Figure 3: MGRFIE focal points

Reference Profession / Trade	Ref Code	Enter national name for profession / type of profession	Definition of the professions (proposal, change if necessary)
Architect	AR	Architect / building designer, project manager, building construction manager, director of the execution of the works, urban architect, structures' calculist, health and safety coordinator, Building Energy Auditor, Building Energy Chief Auditor) technical architect	Architects investigate, design and oversee the implementation of buildings taking into account functional, architectural, aesthetic, structural, technical, regulatory, cost and contextual requirements with due regard to public health and safety.
Civil Engineer	CE	Designer, Electronics engineer , Structural/Building/Installations engineer, Energy engineer, Management engineer, technical engineer	Designer of materials and structures, considering the limitations imposed by practicality, regulation, safety, and cost. Specialisation is possible on topics like construction safety, thermal performance, acoustics, building physics.
Mechanical Engineer	ME	Energy engineer, Multifunctional use for solar PV / Urban wind turbines	Designer of materials and systems for HVAC and sanitary equipment, considering the limitations imposed by practicality, regulation, safety, and cost.
Electrical Engineer	EL	ICT engineer, Building automation engineer, Sensoring and Building Management Systems	Designer of power, lighting, data and or communication installations, considering the limitations imposed by practicality, regulation, safety,

			and cost. Designer of building automation systems, system engineer / system integrator, considering the limitations imposed by practicality, regulation, safety, and cost.
Construction Engineer	CE	Construction design engineer, building construction engineer, building engineer, engineering support manager, construction project engineer, site engineer, Building Surveyor	Engineer of the building construction safety
Environmental engineer	EE	Air protection environmental engineer, environmental engineering expert, environment engineer, industrial environmental engineer, water pollution engineer, environmental engineering adviser, chemical environmental engineer, environmental engineering specialist, environmental engineering consultant, sanitary engineer, pollution engineer, environmental analyst, environmental specialist for water management, agricultural conservation engineer	Designer of solutions to protect human health, nature's beneficial ecosystems, and to improve environmental-related enhancement of the quality of human life.
Data analyst (Software Engineer)	DA	BIM programmers, BIM designers, BIM Software engineers, 3D image technician / engineer, Building Information Modelling/management, Digital twin, Predictive maintenance as roof has shorter lifespan than building	Building Information Modelling, Digital twin, Predictive maintenance as roof has shorter lifespan than building
Material Purchaser (material scouts)	MS	Procuring and buying bio-based and secondary materials for MGRFIE	Procuring and buying bio-based and secondary materials for MGRFIE
Project manager	C	Management engineer, Industrial Engineer / Project manager Building company or Project manager Installation company, Cost engineer, Quality assurance	The person responsible for the planning, execution and closing of any building project
Project developer	PD	Management engineer, Industrial engineer / Project manager Building company or Project manager Installation company	The project developer takes responsibility for the associated risks involved in the building process for the customer and hands over the project to the tenant / buyer after completion and use of the building
Onsite Manager (building process)	C	Architect, Structural/Building engineer, Construction manager/ Building Surveyor	The person responsible for quality assurance during on-site construction works in the realization of MGRFIE
Building owner/Operator	FaM, BO	Facility manager, housing corporation, Asset manager, Real estate investor	The person responsible to maintain the real estate as it was realised at the end of the MGRFIE building process (including facility management). The person responsible for management, monitoring and improvement of operation of facilities.
Financial manager	C	Cost expert	The person responsible for all finances involved during

			planning, execution and closing of any building project
Procurer co-ordinator (Tenders)	PM	Buyer, chief procurement officer	The person responsible for facilitating the process of MGRFIE tenders and (sub)contracts
Landscape Architect	LA	Landscapes architect, landscape engineer, landscape design expert, landscape artist, landscape design specialist, landscape specialist, landscape expert	The person responsible for the construction of gardens and natural spaces in MGRFIE design. Design multi-functional green roofs and facades, Specific plant design based on size, weight, water needs etc
Insulation Installers	II	Lagger, cavity insulation installer, energy saving materials installer, insulation installation worker, insulator	Insulation workers install a variety of insulation materials to shield a structure or materials from heat, cold, and noise from the environment. Roof insulation (on top / below), Root Resistant material selection
Plasterer, Facade worker	FW	Heritage plasterer, fibrous plasterer, wall finisher, solid plasterer, plaster labourer, plaster worker, stucco mason, wall plasterer	Finishing (Suitable finishing for MGRFIE), Innovative facade design using easily repeatable designs
Roofers	R	Roofing carpenter, cladding installer, asphalt roofer, roof tiler, tinsmith, felt roofer, house roofer, roof slater	Roofers cover structures with roofs. They install the weight-bearing elements of a roof, either flat or pitched, then cover it with a waterproof layer. Waterproofing and water collection, Design to reduce flooding, Roof insulation (on top/below)
Landscaper (roof and facade)	Gd	Interior planter/landscaper, exterior planter/landscaper	Plant selection, Soil selection (Lightweight)
Plumber	P	Commercial plumber, gas fitter, domestic plumber, pipe worker	Plumbers maintain and install water, gas and sewage systems. Solar PV, cables and mounting of sensors, Roof accessibility (Lighting)
Electrical installers and technicians	EI	Installation electrician, electrical services installer, electrical maintenance technician, maintenance electrician, electrical systems installer, electrical maintenance worker, electrical installer, electrical worker	Electricians fit and repair electrical circuits and wiring systems. They also install and maintain electrical equipment and machinery. Solar PV, cables and mounting of sensors, Roof accessibility (Lighting)
Renewable energy systems installers (electric)	RESI		Solar PV, cables and mounting of sensors
Renewable energy systems installers (thermal)	RWT		Solar thermal systems
Heat pump installers	HPI		Placement of outdoor unit heat pump
Demolition/Deconstruction auditors	DeA	Demolition expert, Urban miners, Waste Recovery and salvage	Site analysts, Material Recovery, Material Reuse

Repair and maintenance operatives	RM	Maintenance planner, Safety maintenance operative (check on safety measures)	
Ventilation installers	VI	Heating, ventilation, air conditioning engineers design and develop heating, ventilation, air conditioning and possibly refrigeration systems	Placement of air handling unit
Painter and decorator	n/a	Specialist painter, decorator, commercial painter and decorator, construction painter and decorator, painter (construction), industrial painter, commercial decorator, construction decorator, Interior designer	They may use standard latex based paints or specialised paints for decorative effect or protective properties. Building painters are skilled in using brushes, paint rollers and paint sprayers for different applications.
Wood manufacturer and finisher	BA	Prefabricated building assembler, Truss assembler	
Building energy consultants	BEC	Energy assessors, energy saving consultant, energy procurement consultant, energy advice consultant, energy procurement advisor, energy saving equipment advisor, energy and sustainability consulta, energy saving advisor, energy and environmental consultant, sustainability consultant, energy advisor	Energy consultants advise clients on the advantages and disadvantages of different energy sources. They help clients to understand energy tariffs and try to reduce their energy consumption and carbon footprint by using energy efficient products and methods.
Policy maker for building	PA		Setting ambition and providing regulation. Advising on advantages (and disadvantages) of multi-functional roof use policy
Green Public Procurement (GPP) advisor in construction	GPP A		Advising on how to make use of GPP for stimulating MFGRIE in combination with other climate goals
Carpenter	FM	Craftsperson carpenter, commercial carpenter, heritage carpentry, craft carpenter, joiner, woodworker, carpentry framer, frame-maker, joiner supervisor, joinery worker, timber worker	Carpenters cut, shape and assemble wooden elements for the construction of buildings and other structures.
Window installers / glazers	WI	Window installation team worker, window fitter, window installation team member, window technician	Window installers/glazer place windows into structures and service them. They take out old windows if present, prepare the opening, mount the window, and attach it in place plumb, straight, square and watertight.
Stonecutter and mason	Br	Stone carver, structural stoneworker, artisanal stonemason, stoneworker, craft stonemason, stone setter, heritage stonemason, memorial mason, stone finisher, fixer mason, stone cutter, architectural stonemason, craft mason, building mason	Stonemasons/mason manually carve and assemble stone for construction purposes. While CNC operated carving equipment is the industry standard, artisanal carving for ornamental stone is still done manually.

Bricklayer	Br	Industrial oven brick mason, trowel occupation worker, bricklaying labourer, specialist bricklayer, brick laying worker, bricklayer	Bricklayers assemble brick walls and structures by skilfully laying the bricks in an established pattern, using a binding agent like cement to bond the bricks together. They then fill the joints with mortar or other suitable materials.
Green Roofers	R		Design specifically for green roof and facades. Material, weight, water etc specialist when consideration is made for green roof design

Table 1: Professions relating to Circular Economy and MGRFIE

2.3.3: Mapping current and future skills levels

As we are using the PROF/TRAC method we are also using the skills levels that are recommended along with this method. These levels span from 0 to 5 (0 meaning not applicable or no knowledge/skill required while 5 represents an expert in the skills that is corresponding with this). This levelling table allows for a more easily defined skills level.

0	Not applicable / no knowledge and skills required
1	Has little knowledge and skills with respect to the relevant field / technology
2	Understands basic knowledge and has practical skills within the field, is able to solve problems by selecting and applying basic methods, tools, materials and information
3	Has comprehensive, factual and theoretical knowledge, is capable of solving problems within the field
4	Has advanced knowledge involving a critical understanding of theories and principles and skills, required to solve complex and unpredictable problems in the field and is aware of the boundaries
5	Has specialised knowledge and problem-solving skills, partly at the forefront of knowledge in the field, in order to develop new knowledge and procedures and to integrate knowledge from different fields

Table 2: Skills levels table

2.3.4: Mapping of skills

The skills table itself was created in conjunction with the insights and information provided in Task 2.2. Here the skills are broken up into 3 categories, skills specifically relating to Circular Economy (Table 3: Skills specifically relating to circular economy), skills not specific but that heavily influence Circular Economy (Table 4: Skills to assist with circular economy's implementation in construction) and finally skills relating specifically to MGRFIE (Table 5: Skills specifically relating to MGRFIE). The tables themselves are split into the same framework for CE that is Framework for Circular Economy Interventions.

	Specific to Circular Economy	Table including all relevant Circular Skills either solely related to Circular Economy or prominently related to CE.
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 building 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 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).
CCJV 1	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.

Table 3: Skills specifically relating to circular economy

	Not specific to Circular Economy	Including all relevant skills involved in Circular Economy but not necessarily specific to CE within the construction industry.
	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)
	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.
	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.
	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.
	Collaborate to create joint value	
CCJV 2	Collaboration	Experience and knowledge of internal Collaboration, Customer/Consumer Collaboration, Industry Collaboration, Community Collaboration, Government collaboration. Education, Feedback, logistics and data measuring,

	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)
	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 minimising of waste from human error.
IDT4	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).
	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

Table 4: Skills to assist with circular economy's implementation in construction

	Circular Economy specific to MGRFIE	To include all relevant CE skills which relate directly to MGRFIE specifically.
MF	Multi-functional Green Roofs Facades and Interior Elements	The design, construction and maintenance of MGRFIE.
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.

Table 5: Skills specifically relating to MGRFIE

2.4. Interviews, focus groups and data validation

Following the creation of the skills tables and list of professions we began to create focus groups. The rollout of the interview process was split into three categories/groupings throughout participating partner countries and European wide organisations. These focus groups were directed independently by each partner country following guidelines set by TUS to ensure the results across Europe could be easily compared. These divisions were, Pre-Design Phase, Design Phase and Construction and Deconstruction Phase. Each partner country was asked to complete at least one group session with each of the focus groups. This allowed us to tailor our survey and interview process to the professions involved. We received varied levels of feedback from partners and in some cases the results varied greatly from other countries throughout Europe.

Following these focus groups we began to collate the date and create a European skills level for each of our professions. We brought in experts to help us to remove any outliers and resolve any remaining issues that existed due to the high variance/volume of the data and unique challenges this kind of data brings with it.

While this was not the planned route to fulfil this Task, it has been beneficial as it has allowed us to speak with not only experts in the field of CE but also professionals that are not yet familiar with this work. Following the final validation of the Current and Future skills levels we created the skills gap table which then allowed us to create our skills gap graphs. To view the full table please please follow the link here -

CODE	TECHNOLOGY, INTERDISCIPLINARY SKILLS AND PROFESSIONS	EXAMPLES (if needed, please add additional examples)	Architecture									Civil Engineer								
			current	EE	Gap	1	2	3	4	5		current	EE	Gap	1	2	3	4	5	
	Specific to Circular Economy	Examples and remarks																		
PRR	Prioritise regenerative resources	Taking into consideration that renewable, reusable, non-toxic resources are used in the construction and production of the built environment.	3	5	2							3	4	1						

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 building lifecycle. Material Creation and innovation. Knowledge of material impact.	2	5	3	3	4	1
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.	3	5	2	3	4	1
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.	3	4	1	3	4	1
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.	2	4	2	3	4	1
UWR 1	Deconstruction for reuse	Use demolition materials as a resource for new and retrofitting buildings. Specialism in deconstruction, material recovery and deconstruction material innovation.	2	4	2	3	4	1
UWR 2	Material Innovation	Experimentation and innovation with materials to discover new sustainable methods of construction.	3	5	2	3	4	1
UWR 3	Reclaiming Energy	Reclaiming energy from waste materials wherever possible.	2	3	1	2	3	1
UWR 4	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).	2	4	2	3	4	1
DF	Design/Build for the future		3	5	2	3	4	1
DF1	Design/Build for Reuse	Designing for easy dismantling and re-use of built elements, equipment or materials.	3	5	2	3	4	1
DF2	Design/Build for repurpose of materials	The use of Circular materials. Reuse, recycle and repurpose all materials in construction.	3	4	1	3	5	2
DF3	Apply material passports	Apply material passports to enable more timely upgrading and life-time extension.	1	4	3	2	3	1
DF4	Design/Build for material impact reduction	Reduction of the materials impact on the environment from the design to installation phase.	3	4	1	2	4	2
DF5	Reduce/Build reliance on critical raw materials	Design increased use of renewable and sustainable materials in construction.	3	4	1	3	4	1

BUS GoCircular

DF6	Design/Build out waste	Use design as a tool to reduce or eradicate all waste at design phase.	2	4	2							2	4	2						
DF7	Design/Build for Durability	Design so that products and installations are easy to repair. Design for longevity.	3	4	1							3	4	1						
DF8	Design/Build for Cyclability	Design/Build for resource efficiency for all life cycle stages, prioritising material reuse and reduction.	3	4	1							3	4	1						
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).	3	4	1							3	3	0						
CCJV 1	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.	2	4	2							2	4	2						
RBM	Rethink the business model	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.	2	5	3							2	4	2						
RBM1	Repairs as a service	Rethinking repairs as a necessary part of the business model rather than replace.	3	3	0							3	4	1						
RBM2	Environmental costing models and carbon taxes	Rethinking costing and carbon taxes within construction.	2	4	2							3	4	1						
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.	4	4	0							3	4	1						
SAK	Communication, Education and information	Develop research, knowledge transfer, encourage innovation networks and disseminate findings with integrity.	3	5	2							3	4	1						
PRR3	Sustainable Sourcing	Building with sustainable sourced materials i.e. Wood, Hemp, Seaweed, Cork, Bamboo, Earth, straw, wool etc.	4	4	0							3	4	1						
PRR4	Energy storage and distribution	Measures to more efficiently use and store energy in the house.	3	4	1							3	4	1						
PRR5	Production of Renewable Energy	The understanding and operation of creating energy from renewable sources	3	4	1							3	4	1						

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)	3	3	0							3	4	1						
PE1	Maintenance of building components	Share information and knowledge on how to maintain building components e.g. DIY painting. Knowledge specific to maintenance work.	2	3	1							3	3	0						
PE2	Upgrade of building components	Use expertise to upgrade elements. Knowledge specific to maintenance work.	2	3	1							3	4	1						
UWR 5	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)	3	3	0							2	4	2						
UWR 6	Rainwater collection and use	Rainwater harvesting to be used for certain applications e.g. washing, toilets, gardening.	4	4	0							3	4	1						
UWR 7	Sustainable Drainage Systems	Being able to listen and summarise conversations (in common language) Realising common understanding and involving other people in the project objectives.	3	4	1							3	3	0						
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)	4	4	0							3	4	1						
DF10	Modular Design	Use of modularity in construction of all elements of the building envelope to facilitate disassembly and reuse.	3	4	1							3	4	1						
CCJV 2	Collaboration	Experience and knowledge of internal Collaboration, Customer/Consumer Collaboration, Industry Collaboration, Community Collaboration, Government collaboration. Education, Feedback, logistics and data measuring,	4	4	0							3	4	1						

RBM3	Facades as a services	Rethink the use of facades as a service (including services such as Ventilation, heating and cooling Systems).	3	4	1									3	3	0							
RBM4	Technical Installation as a service	Electrical products, Boilers, Heat pumps, Solar systems.	3	3	0									2	4	2							
RBM5	Interior features as a service	Rethink the use of interior features as a service (material, use and systems)	2	4	2									2	3	1							
IDT1	Drones Use	To scan/image frontage and roofs of buildings for data collection and analysis for renovation.	3	3	0									2	3	1							
IDT2	3D Printing	To avoid material loss and to allow for material innovation and experimentation.	2	3	1									2	3	1							
IDT3	Prefabrication	This must include digital rendering leading to a further minimising of waste from human error.	3	4	1									3	4	1							
IDT4	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).	4	4	0									3	4	1							
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	3	4	1									3	4	1							
	Circular Economy specific to MGRFIE																						
MF	Multi-functional Green Roofs Facades and Interior Elements	The design, construction and maintenance of MGRFIE.	3	3	0									2	4	2							
MF1	Solar power systems for electricity generation	Installation, maintenance and electricity production.	3	3	0									3	3	0							
MF2	Solar thermal systems for domestic hot water and/or heating generation	Installation, maintenance and heat production.	2	3	1									3	3	0							
MF3	Heat Pump	Installation, maintenance and energy production.	2	3	1									3	3	0							
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,	3	3	0									2	3	1							

		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.	3	3	0								3	3	0								
MF6	Horticulture	Plant and soil understanding and expertise in relation to heating and cooling, insulation, shading, weight distribution, water collection and use.	2	2	0								2	2	0								

Table 6: Skills gap results for Architect and Civil Engineer

2.5. Reflection on methods and approach

Limitations

The current overview does not allow for the unique positions each partner country finds themselves in - We chose to firstly look at each country individually and then collate the information. This was very interesting as it highlighted the differences in levels of skill within specific roles, however, as we are completing a framework for European levels we did not dive deeper into this variation. Collected data is available on request for people and organisations interested to dive deeper into it.

Skills levels 0 - 5 - We did face some issues with people remarking that these levels are slightly more restrictive due to the small scale. It is also difficult to correctly communicate the scale when talking about different fields as there is quite a lot of room for interpretation depending on who is administering the interview and who is giving their input.

Scope - The main difficulty in creating this skills table is the scope as there is no limit to the number of skills that can impact construction in relation to circular economy. The results of our work could change drastically in a short period of time meaning our table must change, this is another positive attribute of PROF/TRAC as the process is one that can be built upon. As we are focusing on CE specifically relating to MGRFIE we carefully created a skills table we feel reflects the scope of our research.

Positive Findings

Speed, scope and adaptability - The design of PROF/TRAC allows for a huge number of results to be collected quickly and efficiently and it is up to the project lead as to what the

scope can be. Therefore easily adapting the process for small numbers of participants or, as we have shown here, large numbers.

Possible alterations for future use

Process - Upon collection of the data we then had to cleanse the data removing any outliers and creating a concise and clear result. The issue with this kind of data is that when there are a number of outliers, they corrupt the data leading to a common result of 3 when these outliers are not removed. Following this, we noted that due to inconsistencies in the volume of data and possibly the misinterpretation or miscommunication of the project, some of the results showed higher current skills than future skills needed. This is clearly an issue with the results, so we began to validate the results first with in-house experts and secondly with focus groups throughout Europe. This allowed us to verify that our data was of a high quality as well as filling in any blanks that may have appeared due to a lack of respondents for certain professions. This process would be a more beneficial approach as the participants can receive extra time and therefore can fully understand the work. It also allows us to directly target smaller groups of each profession as we found that some professions received very little feedback while others received large volumes.

3. Results

3.1. Skills gap analysis for Circular Economy in relation to MGRFIE

The graphs were created using the data collected utilising the PROF/TRAC methodology. These graphs can be read by finding the required skill on the exterior ring (Ring 5) and following that point into the centre of the circle. Where this radial line intersects with the drawn line will indicate the skills level for that specific skill as the centre of the graph is indicated as 0 while the exterior indicates a level of 5. Each profession is indicated in the title and by an artist's rendering of the profession shown at the centre of the graph.

The skills level here represents the future skills level which is recommended by our experts throughout Europe.

As shown in Figure 3: Future skills - Architect, for PRR (Prioritise Regenerative Resources) a skills level of 5 is indicated as the future skills level required by this profession.

Please follow the link to view the complete current and future skills gap analysis and the basis for all our graphs to follow -

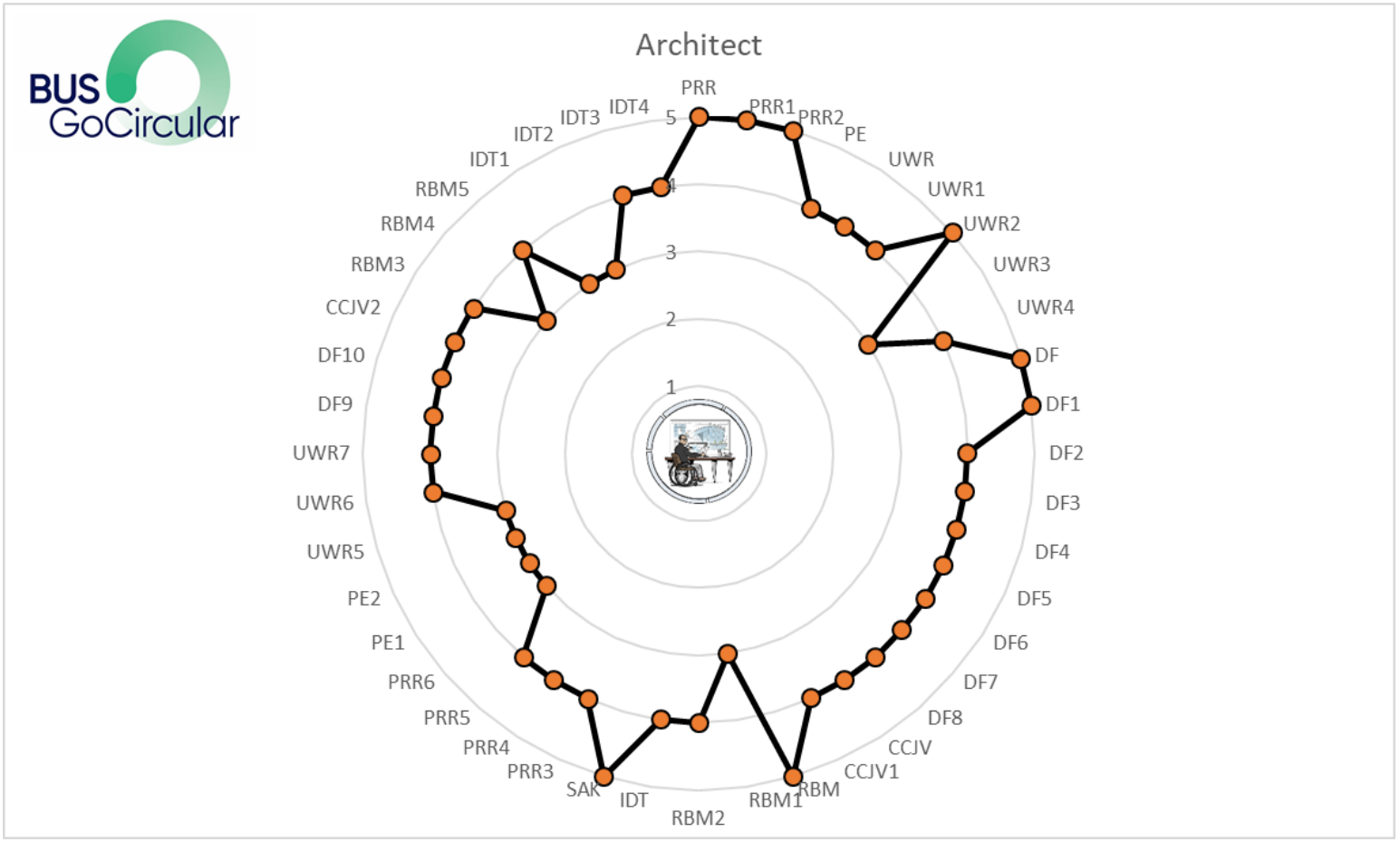

Figure 3: Future skills - Architect

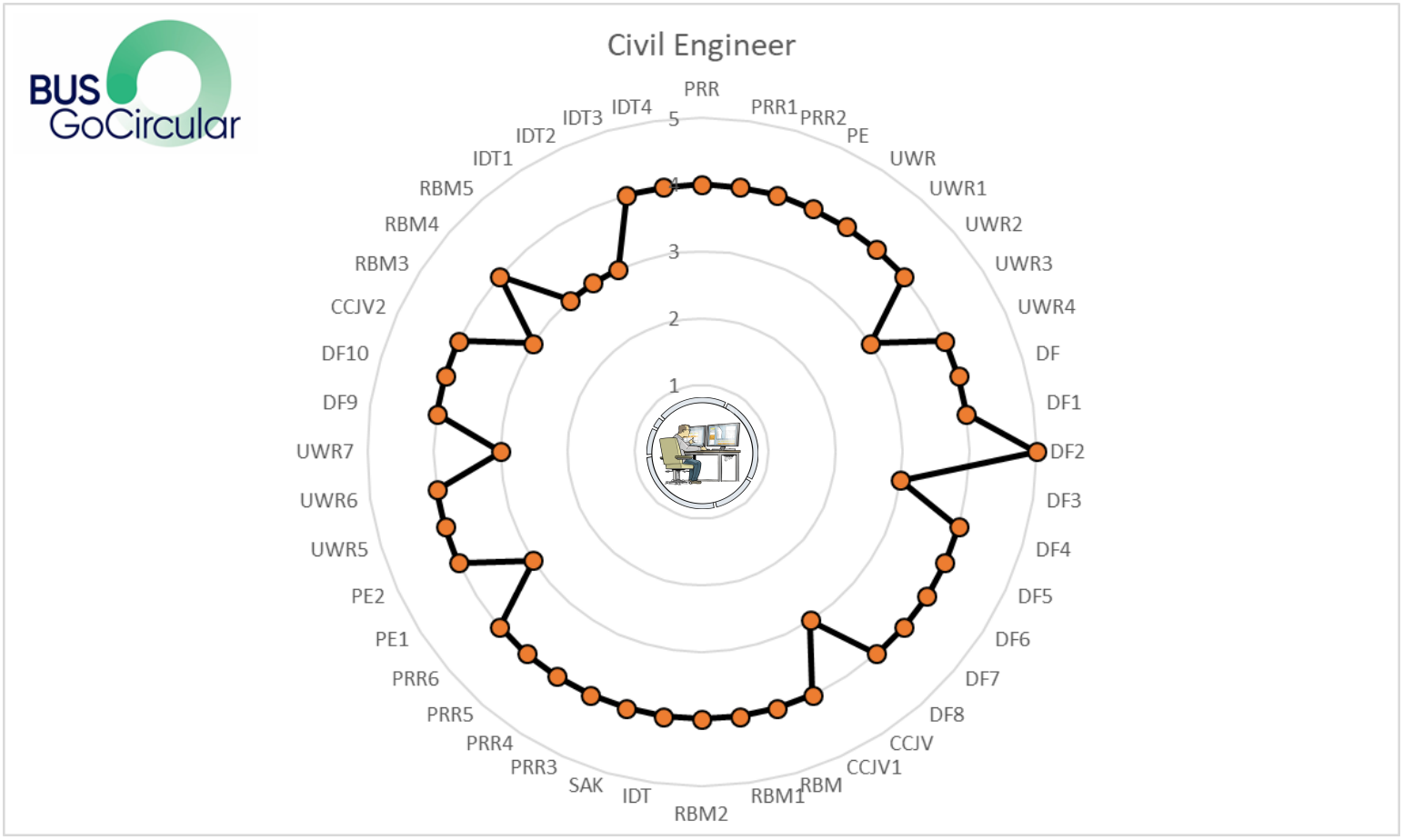

Figure 4: Future skills - Civil Engineer

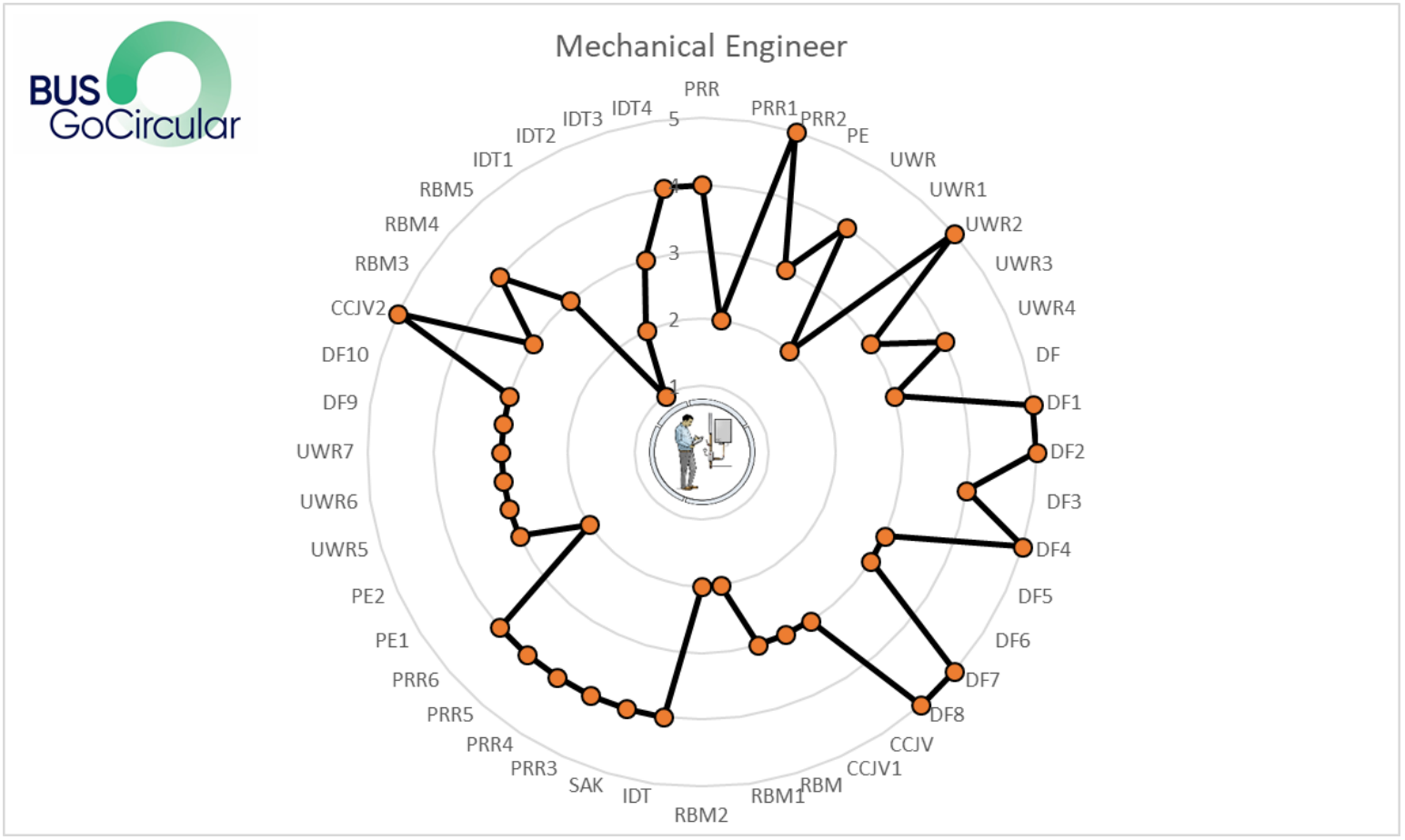

Figure 5: Future skills - Mechanical Engineer

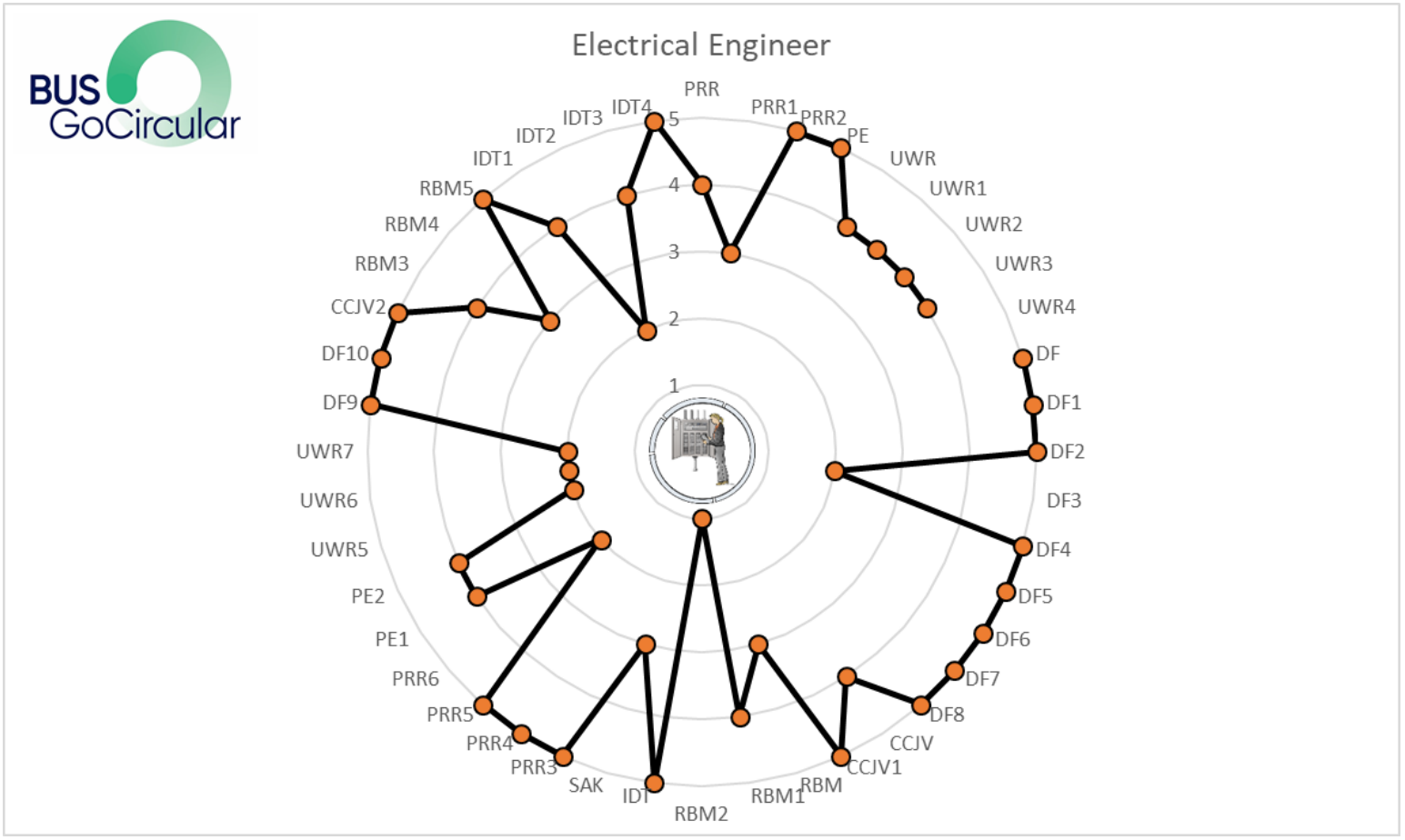

Figure 6: Future skills - Electrical Engineer

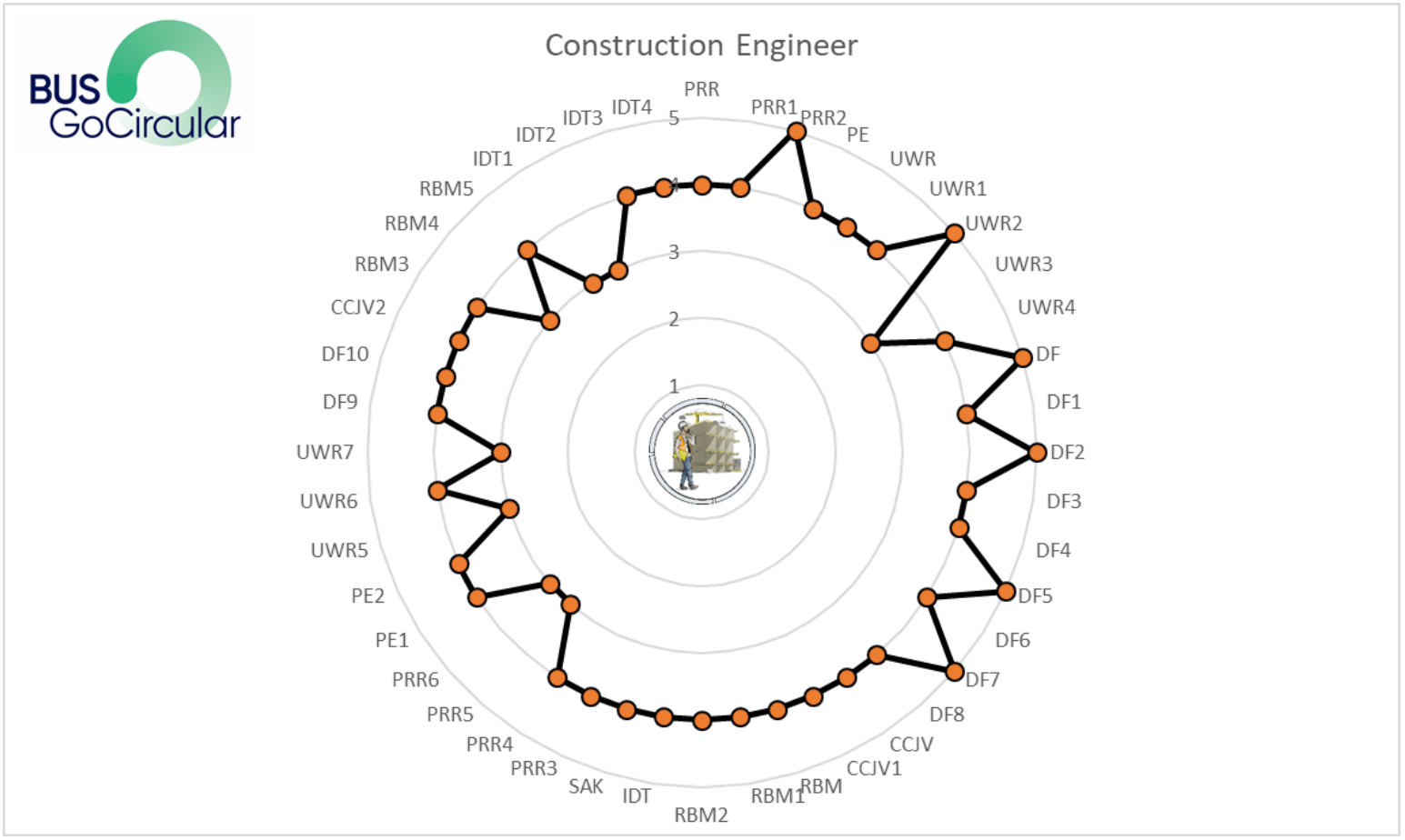

Figure 7: Future skills - Construction Engineer

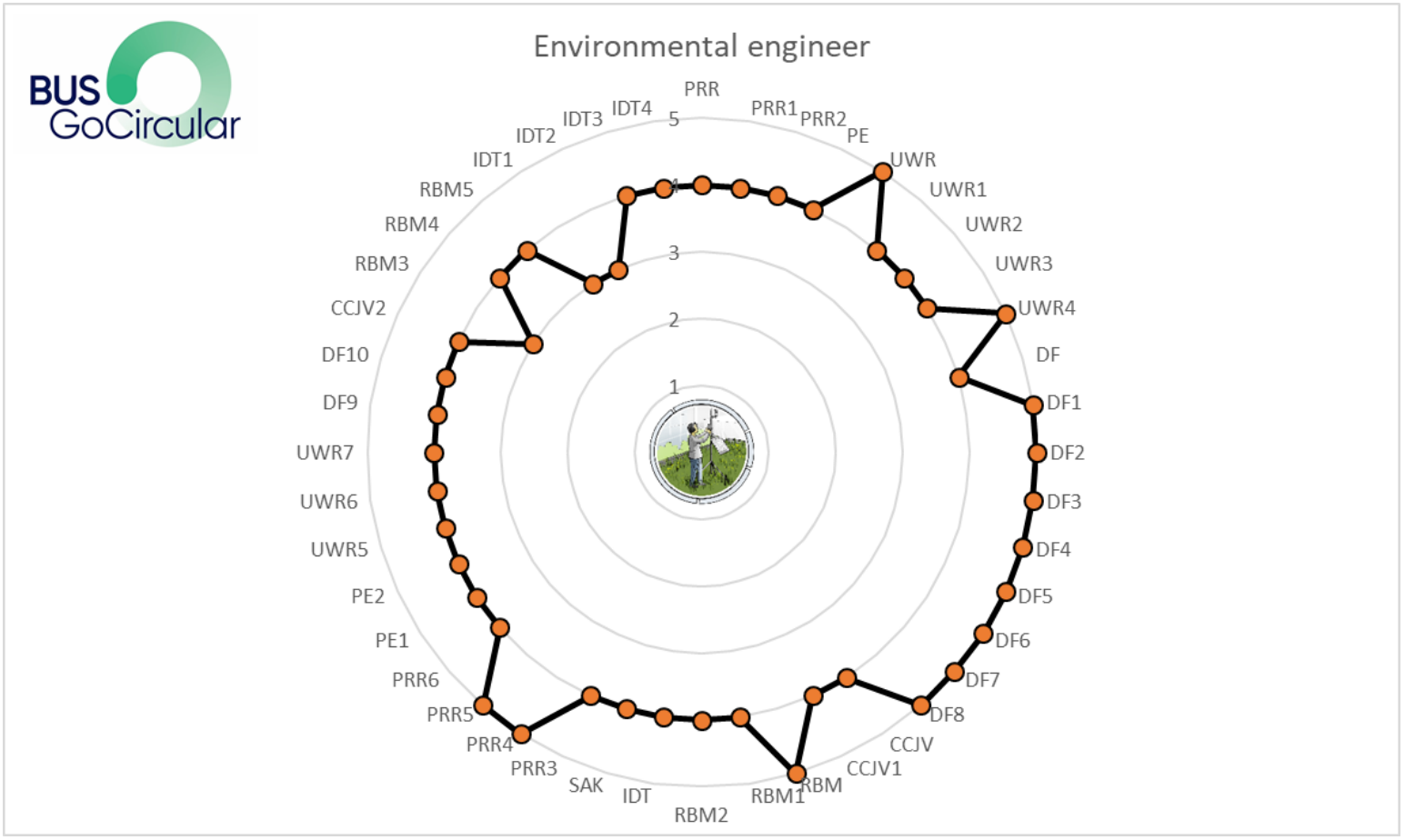

Figure 8: Future skills - Environmental Engineer

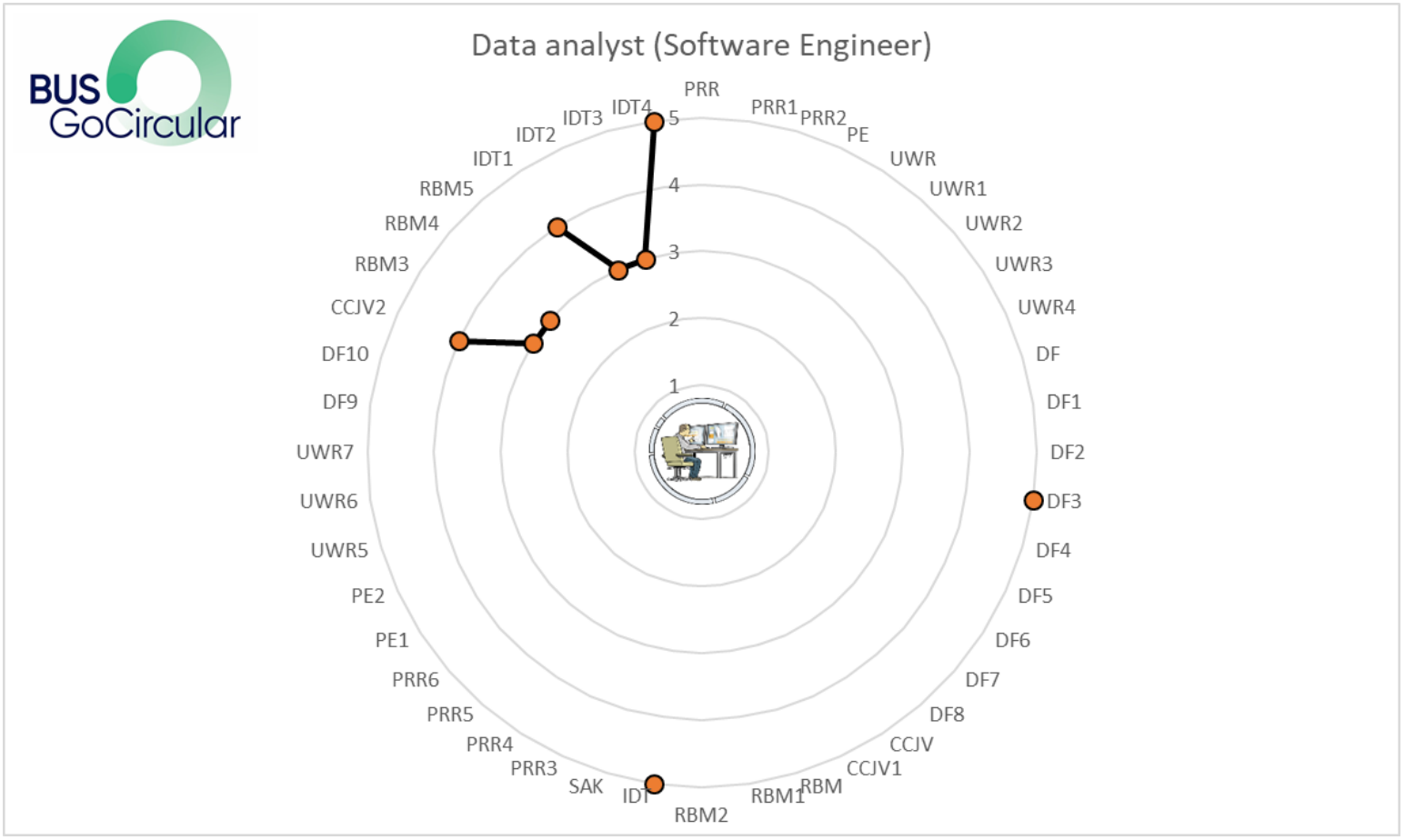

Figure 9: Future skills - Data Analyst (Software Engineer)

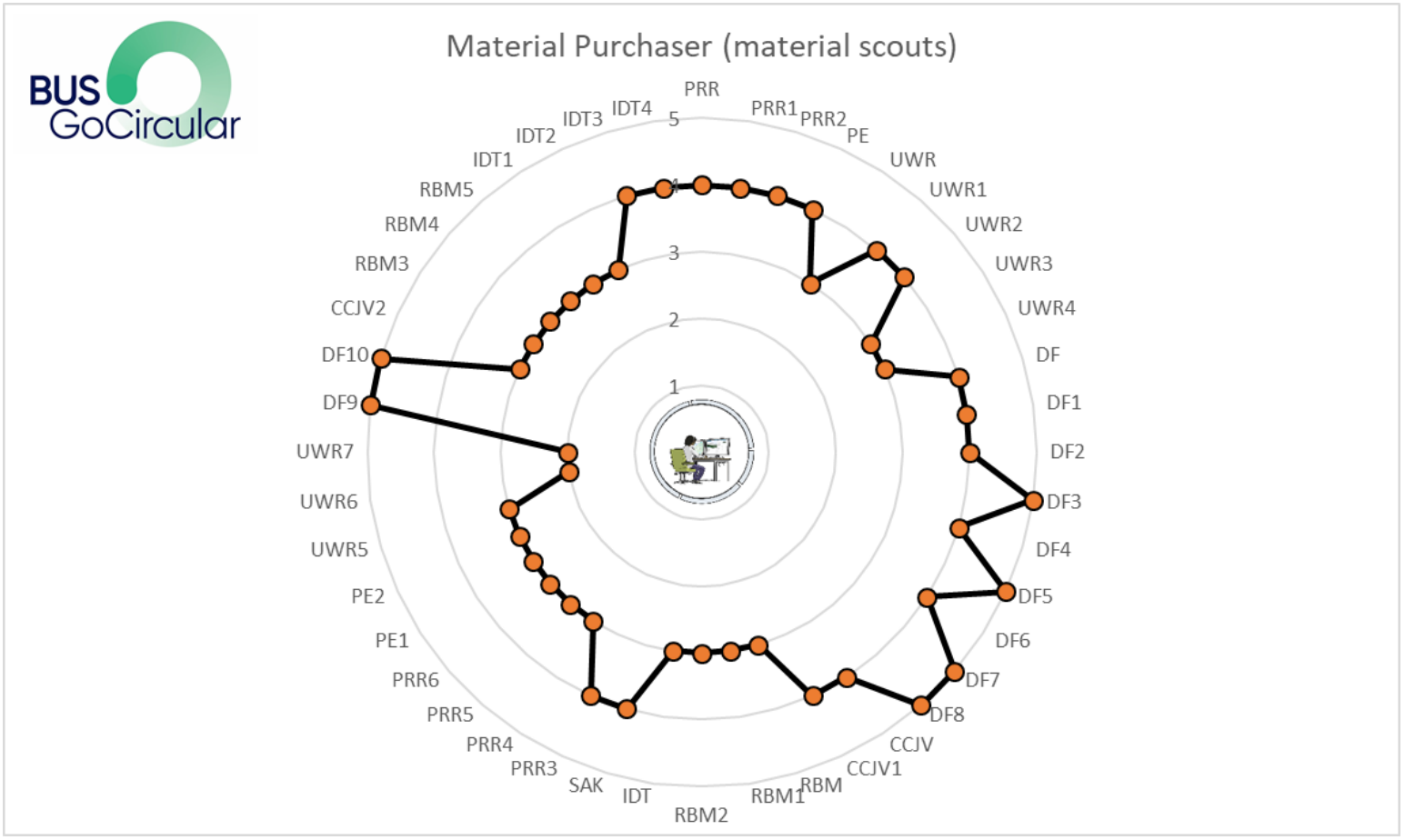

Figure 9: Future skills - Material Purchaser (Material Scout)

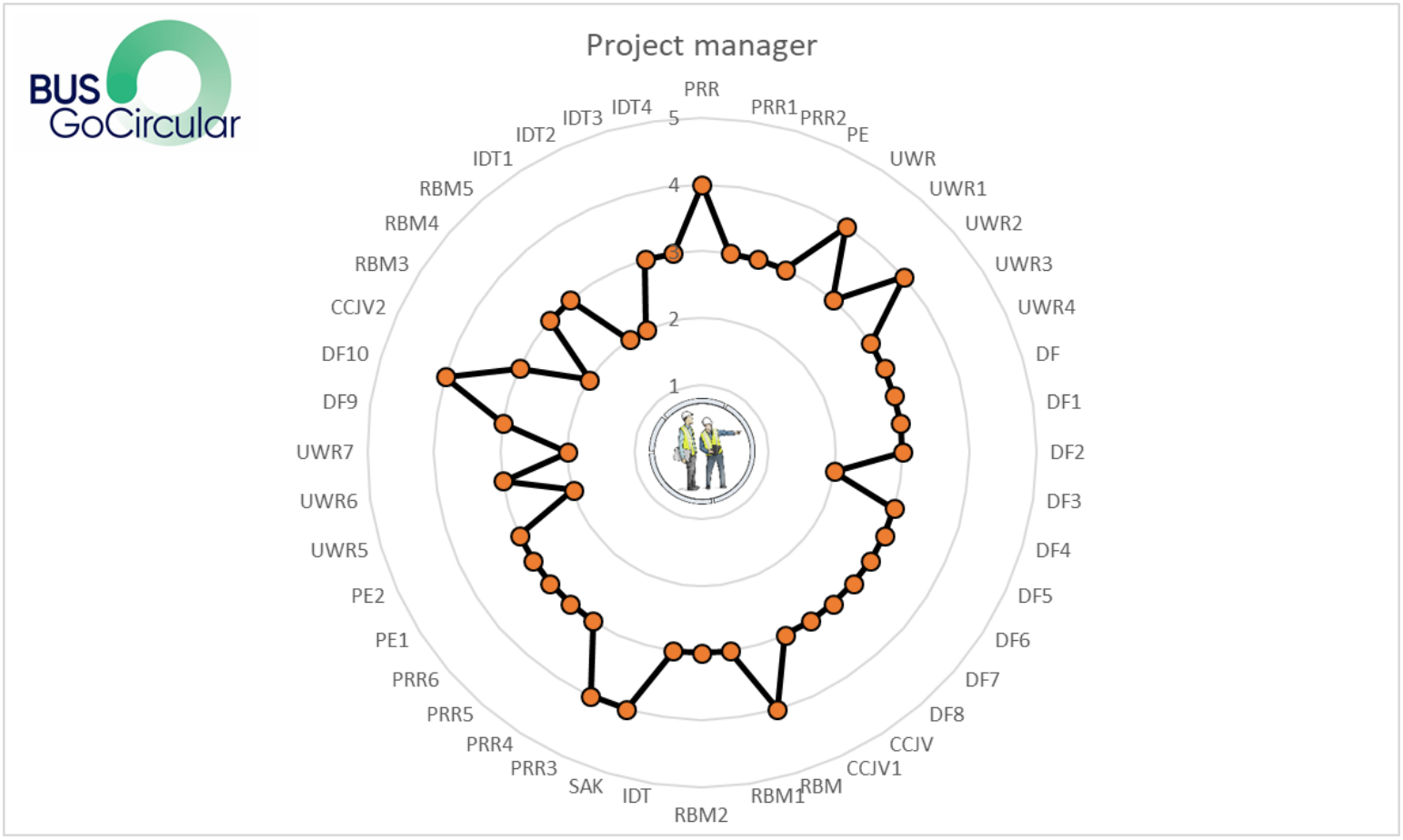

Figure 10: Future skills - Project Manager

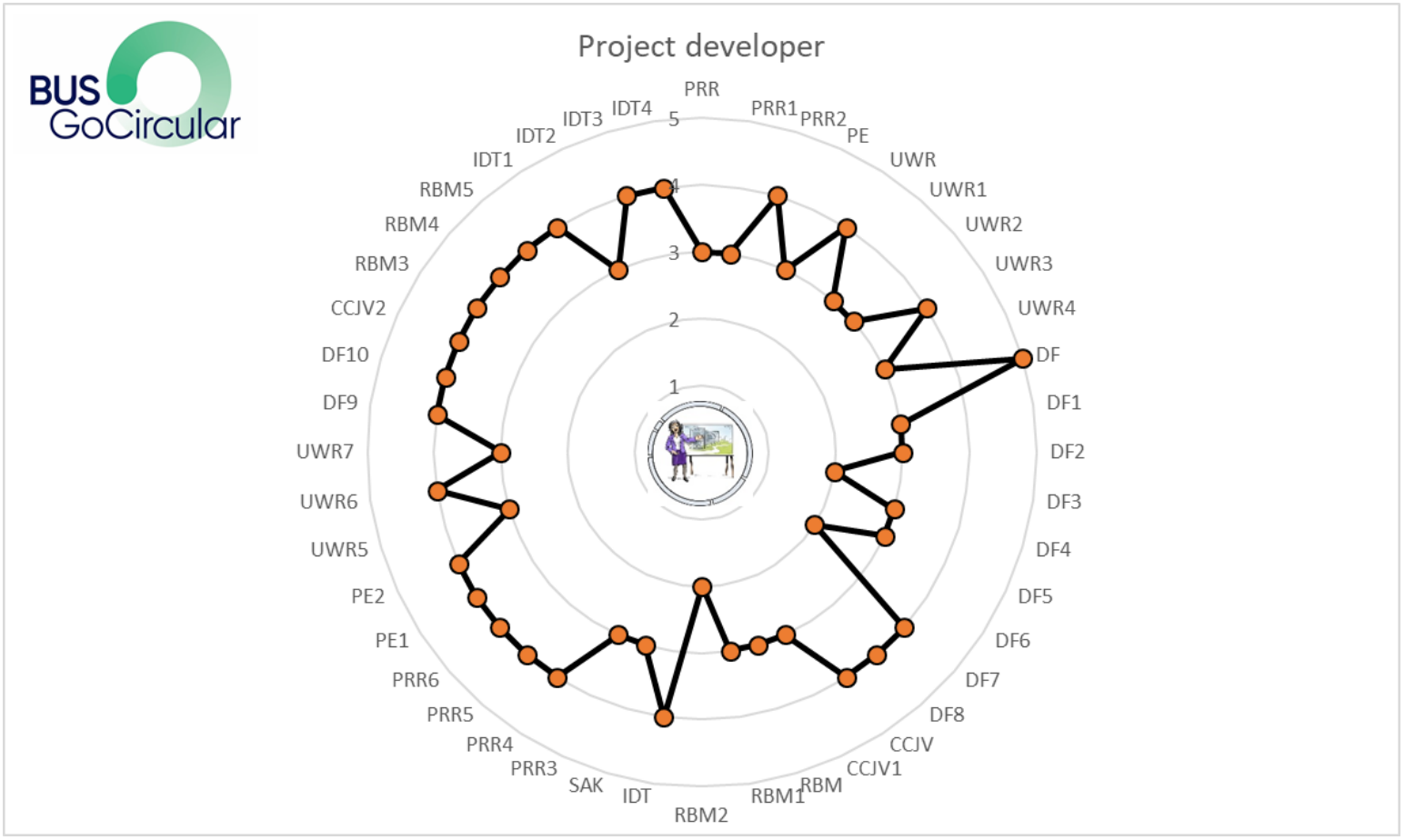

Figure 11: Future skills - Project Developer

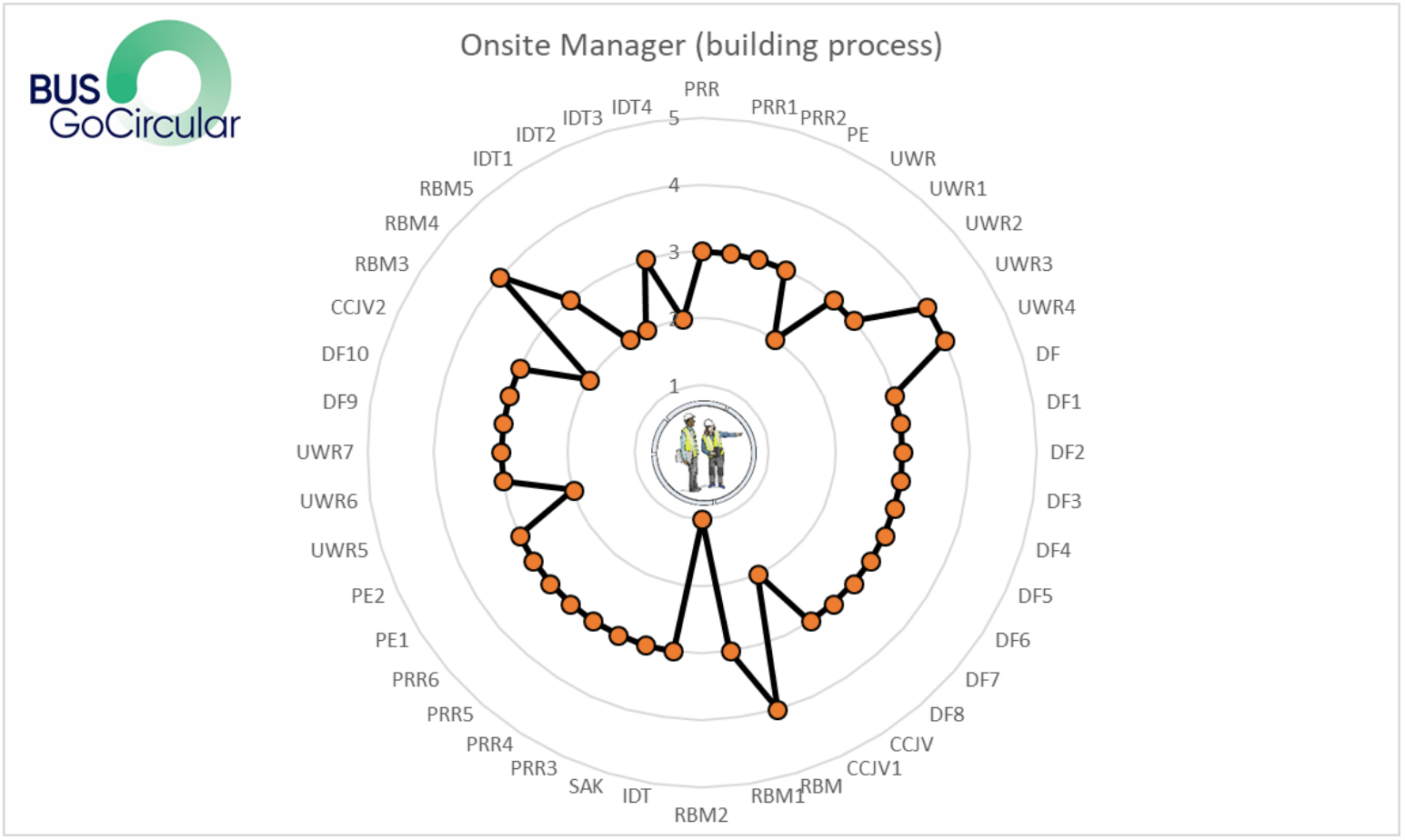

Figure 12: Future skills - Onsite Manager (Building Process)

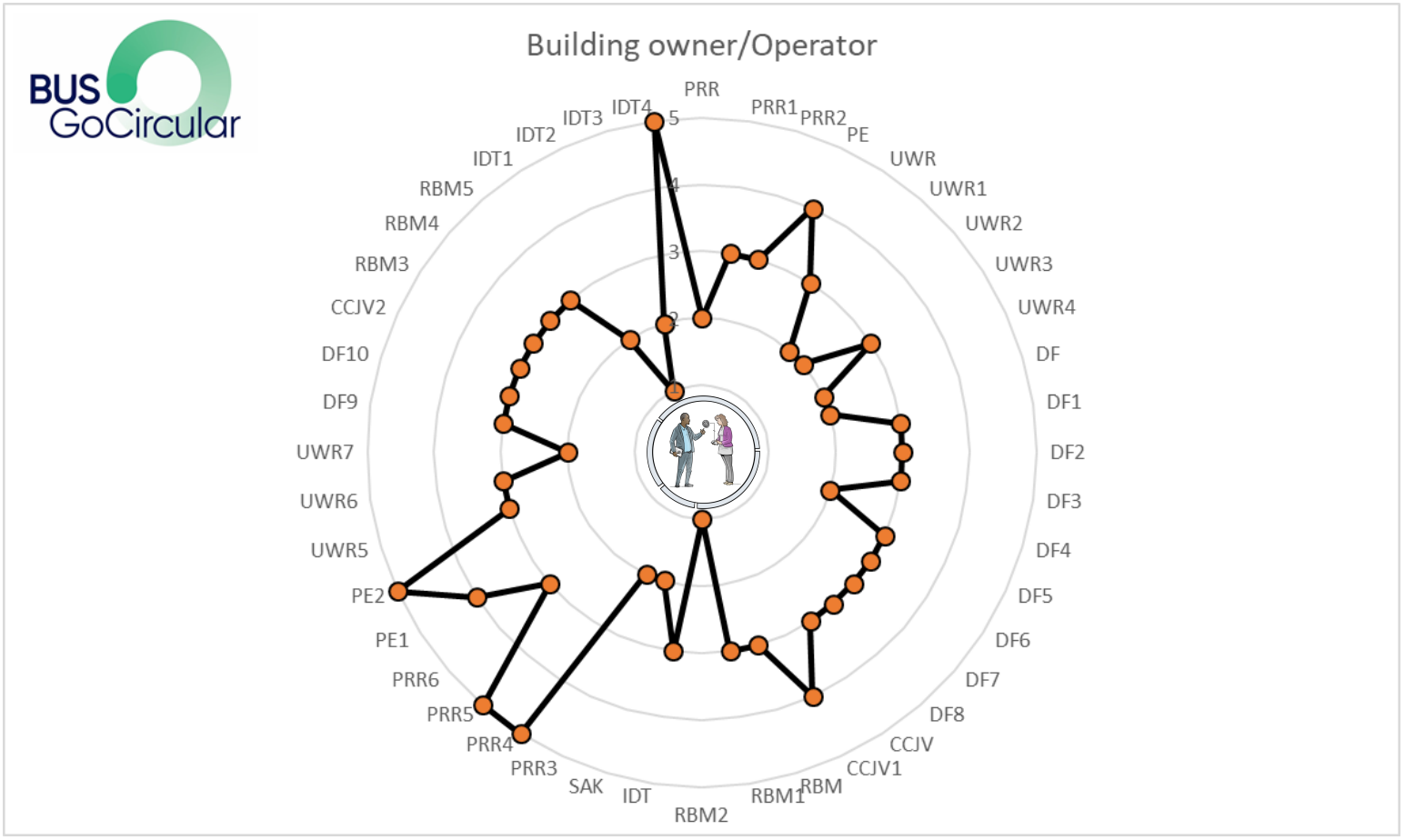

Figure 13: Future skills - Building Owner/Operator

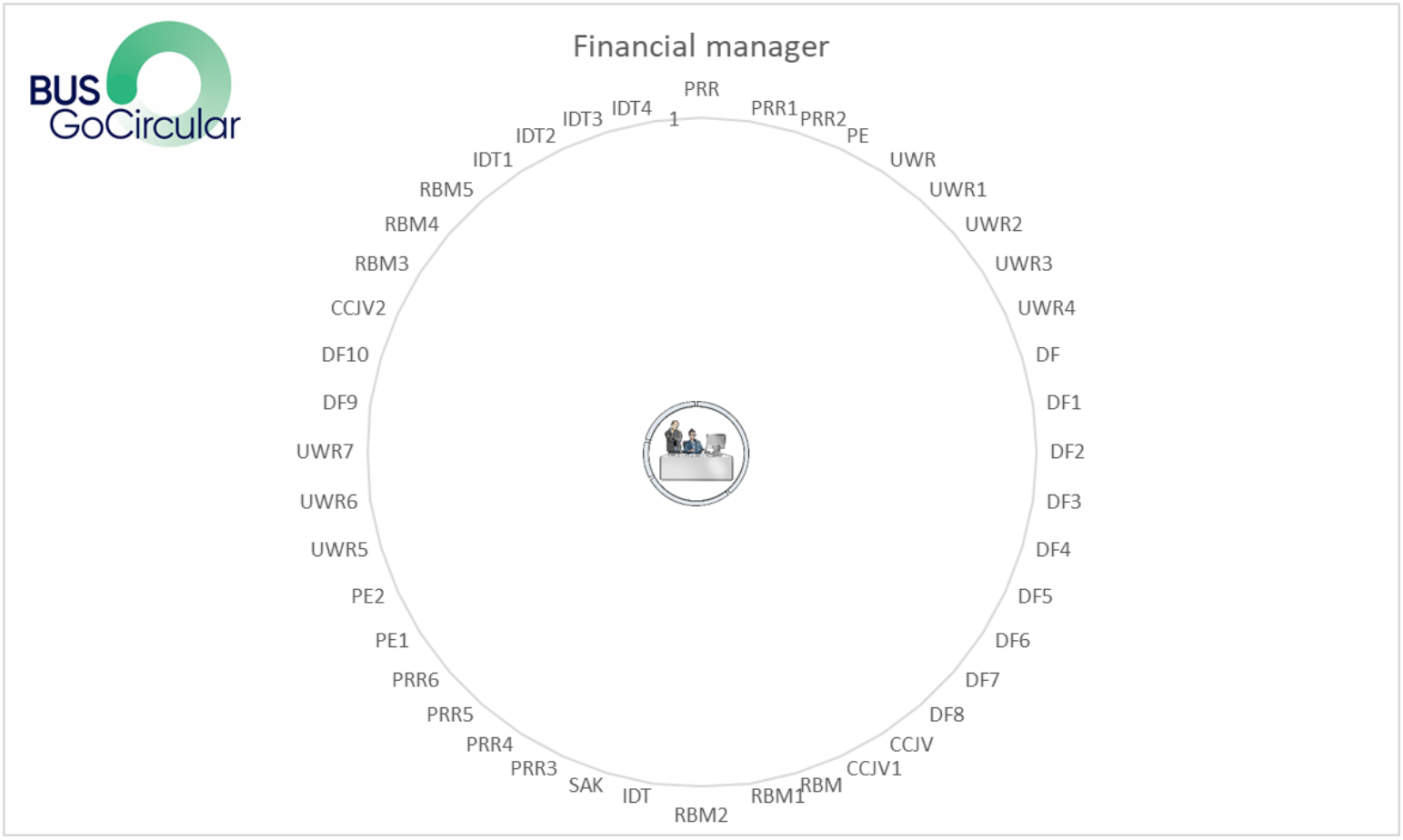

Figure 14: Future skills - Financial Manager

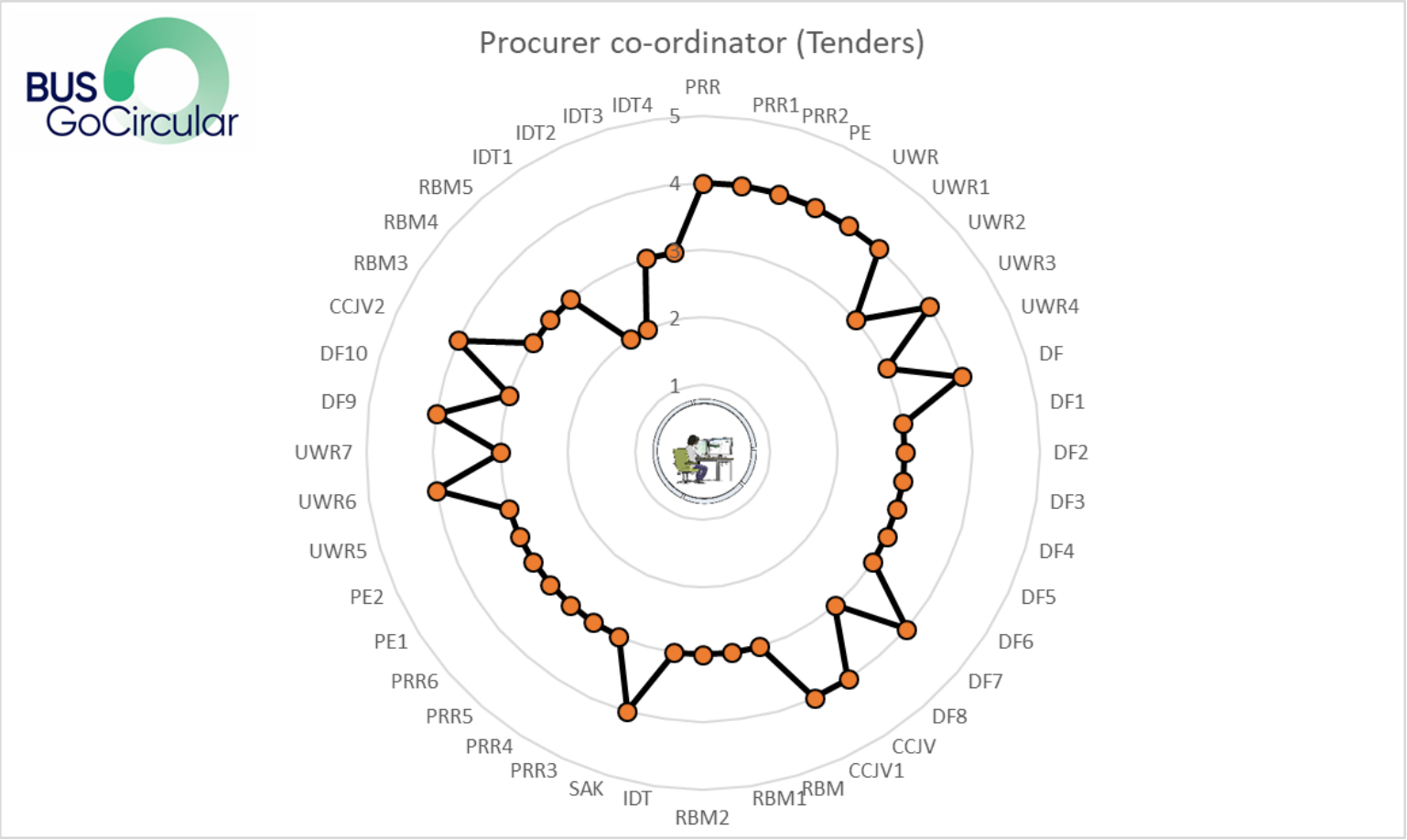

Figure 15: Future skills - Procurer Coordinator (Tenders)

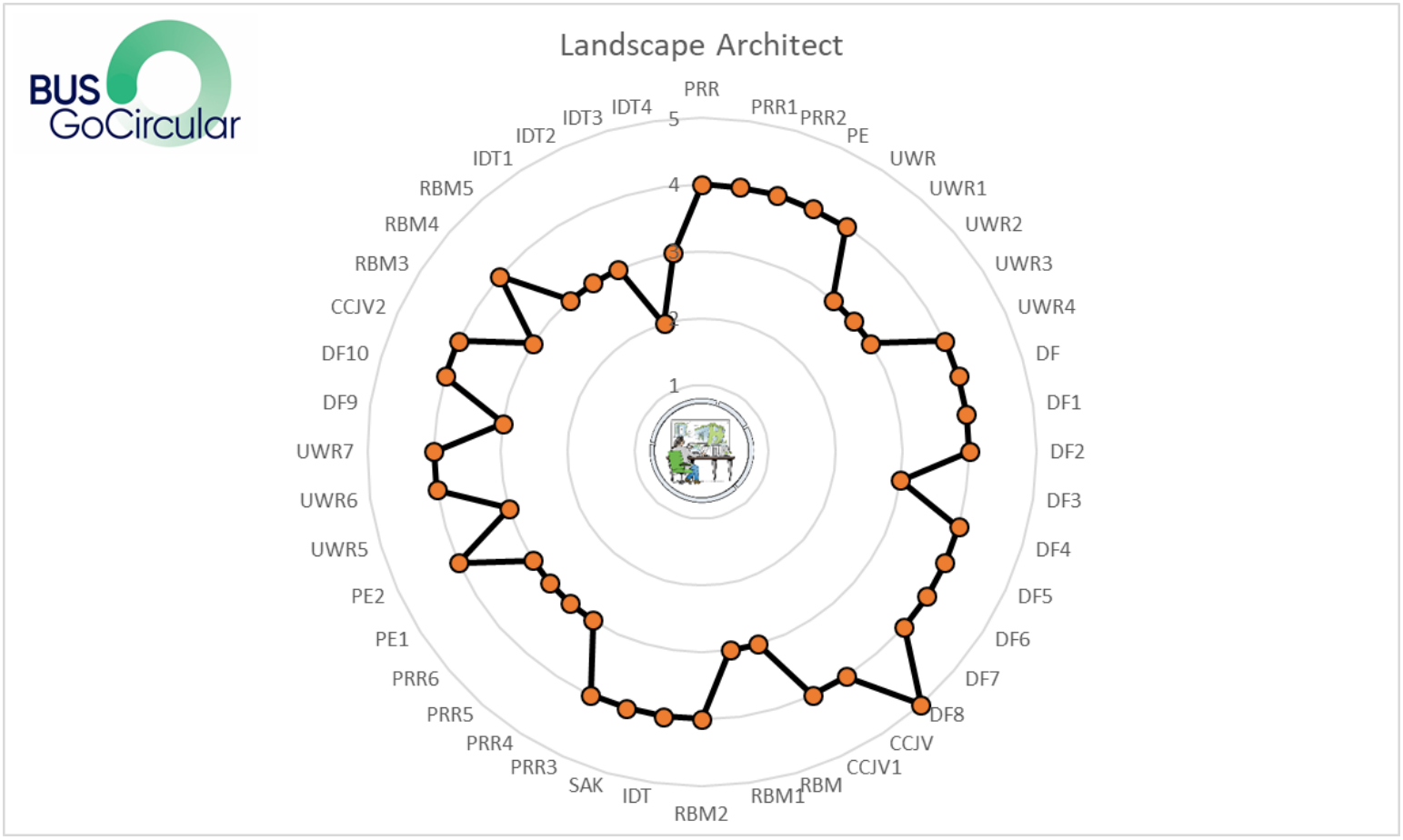

Figure 16: Future skills - Landscape Architect

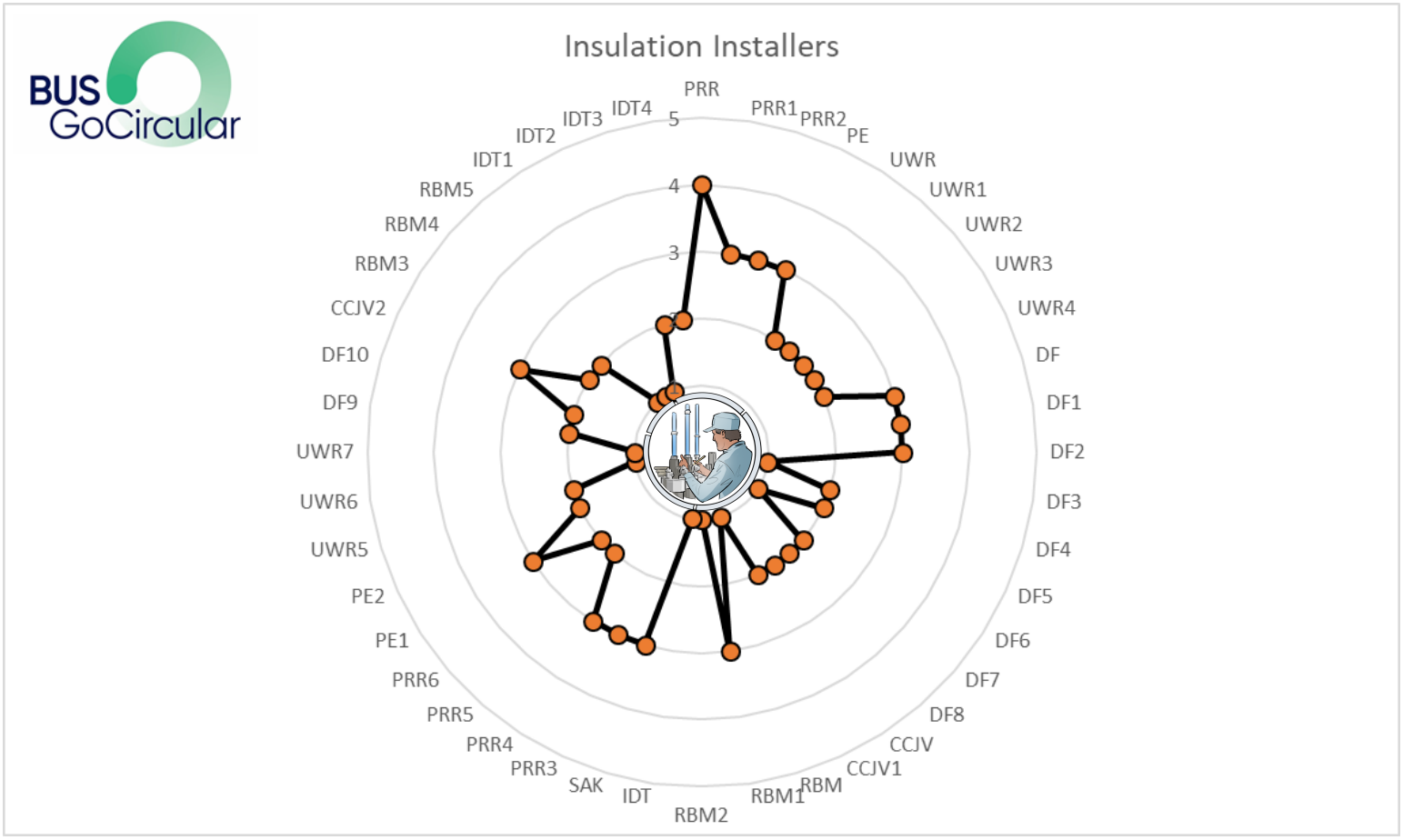

Figure 17: Future skills - Insulation Installer

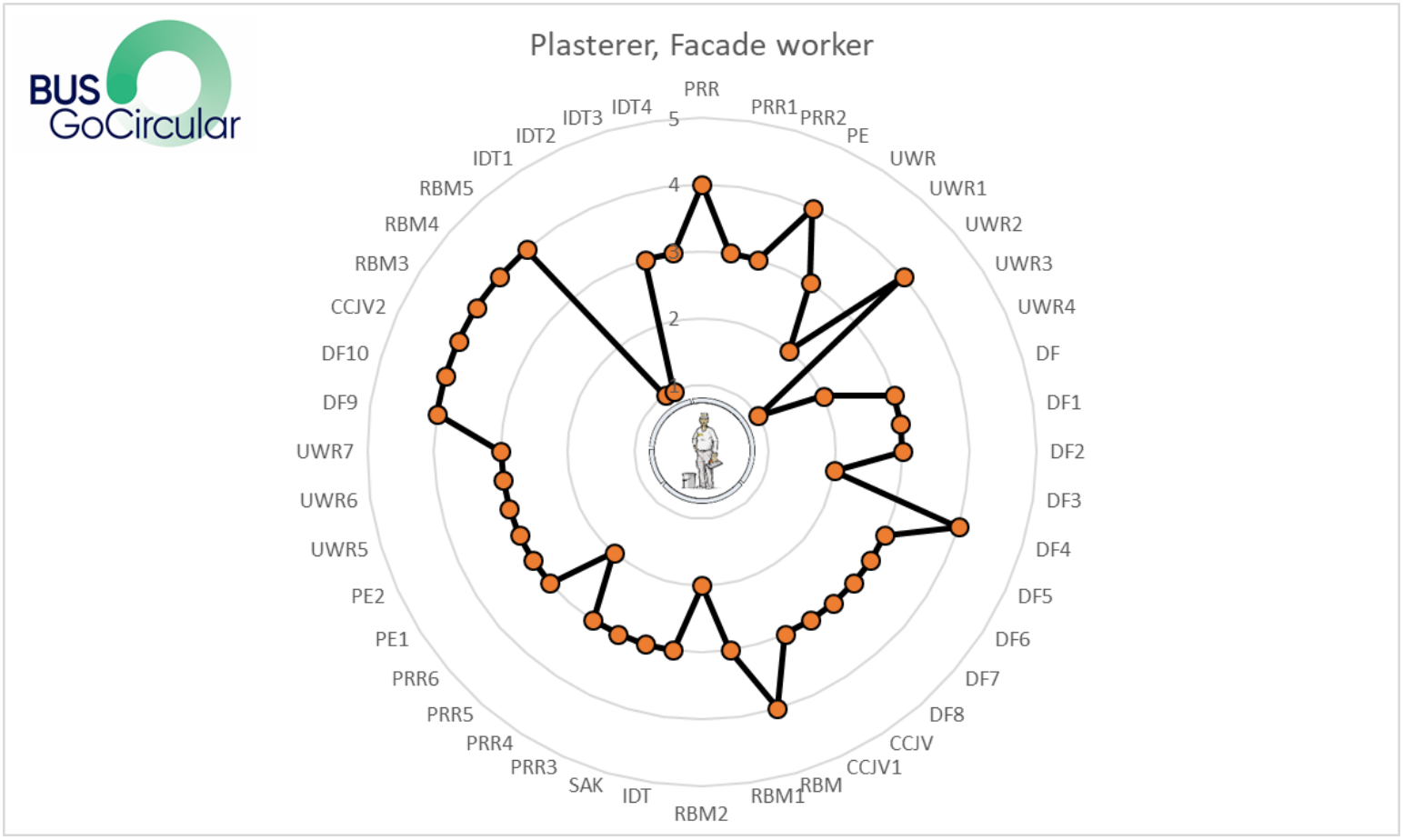

Figure 18: Future skills - Plasterer, Facade Worker

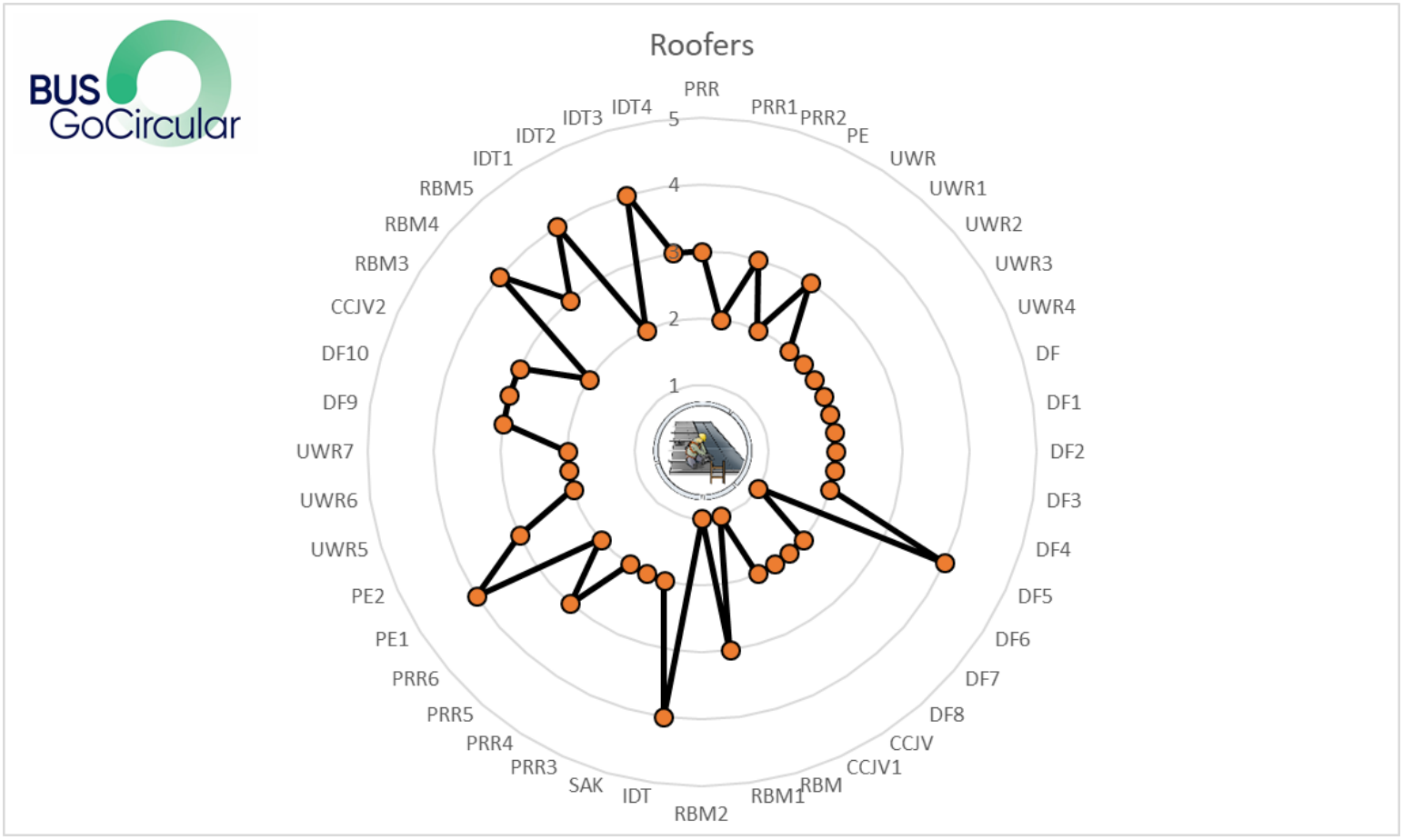

Figure 19: Future skills - Roofers

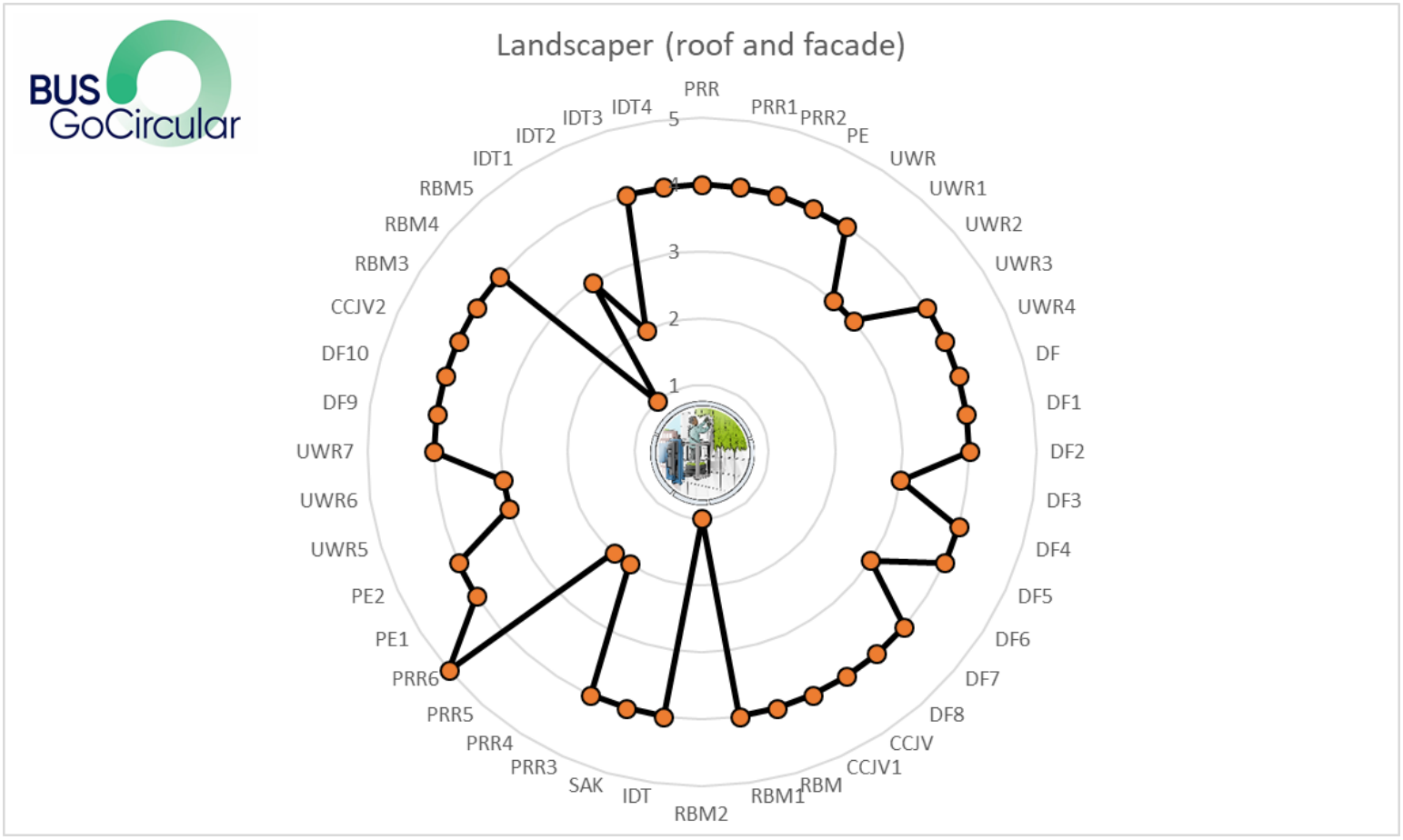

Figure 20: Future skills - Landscaper (Roof and Facade)

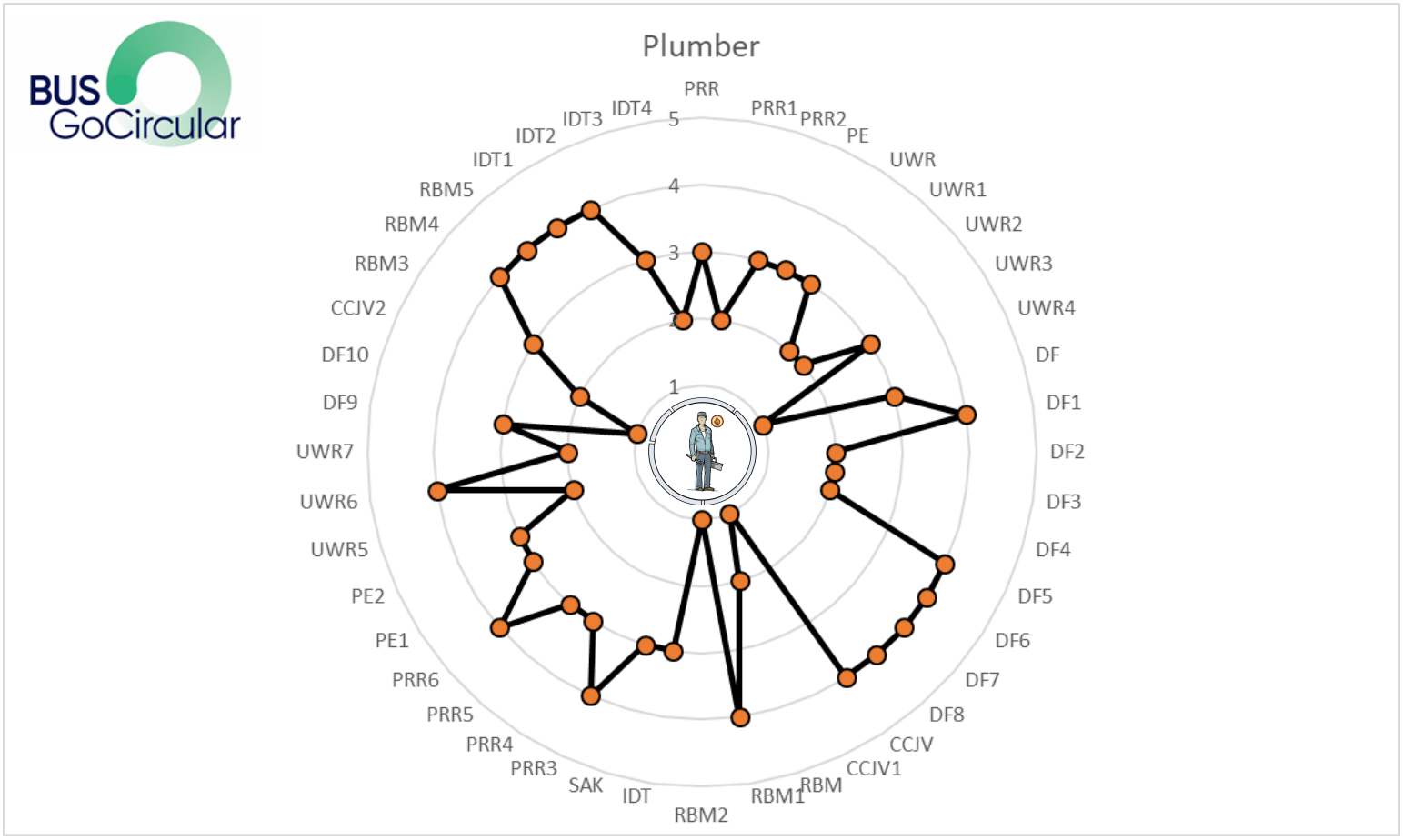

Figure 21: Future skills - Plumber

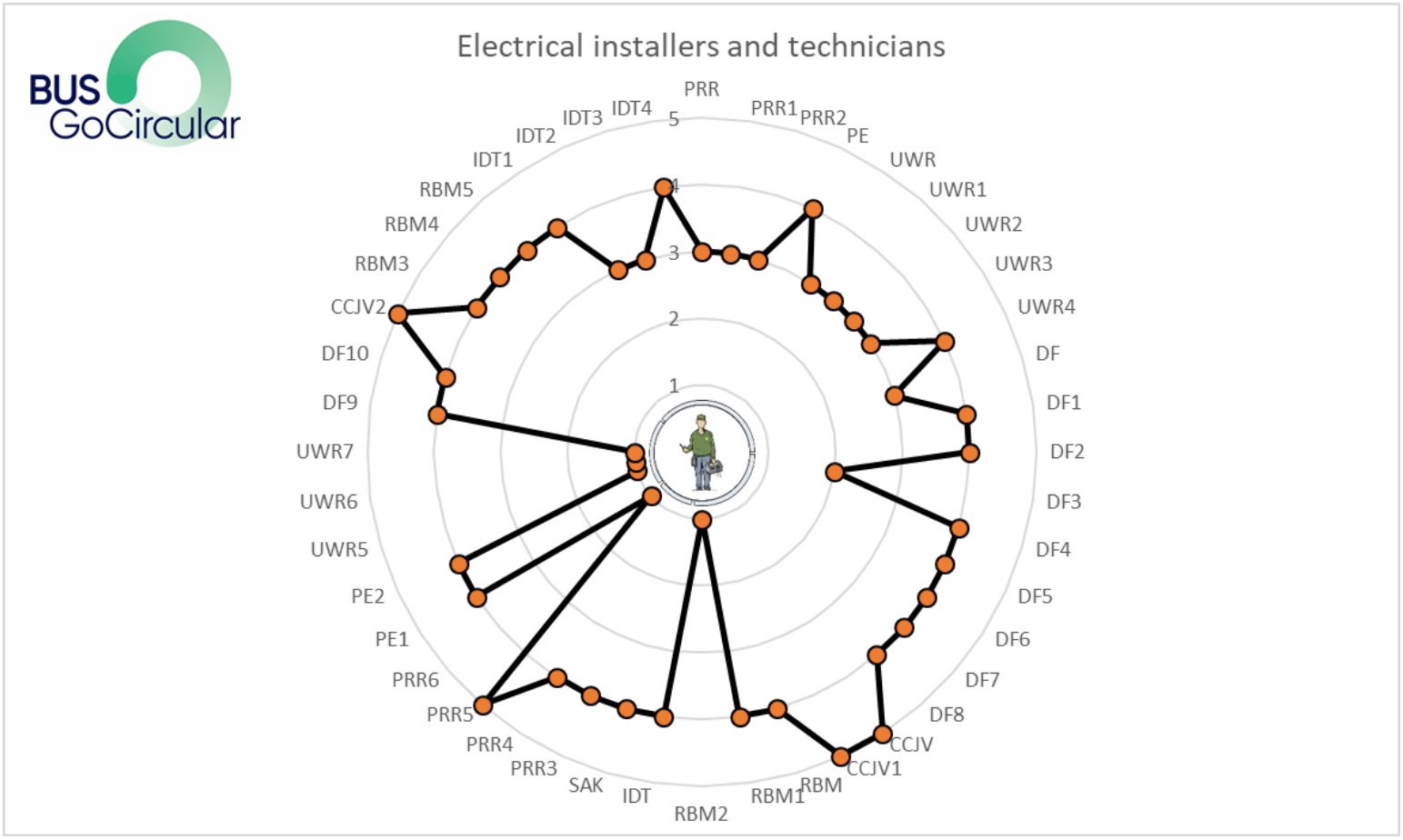

Figure 22: Future skills - Electrical Installer and Technicians

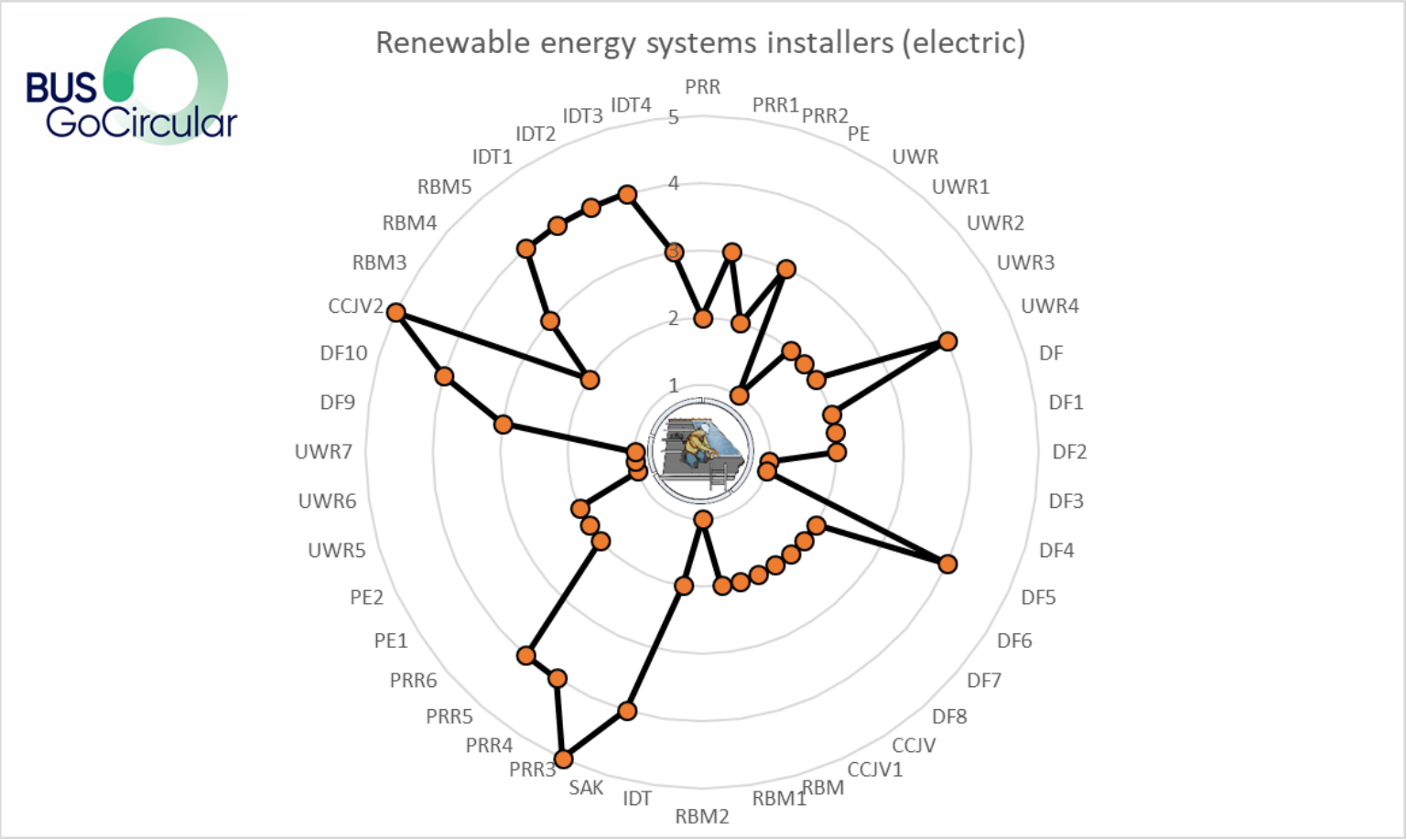

Figure 23: Future skills - Renewable Energy Systems Installers (Electric)

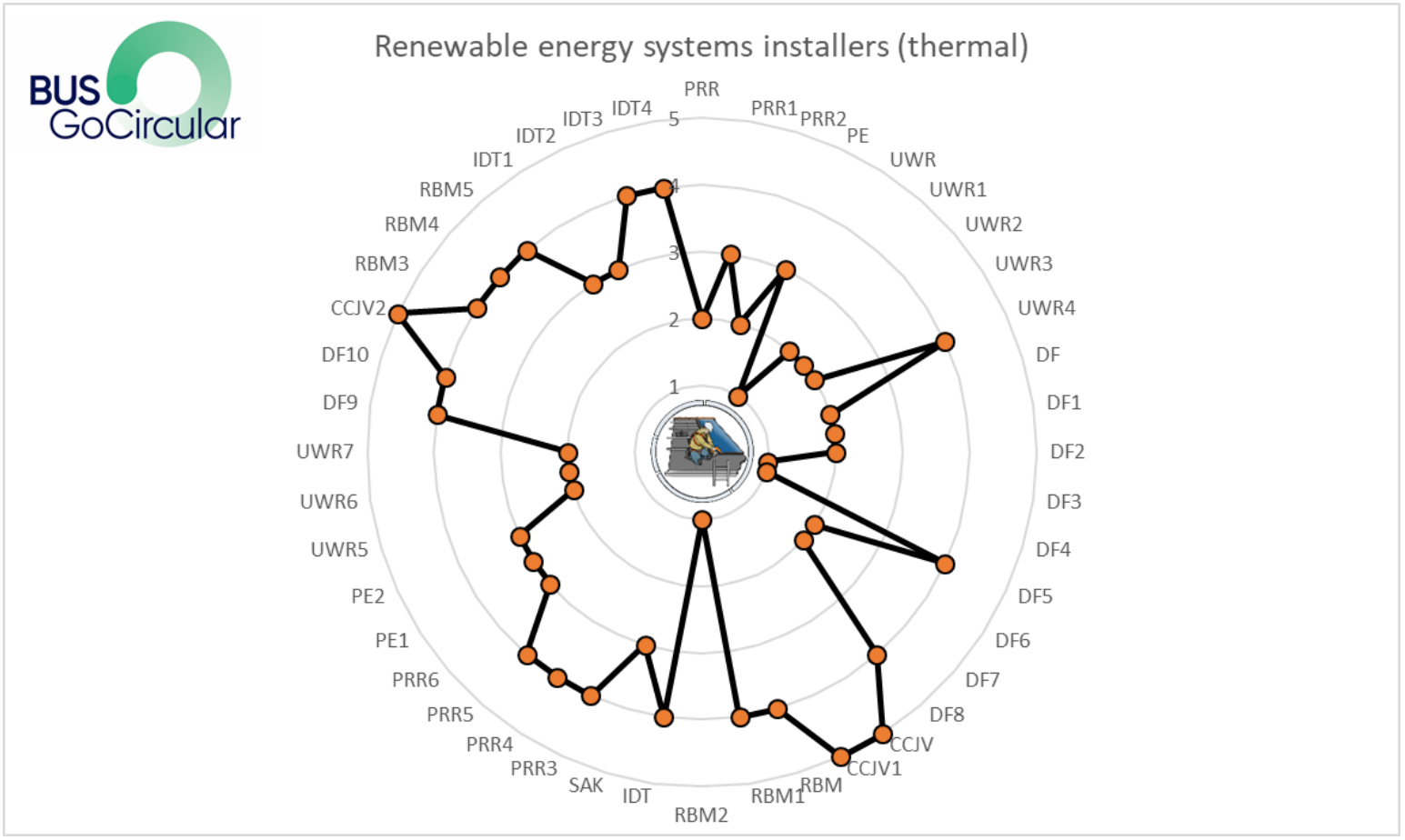

Figure 24: Future skills - Renewable Energy Systems Installers (Thermal)

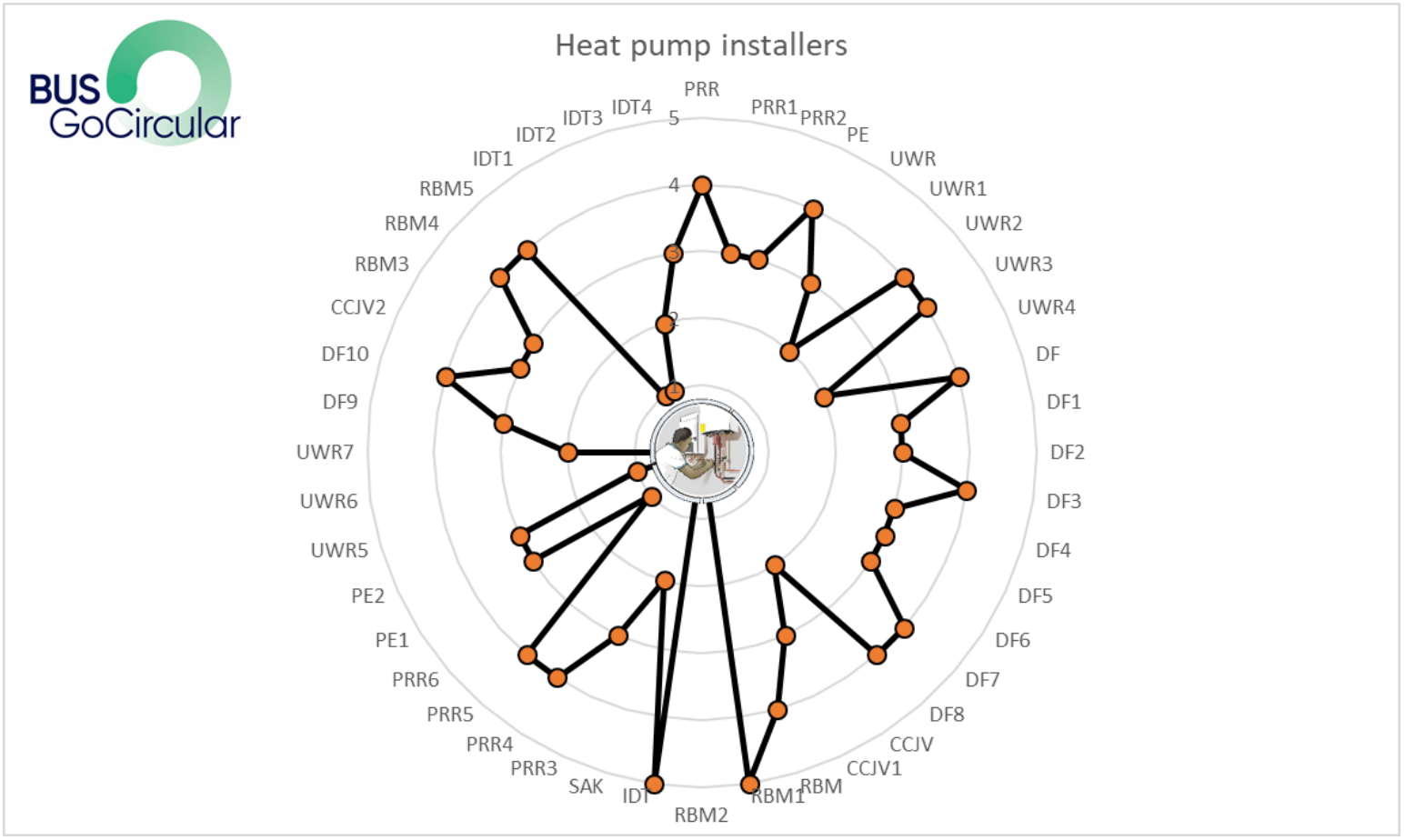

Figure 25: Future skills - Heat Pump Installers

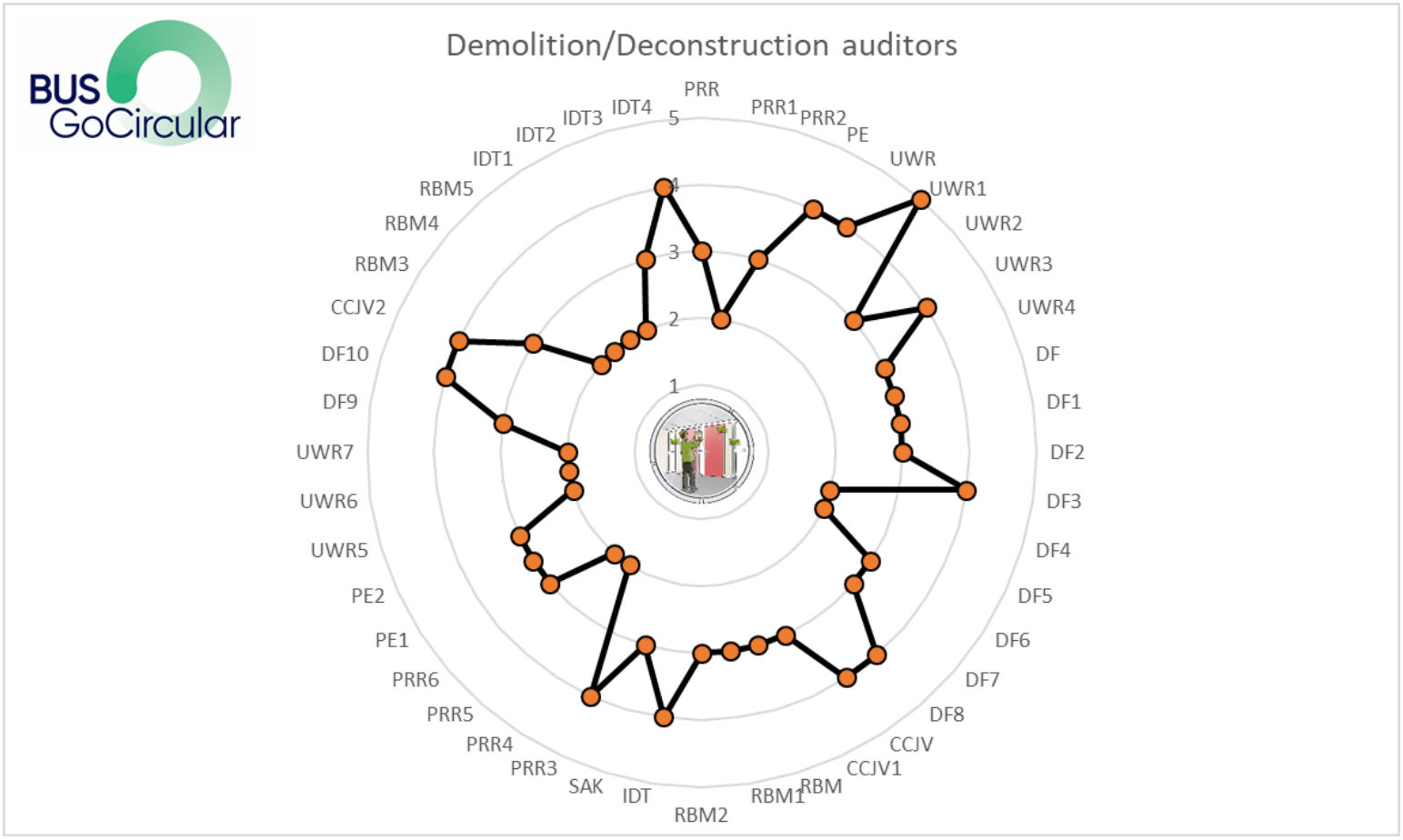

Figure 26: Future skills - Demolition/Deconstruction Auditors

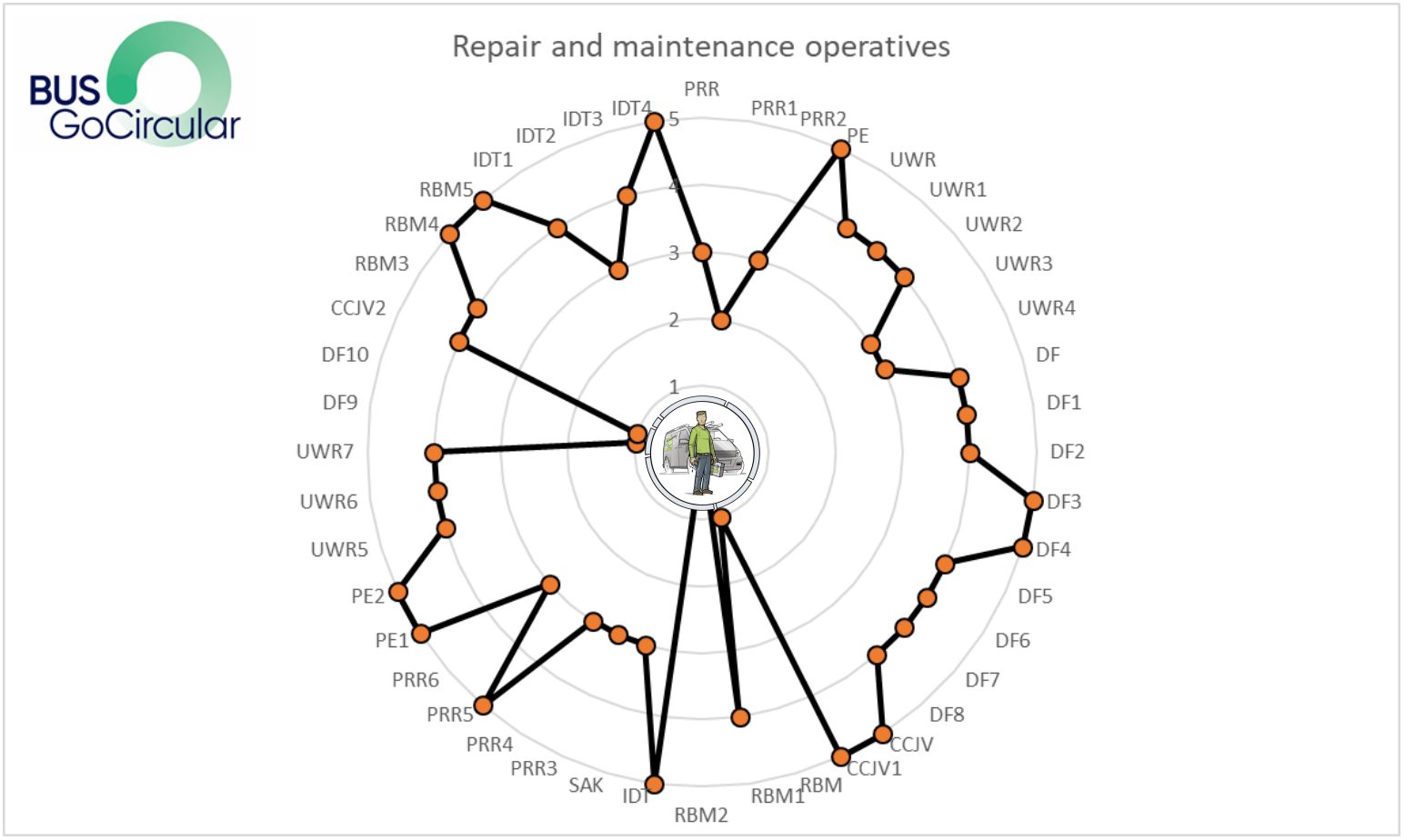

Figure 27: Future skills - Repair and Maintenance Operatives

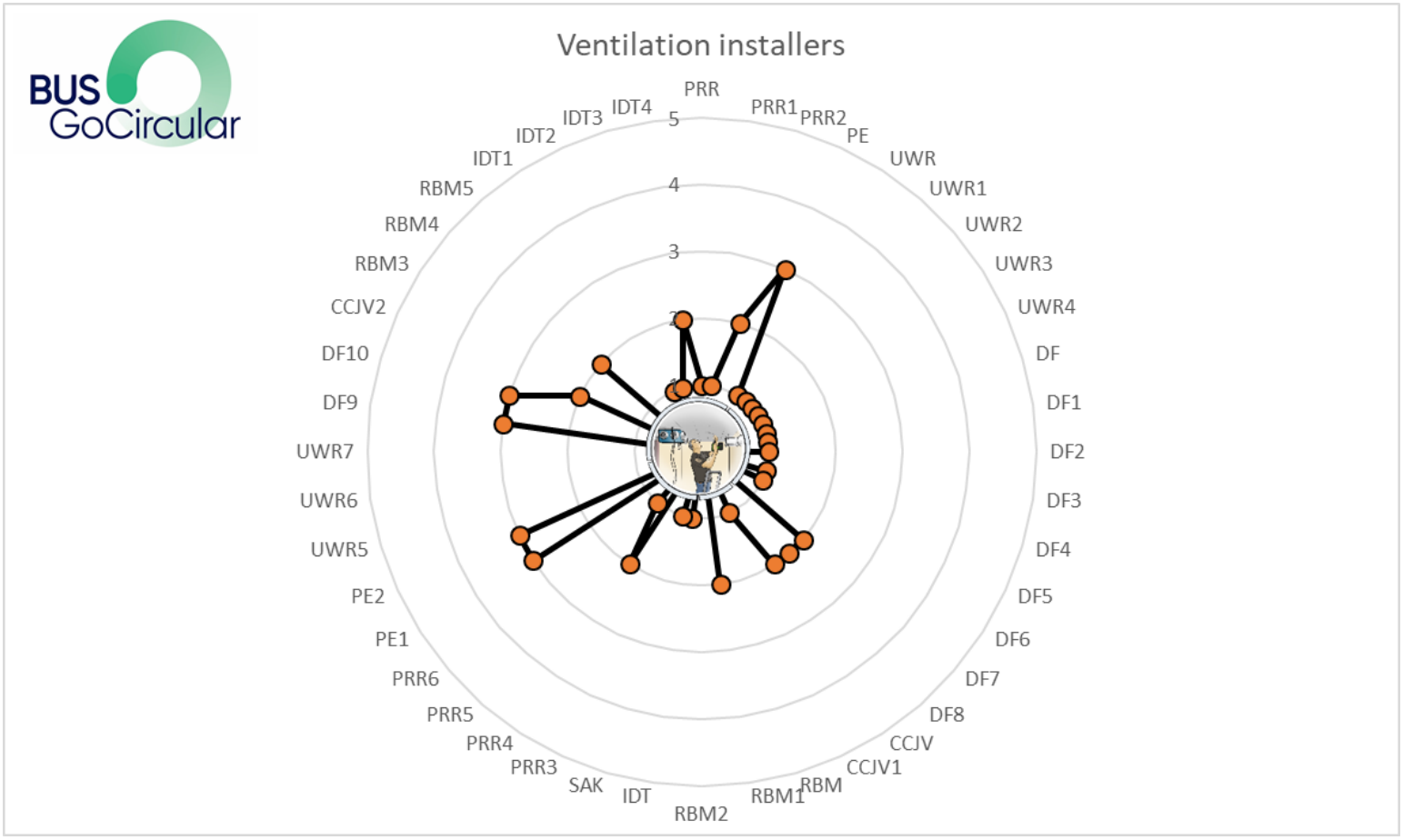

Figure 28: Future skills - Ventilation Installers

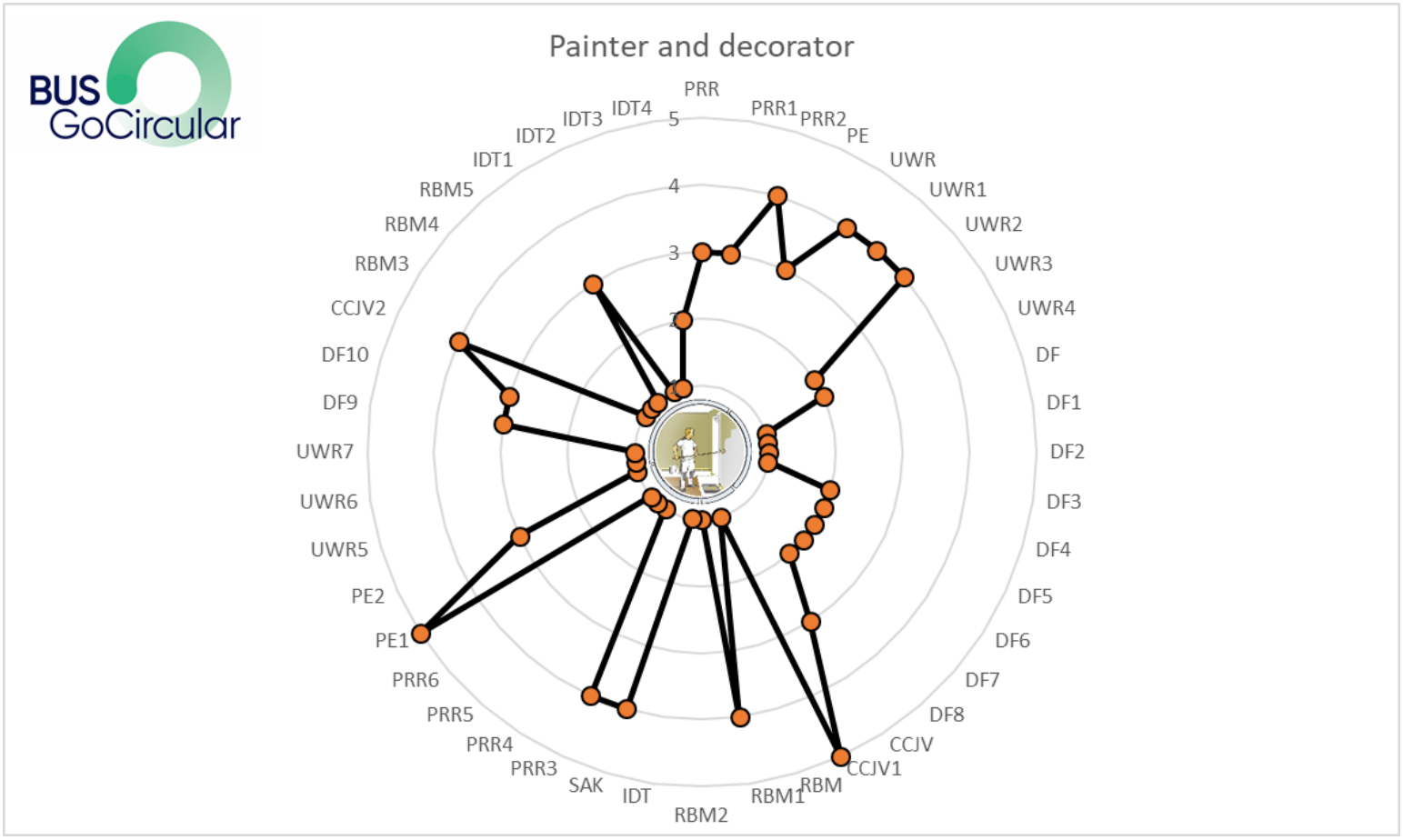

Figure 29: Future skills - Painter and Decorator

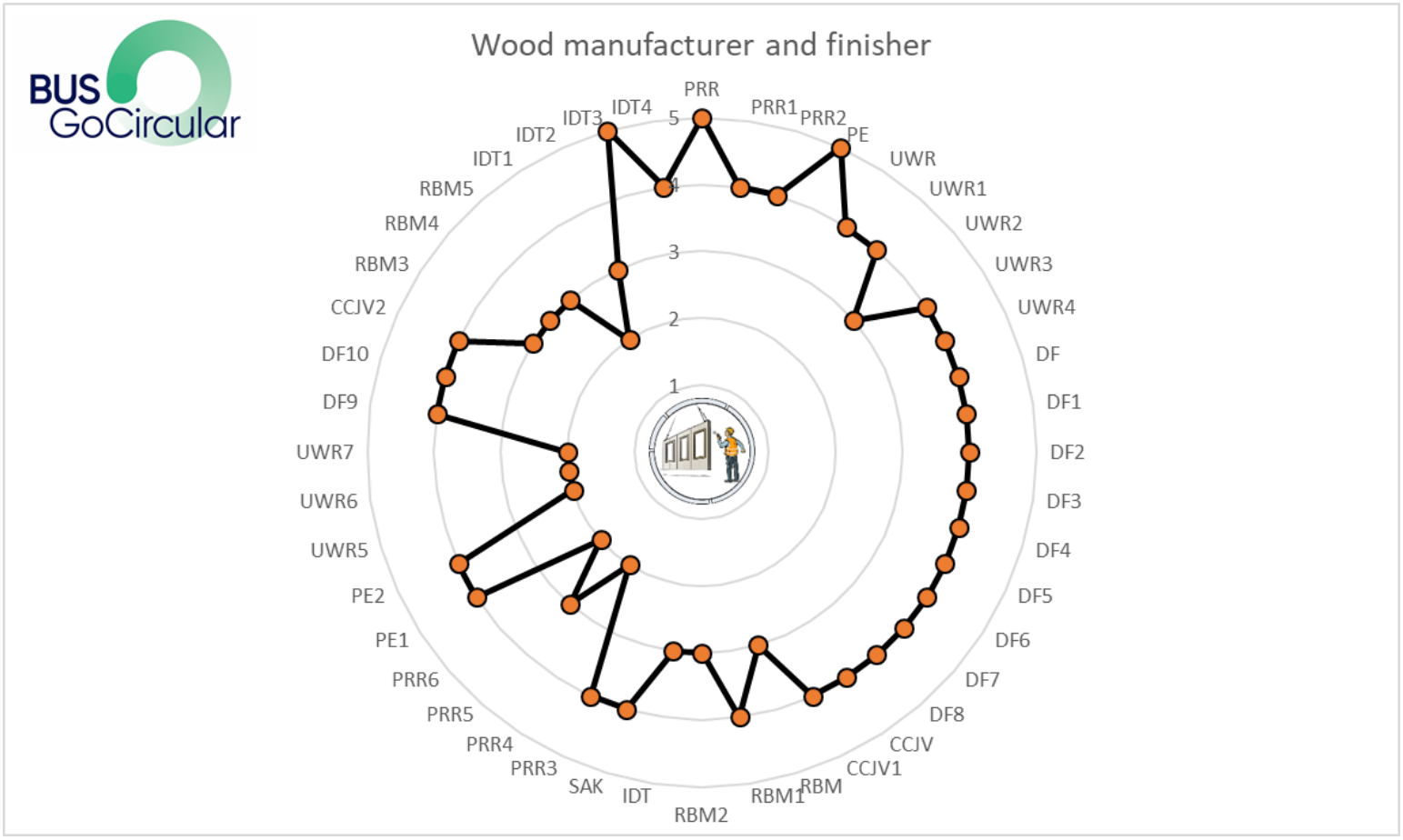

Figure 30: Future skills - Wood Manufacturer and Finisher

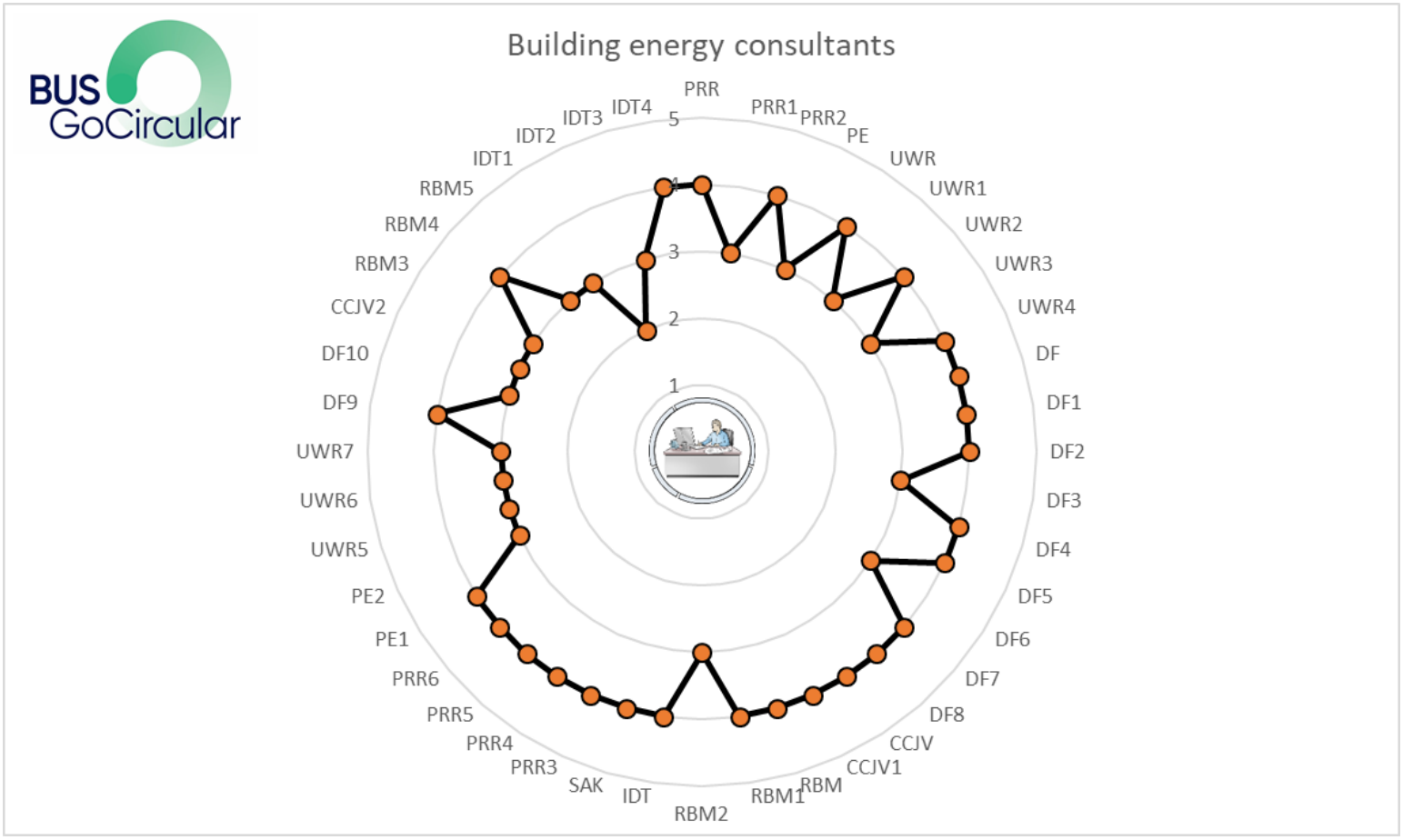

Figure 31: Future skills - Building Energy Consultants

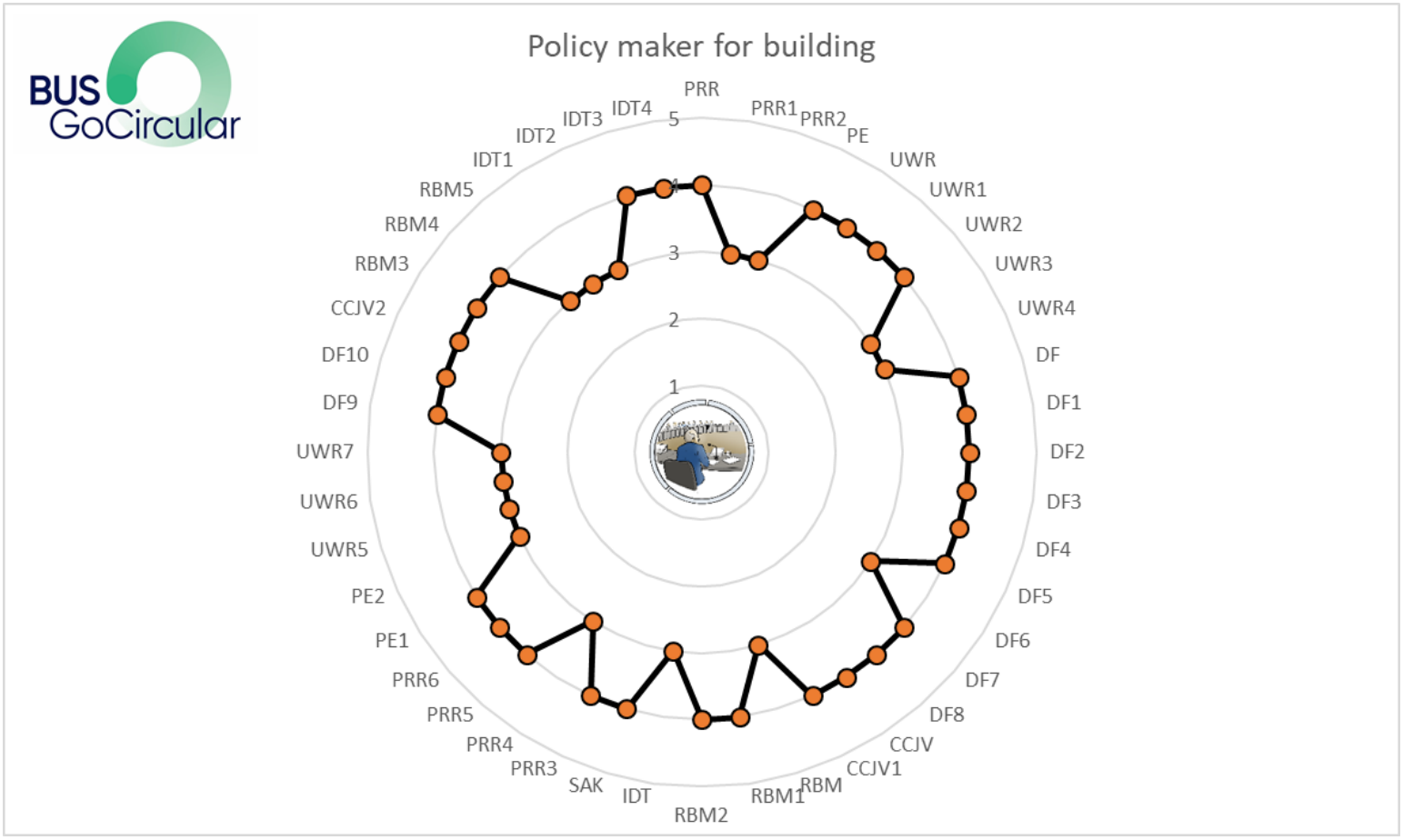

Figure 32: Future skills - Policy Maker for Building

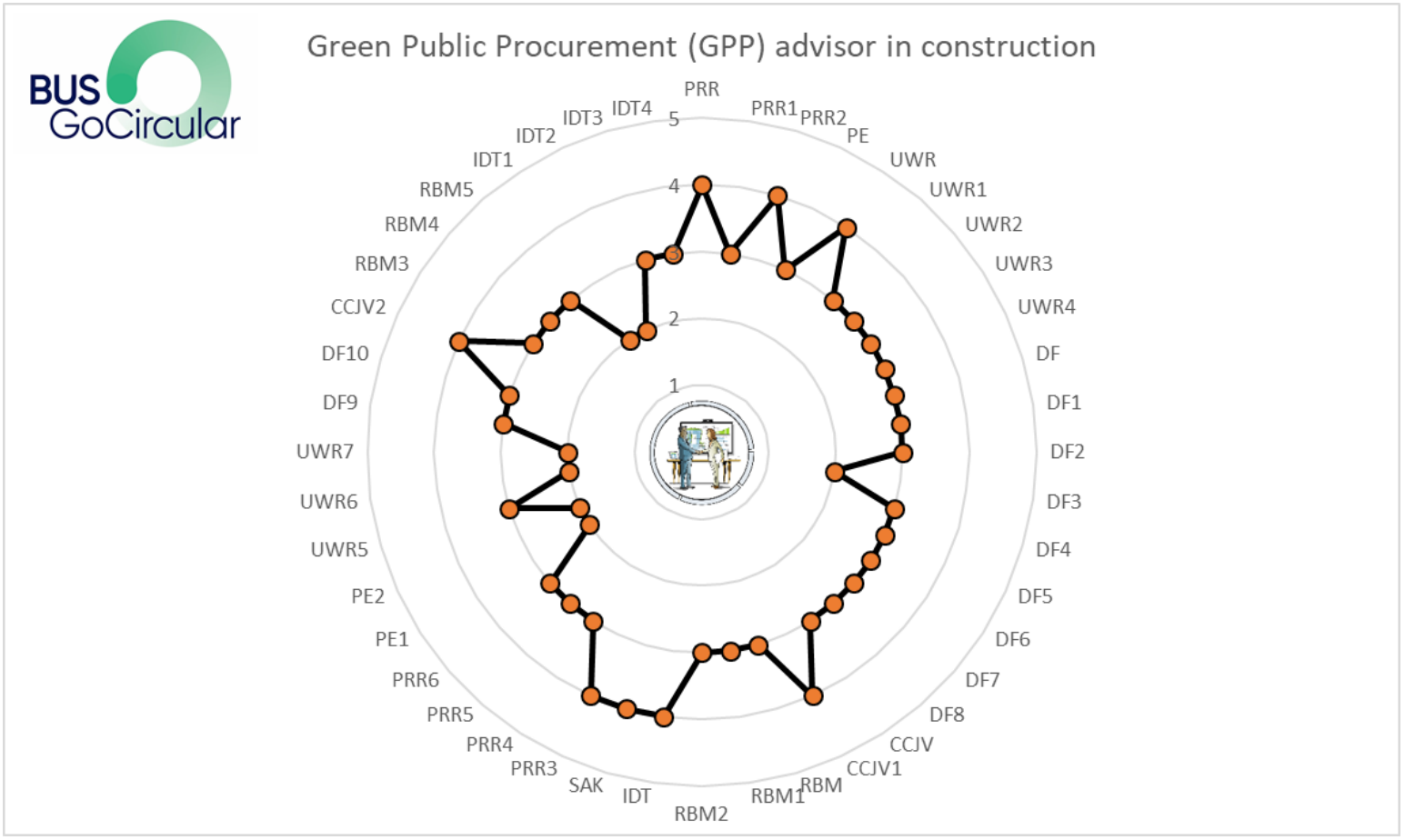

Figure 33: Future skills - Green Public Procurement (GPP) Advisor in Construction

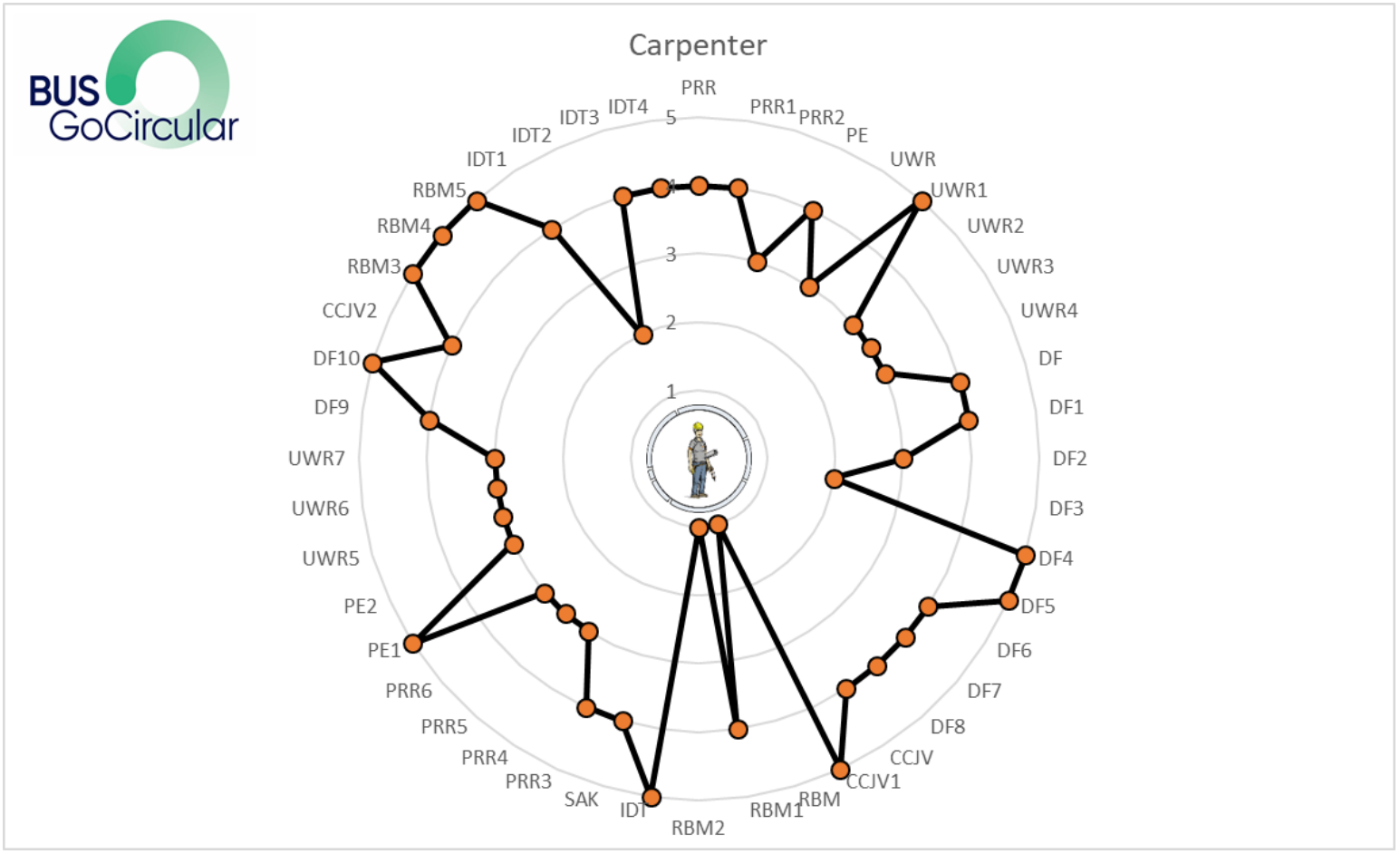

Figure 34: Future skills - Carpenter

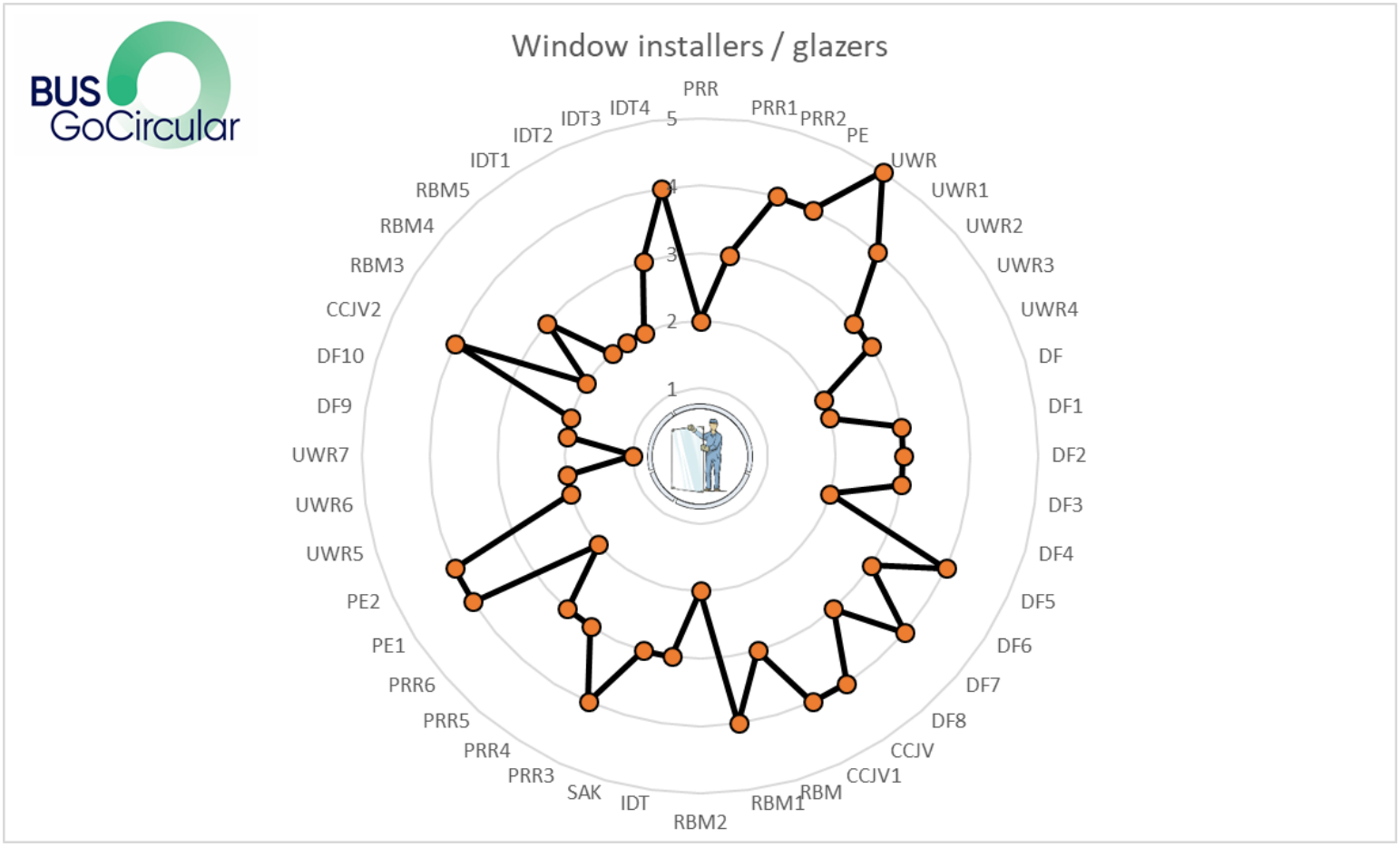

Figure 35: Future skills - Window Installers/Glazers

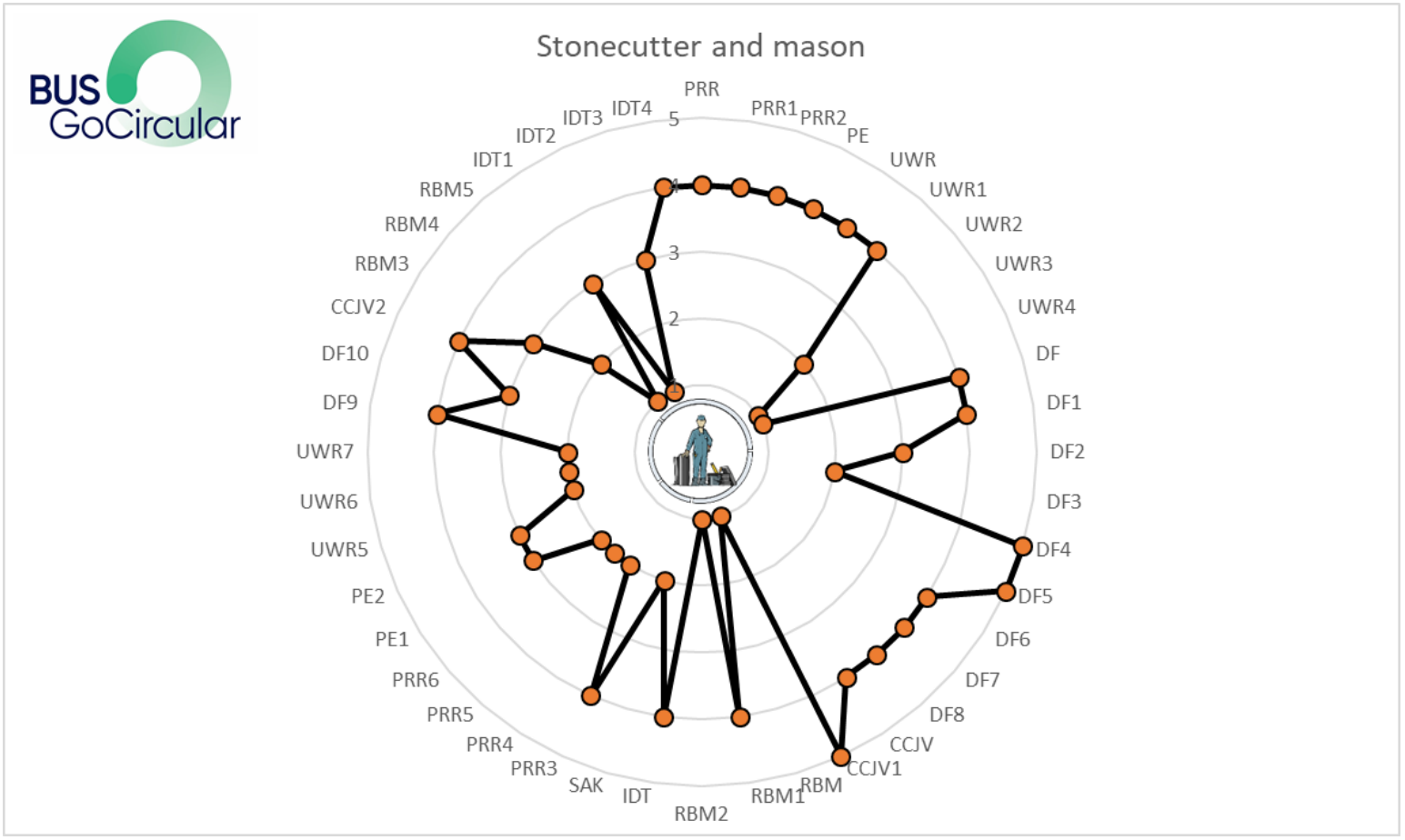

Figure 36: Future skills - Stonecutter and Mason

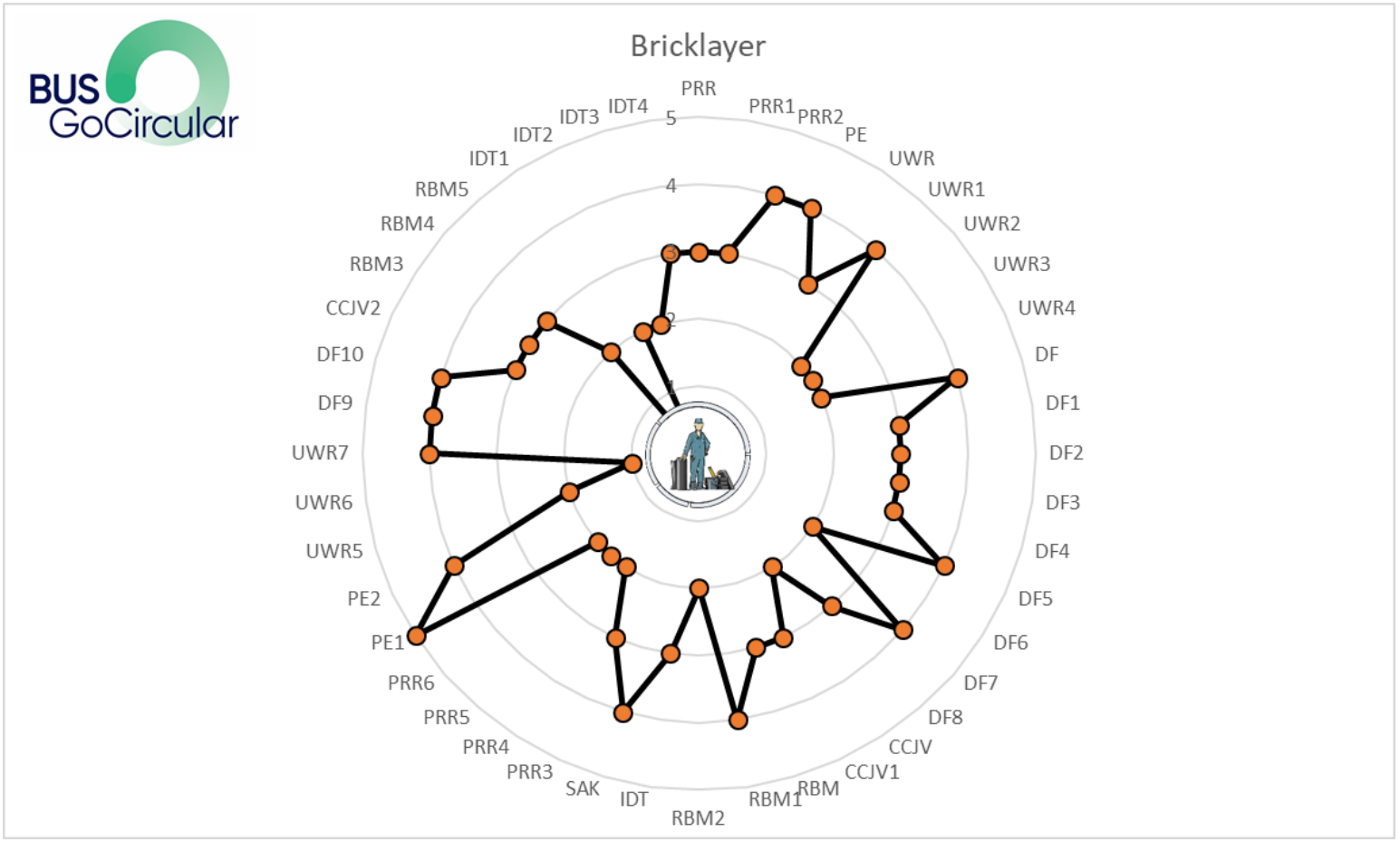

Figure 37: Future skills - Bricklayer

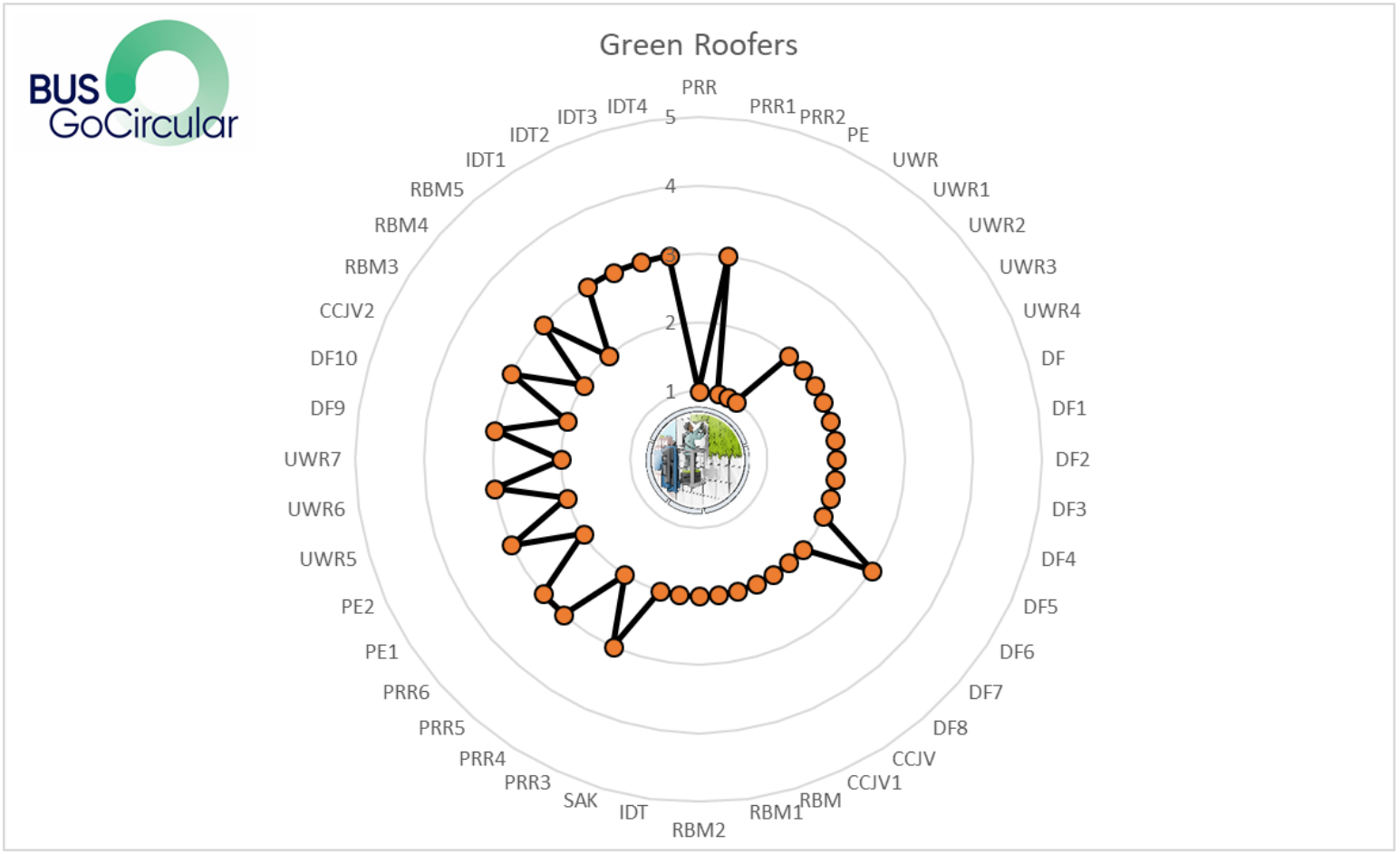

Figure 38: Future skills - Green Roofers

4. Future development and applications

Mapping of Required Skills and Skills Gaps provides a basis for the required upskilling needs within the construction industry. These mappings help to identify where gaps are most prevalent and therefore create training programs which can tackle these areas specifically with regard to circular strategies in the construction value chain relating to MGRFIE specifically. The development of a circular construction qualifications framework will build on this work and help us to develop these skills into Units of Learning Outcomes (ULO's) which can relate directly to the gaps we can identify. Together, these findings will enable the consortia to design a train-the-trainer programme that addresses the application of the frameworks developed, capacity building activities to provide formal and informal skill recognition on the qualification developed, and the national implementations which will tie all this work together.

Based on additional feedback from applying the skills mapping and other stakeholders applying the various circular strategies and interventions, the skills mapping can be further refined in the future. Furthermore, the lessons from applying the circular construction framework to the case of multifunctional green roofs, façades and interior elements provides valuable lessons on how the skills mapping can also be applied to other more specific circular built environment related focus areas, such as circular heat pumps and ventilation installations.

5. References

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APPENDIX 1 - Collection and collation of CPD courses.

Profession	Qualification	Type	EQF-IP	EQF-OP	Degree	Educational program in ENG [national name between brackets]	Educational provider in ENG [national name between brackets]	Training program in ENG [national name between brackets]	Training provider in ENG [national name between brackets]
Ireland									
TUS									
BIMzeED	Certificate	Various	No initial qualification necessary	5 to 7	Certificate	BIMzeED (Education for Near Zero Energy Buildings Using Building Information Modelling)	Technical University of the Shannon	Currently rolling out (Train The Trainer)	Technical University of the Shannon
The Green Register Event 2 of 3 - Roofs, External Walls & Floors - Best Practice Refurbishment Solutions for Residential Projects	Certificate	MOOC	No initial qualification necessary		Certificate		Ecological Building Systems	The Green Register Event 2 of 3 - Roofs, External Walls & Floors - Best Practice Refurbishment Solutions for Residential Projects	The GreenRegister of Construction Professionals
Ventilation Solutions for	Certificate	CPD Se	No initial qualifi		Certifi		Partel	Ventilation Solutions for	Partel

Energy-efficient Buildings		minar	cation necessary		cate			Energy-efficient Buildings	
Sustainable Construction and Development	Certificate - when fee is payed	MOOC	No initial qualification necessary		Certificate		CIOB Academy	Sustainable Construction and Development	CIOB Academy
NZEB training courses Ireland	Certificate	MOOC	No initial qualification necessary		Certificate		Waterford and Wexford training centre	Retrofit	Waterford and Wexford training centre
NZEB training courses Ireland	Certificate	MOOC	No initial qualification necessary		Certificate		Waterford and Wexford training centre	Electrical (Energy efficiency and quality in dwellings)	Waterford and Wexford training centre
The Netherlands									
ISSO, CE, BC									
New Business Models - Working Together on Value Creation	Unknown	MOOC	None				Radbout University	New Business Models - Working Together on Value Creation	Iversity
Circular Economy for a Sustainable Built Environment	Certificate (when fee is paid)	MOOC	None				Technical University of Delft	Circular Economy for a Sustainable Built Environment	EdX Courses
Circular Economy - Sustainable Materials Management	Certificate (when fee is paid)	MOOC	None				Lund University (and others)	Circular Economy - Sustainable Materials Management	Coursera

Zero Energy Design: an Approach to Make Your Building Sustainable	Certificate (when fee is paid)	MOOC	None				Technical University of Delft	Zero Energy Design: an Approach to Make Your Building Sustainable	EdX Courses
Bulgaria									
EnEffect, UASG									
Fit-to-nZEB / blue-collar worker	Certificate	Various	2nd EQF	2 EQF	Certificate			Specialist on deep energy retrofitting [Специалист по енергийно ефективно обновяване]	BKH-Bulgaria [Център за знания за енергийна ефективност и ВЕИ в сградите] PGSA-Pazardzhik [ПГСА-Пазарджик]
Fit-to-nZEB / professional high school/college	Certificate	Various	3-5 EQF	3-5 EQF	Certificate			Specialist on deep energy retrofitting [Специалист по енергийно ефективно обновяване]	PGSA-Pazardzhik [ПГСА-Пазарджик]
Fit-to-nZEB / higher education	Certificate	Various	6-7 EQF	6-7 EQF	Certificate	Deep energy retrofitting project management [Управление на проекти за енергийно ефективно сградно обновяване]	UACEG [УАСГ]		

Train-to-nZEB	Certificate	Various	6-7 EQF	6-7 EQF	Certificate			General principles of nZEB [Основни принципи на ПНЕС]	ВКН-Bulgaria [Център за знания за енергийна ефективност и ВЕИ в сградите]
Green Public Procurement under SPP Regions	Certificate	Classroom	6-7 EQF	6-7 EQF	Certificate			GPP specialists (Специалист по ЗеОП)	ЕнЕфект
Certified Passive House Designer course (incl. add-ons)	Certificate	Classroom	6-7 EQF	6-7 EQF	Certificate			Certified Passive House Designer (Сертифициран проектант на пасивни сгради)	Passive House Bulgaria [Пасивна къща България]
Czech Republic									
CVUT, INCIEN									
How to design new buildings after 2022 - nZEB theory and practice		CPD Seminar (webinar)	None					How to design new buildings after 2022 - nZEB theory and practice (Jak navrhovat nové budovy po roce 2022 – teorie a praxe nzeb)	Passive house center (Centrum pasivního domu)
Utilization of construction and demolition waste		CPD Seminar (we	None					Utilization of construction and demolition waste	ČKAIT Praha

		bin ar)						(Využití stavebních a demoličníc h odpadů)	
Ventilation and air conditionin g course 2022	Certifica te	CP D Co urs e	None			Ventilation and air conditioning course 2022 (Větrání a klimatizace)	Czech technical university, Faculty of Mechanica l Engineerin g (České vysoké učení technické v Praze, Fakulta strojní)		
Design of sustainable buildings and certification systems		CP D Se min ar	None					Design of sustainable buildings and certification systems (Navrhová ní šetrných budov a certifikační systémy)	ČKAIT Praha
The case of sustainable buildings		CP D Co urs e	None			Academy 15 - The case of sustainable buildings (Akademie 15 - problematika šetrných budov)	Czech council for sustainabl e buidldings (Česká rada pro šetrné budovy)		
Spain									
IVE, FEVEC									

Specialist in Life Cycle Analysis and Principles of Circular Economy	Certificate	MOOC	3-5 EQF	6-7 EQF	Certificate		Higher Institute of the Environment (ISM-Instituto Superior del Medio Ambiente)	Specialist in Life Cycle Analysis and Principles of Circular Economy (Especialista en Análisis de Ciclo de Vida y Principios de la Economía Circular)	Higher Institute of the Environment (ISM-Instituto Superior del Medio Ambiente)
Managing smart and sustainable cities	Certificate	Classroom	3-5 EQF	6-7 EQF	Certificate	Degree in management of smart and sustainable cities (Grado en Gestión de Ciudades Inteligentes y Sostenibles)	School of Engineering-Autonomous University of Barcelona (Escuela de Ingeniería-Universidad Autónoma de Barcelona)	Degree in Management of Smart and Sustainable cities (Grado en Gestión de Ciudades Inteligentes y Sostenibles)	School of Engineering-Autonomous University of Barcelona (Escuela de Ingeniería-Universidad Autónoma de Barcelona)
International Master in Circular Construction	Certificate	Online	6-7 EQF	6-7 EQF	Certificate	International Master in Circular Construction (Máster Internacional en Construcción Circular)	Zigurat-Global Institute of Technology	International Master in Circular Construction (Máster Internacional en Construcción Circular)	Zigurat-Global Institute of Technology
Architecture and Health	Certificate	Classroom and Streaming	6-7 EQF	6-7 EQF	Certificate			Architecture and Health (Arquitectura y Salud)	Association of Architects of Catalonia-School of Professional Practice "Josep Lluís Sert". (Colegio de Arquitectos de

									Cataluña-Escuela de práctica profesional "Josep Lluís Sert")
Applying the circular economy to the construction industry	Certificate	Classroom and e-learning	3-5 EQF	5 EQF	Certificate	Applying the circular economy to the construction industry (Aplicación de la economía circular a la construcción)	State Public Employment Service-SEPE (Servicio Público de Empleo Estatal-SEPE)	Applying the circular economy to the construction industry (Aplicación de la economía circular a la construcción)	
Bioconstruction	Certificate	Classroom and e-learning	3-5 EQF	5 EQF	Certificate	Bio Construction (BIOCONSTRUCCIÓN)	State Public Employment Service-SEPE (Servicio Público de Empleo Estatal-SEPE)	Bio Construction (BIOCONSTRUCCIÓN)	
CTE-HE 2013: Compliance with the basic document on energy saving and energy certification of buildings	Certificate	e-learning	6-7 EQF	6-7 EQF	Certificate			CTE-HE 2013: Compliance with the basic document on energy saving and energy certification of buildings	Construction Labour Foundation (Fundación Laboral de la Construcción)
NZEB Buildings - PASSIVHAUS Standard	Certificate	Online	6-7 EQF	6-7 EQF	Certificate			NZEB BUILDINGS - PASSIVHAUS STANDARD	Association of Architects of Catalonia-School of Professional Practice "Josep Lluís Sert". (Colegio de Arquitectos de Cataluña-E

									scuela de práctica profesional "Josep Lluís Sert")
Croatia									
UZ-FCE									
BIMzeED	Certificate	Various	No initial qualification necessary	5 to 7	Certificate	BIMzeED (Education for Near Zero Energy Buildings Using Building Information Modelling)	University of Zagreb, Faculty of Civil Engineering	Currently rolling out (Train The Trainer and pilot trainings)	University of Zagreb, Faculty of Civil Engineering
Fit-to-nZEB / higher education	Certificate	CPD course	6-7 EQF	6-7 EQF	Certificate	Continuous professional development program of the University of Zagreb, Faculty of Civil Engineering	University of Zagreb, Faculty of Civil Engineering	Energy renovation of buildings to the NZEB level [Energetska obnova zgrada do razine gotovo nulte energije (NZEB)]	University of Zagreb, Faculty of Civil Engineering
Design and construction of NZEBs	Certificate	CPD course	6-7 EQF	6-7 EQF	Certificate	Continuous professional development program of the University of Zagreb, Faculty of Civil Engineering	University of Zagreb, Faculty of Civil Engineering	Design and construction of NZEB [Projektiranje i izvođenje zgrada gotovo nulte energije (NZEB)]	University of Zagreb, Faculty of Civil Engineering

CROSKILLS	Certificate	CPD course	2-4 EQF	2-4 EQF	Certificate	Regulation on the system of training and certification of construction workers installing parts of the building affecting energy efficiency in buildings [Pravilnik o sustavu izobrazbe i certificiranja građevinskih radnika koji ugrađuju dijelove zgrade koji utječu na energetsku učinkovitost u zgradarstvu]	11 Training centers throughout Croatia	CROSKILLS training (CROSKILLS izobrazba)	11 Training centers throughout Croatia
GBPro	Certificate	CPD course	6-7 EQF	6-7 EQF	Certificate	Green Building Professional - Green Builging Council Croatia	Green Builging Council Croatia	Green Building Professional educational program [Green Building Professional edukacijski program]	Green Builging Council Croatia
Educational module: Affirmation of green building	Certificate	CPD course	6-7 EQF	6-7 EQF	Certificate	Continuous professional development of the Croatian Chamber of Civil Engineers	Croatian Chamber of Civil Engineers	Educational module: Affirmation of green building [Edukativni modul: Afirmacija zelene gradnje]	Croatian Chamber of Civil Engineers
Construction, sustainable construction and context	Certificate	CPD course	6-7 EQF	6-7 EQF	Certificate	Continuous professional development of the Croatian Chamber of Architects	Croatian Chamber of Architects	Construction, sustainable construction and context [Gradnja, održiva	Croatian Chamber of Architects

								gradnja i kontekst]	
DGNB training	Certificate	CPD course	6-7 EQF	6-7 EQF	Certificate	DGNB International Certificate for Sustainable Construction [DGNB međunarodni certifikat za održivu gradnju]	Greenika	DGNB International Certificate for Sustainable Construction [DGNB međunarodni certifikat za održivu gradnju]	Greenika
Hungary									
EMI									
BIMzeED	Certificate	Various	No initial qualification necessary	5 to 7	Certificate	BIMzeED (Education for Near Zero Energy Buildings Using Building Information Modelling)	University of Győr, Budapest University of Technology and Economics (Széchenyi István Egyetem, Budapesti Műszaki és Gazdaságtudományi Egyetem)	BIMzeED (Education for Near Zero Energy Buildings Using Building Information Modelling)	University of Győr, Budapest University of Technology and Economics (Széchenyi István Egyetem, Budapesti Műszaki és Gazdaságtudományi Egyetem)
NEWCOM (flat roofer)	Certificate	Various	No initial qualification necessary	1 to 5	Certificate	New competence for building professionals and blue collar workers – certified qualification schemes to upgrade the qualification for building nZEBs	ÉMI Nonprofit Llc. And Hungarian Roofing Federation (ÉMI , ÉMSZ)	New competence for building professionals and blue collar workers – certified qualification schemes to upgrade the qualificatio	ÉMI Nonprofit Llc. And Hungarian Roofing Federation (ÉMI , ÉMSZ)

								n for building nZEBs	
NEWCOM (ventilation installer)	Certificate	Various	No initial qualification necessary	3 to 5	Certificate	New competence for building professionals and blue collar workers – certified qualification schemes to upgrade the qualification for building nZEBs	ÉMI Nonprofit Llc., ventilation companies	New competence for building professionals and blue collar workers – certified qualification schemes to upgrade the qualification for building nZEBs	ÉMI, ventilation companies
NEWCOM (building inspector)	Certificate	Various	No initial qualification necessary	6 to 7	Certificate	New competence for building professionals and blue collar workers – certified qualification schemes to upgrade the qualification for building nZEBs	ÉMI Nonprofit Llc.	New competence for building professionals and blue collar workers – certified qualification schemes to upgrade the qualification for building nZEBs	ÉMI Nonprofit Llc.
Reginal days/trainings for roofers	Credit for Chamber members	Various	No initial qualification necessary	3 to 7	Credit for Chamber members	Regional days of the Hungarian Roofing Federation (ÉMSZ Regionális Napok)	Hungarian Roofing Federation (ÉMSZ)	Regional days of the Hungarian Roofing Federation (ÉMSZ Regionális Napok)	Hungarian Roofing Federation (ÉMSZ)

Table 7: CPD courses throughout Europe

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Colophon