

Circular Economy innovation ecosystems REdesigning Skills



D2.1 COMPETENCY MAPS



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D2.1

Competency Maps

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Short abstract: Deliverable D2.1 within Work Package 2 (WP2) focuses on creating CERES competency maps that will be the blueprint for developing CERES education and training curricula, empowering stakeholders to proactively contribute to sustainable innovation, societal challenges, and the European Green Deal's (EGD) implementation. To this end, the methodology of this deliverable includes a comprehensive overview of qualification frameworks, including micro-credentials, the European Reference Framework, and the European frameworks for entrepreneurship, sustainability, digital, personal, social, and learning-to-learn competences. It also analyses the employment landscape on skills needed to support the twin (digital and green) transition, aligning with Circular Economy (CE) principles. As a result, the CERES competency maps outline the following essential skills: Resilience and Soft, Entrepreneurship, Green, and Digital transition skills required to transition toward digitalization and circularity, providing a clear trajectory for individuals and businesses to thrive in these transformative domains.

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Executive Summary

Work Package 2 (WP2) started in Month 4 (M4). It aims to develop two training curricula for High Education (HE) and Vocational Education and Training (VET). The training material design will consider the learning outcomes (i.e., knowledge, skills, and autonomy-responsibility) defined by the European Qualification Framework (EQF) and the micro-credentials approach to make the qualifications more readable and understandable. Aligning with the EQF will guarantee cross-border competence recognition and facilitate replicability across different countries and systems.

Deliverable D2.1 is due on Month 6 (M6) and aims to deliver the competency maps of the CERES project. It is based on reviewing and analysing existing definitions, frameworks, and standards in various European policy documents, recommendations, and reports for learning and qualifications to support recognizing skills across the European Union (EU). The document is organized into distinct sections as follows. Section 1 provides a summary of the deliverable. Section 2 describes the methodology employed in the development of the deliverable. Section 3 offers a comprehensive glimpse into National Qualification Frameworks (NQF), the European Qualification Framework (EQF), and micro-credentials for recognizing competences in Europe, elucidating their relevance and impact on the CERES project. Section 4 offers a comprehensive analysis of the employment landscape, projecting trends up to 2035 about the skills needed to support the twin transition (digital and green), including Circular Economy (CE) principles. Section 5 provides an overview of the European Reference Framework regarding key lifelong learning competences and the competence frameworks for entrepreneurship, sustainability, digital, personal, social, and learning-to-learn competences. Section 6 identifies and categorizes competences relevant to the CERES project in line with the different competence frameworks and determines the CERES proficiency levels to respond to the trends in job demand. Section 7 presents the CERES competences framework and the bespoke CERES competency maps offering the blueprint for the CERES curricula development. The document culminates in Section 8, which points out the main conclusions derived from the comprehensive analysis conducted in D2.1.

In essence, D2.1 is not just a deliverable. It represents the cornerstone of the entire CERES project's educational framework. It is customized to meet the project's unique objectives and aspirations.

List of Abbreviations

Abbreviations	Descriptions
AC	Assessment Committee
AI	Artificial Intelligence
CC	Certification Committee
CCs	Core Courses
CE	Circular Economy
CE-DIH	Circular Economy Digital Innovation Hub
CERES	Circular Economy innovation ecosystems REdesigning Skills
Cedefop	European Centre for the Development of Vocational Training
CS	Certification Scheme
D	Deliverable
DigComp	Digital Competence Framework for Citizens
DT	Digital Technology
EC	European Commission
ECTS	European Credit Transfer and Accumulation System
ECVET	European Credit System for Vocational Education and Training
EGD	European Green Deal
EI	Emotional Intelligence
ELM	European Learning Model
EntreComp	Entrepreneurship Competence Framework
EU	European Union
EQF	European Qualifications Framework
GreenComp	Sustainability Competence Framework
HE	High Education
HEI	Higher Education Institution
ICT	Information and Communication Technologies
IoT	Internet of Things
I4.0	Industry 4.0
KSA	Knowledge, Skills, Attitude
LifeComp	Personal, Social, and Learning-to-learn Competence Framework

NQF	National Qualification Framework
PC	Project Coordinator
PMT	Project Management Team
PU	Public
QE	Quality Expert
QF-EHEA	Qualifications Framework of the European Higher Education Area
R	Report
SC	Steering Committee
SMs	Specialised Modules
SMEs	Small and medium-sized enterprises
ToC	Table of Contents
VE	Vocational Education
VET	Vocational Education and Training
VR	Virtual Reality
VUCA	Volatile, Uncertain, Complex, and Ambiguous
WP	Work Package

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1 Document Summary

1.1 Project Overview

The Circular Economy (CE) paradigm, accelerated within the context of Industry 4.0, has been increasingly applied inside and outside the manufacturing domain. The new capabilities, skills, and competences developed through I4.0 must be augmented and enhanced to conform to the Triple Bottom Line perspective (profit, people, planet). These enhancements initially affect supply chain management and then expand towards entrepreneurship, business model development, innovation management, and societal development.

Research shows a significant potential to address the complex challenges toward a more sustainable and resilient society by cross-fertilizing these disciplines through the CE perspective via provisioning new courses and practical cases.

For this reason, the joint CE-I4.0 evolution needs to be grounded on a new set of knowledge and best practices to be provided through both high education (HE) and vocational education and training (VET), demanding systemic ways for sustainable development.

CERES recognizes the need to shift the restricted focus of CE from firms to a more extended and system-level view that considers skills, competences, and knowledge needs (provided from various business sectors such as e-waste, textiles, renewable energy, etc.) to be supplied to HE and VET. This would catalyse the embracement of CE from a social development perspective from the preliminary stage of training and education.

In this context, the CERES innovation ecosystem, the Circular Economy Digital Innovation Hub (CE-DIH), aims to promote stakeholder connectedness and generate a systematized set of services, skills, competences, and knowledge to support the multi-faceted CE domain. The CE-DIH can strategically raise awareness and provide the most suitable and complete services to support the circular enrichment and transition of both companies on the market and individuals in society.

1.2 Deliverable Purpose and Scope

This deliverable aims to build on the skills initially proposed by the CERES project and to respond to the need for skills to support the twin (digital and green), including CE skills. It engages in a comprehensive review and analysis of existing definitions and standards in various policy documents and recommendations linked to learning and qualification in Europe and competence frameworks for entrepreneurship, sustainability, digital, personal, social, and learning-to-learn competences. Based on them, it lays the groundwork for creating the innovative CERES competency maps, which include a dedicated focus on circularity-related competences.

The outcomes of this deliverable will play a pivotal role in shaping the design of CERES' competence-based educational curricula. The insights garnered will inform the selection of the most effective approaches and guide the seamless integration of learning outcomes into these curricula.

1.3 Impact and Target Audiences

Deliverable D2.1 is a public deliverable; it considers the European Commission's (EC) key priorities in education and training for 2019 – 2024, including sustainability. It offers valuable information for policymakers, government officials, economic and labor market researchers, educational institutions and academic researchers, industry professionals and business leaders, students and job seekers, and European Union Entities and International Organizations.

This deliverable includes developing a consolidated competence map for the CERES project aiming to have a transformative impact and allowing organizations to align their workforce with strategic goals, enhance employee performance, foster a culture of continuous improvement, and ultimately drive long-term success and innovation. CERES competency maps should thus be treated as a living document. It also serves as a reference for other stakeholders in education in the same fields as the CERES project.

1.4 Deliverable Methodology

The methodology for creating CERES competency maps is based on a systematic and comprehensive review and analysis of definitions and standards found in various policy documents, recommendations, and reports for learning and qualifications in Europe to support recognizing skills across countries. The review process included documents such as the National Qualification Frameworks (NQF), the European Qualification Framework (EQF), micro-credentials for recognizing competences in Europe (Section 3), the European Reference Framework regarding key lifelong learning competences, the competence frameworks for entrepreneurship, sustainability, digital, personal, social, and learning-to-learn elucidating their relevance and impact on the CERES project (Section 5). The review also includes an analysis of the employment landscape, projecting trends up to 2035 about the skills needed to support the twin (digital and green) transition, including CE principles (Section 4).

The methodology adopted by D2.1 supported identifying the CERES proficiency levels and categorizing CERES competences into resilience and soft, entrepreneurship, green transition, and digital skills (Section 6). The skills categorization laid the foundation for developing the CERES competency maps, outlining and aligning the skill levels with frameworks for recognizing qualifications and outlining the competences within each category, further distinguishing them into specific areas (Section 7). This systematic approach ensures that the CERES curricula are underpinned by a well-defined and dynamic set of competences, enhancing the effectiveness and relevance of CERES educational offers responding to the trends in job demand.

1.5 Document Status

This document is a public report. The Quality and Evaluation Strategy is created by the Project Coordinator (PC) and fine-tuned with the cooperation of the Steering Committee (SC), the Project Management Team (PMT), and the Quality Expert (QE). The deliverable's Table of Contents (ToC) was shared with partners for contributions. After, a consolidated version of the deliverable was shared for review. Once a final version was reached, it was distributed to the Consortium. Once distributed, it is binding on all partners.

1.6 Dependencies and Supporting Documents

The work presented in D2.1 holds significant importance for the overall success of the CERES project and its various work packages. WP2, responsible for developing CERES training curricula, is a central project component and collaborates closely with WP1, WP3, WP4, and WP5. The analysis conducted in D2.1 plays a pivotal role in facilitating the development and execution of tasks and deliverables within the CERES project, serving as a foundational resource that informs and guides the subsequent work in the different WPs.

Concerning the relation with WP1, the outcomes of D2.1 will flank the results of the analysis conducted in WP1 (that will end at month 10), composed of the analysis of the literature about the needed skills and competences in the CE domain, a market analysis of the course so far offered for

HE and VET, and the survey (and eventual interviews) conducted with practitioners and industrials to grasp hints and directions concerning the practical needs in terms of competences and skills for the adoption of the CE paradigm.

The maps obtained in this deliverable are instrumental in shaping the content and structure of the project's deliverables, including D2.2 ("Curricula for Higher Education and Vocational Education and Training Core Courses") and D2.3 ("Certification and Competences Scheme"). The analysis carried out in D2.1 will lay the groundwork for the educational materials and certification systems that WP2 will produce.

WP3 will be in charge of the courses implementation following the content development for the curricula. Furthermore, the Core Courses (CCs) developed as part of the curricula will be part of the MOOC included in WP4.

Figure 1 illustrates the deliverables associated with D2.1 within WP2 and their respective due dates, with D2.1 being due on month 6 (M6). It emphasizes how D2.1's findings and insights will be crucial in shaping the subsequent milestones and outcomes within WP2 and, consequently, in achieving the broader objectives of the CERES project.

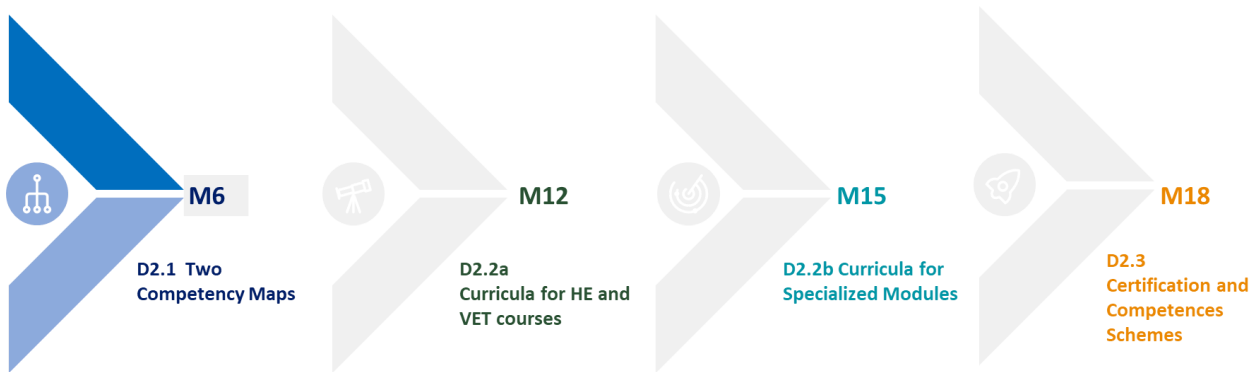


Figure 1 D2.1 link to other WP2's deliverables and due dates (months)

2 Methodology

D2.1 employed a methodology forming the backbone of the deliverable analytical approach. This section describes the systematic and comprehensive method used to compile and analyse the information presented in this document (Figure 2). The methodology comprised the following five main steps:

- Alignment with Qualification Frameworks (Section 3),
- Skills overview (Section 4),
- Identification of competences (Section 5),
- Categorization of competences and definition of proficiency levels (Section 6),
- Organization of the competency map (Section 7).

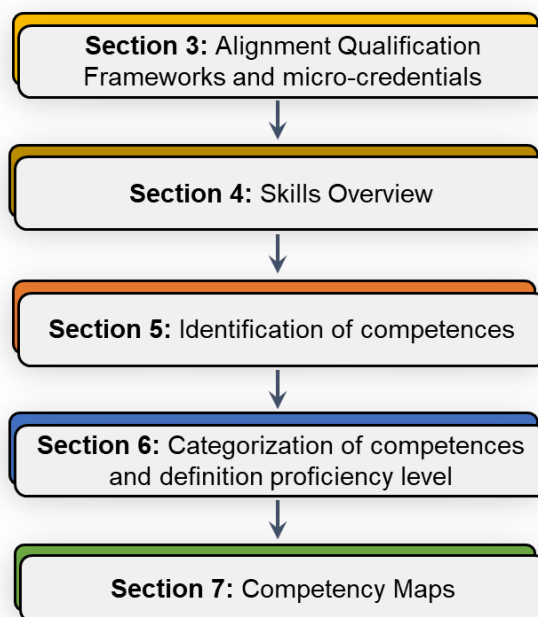


Figure 2 Methodology Definition Competency Maps

In this sense, section 3 aimed to ensure the alignment with recognized frameworks for qualifications in Europe to streamline and enhance the recognition of skills, fostering a cohesive and standardized framework. Moreover, section 3 describes using micro-credentials as a unified approach to lay the foundation for a harmonized system that facilitates seamless skill recognition across diverse countries and contexts.

Section 4 provides an overview of the employment landscape, projecting trends up to 2035, examining the evolving job market dynamics, and identifying sectors poised for significant growth. By understanding the forecasted changes, the goal was pinpointing the specific high-demand profiles and skill sets, allowing for proactive preparation and adaptation to emerging workforce needs. The section includes an overview of the circular and digital skills needed to support the twin (green and digital) transition.

Section 5 provides an overview of the key competences for lifelong learning in Europe and the different European competence frameworks that supported the identification of competences for the CERES competency maps.

Section 6 focused on categorizing the skills and defining the proficiency levels for the CERES curricula aligned with the frameworks for recognizing qualifications. This task involved structuring the identified competences and thematic areas into a coherent and accessible framework, clarifying the competences required in different categories. Finally, Section 7 presents the organization and visual definition of the CERES competency maps that will guide the development of the core and specialized modules of the curricula.

3 Qualification Frameworks and Micro-credentials for the Recognition of Competences in Europe

Pursuing lifelong learning has become fundamental in today's rapidly evolving knowledge-based society. The ever-expanding landscape of education and training demands a structured approach to recognize and validate the skills and knowledge acquired throughout one's life. In Europe, this pursuit is underpinned by understandable learning and qualifications frameworks, which are instrumental in shaping and supporting lifelong learning initiatives. This section offers a comprehensive glimpse into EQF and NQF and the approach for micro-credentials, providing the necessary context for recognizing the CERES educational *curricula* across countries.

3.1 European Qualification Framework (EQF)

Qualifications serve multiple purposes, signaling holders' knowledge and abilities to employers, often as prerequisites for regulated professions. Also, qualifications support education authorities in assessing an individual's acquired knowledge and level, representing individual personal achievements. They result from a formal assessment and validation process, usually in the form of certificates or diplomas, attesting that individuals have met specific learning standards through diverse paths in formal, non-formal, or informal settings. Acquiring qualifications aims to boost employability, mobility, and educational access.

To support lifelong learning, the creation of a European Reference Framework for qualifications systems, the EQF (European Parliament, 2008), revised in 2017 (Council of the European Union, 2017), aims to promote and improve learner and worker mobility, employability, and social integration. The EQF for lifelong learning established a common reference framework of eight levels of qualifications, expressed as learning outcomes with increasing proficiency levels (Table 1), enhancing transparency and comparability among different systems and facilitating qualification portability. Moreover, in the report on the evaluation of the EQF (European Commission, 2013), the EC concluded that the EQF is widely accepted as a reference point for developing NQFs, implementing the learning outcomes approach, and improving the transparency and recognition of skills and competences.

The learning outcomes represent what a learner knows, understands, and can do to complete a learning process, defined in terms of descriptors. The descriptors in learning outcomes are knowledge, skills, and responsibility & autonomy. These descriptors are for each level relevant to the qualification, as follows:

- Knowledge: refers to acquiring theoretical and/or factual knowledge.
- Skills: refers to developing cognitive skills (logical, intuitive, and creative thinking) and practical skills (manual dexterity and using methods, materials, tools, and instruments).
- Responsibility and Autonomy: describe the ability of the learner to apply knowledge and skills autonomously and with accountability.

Table 1 shows the eight levels and the descriptors of the EQF.

Table 1 EQF Levels and Descriptors (European Parliament, 2008)

Level	Knowledge	Skills	Responsibility and autonomy
EQF 8	knowledge at the most advanced frontier of a field of work or study and at the interface between fields	The most advanced and specialized skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice.	Demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity, and sustained commitment to developing new ideas or processes at the forefront of work or study contexts, including research.
EQF 7	<ul style="list-style-type: none"> - Highly specialized knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research - Critical awareness of knowledge issues in a field and at the interface between different fields 	Specialized problem-solving skills are required in research and/or innovation to develop new knowledge and procedures and to integrate knowledge from different fields.	<ul style="list-style-type: none"> - Manage and transform work or study contexts that are complex, unpredictable, and require new strategic approaches, - Take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.
EQF 6	Advanced knowledge of a field of work or study involving a critical understanding of theories and principles	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study.	<ul style="list-style-type: none"> - Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts, - Take responsibility for managing professional, development of individuals and groups.
EQF 5	Comprehensive, specialized, factual, and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills is required to develop creative solutions to abstract problems	<ul style="list-style-type: none"> - Exercise management and supervision in contexts of work or study activities where there is unpredictable change, - Review and develop the performance of self and others.
EQF 4	factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study.	<ul style="list-style-type: none"> - Exercise self-management within the guidelines of work or study contexts that are usually predictable but are subject to change,

			- Supervise the routine work of others, taking some responsibility for evaluating and improving work or study activities.
EQF 3	knowledge of facts, principles, processes, and general concepts in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials, and information.	- Take responsibility for the completion of tasks in work or study, - Adapt own behavior to circumstances in solving problems.
EQF 2	basic factual knowledge of a field of work or study	Basic cognitive and practical skills required to use relevant information to carry out tasks and to solve routine problems using simple rules and tools.	Work or study under supervision with some autonomy.
EQF 1	basic general knowledge	Essential skills required to carry out simple tasks.	Work or study under direct supervision in a structured context.

The EQF aligns with the Bologna process's Framework for Qualifications of the European Higher Education Area (QF-EHEA). The framework provides descriptors for three cycles (e.g., bachelor, master, doctorate), and each cycle descriptor offers a generic statement of typical expectations of achievements and abilities associated with qualifications that represent the end of that cycle. The descriptor for the first cycle corresponds to the learning outcomes for EQF level 6, the second cycle to EQF level 7, and the third cycle to EQF level 8 (Bologna Working Group, 2005).

Moreover, CERES will align with the elements for data fields for the electronic publication of information on qualification with an EQF level (Table 2), in line with Annex VI of the EQF to make the qualifications and their learning outcomes accessible and public (Council of the European Union, 2017). These elements include some that are mandatory (i.e., the title of the qualification, the field, the country/region (code), the EQF level, the description of the qualification, the awarding body or competence authority), and some that are optional (i.e., the credit points/notional workload needed to achieve the learning outcomes, the internal quality assurance processes, the external quality assurance/regulatory body, further information on the qualification, the source of information, the link to relevant supplements, the URL of qualifications, the information language (code), the entry requirements, the expiry date (if relevant), the ways to acquire qualifications, and the relationship to occupations or occupational fields).

Table 2 Annex VI: Elements for data fields for the electronic publication of information on qualification with an EQF level. (Adapted from Council of the European Union, 2017)

DATA			Required / Optional
Title of the qualification			Required
Field (*)			Required
Country/Region (code)			Required
EQF Level			Required
Description of the qualification (**)	Either	Knowledge	Required
		Skills	Required
		Responsibility and autonomy	Required
	Or	Open text field describing what the learner is expected to know and able to do	Required
Awarding body or competent authority (***)			Required
Credit points/notional workload needed to achieve the learning outcomes			Optional
Internal quality assurance process			Optional
External quality assurance / regulatory body			Optional
Further information on the qualification			Optional
Source of information			Optional
Link to relevant supplements			Optional
URL of the qualification			Optional
Information language (code)			Optional
Entry requirements			Optional

Expiry date (if relevant)		Optional
Ways to acquire qualification		Optional
Relationship to occupations or occupational fields		Optional

(*) ISCED FoET2013

(**) This description shall consist of open text fields, with no prescribed use of standard terminology and no obligation for the Member States to translate the description into other EU languages.

(***) The minimum required information on the awarding body or the competent authority should facilitate finding information about it, including its name or, if applicable, the name of the group of awarding bodies or competent authorities, completed with a URL or contact information.

3.2 National Qualification Framework (NQF)

The primary catalyst for developing comprehensive NQF in Europe has been the development of the EQF. EQF supports recognizing capabilities, easing cross-border mobility of learners and workers, and lifelong learning. All countries committed to the EQF are developing or implementing national frameworks mainly covering all levels and types of qualifications. Thirty-six countries have formally linked (referenced) their NQFs to the EQF (Cedefop, 2020).

European countries use their frameworks to create comprehensive maps of qualifications, including all sectors (VET, HE, general education, adult training) and to help validate non-formally and informally acquired competences. The validation of competences is central to policies fostering lifelong learning and progression through different pathways for individuals. Following the European Inventory that describes the NQF per country, Table 3 summarizes the NQF of the countries participating in the CERES project, namely Bulgaria (Cedefop, 2023c), Cyprus (Cedefop, 2023d), Denmark (Cedefop, 2023e), France (Cedefop, 2023f), Italy (Cedefop, 2023g), and the United Kingdom (UK) (Cedefop, 2019).

All participating countries in the CERES project have seamlessly integrated the comprehensive eight-level framework. Regarding HE, the NQF established across the countries is similar and aligns with the QF-EHEA for levels 6, 7, and 8, fostering consistency and facilitating cross-border recognition of qualifications in HE.

Regarding VET, each participating country offers a diploma or certificate up to NQF level 5, showing a standardized approach that can ensure a foundational equivalence in vocational qualifications. Annex 1, "Vocational education and training system chart," offers the different VET system charts per country participating in the CERES project. The graphs show that officially recognized vocational qualifications are at level EQF 5.

For levels 6 and 7, beyond the traditional bachelor's or master's degree, France and Denmark show an alignment with VET. This integration can foster a holistic understanding of education and skill development, acknowledging the importance of blending academic rigor with practical expertise. A comprehensive and adaptive approach that recognizes and incorporates professional qualifications at these higher levels can support preparing individuals for the multifaceted demands of the workforce.

Table 3 National Qualifications Frameworks

Level	France - NPQF *	Cyprus - CyQF *	Denmark - DKQF *	Italy - QNQ *	Bulgaria - BQF *	England and Northern Ireland **
EQF 8	<p>NQF 8</p> <ul style="list-style-type: none"> - Doctorate degrees (Doctorat) - Professional certificates/titles level 8 (Titres professionnels) - Professional qualification certificates – level 8 (Certificat de qualifications professionnelles – CQP) - Professional qualifications on demand – level 8 	<p>NQF 8</p> <p>Doctoral degree (Διδακτορικός Τίτλος)</p>	<p>NQF 8</p> <p>PhD degree (Ph.d. grad)</p>	<p>NQF 8</p> <ul style="list-style-type: none"> - Research doctorate (Dottorato di ricerca) - Academic diploma for research training (Diploma accademico di formazione alla ricerca) - Specialisation diploma (Diploma di specializzazione) - Second level university master (Master universitario di secondo livello) - Academic specialisation diploma (II) (Diploma accademico di specializzazione (II)) - Higher specialisation diploma or master (II) (Diploma di perfezionamento o Master (II)) 	<p>NQF 8</p> <p>Doctor degree (Доктор)</p>	<p>NQF 8</p> <p>doctorate, for example doctor of philosophy (PhD or DPhil)</p> <ul style="list-style-type: none"> - level 8 award - level 8 certificate - level 8 diploma
EQF 7	<p>NQF 7</p> <ul style="list-style-type: none"> - Master degrees (Grade de Master) - National diplomas at level 7 - Professional diploma in engineering with Master degree (diplôme / titre d'ingénieur) - Professional certificates/titles – level 7 (Titres professionnels) - Professional qualification certificates – level 7 (CQP) - Professional qualifications on demand – level 7 	<p>NQF 7c</p> <p>Master degree (Μεταπτυχιακός Τίτλος)</p> <p>NQF 7b</p> <p>- Postgraduate diplomas (Μεταπτυχιακό Δίπλωμα)</p> <p>NQF 7a</p> <p>- Postgraduate certificates (Μεταπτυχιακό Πιστοποιητικό)</p>	<p>NQF 7</p> <ul style="list-style-type: none"> - Master degree – Candidatus (Kandidat og masteruddannelser) - Master degree in arts/fine arts - Master degree 	<p>NQF 7</p> <ul style="list-style-type: none"> - Master degree (Laurea magistrale) - Second level academic diploma (Diploma accademico di secondo livello) - First level university master (Master universitario di primo livello) - Academic specialisation diploma (I) (Diploma accademico di specializzazione) - Higher specialisation diploma or master (I) (Diploma di perfezionamento o Master (I)) 	<p>NQF 7</p> <p>Master degree (Магистър)</p>	<p>NQF 7</p> <p>integrated master degree, for example master engineering (MEng)</p> <ul style="list-style-type: none"> - level 7 award - level 7 certificate - level 7 diploma - level 7 NVQ - master degree, for example master of arts (MA), master of science (MSc) - postgraduate certificate - postgraduate certificate in education (PGCE) - postgraduate diploma

EQF 6	NQF 6	NQF 6	NQF 6	NQF 6	NQF 6	NQF 6
	<ul style="list-style-type: none"> - Bachelor degrees (Grade Licence) - Bachelor (Licence) - University Bachelor of technology (Bachelor universitaire de technologie – BUT) - National diploma in arts (Diplôme National d’Art – DNA) - National diplomas at level 6 - Professional certificates/titles – level 6 (Titres professionnels) - Professional qualification certificates – level 6 (CQP) - Professional qualifications on demand – level 6 	Bachelor degree (Πτυχίο)	<ul style="list-style-type: none"> - Bachelor degree (Bachelor og diplomuddannelser) - Bachelor degree in arts - Professional bachelor degree (Professionsbacheloruddannelser) - Diploma degree - CISPA 3 years professional acting course - Financial advisor wealth advisory (Eksamineret finansrådgiver formuesrådgivning) 	<ul style="list-style-type: none"> - Bachelor degree (Laurea) - First level academic diploma (Diploma accademico di primo livello) 	<ul style="list-style-type: none"> - Bachelor degree (Бакалавър) - Professional Bachelor degree (Професионален Бакалавър) 	<ul style="list-style-type: none"> - degree apprenticeship - degree with honours - for example bachelor of the arts (BA) honours, bachelor of science (BSc) honours - graduate certificate - graduate diplomadegree apprenticeship - degree with honours - for example bachelor of the arts (BA) honours, bachelor of science (BSc) honours - graduate certificate - graduate diploma
EQF 5	NQF 5	NQF 5c	NQF 5	NQF 5	NQF 5	NQF 5
	<ul style="list-style-type: none"> - Undergraduate technician certificates (Brevet de technicien supérieur – BTS) - Undergraduate technician certificates in agriculture (Brevet de technicien supérieur agricole – BTSA) - Undergraduate diploma in technology (Diplôme universitaire de technologie – DUT) - National diploma ‘One of the best workers in France’ (Diplôme d’Etat ‘Un des meilleurs ouvriers 	<p>Higher certificates and diplomas – three years (Ανώτερα Διπλώματα και Πιστοποιητικά)</p> <p>NQF 5b</p> <ul style="list-style-type: none"> - Post-secondary certificates and diplomas – two years (Μεταλυκειακά Διπλώματα Διετούς Διάρκειας) <p>NQF 5a</p>	<ul style="list-style-type: none"> - VET certificate - Academy profession degrees (Erhvervsakademi uddannelser) - Certificate for supplementary single subject courses at academy profession level - Adult VET certificate - Acupuncture (AkupunkturAkademiet) - Nordic acupuncture education (Nordisk akupunkturuddannelse) - Certified private client advisor (certificeret privatkunderådgiver) 	<ul style="list-style-type: none"> Higher technical education diploma (Diploma di tecnico superiore) 	<ul style="list-style-type: none"> Vocational qualification – national VET level 4 (IV Степен На Професионална Квалификация) 	<ul style="list-style-type: none"> - diploma of higher education (DipHE) - foundation degree - higher national diploma (HND) - level 5 award - level 5 certificate - level 5 diploma - level 5 NVQ - certificate of higher education (CertHE) - higher apprenticeship - higher national

de France’)
 - National diplomas at level 5
 - Professional certificates/titles – level 5 (Titres professionnels)
 - Professional qualification certificates – level 5 (CQP)
 - Master craftsman qualifications issued by the Chambers of Trades (Brevets de maîtrise – Chambre des métiers)
 - Professional qualifications on demand – level 5

- Post-secondary certificates and diplomas – one year (Μεταλυκειακά Διπλώματα Μονοετούς Διάρκειας)

certificate (HNC)
 - level 4 award
 - level 4 certificate
 - level 4 diploma
 - level 4 NVQ

**EQF
4**

NQF 4

NQF 4

NQF 4

NQF 4

NQF 4

NQF 4

<ul style="list-style-type: none"> - National baccalaureate diploma – general, technological or vocational education (National baccalaureate diploma – general, technological or vocational education) - Applied arts certificates (Brevet des métiers d’art – BMA) - Professional certificate for youth, adult education and sports (Brevet professionnel de la jeunesse, de l’éducation nationale et du sport – BPJEPS) - Higher technical diploma in craftsmanship (Brevet technique des métiers) - Secondary vocational certificates at level 4 - Professional certificates/titles – level 4 (Titres professionnels) - Professional qualification certificates – level 4 (CQP) - Professional qualifications on demand – level 4 	<ul style="list-style-type: none"> - Upper secondary general education and evening schools certificates – 12th and 13th for some private schools (Απολυτήριο Μέσης Γενικής Εκπαίδευσης) - Upper secondary technical and vocational education and evening technical schools certificates – 12th grade (Απολυτήριο Μέσης Τεχνικής Εκπαίδευσης και Κατάρτισης) 	<ul style="list-style-type: none"> - General upper secondary school certificate (Gymnasiale uddannelser) - Certificate for two-year general upper secondary programme (higher preparatory examination) - VET certificate - Certificate for supplementary single subject courses at upper secondary level - Adult VET certificate - Certificate for single subject VET 	<ul style="list-style-type: none"> - Upper secondary education diploma (Licei diploma liceale) - Upper secondary education diploma – technical schools (Diploma di istruzione tecnica) - Upper secondary education diploma – vocational schools (Diploma di istruzione professionale) - Higher technical specialisation certificate (Certificato di specializzazione tecnica superiore) 	<ul style="list-style-type: none"> - Upper secondary general education school leaving certificate (Средно Образование Общо Образование) - Vocational qualification – national VET level 3 (III) (Степен На Професионална Квалификация) 	<ul style="list-style-type: none"> A level - grade A, B, C, D or E - access to higher education diploma - advanced apprenticeship - applied general - AS level - international Baccalaureate diploma - level 3 award - level 3 certificate - level 3 diploma - level 3 ESOL - level 3 national certificate - level 3 national diploma - level 3 NVQ - music grades 6, 7 and 8 - tech level
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EQF 3	NQF 3	NQF 3	NQF 3	NQF 3	NQF 3	NQF 3
	<ul style="list-style-type: none"> - Secondary vocational certificates (Certificat d'aptitude professionnelle – CAP; Brevet d'études professionnelles – BEP) - Secondary vocational certificates in agriculture (Certificat d'aptitude professionnelle agricole – CAPA; Brevet d'études professionnelles agricoles – BEPA) - Secondary vocational certificate 	<ul style="list-style-type: none"> - Lower secondary education certificate – 10th grade – preparatory year for upper secondary education (Απολυτήριο Πρώτου Κύκλου Δευτεροβάθμιας Εκπαίδευσης – 10η 	<ul style="list-style-type: none"> - VET certificate - Certificate for preparatory basic education and training (FGU) - Basic programme VET - Certificates for supplementary, single subject VET courses - Higher preparatory courses, single course subjects - General adult education level D - Adult VET certificate 	<ul style="list-style-type: none"> Professional operator certificate (Attestato di qualifica di operatore professionale) 	<ul style="list-style-type: none"> Vocational qualification – national VET level 2 (II) (Степен На Професионална Квалификация) 	<ul style="list-style-type: none"> CSE - grade 1 - GCSE - grade A*, A, B or C - intermediate apprenticeship - level 2 award - level 2 certificate - level 2 diploma - level 2 ESOL - level 2 essential skills

<p>for youth, adult education and sports (Certificat professionnel de la jeunesse, de l'éducation nationale et du sport – CPJEPS)</p> <ul style="list-style-type: none"> - Certificate issued by the Chambers of Trades and crafts (Certificat technique des métiers – CTM) - Secondary vocational certificates at level 4 - Professional certificates/titles – level 3 (Titres professionnels) - Professional qualification certificates – level 3 (CQP) - Professional qualifications on demand – level 3 	<p>τάξη)</p> <ul style="list-style-type: none"> - New modern apprenticeship certificate - 10th grade (Νέα Σύγχρονη Μαθητεία – 10η τάξη) 	<ul style="list-style-type: none"> - Certificates for single subject courses in VET 	<ul style="list-style-type: none"> - level 2 functional skills - level 2 national certificate - level 2 national diploma - level 2 NVQ - music grades 4 and 5 - level - grade A, B or C
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EQF 2	NQF 2	NQF 2	NQF 2	NQF 2	NQF 2	NQF 2
No available qualifications for this EQF level	<ul style="list-style-type: none"> - Compulsory lower secondary education certificate – 9th grade (Απολυτήριο Πρώτου Κύκλου Δευτεροβάθμιας Εκπαίδευσης - 9η τάξη) - Preparatory programme – New modern apprenticeship (Προπαρασκευαστικό Πρόγραμμα Νέας Σύγχρονης Μαθητείας) 	<ul style="list-style-type: none"> - Leaving certificate for primary and lower secondary school - 10th grade (10. klasse afgangsprøve) - Certificate for preparatory basic education and training (FGU) - Basic VET certificates - General adult education (levels E and F, approximates 10th grade) - Adult VET certificate 	<ul style="list-style-type: none"> - Leaving certificate for primary and lower secondary school - 10th grade (10. klasse afgangsprøve) - Certificate for preparatory basic education and training (FGU) - Basic VET certificates - General adult education (levels E and F, approximates 10th grade) - Adult VET certificate 	Compulsory education certificate (Certificato delle competenze di base acquisite in esito all'assolvimento dell'obbligo di istruzione)	<ul style="list-style-type: none"> - Lower secondary (basic education) certificate (grades 5-7) (Основно Образование) - Vocational qualification – national VET level 1 (I Степен На Професионална Квалификация) 	<ul style="list-style-type: none"> - first certificate - GCSE - grade D, E, F or G - level 1 award - level 1 certificate - level 1 diploma - level 1 ESOL - level 1 essential skills - level 1 functional skills - level 1 national vocational qualification (NVQ) - music grades 1, 2 and 3

EQF 1	NQF 1	NQF 1	NQF 1	NQF 1	NQF 1	NQF 1
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No available qualifications for this EQF level	Compulsory education certificate – elementary school certificate, or graduates of 7th and/or 8th grade (Υποχρεωτική Εκπαίδευση)	<ul style="list-style-type: none"> - Leaving certificate for primary and lower secondary school (ninth grade) (Folkeskolens afgangsprøve) - Certificate for preparatory basic education and training (FGU) - Certificate for preparatory adult education - Certificate for general adult education (level G, approximates ninth grade) 	Lower secondary school-leaving diploma (Diploma di licenza conclusiva del primo ciclo di istruzione)	Primary education certificate (grades 1-4) (Начален Етап На Основното Образование)	<ul style="list-style-type: none"> - entry level award - entry level certificate (ELC) - entry level diploma - entry level English for speakers of other languages (ESOL) - entry level essential skills - entry level functional skills - skills for life
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* European inventory of NQF 2022

**European inventory of NQF 2016

3.3 Micro-credentials for Lifelong Learning and Employability

CERES will consider micro-credentials and the European Learning Model (ELM), a multilingual data model developed by the EC that provides a single vocabulary to describe learning in Europe. It offers a single format for describing certificates of attendance, examination results, degrees and diplomas, diploma supplements, professional certifications, employer recommendations, and any other kind of claim related to learning. It is a Data Model for the Interoperability of European Learning Opportunities, Qualifications, Accreditation, and Credentials (European Union, 2023). Version 3 of the ELM applies to more education and employment scenarios and can benefit a broader range of European stakeholders. It provides a stable, standardized vocabulary for the united model, and all future adjustments will be reflected across all application profiles (European Commission, 2016a).

The micro-credentials-focused approach to skills and knowledge validation emerged as a transformative force in education and professional development, and it is among the 12 flagship actions of the European Skills Agenda 2020 (European Commission, 2020). The European approach to micro-credentials aims to help widen learning opportunities, strengthening the role of HE and VET institutions in lifelong learning by providing more flexible and modular learning opportunities. The European Skills Agenda also announced an initiative on individual learning accounts that could help close gaps in access to education and training for working-age adults and enable people to manage labour market transitions successfully. Micro-credentials can be used as part of the education and training made available to people to underpin the operation of these individual learning accounts.

The European Pillar of Social Rights Action Plan refers to micro-credentials as an innovative instrument that can facilitate flexible learning pathways and support workers on their jobs or during professional transitions (European Commission, 2021, p. 24). This deliverable considers the definition provided by the Council Recommendation on a European approach to micro-credentials for lifelong learning and employability, where micro-credential means the record of the learning outcomes that a learner has acquired following a small volume of learning. Learning experiences from micro-credentials are designed to provide the learner with specific knowledge, skills, and competences that respond to societal, personal, cultural, or labor market needs (Council of the European Union, 2022).

Well-designed micro-credentials can support inclusion and accessibility to education and training for a broader range of learners, complementing and enhancing education, training, lifelong learning, and employability ecosystems. Micro-credentials could actively support EU policy initiatives to advance the twin (digital and green transition), such as the European Green Deal (EGD).

Since micro-credentials can be designed and issued by various providers in different learning settings (formal, non-formal, and informal), CERES will use the micro-credential initiative under the Skills Agenda as a reference to develop its courses' certificates. Table 4 depicts the elements of European standards to describe the micro-credentials. Among them, some elements are mandatory (i.e., identification of the learner, title of the micro-credential, country(ies)/region(s) if the issuer, awarding body(ies), date of issuing, learning outcomes, notional workload needed to achieve the learning outcomes, level of the learning experience leading to the micro-credential, type of assessment, form of participation in the learning activity, type of quality assurance used to underpin the micro-credentials) and others that are optional (i.e., prerequisites needed to enroll in

the learning activity, supervision and identity verification during assessment, grade achieved, integration/stackability options, and further information). CERES will also refer to the European principles for designing and issuing micro-credentials (i.e., quality, transparency, relevance, valid assessment, learning pathways, recognition, portable, learned-centred, authentic, and information, and guidance). This approach will thus support the European Education Area 2025 and micro-credentials uptake.

Table 4 Annex I European Standard elements to describe a micro-credential (Council of the European Union, 2022)

Mandatory elements:	Identification of the learner
	Title of the micro-credential
	Country(ies)/Region(s) of the issuer
	Awarding body(ies)
	Date of issuing
	Learning outcomes
	Notional workload needed to achieve the learning outcomes (in ECTS credits, where possible)
	Level (and cycle, if applicable) of the learning experience leading to the micro-credential (EQF, QF-EHEA), if applicable
	Type of assessment
	Form of participation in the learning activity
	Type of quality assurance used to underpin the micro-credential
Optional elements, where relevant (non-exhaustive list)	Prerequisites needed to enrol in the learning activity
	Supervision and identity verification during assessment (unsupervised with no identity verification, supervised with no identity verification, supervised online, or onsite with identity verification)
	Grade achieved
	Integration/stackability options (stand-alone, independent micro-credential/integrated, stackable towards another credential)
	Further information

KEY TAKEAWAYS

The section collectively highlights the EQF, NQFs, and micro-credentials' role in the CERES project. The EQF, with eight levels of qualifications, emphasizes transparency and comparability across different systems, aligning with the Bologna process. NQFs, influenced by the EQF, facilitate cross-border mobility and recognize capabilities, with participating CERES countries seamlessly integrating an eight-level framework. In parallel, micro-credentials emerge as transformative tools, aligning with the ELM and acknowledging their role in flexible learning pathways, promoting inclusivity, accessibility, and support for EU policy initiatives. CERES plans to reference the Skills Agenda for course certification, adhering to European standards and principles for designing and issuing micro-credentials. This strategic approach aims to contribute to the European Education Area 2025, fostering lifelong learning and adopting micro-credentials widely. The integrated framework proposed by CERES seeks to reflect a comprehensive strategy to enhance education, training, and employability ecosystems in line with EU objectives.

4 Skills Overview

This section provides a comprehensive analysis and overview of the employment landscape, projecting trends up to 2035 about the skills needed to support the twin (green and digital) transition (sub-section 4.1). This forward-looking approach involved examining the evolving job market dynamics and identifying sectors poised for significant growth. Then, core competences were identified, involving a nuanced exploration of the fundamental skills and knowledge areas that underpin success for the circular (sub-section 4.2) and digital (sub-section 4.3) transition.

4.1 Skills Forecast 2023

The European Skills Agenda 2020 aims to assist businesses and individuals in acquiring improved and pertinent skills, enhancing sustainable competitiveness, promoting social fairness by enhancing access to education, providing opportunities for lifelong learning, and fostering resilience to respond to crises effectively (European Commission, 2020). Ensuring the workforce possesses the appropriate skills is a central aspect of the EU strategy for achieving smart, sustainable, and inclusive growth, especially with the rapid swift transition towards a climate-neutral Europe under initiatives like the EGD or the EU's digital strategy, outlining the transformation of work for individuals and businesses intending to achieve climate neutrality by 2050.

To support this, the European Centre for the Development of Vocational Training (Cedefop) consistently and systematically undertakes skill demand and supply forecasts, ensuring alignment with the latest policy developments and anticipating future skills requirements. According to the estimates for 2035, Information and Communication will be the fastest-growing sector in the EU (Cedefop, 2023a). Table 5 shows the fastest-growing sectors according to the 2023 skills forecasts for the countries participating in the CERES consortium: Bulgaria (Cedefop, 2023h), Cyprus (Cedefop, 2023i), Denmark (Cedefop, 2023j), France (Cedefop, 2023k), and Italy (Cedefop, 2023l).

Table 5 Fastest growing sectors per country CERES project Source Cedefop Skills forecast 2023

Fastest-growing sectors	France (%)	Denmark (%)	Bulgaria (%)	Italy (%)	Cyprus (%)
Real estate, professional, scientific & technical activities	18	32	-	-	-
Information & Communication	17	36	18	-	-
Accommodation & food service activities	-	-	20	20	-
Human health & social work activities	-	-	-	11	-
Electricity, gas, steam & air conditioning supply	-	-	-	-	60
Mining & quarrying	-	-	-	-	51

Furthermore, the Information and Communication sector will grow significantly in France, Denmark, and Bulgaria, with 17, 36, and 18%, respectively. Accommodation & food service activities will increase by 20% in Italy and Bulgaria, while real estate, professional, scientific & technical activities will experience growth in France and Denmark by 18% and 36%, respectively (Table 5). In Cyprus, electricity, gas, steam & air conditioning supply, and mining & quarrying are the fastest-growing sectors, with 60 and 51%, respectively.

Figure 3 shows the forecast for 2035 for creating new jobs due to employment change. *Business and administration professionals* tend to be the most demanding in Denmark, France, and Italy, with 38, 351, and 270 thousand new jobs, respectively. Only Production and specialized services managers in France show a higher demand, with 498 thousand new jobs.

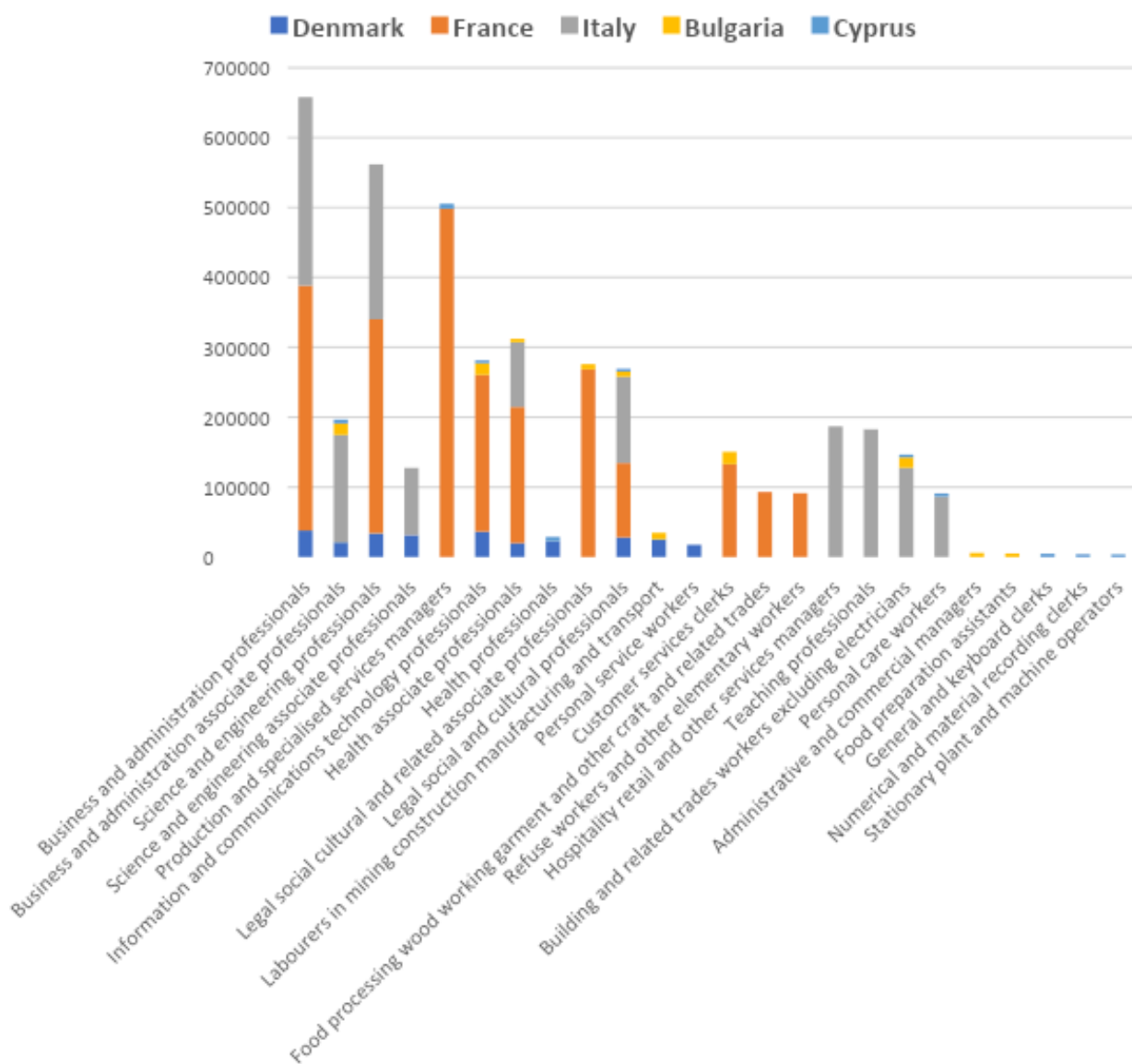


Figure 3 Top 10 occupations – Largest Creation of new jobs 2021 – 2035 per country participating in CERES Source Cedefop Skills forecast 2023

Moreover, *Science and engineering professionals* are also shared between these countries, with 34, 307, and 222 thousand in Denmark, France, and Italy, respectively. *Business and administration*

associate professionals also show an increase in Denmark, Italy, Bulgaria, and Cyprus, with 21, 154, 17, and 6 thousand. The estimations also show the creation of jobs in Denmark, France, Bulgaria, and Cyprus for *Information and communication technology professionals*, with 37, 225, 17, and 4 thousand, respectively. The highest demand in Bulgaria is for *customer service clerks*, with 18 thousand. France also shows a need for 133 thousand. The forecast also shows an increase in new jobs for *health and legal, social & cultural professionals*. *Health and associate professionals* showed an increase of 42, 195, 93, 5, and 6 thousand in Denmark, France, Italy, Bulgaria, and Cyprus, respectively. *Legal, social, cultural, and associate professional* new job creation in Denmark, France, Italy, Bulgaria, and Cyprus show 29, 269, 124, 8, and 4 thousand, respectively. Other job creation includes *personal and administrative managers, clerks, workers, and operators in the hospitality, education, construction, mining, and food sectors* (Figure 3). Annex 2 shows more detailed information about the skills forecast per country participating in the CERES project.

4.2 Circular Economy Skills

The circular transition requires diverse skills to increase the number of professionals who build and master green technologies. Central to this is sustainability, which is pivotal in advancing the growth of the CE. Competences in CE may include understanding the impact of sustainability practices that align with sustainable development goals, digital, circular products, services, and business models, creating innovative nature-based solutions, helping minimize activities' environmental footprint, and advocating for sustainable waste and resource management (European Commission, 2020).

In this context, this section aims to underscore the need for skills for assessing and balancing economic performance with environmental and social impacts, including strategies, resources, and competences for implementing CE practices, particularly in small and medium-sized enterprises (SMEs) (Dey et al., 2020), adopting a lifecycle perspective, employing sustainability-oriented instruments, ideating sustainable value propositions, and developing sustainability strategies.

Transitioning to the CE involves engaging the various stakeholders in the business ecosystem (Santa-Maria et al., 2022). Competences in a circular design, product design for multiple use cycles (Sassanelli et al., 2020), and circular business models (Bocken et al., 2014) (Rosa et al., 2019) are crucial for creating sustainable products and services (Sumter et al., 2018). Also, Emotional Intelligence (EI) and cultural literacy are important for understanding and navigating the human aspects of sustainability and CE initiatives (Abina et al., 2022). EI is acknowledged as the new crucial soft skill in accelerating the transition to a CE (Ceschin & Gaziulusoy, 2016). Its essential components enhance interpersonal relationships, foster collaboration, and help address complex challenges such as environmental sustainability and social equity, helping to redesign products, processes, and systems to minimize waste and maximize resource efficiency. Additionally, empathy, a key component of EI, is essential for understanding the needs and concerns of various stakeholders involved in the CE, including consumers, suppliers, and local communities.

4.3 Digital skills

Our societies are undergoing rapid changes in a contemporary global context that is increasingly volatile, uncertain, complex, and ambiguous (VUCA); technological developments are driving such a fast pace. The EU, its Member States, and businesses are transitioning to a more resource-efficient, circular, digitized, and climate-neutral economy and society. The digital transition is building upon increased connectivity; the gathering, sharing, and analysis of data and maximising its value to produce better products and services; the use of data and digitally enabled

solutions to change people’s and businesses’ mindset as well as the processes, products, and services needed for the creation of a more sustainable and CE (Annika & Stefan, 2020).

There is a wide spread of new digital tools (e.g., artificial intelligence (AI), virtual reality (VR), Internet of Things (IoT), big data, etc.) which are becoming omnipresent and playing an increasingly important role in almost all essential areas of life, such as education, work, and research. Automation is transforming the labor market, with routine and low-skill tasks increasingly being performed by robots. This wide deployment of new technologies is expected to increase the demand for digital experts and create new jobs while other jobs change or disappear.

The twin transition, specifically the deployment of digital technologies across all economic sectors, including non-tech sectors, will require a more digitally skilled workforce at all skill levels and ages. Organisations providing education and training must deliver relevant skills along the lifelong learning continuum and ensure that graduates have the education and skills the labor market requires, especially those needed for the growing demand created by the twin transition (European Commission, 2020).

Considering that the green and digital transition has emerged as a prominent and sustainable solution for reshaping industries, integrating CE into education is paramount, aligning with the trend towards more sustainable and responsible practices in various sectors. The demand for CE expertise is a strategic imperative. Businesses, organizations, and governments increasingly recognize the benefits of circular approaches. As the CERES project evolves, developing specialized modules for HE and VET will actively consider inputs from the market analysis in WP1. These considerations will support the development of a dynamic, adaptable, and inclusive educational framework.

In this sense, as a first step in identifying courses/modules in CE, the following table shows some of the modules in HE provided by CERES academic partners. More detailed information about the learning outcomes of each course/module profile is available in Annex 3.

Table 6 Higher Education Courses - Academic Partners

Skills category	Course/Module Title	Level	ECTS
Entrepreneurship	Innovation, Entrepreneurship, and Business Models	EQF - 6	5
	Corporate Entrepreneurship, Management and Technology	EQF - 7	5
	Potentials and challenges of circular economy as sustainability strategy in businesses and cities	EQF - 8	5
	Circular Economy Business Models	EQF - 7	5
	Entrepreneurship And Design for Sustainability	EQF - 7	60
	Business and Sustainability	EQF - 7	6
	Corporate Accounting and Sustainability	EQF - 7	9

	Leading with Impact	EQF - 7	7 days
	Leading in a volatile, uncertain, complex, and ambiguous (VUCA) World, Leading in Society	EQF - 7	6 days
Soft skills	Authentic Leadership and Marketing Leadership	EQF - 7	6 days
	Learning Lab Research, Depth & Mastery: An Enquiry into Your Practice	EQF - 8	73
	Learning Lab Making Sense of Your Journey	EQF - 8	73
	Summer School in Applied Circular Economy	EQF - 7	5
	Sustainable design	EQF - 7	120
	Sustainable Products and Services	EQF - 7	5
	Master in Circular Economy	EQF - 7	60
Green transition	Environmental Management of Production Systems	EQF - 7	6
	Mobility systems and environment	EQF - 7	6
	Green Product Strategy and Sustainable Consumption	EQF - 7	6
	Sustainable Chemistry for Construction	EQF - 7	6
	Continuous Improvement of Sustainable Manufacturing Processes	EQF - 7	12
	New value economy: Strategy, Value Chains and Circular Economy	EQF - 7	7 days
	Digital Technologies and Sustainable Development	EQF - 7	6
	Sustainability of building systems + Building Information Modeling	EQF - 7	12
	Sustainable Technologies for wastes and reclamation	EQF - 7	12
Digital Technologies	Sustainable Manufacturing Processes and Technologies	EQF - 7	6
	Design Thinking, Digital Innovation & Technology Management	EQF - 7	7 days
	Startup Bootcamp: Innovation & Technology Management by Design	EQF - 7	7 days
	Circular Economy and Technology Assessment	EQF - 6	5
	Innovative Communication Technologies and Entrepreneurship (ICTE)	EQF - 7	120

KEY TAKEAWAYS

This section presents a forward-looking examination of the employment landscape, emphasizing the importance of acquiring relevant skills for sustainable competitiveness and inclusive growth. Skill forecasts for 2035 outline job creation with a notable demand for business and administration professionals and a growing need in the Information and Communication sector. Therefore, focusing on the skills necessary for the twin transition, CE skills demand diverse competences, including understanding sustainability practices aligned with development goals, circular product

and service design, and EI as a crucial soft skill for navigating human aspects of sustainability initiatives. Furthermore, integrating digital technologies across sectors necessitates a digitally skilled workforce, emphasizing the need for relevant education and training to meet the evolving demands of the job market. Combining CE as a transversal topic and digital expertise into education is vital for sustainable industry reshaping. In this sense, the CERES project aims to develop educational content aligned with market demands, promoting a dynamic and inclusive educational framework.

5 Identifying CERES Competences

Competences represent a multifaceted blend of knowledge, skills, and attitudes tailored to a specific context. They form the basis of personal and professional development, transcending traditional boundaries and adapting to the ever-evolving demands of contemporary life. This section provides an overview of the European Reference Framework regarding key lifelong learning competences. Moreover, the section provides an overview of the competence frameworks for entrepreneurship, sustainability, digital, personal, social, and learning-to-learn competences. The competences described in the different frameworks are essential for thriving in the digital age, mastering entrepreneurship, championing sustainability, nurturing personal growth, fostering social intelligence, and improving the critical skill of learning to learn.

5.1 Key Competences for Lifelong Learning

Formal education and training should provide individuals with diverse skills, enabling them access to personal fulfillment and development, social inclusion, active citizenship, and employment. The early acquisition of these foundational skills is the basis for nurturing advanced and more complex competences essential for fostering creativity and driving innovation (European Commission, 2016b).

In this sense, the European Parliament's recommendation and the Council of the EU of 18 December 2006 (European Parliament, 2006) defined eight core competences for lifelong learning as part of the European Reference Framework. In May 2018, the Council of the EU updated the key competences for lifelong learning (European Commission, 2019), establishing that a shared knowledge of the competences is required today and in the future. The recommendation also identified the core competences to support citizens to live healthy, sustainable lifestyles, be employable, engage in active citizenship, and be socially inclusive. The eight key competences are:

1. communication in the mother tongue;
2. communication in foreign languages;
3. competences in maths, science, and technology;
4. digital competence;
5. learning to learn;
6. social and civic competences;
7. sense of initiative and entrepreneurship;
8. cultural awareness and expression

The reference framework offers practical strategies for fostering the development of competences via cutting-edge teaching strategies, evaluation techniques, or staff assistance. The elements constituting the core competences are:

- **Knowledge** consists of preexisting ideas, theories, facts, and figures contributing to comprehending a specific field or subject.
- **Skills** are the capacity to carry out procedures and apply previously acquired knowledge to produce outcomes.
- **Attitudes** characterize how a person is inclined to act or respond to concepts, people, or circumstances.

Every fundamental competence is equally significant, and elements necessary for one area facilitate the development of competences in another. Table 7 summarizes the core competences

and their corresponding elements. While some of these competences already have an established place in educational systems, this is not typically true for crucial competences such as entrepreneurship, digital and citizenship, or transversal skills. Promoting key competences for lifelong learning strategies that recognize the acquisition of transversal skills, like entrepreneurship, technologies/digital competences, and languages, plays an essential role in enhancing people's employability and improving the economy's potential for growth.

Nowadays, the demands for competences have evolved. Automation has extended its reach to more jobs, and technology has assumed a more central role across various work and daily life domains. Competences related to entrepreneurship, social engagement, and civic participation have gained prominence as vital attributes for fostering resilience and adaptability in the face of change. Skills like problem-solving, critical thinking, collaboration, creativity, computational thinking, and self-regulation have become more important than ever in our rapidly evolving society. These proficiencies are essential tools for applying acquired knowledge in real-time to generate novel ideas, theories, products, and knowledge.

Table 7 Key Competences for Lifelong Learning: knowledge, skills and attitudes

N.	Core Competence	Knowledge	Skills	Attitudes
1	Literacy competence	<ul style="list-style-type: none"> • reading and writing, understanding of written information, • vocabulary, functional grammar, and the functions of language. 	<ul style="list-style-type: none"> • communicate both orally and in writing, adapting to the requirements of the situation, • abilities to distinguish and use different types of sources, • critical thinking and ability to assess and work with information. 	<ul style="list-style-type: none"> • disposition to critical and constructive dialogue, • appreciation of aesthetic qualities, • interest in interaction with others.
2	Multilingual competence	<ul style="list-style-type: none"> • vocabulary and functional grammar of different languages, • main types of verbal interaction and registers of languages, • societal conventions, and the cultural aspect and variability of languages. 	<ul style="list-style-type: none"> • understand spoken messages, • initiate, sustain, and conclude conversations, • read, understand, and draft texts, • learn languages. 	<ul style="list-style-type: none"> • appreciation of cultural diversity, • interest and curiosity about different languages and intercultural communication, • respect for each person's linguistic profile.
3A	Mathematical competence	<ul style="list-style-type: none"> • numbers, measures and structures, basic operations and basic mathematical presentations, • mathematical terms and concepts, • questions to which mathematics can offer answers 	<ul style="list-style-type: none"> • apply basic mathematical principles and processes in everyday contexts, • follow and assess chains of arguments, • reason mathematically, • understand the mathematical proof, • communicate in mathematical language, • use appropriate aids, including statistical data and graphs, • understand the mathematical aspects of digitalisation 	<ul style="list-style-type: none"> • respect for truth, • willingness to look for reasons and to assess their validity.
3B	Competence in science, technology, and engineering	<ul style="list-style-type: none"> • natural world basic principles, fundamental scientific concepts, theories, principles and methods, technology and technological products and processes, • impact of science, technology, engineering, and human activity in general on the natural world, • advances, limitations, and risks of scientific theories, applications, and technology in societies 	<ul style="list-style-type: none"> • science as a process for the investigation through specific methodologies, including observations and controlled experiments, • use logical and rational thought to verify a hypothesis • discard one's convictions when they contradict new experimental findings, • use and handle technological tools, machines, and scientific data to achieve a goal or to reach an evidence-based decision or conclusion, • recognise the essential features of scientific inquiry, • ability to communicate the findings and reasoning that led to them. 	<ul style="list-style-type: none"> • critical appreciation and curiosity, • ethical issues and safety and environmental sustainability, • scientific and technological progress in relation to oneself, family, community, and global issues.

4	Digital competence	<ul style="list-style-type: none"> • how digital technologies (DT) can support communication, creativity and innovation, • DT opportunities, limitations, effects, and risks. • general principles, mechanisms, and logic underlying evolving DTs, • basic function, and use of different devices, software, and networks. • validity, reliability, and impact of information and data made available by DT means, • legal and ethical principles involved in engaging with DTs. 	<ul style="list-style-type: none"> • use DT to support their active citizenship and social inclusion, collaboration with others, and creativity towards personal, social, or commercial goals, • use, access, filter, evaluate, create, program, and share digital content, • manage and protect information, content, data, and digital identities, recognise and effectively engage with software, devices, artificial intelligence or robots. 	<ul style="list-style-type: none"> • reflective, critical, curious, open-minded, and forward-looking attitude to DT's evolution. • ethical, safe, and responsible approach to the use of DTs.
5	Personal, social, and learning to learn competence	<ul style="list-style-type: none"> • understand the codes of conduct and rules of communication in different societies and environments, • components of a healthy mind, body, and lifestyle, • personal preferred learning strategies, • personal competence development needs and ways to develop competences and search for the education, training, career opportunities and guidance or support available. 	<ul style="list-style-type: none"> • identify one's capacities, focus, deal with complexity, critically reflect and make decisions, • learn and work both collaboratively and autonomously, • organise and persevere with one's learning, evaluate and share it, seek support when appropriate, and effectively manage one's career and social interactions. • resilience, • communicate constructively in different environments, collaborate in teams and negotiate, • showing tolerance, expressing and understanding different viewpoints, as well as the ability to create confidence and feel empathy. 	<ul style="list-style-type: none"> • attitude toward one's personal, social, and physical well-being and learning throughout one's life, • attitude of collaboration, assertiveness, and integrity, respecting the diversity of others and their needs and being prepared both to overcome prejudices and to compromise, • identify and set goals, motivate themselves, and develop resilience and confidence to pursue and succeed at learning throughout their lives, • problem-solving attitude, • desire to apply prior learning and life experiences, • curiosity to look for opportunities to learn and develop in various life contexts.
6	Citizenship competence	<ul style="list-style-type: none"> • basic concepts and phenomena relating to individuals, groups, work organisations, society, economy and culture, • European common values, • contemporary events, main developments in national, European and world history, • aims, values and policies of social and political movements, of sustainable systems, in particular climate and demographic change at the global level and their underlying causes, • European integration, • diversity and cultural identities in Europe and the world, • multi-cultural and socioeconomic dimensions of European societies, and how national cultural identity contributes to the European identity. 	<ul style="list-style-type: none"> • engage effectively with others in common or public interest, including the sustainable development of society. • critical thinking and integrated problem solving • develop arguments and constructive participation in community activities, and in decision-making at all levels, • access, have a critical understanding of, and interact with both traditional and new forms of media, • role and functions of media in democratic societies. 	<ul style="list-style-type: none"> • respect for human rights, • responsible and constructive attitude, • willingness to participate in democratic decision-making at all levels and civic activities, • support for social and cultural diversity, gender equality and social cohesion, sustainable lifestyles, promotion of culture of peace and non-violence, • a readiness to respect the privacy of others, and to take responsibility for the environment, • Interest in political and socioeconomic developments, humanities and intercultural communication • to overcome prejudices, to compromise where necessary, and to ensure social justice and fairness.

7	Entrepreneurship competence	<ul style="list-style-type: none"> different contexts and opportunities for turning ideas into action in personal, social, and professional activities; and how these arise, approaches to planning and management of projects (processes and resources), economics, social and economic opportunities and challenges facing an employer, organisation, or society, ethical principles and challenges of sustainable development and have self-awareness of their own strengths and weaknesses. 	<ul style="list-style-type: none"> creativity (imagination, strategic thinking and problem-solving, and critical and constructive reflection within evolving creative processes and innovation), work both as an individual and collaboratively in teams, mobilize resources (people and things), and sustain activity. make financial decisions relating to cost and value. communicate and negotiate with others, cope with uncertainty, ambiguity, and risk as part of making informed decisions. 	<ul style="list-style-type: none"> sense of initiative and agency, pro-activity, being forward-looking, courage and perseverance in achieving objectives. desire to motivate others and value their ideas, empathy and taking care of people and the world, accepting responsibility taking ethical approaches throughout the process.
8	Cultural awareness and expression competence	<ul style="list-style-type: none"> local, national, regional, European, and global cultures and expressions, including their languages, heritage and traditions, and cultural products, understanding of how these expressions can influence each other as well as the ideas of the individual. different ways of communicating ideas between creator, participant, and audience within written, printed, and digital texts, theatre, film, dance, games, art and design, music, rituals, architecture, and hybrid forms. one's own developing identity and cultural heritage within a world of cultural diversity, how arts and other cultural forms can be a way to view and shape the world. 	<ul style="list-style-type: none"> express and interpret figurative and abstract ideas, experiences, and emotions with empathy in various arts and other cultural forms. identify and realise opportunities for personal, social, or commercial value through the arts and other cultural forms, engage in creative processes, both as an individual and collectively. 	<ul style="list-style-type: none"> open attitude towards, and respect for, diversity of cultural expression, ethical and responsible approach to intellectual and cultural ownership, a curiosity about the world, an openness to imagine new possibilities, a willingness to participate in cultural experiences.

When considering developing key competences with the lifelong learning perspective, it is essential to guarantee support at various educational and training levels and throughout different learning journeys, ensure teaching excellence, and continue enhancing initial and ongoing VET while modernizing HE.

In this sense, and acknowledging the evolving and dynamic landscape of jobs and the need to support the development of key competences, the CERES curricula will support the development of skills corresponding to entrepreneurship, personal development, and digital and transversal skills. As an initial step, the analysis of key competences in VET of the countries participating in the CERES project following the country-specific reports developed by Cedefop supported identifying the foundational knowledge learners should possess to enroll in the courses. Table 8 summarises the main objectives of three key competences selected from the European Reference Framework to consider while developing the CERES curricula: digital competences, entrepreneurship, and learning to learn.

The analysis showed that the key competences described in the country reports aligned seamlessly with the EQF at level 4, providing learners with a comprehensive understanding of skills and knowledge. The alignment with EQF level 4 ensures that individuals undergoing VET programs acquire a solid foundation, laying the groundwork for competence development that is recognized nationally and harmonized with European standards. More detailed information is available in Annex 4.

Therefore, a holistic approach proposed to shape the competency maps for the CERES project considers the key competences described in table 8 as a foundation cornerstone. Key competences are core in VET, and the aim is to complement them by aligning with the evolving needs of the workforce, incorporating the insights derived from the Skills Agenda 2016 (European Commission, 2016b) and 2020 (European Commission, 2020) to accompany the green and digital transition in jobs and beyond. These crucial elements will forge a robust curricula that empowers learners with the proficiencies vital for today's world and its rapidly changing demands. The emphasis on green and digital transformation, entrepreneurship, and self-management will prepare individuals with technical skills and the adaptability and strategic thinking necessary for success in a digitally driven professional landscape. By doing so, the CERES curricula aim to influence academic and job market transformations.

Table 8 Main objectives Digital, Entrepreneurship, and Learn to learn key competences in VET per country involved in the CERES project

	Digital competences	Entrepreneurship	Learning to learn
Bulgaria	<ul style="list-style-type: none"> - Improved digital competences. - Collecting, storing, monitoring, and using information - Conducting studies, investigations and tests - maintaining records managing, evaluating, processing, analysing and monitoring information and projecting outcomes 	<ul style="list-style-type: none"> - Improved competences in entrepreneurship. - Development, organization and management of an own business venture. 	<ul style="list-style-type: none"> - Improved competences. - Show a positive attitude towards new and challenging demands that can only be met via lifelong learning
Cyprus	<ul style="list-style-type: none"> - Involve the confident and critical use of information society technology for work, leisure, and communication. - Basic skills in ICT underpin it: the use of computers to retrieve, assess, store, produce, present, and exchange information and to communicate and participate in collaborative networks via the Internet. 	<ul style="list-style-type: none"> - Ability to turn ideas into action. It includes creativity, innovation and risk-taking, as well as the ability to plan and manage projects in order to achieve objectives. - Supports individuals, not only in their everyday lives at home and in society, but also in the workplace in being aware of the context of their work and being able to seize opportunities, and is a foundation for more specific skills and knowledge needed by those establishing or contributing to social or commercial activity. This should include awareness of ethical values and promote good governance. 	<ul style="list-style-type: none"> - Prepare students for further learning and analyze and solve everyday problems. - Applying theoretical knowledge and enhancing existing knowledge through technological subjects contribute to acquiring the learning-to-learn competences. - VET curricula help students acquire competences to learn and equip them with the capacity to adjust in dynamic and unpredictable situations, to search for, select, assess, interpret, and make optimal use of information
Italy	<ul style="list-style-type: none"> - Digital competence (EU key competence No 4) is intended as a transversal area. However, it is specifically quoted in the first cultural axe language skills, in terms of 'using and producing multimedia texts', but also in the mathematical skills in terms of 'making calculations, also by using computer applications and charts', as well as in the scientific-technological skills 'awareness of the potential and limitations of technology'. 	<ul style="list-style-type: none"> - Problem solving and 'ability to organise and manage the working environment with an high level of autonomy and responsibility' 	<ul style="list-style-type: none"> - Autonomy, responsibility, differentiation. - Transversal competence within the set of nationally defined key competences (it is No 1). At national level learning to learn is intended in terms of ability to 'self-organise learning, identify, choose and use different sources and methods of information and learning (formal, non-formal and informal), also following personal timing, strategies and methods of both working and/or studying'.

<p>UK</p> <ul style="list-style-type: none"> - Using appropriate software to solve problems, using ICT to learn effectively and using computing to process and manage information. - Wales: Courses will teach digital: responsibility; information literacy; productivity; collaboration; creativity and learning. 	<ul style="list-style-type: none"> - Teach enterprising skills, management, employer engagement. - Scotland: Recognising need and opportunity, influencing and negotiating, evaluating risk to aid decision-making, taking initiative and working with others, self-awareness and having an open mindset, modern world view and resilience, adaptability and determination, and meeting expectations. - Wales: Understanding the world of work is a key focus. 	<ul style="list-style-type: none"> - FE: Independent study and learning, teamwork, peer interaction, using feedback and learner voice. - Apprenticeships: must demonstrate PLTS Skills; independent enquiry, creative thinking, reflective learning, teamwork, effective participation and self-management. - IOLP: Develop strategies to learn more effectively. Take responsibility for their learning, set goals, plan and review progress. - Scotland: Thinking skills developed by: remembering, understanding, applying, evaluating and creating ideas or knowledge.
<p>Denmark</p> <ul style="list-style-type: none"> - Information technologies are of highest priority in the Danish VET system. The key competences in VET are regulated by national curricula. The digital competence is an integrated part of the whole VET education but is also a basic course in Information Technology. 	<ul style="list-style-type: none"> - VET must give the students an education that provides them with innovative and entrepreneurial thinking, future work, including establishing self-employment and meets the labour markets need for an innovative and creative workforce. 	<ul style="list-style-type: none"> - National curricula regulate the key competences in VET. Learning to learn is addressed as a general endeavor in many curricula by stressing the importance of students' self-evaluation and portfolio work. This is also embedded in the national framework of the learner's personal educational plan.
<p>France</p> <ul style="list-style-type: none"> - The certificate certifies the level acquired by students in mastering multimedia tools and the internet 	<ul style="list-style-type: none"> - Two courses cover this competence in the vocational baccalaureate: economics-law and economics-management. Depending the curricula, entrepreneurship education is integrated as a cross-curricular objective; it exists on its own as a specific topic only for tertiary education 	<ul style="list-style-type: none"> - The certificate certifies the level acquired by students in mastering multimedia tools and the internet

5.2 Review of European Competence Frameworks

The following competence frameworks in Europe served as structured models that outline the essential skills, knowledge, and behaviors required for effective performance in various professional domains. These frameworks are crucial in shaping education, training, and workforce development policies across European countries and align with the EQF to foster compatibility and mobility within the European labor market.

5.2.1 The Digital Competence Framework for Citizens (DigComp 2.2)

Following the aim of the European Skills Agenda (2020) to support the objectives of the Digital Education Action Plan and enhance digital skills to ensure a digital transformation path for the entire society and to foster high-performing digital education systems, the Digital Competence Framework for Citizens, i.e., DigiComp 2.2 (Vuorikari et al., 2022) has been developed. This framework is characterized by five key areas, out of which the last two (i.e., safety and problem-solving) can be considered transversal skills. Specific competences characterize these five areas (Table 9).

Table 9 DigiComp 2.2: the five key areas and associated competences

<i>Key areas</i>	<i>Competences</i>
Information and Data Literacy	<ul style="list-style-type: none"> • Browsing, searching, and filtering data, information, and digital content • Evaluating data, information, and digital content • Managing data, information, and digital content
Communication and Collaboration	<ul style="list-style-type: none"> • Interacting through digital technologies • Sharing through digital technologies • Engaging citizenship through digital technologies • Collaborating through digital technologies • Netiquette • Managing digital identity
Digital content creation	<ul style="list-style-type: none"> • Developing digital content • Integrating and re-elaborating digital content • Copyright and licenses • Programming
Safety	<ul style="list-style-type: none"> • Protecting devices • Protecting personal data and privacy • Protecting health and well-being • Protecting the environment
Problem-Solving	<ul style="list-style-type: none"> • Solving technical problems • Identifying needs and technological responses • Creatively using digital technologies • Identifying digital competence gaps

Each competence can be assessed through a maturity scale that covers four main levels: (1) foundation, (2) intermediate, (3) advanced, and (4) highly specialized. These levels are described through detailed sentences clarifying what a person at that level should know and could do.

The CERES project could employ this framework as the starting point to exploit digital skills during the circular transition. Moreover, the maturity scale of this framework could be used to align a potential maturity model developed to assess circular skills throughout the project.

5.2.2 The Entrepreneurship Competence in Vocational Education and Training (VET) in Europe and the EntreComp Framework

The concept of entrepreneurship competence varies within countries; none of the definitions are VET-specific (Cedefop, 2023b). However, these definitions often are derived from EU key competence frameworks where entrepreneurship is *'the capacity to act upon opportunities and ideas, and to transform them into value for others, characterized by elements such as resilience, flexibility, adaptability, acting upon ideas, and opportunities'* (Council of the European Union, 2018).

Some European countries, such as Italy, use the EntreComp framework to define this competence in policy documents, while in France, the concept of entrepreneurship competence is not clearly defined. At the VET provider level, sustainable entrepreneurship is gaining momentum since it is considered a possible solution to social and environmental issues, even if digitalization and sustainability are rarely integrated into national guidelines for entrepreneurship.

The VET entrepreneurial learning ecosystem is characterized by policymakers, employers, VET providers, teachers/trainers, learners, chambers of commerce, business start-up support agencies, and research centres. They collaborate in developing agenda-setting, curriculum-making, teacher training, teaching, learning, performance assessment, and extracurricular activities.

VET providers are central to the entrepreneurial learning ecosystem to understand interaction from internal and external perspectives (Figure 4). The internal perspective relates to strategic, organizational, and pedagogical decisions/actions at the VET provider level. At the same time, the external one explores the role of VET providers and the level and type of engagement with other stakeholders to promote learning. Exchanges between teachers and learners trigger new connections with external stakeholders, and cooperation with business is common in VET.

The policy dimensions in the VET entrepreneurial learning ecosystem consider an array of policies, strategies, action plans, and legislation developed by public authorities to improve entrepreneurship competence development in VET. The evolution of EU policies over the past 25 years reflects the growing emphasis on entrepreneurship competence and the EU's commitment to implement strategies to support it across education levels. However, VET providers struggle with policies, policy gaps, many challenges, and contradictory guidelines, often resulting in challenges in translating policies into practice.

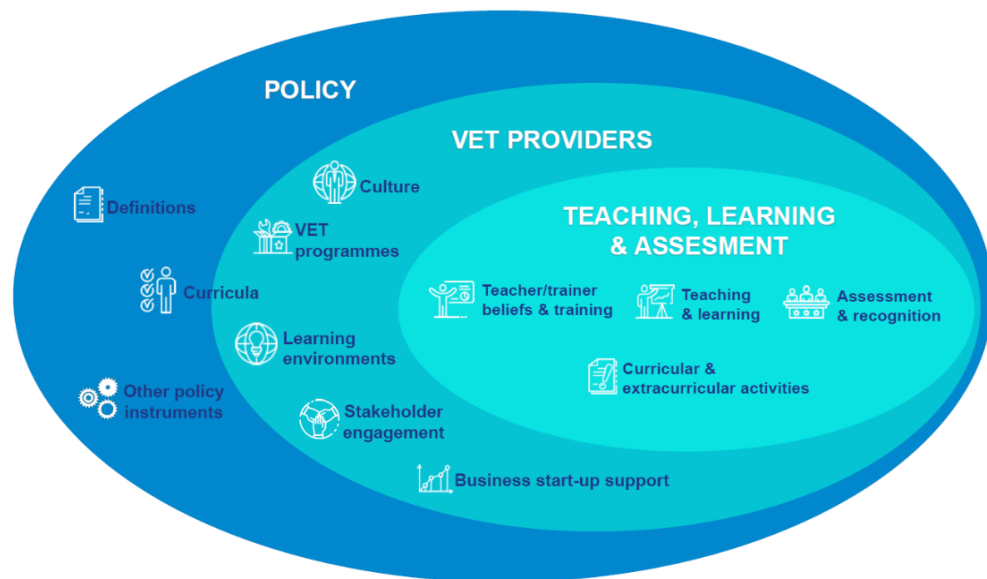


Figure 4 VET entrepreneurial learning ecosystem Source: Cedefop (2023). *Entrepreneurship competence in vocational education and training in Europe: synthesis report*. Luxembourg: Publications Office. Cedefop research paper.

The EntreComp framework identifies three competence areas of entrepreneurship (ideas and opportunities, resources, action), 15 competences, 15 descriptors, 8 proficiency levels, and 442 learning outcomes. This framework integrates entrepreneurship competence in learning by linking skills, knowledge, and attitudes with financial, cultural, and social value creation.

The EntreComp Progression Model provides a reference for developing proficiency, from value creation obtained through external support to transformative value creation. There are four primary levels :

1. Foundation: entrepreneurial value is created with external support,
2. Intermediate: entrepreneurial value is created with increasing autonomy,
3. Advanced: the responsibility to transform ideas into action is developed,
4. Expert: the value created has a considerable impact on its reference domain.

In Table 10, the first three proficiency levels are reported. Hence, the expert level is not detailed in the overview table since it captures a level of expertise beyond the average and is context-dependent.

Table 10 Three Levels of proficiency. Source *EntreComp*

		Levels of proficiency		
Area	Competence	Foundation	Intermediate	Advanced
Ideas and opportunities	Spotting opportunities	Learners ⁸ can find opportunities to generate value for others.	Learners can recognise opportunities to address needs that have not been met.	Learners can seize and shape opportunities to respond to challenges and create value for others.
	Creativity	Learners can develop multiple ideas that create value for others.	Learners can test and refine ideas that create value for others.	Learners can transform ideas into solutions that create value for others.
	Vision	Learners can imagine a desirable future.	Learners can build an inspiring vision that engages others.	Learners can use their vision to guide strategic decision-making.
	Valuing ideas	Learners can understand and appreciate the value of ideas.	Learners understand that ideas can have different types of value, which can be used in different ways.	Learners can develop strategies to make the most of the value generated by ideas.
	Ethical and sustainable thinking	Learners can recognise the impact of their choices and behaviours, both within the community and the environment.	Learners are driven by ethics and sustainability when making decisions.	Learners act to make sure that their ethical and sustainability goals are met.
Resources	Self-awareness and self-efficacy	Learners trust their own ability to generate value for others.	Learners can make the most of their strengths and weaknesses.	Learners can compensate for their weaknesses by teaming up with others and by further developing their strengths.
	Motivation and perseverance	Learners want to follow their passion and create value for others.	Learners are willing to put effort and resources into following their passion and create value for others.	Learners can stay focused on their passion and keep creating value despite setbacks.
	Mobilising resources	Learners can find and use resources responsibly.	Learners can gather and manage different types of resources to create value for others.	Learners can define strategies to mobilise the resources they need to generate value for others.
	Financial and economic literacy	Learners can draw up the budget for a simple activity.	Learners can find funding options and manage a budget for their value-creating activity.	Learners can make a plan for the financial sustainability of a value-creating activity.
	Mobilising others	Learners can communicate their ideas clearly and with enthusiasm.	Learners can persuade, involve and inspire others in value-creating activities.	Learners can inspire others and get them on board for value-creating activities.
Into action	Taking the initiative	Learners are willing to have a go at solving problems that affect their communities.	Learners can initiate value-creating activities.	Learners can look for opportunities to take the initiative to add or create value.
	Planning and management	Learners can define the goals for a simple value-creating activity.	Learners can create an action plan, which identifies the priorities and milestones to achieve their goals.	Learners can refine priorities and plans to adjust to changing circumstances.
	Coping with uncertainty, ambiguity and risk	Learners are not afraid of making mistakes while trying new things.	Learners can evaluate the benefits and risks of alternative options and make choices that reflect their preferences.	Learners can weigh up risks and make decisions despite uncertainty and ambiguity.
	Working with others	Learners can work in a team to create value.	Learners can work together with a wide range of individuals and groups to create value.	Learners can build a team and networks based on the needs of their value-creating activity.
	Learning through experience	Learners can recognise what they have learnt through taking part in value-creating activities.	Learners can reflect and judge their achievements and failures and learn from these.	Learners can improve their abilities to create value by building on their previous experiences and interactions with others.

The model does not refer to any specific setting. Still, it breaks down the boundaries between education, work, and civic engagement by focusing on developing competences through creating entrepreneurial value. It is transversal to formal, non-formal, and informal learning contexts.

Entrepreneurship is often regarded as a cross-curricular element in VET, with the creation of stand-alone subjects that are seen to play second fiddle to technical ones. This siloed approach may lead to significant neglect of cross-curricular approaches since teachers may think developing them is someone else's duty, and it is challenged by insufficient training and support.

Digital technologies enable subjects to be more compelling to young people, as well as collaboration and networking, but it must be considered that VET teachers' digital competences vary depending on their training. Embedding entrepreneurship competence in VET is essential to understanding the entrepreneurial learning ecosystem, identifying optimal approaches, and facing knowledge gaps.

5.2.3 The European Sustainability Competences – GreenComp

The importance of integrating sustainability into educational and training systems to safeguard our planet's well-being cannot be overstated. The EC has underscored the significance of environmental sustainability in learning initiatives. The introduction of GreenComp, the European Sustainability Competence Framework, exemplifies this commitment. This deliverable considers GreenComp an essential reference framework to infuse environmental sustainability themes into its educational curricula, facilitating the transition toward circularity.

The European sustainability competence framework, GreenComp, provides a common ground for learners and guides educators on an agreed definition of what sustainability as a competence entails (Bianchi et al., 2022). This deliverable adopts the definition of competence following the 2018 Council Recommendation on Key Competences for lifelong learning, whereby competence is '*a dynamic combination of knowledge, skills and attitudes*' (p.12) (Council of the European Union, 2018).

Table 11 Green Comp: areas, competences, and the related Knowledge (K), Skills (S), and Attitudes (A)

Area	Competence	Descriptor	KSA examples
Embodying sustainability values	Valuing sustainability	To reflect on personal values, identify and explain how values vary among people and over time while critically evaluating how they align with sustainability values.	K: knows the main views on sustainability: anthropocentrism (human-centric), technocentrism (technological solutions to ecological problems), and ecocentrism (nature-centred), and how they influence assumptions and arguments; S: can articulate and negotiate sustainability values, principles, and objectives while recognizing different viewpoints; A: is prone to acting in line with values and principles for sustainability.
	Supporting fairness	To support equity and justice for current and future generations and learn from previous generations for sustainability.	K: knows that ethical concepts and justice for current and future generations are related to protecting nature; S: can apply equity and justice for current and future generations as criteria for environmental preservation and the use of natural resources; A: is committed to respecting the interests of future generations.
	Promoting nature	To acknowledge that humans are part of nature and respect the needs and rights of other species and nature itself to restore and regenerate healthy and resilient ecosystems.	K: knows that our wellbeing, health, and security depend on the wellbeing of nature; S: can assess own impact on nature and consider the protection of nature an essential task for every individual; A: cares about a harmonious relationship existing between nature and humans.
Embracing complexity in sustainability	Systems thinking	To approach a sustainability problem from all sides, to consider time, space, and context to understand how elements interact within and between systems.	K: knows that every human action has environmental, social, cultural, and economic impacts; S: can describe sustainability as a holistic concept that includes environmental, economic, social, and cultural issues; A: is concerned about the short- and long-term impacts of personal actions on others and the planet.
	Critical thinking	To assess information and arguments, identify assumptions, challenge the status quo, and reflect on how personal, social, and cultural backgrounds influence thinking and conclusions.	K: knows sustainability claims without robust evidence are often mere communication strategies, also known as greenwashing; S: can analyse and assess arguments, ideas, actions, and scenarios to determine whether they are in line with evidence and values in terms of sustainability; A: trusts science even when lacking some of the knowledge required to understand scientific claims fully.
	Problem framing	To formulate current or potential challenges as a sustainability problem in terms of difficulty, people involved, time, and geographical scope to identify suitable approaches to anticipating and preventing problems and mitigating and adapting to existing problems.	K: knows that to identify fair and inclusive actions, it is necessary to look at sustainability problems from different stakeholder perspectives; S: can establish a transdisciplinary approach to framing current and potential sustainability challenges; A: listens actively and shows empathy when collaborating with others to frame current and potential sustainability challenges.

Envisioning sustainable futures (circular economy)	Futures literacy (circular economy)	To envision alternative sustainable futures by imagining and developing alternative scenarios and identifying the steps needed to achieve a preferred sustainable future.	<p>K: knows the difference between expected, preferred, and alternative futures for sustainability scenarios;</p> <p>S: can envisage alternative futures for sustainability that are grounded in science, creativity, and values for sustainability;</p> <p>A: is aware that the projected consequences on self and community may influence preferences for specific scenarios above others.</p>
	Adaptability	To manage transitions and challenges in complex sustainability situations and make decisions related to the future in the face of uncertainty, ambiguity, and risk.	<p>K: knows that human actions may have unpredictable, uncertain, and complex consequences for the environment;</p> <p>S: can take into account local circumstances when dealing with sustainability issues and opportunities;</p> <p>A: is willing to discontinue unsustainable practices and try alternative solutions.</p>
	Exploratory thinking (circular economy)	To adopt a relational way of thinking by exploring and linking different disciplines, using creativity, and experimentation with novel ideas or methods.	<p>K: knows that sustainability problems must be tackled by combining different disciplines, knowledge cultures, and divergent views to initiate systemic change;</p> <p>S: can synthesise sustainability-related information and data from different disciplines;</p> <p>A: is committed to considering sustainability challenges and opportunities from different angles.</p>
Acting for sustainability (circular economy)	Political agency	To navigate the political system, identify political responsibility and accountability for unsustainable behaviour, and demand effective policies for sustainability.	<p>K: knows policies that assign responsibility for environmental damage (e.g., ‘polluter pays’);</p> <p>S: can identify relevant social, political, and economic stakeholders in one’s community and region to address a sustainability problem;</p> <p>A: demands political accountability for unsustainable behaviour.</p>
	Collective action	To act for change in collaboration with others.	<p>K: knows how to work with diverse participants to create inclusive visions for a more sustainable future;</p> <p>S: can create transparent, inclusive, and community-driven processes;</p> <p>A: is willing to engage with others to challenge the status quo.</p>
	Individual initiative	To identify my potential for sustainability and actively contribute to improving prospects for the community and the planet.	<p>K: knows that preventive action should be taken when specific actions or inaction may damage human health and all life forms (precautionary principle);</p> <p>S: can act promptly, even in the face of uncertainty and unforeseen events, keeping in mind the precautionary principle;</p> <p>A: is confident about anticipating and influencing sustainable changes.</p>

Learning about environmental sustainability is part of the strategic action needed to help Europeans participate fully in the green transition. A competence-based education that helps learners develop sustainability skills based on knowledge and attitudes can help promote responsible action and stimulate willingness to take or demand action at local, national, and global levels. Becoming competent in sustainability issues will enable learners to overcome the cognitive dissonance that comes from knowing about an issue but lacking the agency to act.

Examples of pedagogical practices that can be effective in developing the competences set out in GreenComp include: active learning; student-centred, design-based, project-based, transformative (situated) learning contexts; gamification; role plays, experimental games, and simulations; analysis of real-world case studies taken from the local context; blended and online learning; project-based learning; outdoor approaches; and collaborative approaches (cooperation with external partners).

The GreenComp provides a conceptual reference model that everyone involved in lifelong learning can use with various objectives. The CERES project will use it to design and shape its educational curricula to develop circular competences.

5.2.4 Personal, Social, and Learning-to-learn Competences

This section provides an overview of the European Framework for Personal, Social, and Learning to Learn Key Competence: LifeComp for education systems, students, and learners. LifeComp is a crucial complement to other frameworks. It may even constitute the baseline, as it deals with life skills – the skills and competences that everybody should continually develop throughout life (Sala et al., 2020). The framework could be adapted to different educational contexts.

LifeComp comprises three intertwined competence areas:

- **Personal:** Most emerging jobs that were expected to expand between 2020 and 2025 require strong collaboration and communication skills. With empathy, entrepreneurship, innovation, and other skills, collaboration and communication will be fundamental to becoming “robot-proof” in a labour market profoundly shaped by technological breakthroughs.
- **Social:** The social area is related to learning to live together and to awareness of the social nature of the human being. It implies the ability and willingness to interact, communicate, and collaborate with others constructively.
- **Learning to learn:** Learning to Learn is the “most important skill of all.” This competence can be acquired throughout the lifespan. It is a relevant driver for change in adulthood, promoting employability and competitiveness.

Each area includes three competences: Self-regulation, Flexibility, Wellbeing (Personal Area), Empathy, Communication, Collaboration (Social Area), Growth mindset, Critical thinking, and Managing learning (Learning to learn Area) (Table 12). Each competence has, in turn, three descriptors that generally correspond to the awareness, understanding, and action model. “Personal, Social, and Learning to Learn” is intertwined with other key competences (i.e., Literacy; Multilingual; Mathematical, science, technology and engineering; Digital citizenship; Entrepreneurship; and Cultural awareness and expression); it spans relevant competences which all citizens should develop to empower them to actively participate in society and the economy, in the context of the increasing importance of ‘soft skills’ in a fast-changing global context.

Learning to Learn can unleash the potential for change in individuals and communities, contribute to society's common good, and empower them to thrive in a rapidly changing world. Therefore, to enhance economic performance and social cohesion, it is relevant to provide all citizens, especially those at most risk of exclusion, with high-quality opportunities for formal, non-formal, and informal learning all over the lifespan and of reflection on one's learning for its enhancement.

LifeComp, through education, may contribute to achieving the United Nations Target 4.7 of Sustainable Development Goals. That is to ensure that *“all learners, by 2030, acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and culture's contribution to sustainable development”*.

Table 12 LifeComp: areas, competences, and related descriptors

Area	Competences	Descriptors
Personal	P1: Self-regulation is a key component of Entrepreneurship competence, i.e., the capacity to create cultural, social, or economic value.	P1.3 Nurturing optimism, hope, resilience, self-efficacy, and a sense of purpose to support learning and action
	P2: Flexibility is the capacity to adapt to new situations and adjust to accommodate changes. Adap to change is the “ability to modify one’s attitude or behaviour to accommodate modifications in the workplace” (EntreComp).	P2.1: Readiness to review opinions and courses of action in the face of new evidence
		P2.2: Understanding and adopting new ideas, approaches, tools, and actions in response to changing contexts
		P2.3: Managing transitions in personal life, social participation, work, and learning pathways while making conscious choices and setting goals. Flexibility encompasses career management skills, continually pursuing further training to adapt to different employment contexts at any age, setting meaningful goals, and making effective career decisions toward successful transitions.
P3: Wellbeing: This definition highlights the interconnectedness and interdependence of physical, mental, social, and environmental aspects of wellbeing. Environmental well-being is also part of personal well-being. It can be promoted by adopting a sustainable lifestyle, responsibly reducing our environmental impact, raising awareness, and advocating for actions to combat climate change.	P3.1: Awareness that individual behaviour, personal characteristics, and social and environmental factors influence health and wellbeing. Awareness of the interaction between the various factors that influence wellbeing may empower citizens to act, whether individually (e.g., by abandoning unhealthy personal behaviours) or collectively, by advocating for policies to address climate change, among others.	
	P3.3: Adopting a sustainable lifestyle that respects the environment and the physical and mental wellbeing of self and others while seeking and offering social support. Promoting wellbeing includes adopting a sustainable lifestyle that considers “the dynamic relationship between natural resource use, environmental quality, and health and wellbeing”. It underlines the need to adopt a systemic approach that considers the interdependence of one’s and others’ health and well-being and safeguarding healthy environments. It requires understanding that everyday choices can impact the environment and that adopting certain ways of life can allow individuals to reduce their carbon footprint.	
Social	S2: Communication: The use of relevant communication strategies, domain-specific codes, and tools, depending on the context and content	S2.2: Understanding and managing interactions and conversations in different socio-cultural contexts and domain-specific situations.
	S3: Collaboration: Engagement in group activity and teamwork, acknowledging and respecting others.	S3.1: Intention to contribute to the common good and awareness of different cultural affiliations, backgrounds, beliefs, values, opinions, or personal circumstances. It is, learn to cope with diversity and also to take advantage of it by collaborating and creating synergies.
S3.3: Fair sharing of tasks, resources, and responsibilities within a group, considering its specific aim, eliciting different views, and adopting a systemic approach. A systemic approach requires understanding how the various and interconnected aspects of a group task and external factors influence its outcomes. It entails focusing on the dynamic, complex, and evolving relations among components and how they contribute to the system's stability.		

Learning to learn	L1: Growth Mindset: This competence is linked to self-awareness and self-direction and stresses the importance of continuously developing the capacity to face challenges and learn through believing in the improvement of their potential.	L1.1: Awareness of and confidence in one's and others' abilities to learn, improve, and achieve with work and dedication. Educators and learners must value the learning process, various strategies employed, perseverance, learning progress, and effort.
		L1.2: Understanding that learning is a lifelong process that requires openness, curiosity, and determination. Self-directed lifelong learning is a demand in modern societies, in which adult learners are required to upskill and reskill to thrive in a rapidly changing labour market.
		L1.3: Reflecting on other people's feedback and successful and unsuccessful experiences to continue developing one's potential. Dealing with setbacks, failure, and negative feedback and learning from it enables to move forward effectively.
	L2: Critical thinking: Assessing information and arguments to support reasoned conclusions and develop innovative solutions.	L2.2: Comparing, analysing, assessing, and synthesizing data, information, ideas, and media messages to draw logical conclusions and make sense of data.
		L2.3: Developing creative ideas, synthesizing and combining concepts and information from different sources to solve problems. Creativity is a transversal skill that anyone can develop and is also a driver for innovation.
	L3: Managing Learning: The planning, organising, monitoring, and reviewing of one's learning.	L3.1: Awareness of one's learning interests, processes, and preferred strategies, including learning needs and required support.
		L3.2: Planning and implementing learning goals, strategies, resources, and processes.
		L3.3: Reflecting on and assessing purposes, processes, and outcomes of learning and knowledge construction, establishing relationships across domains. This descriptor stresses the importance of reflection on and evaluation of the learning outcomes.

Following the review of the lifelong learning key competences and the different competence frameworks in Europe, to develop competences with a lifelong learning perspective, it is essential to guarantee support at various educational and training levels and throughout different learning journeys and ensure the excellence of teaching, establishing pathways for upskilling low-skilled adults, and continuing the enhancement of both initial and ongoing VET while modernizing HE.

Moreover, the need for highly qualified specialists has increased in recent years, and according to the skills forecast performed by Cedefop, this trend is likely to continue (see Section 4). This demand concerns university degrees and increasingly focuses on higher-level vocational skills, validation, and certification possibilities for employed skilled workers.

In many countries, such programs and qualifications are outside the regulated formal education and training, and the provision is heterogeneous, often fragmented, and non-transparent. NQFs, with levels based on learning outcomes, have helped reveal the diversity and increasing importance of VET provision at EQF levels 5 to 8. NQFs provide a robust framework to help structure it. Therefore, the following section describes the CERES competence framework focusing on levels 6 and 7 within the EQF and NQFs, considering the specific educational context and missing VET qualifications recognized at these levels.

KEY TAKEAWAYS

The section reviewed the European Reference Framework and highlighted the eight core lifelong learning competences. It emphasizes the need to pay more attention to developing key competencies related to entrepreneurship, sustainability, digital skills, personal growth, and social, emphasizing their importance in personal fulfillment, social inclusion, citizenship, and employment. The discussion also addresses the importance of integrating recognized certifications for VET at EQF levels 6, 7, and 8. Moreover, the section reviewed the European competence frameworks DigComp 2.2 for digital skills, EntreComp for entrepreneurship, GreenComp for sustainability, and LifeComp for personal, social, and learning-to-learn competences. These frameworks provide structured models outlining essential skills, knowledge, and behaviors for effective performance in various domains. The EntreComp framework outlines competence areas, proficiency levels, and learning outcomes. The GreenComp framework is also introduced as a reference model for infusing environmental sustainability into educational curricula. The LifeComp framework addresses personal, social, and learning-to-learn competences, emphasizing their intertwining nature with other key competences. Therefore, the CERES Competency Maps will align with these frameworks to develop the CERES curricula to address the evolving needs of the workforce, including digital and transversal skills such as circular economy supporting the development of competences with a lifelong learning perspective, especially in the increasing demand for highly qualified specialists.

6 Categorization of Competences and Definition of Proficiency Levels

This section aims to categorize the identified competences for the CERES curricula following the different competence frameworks and to determine the proficiency levels to respond to the trends in job demand. By integrating the insights from the frameworks reviewed, CERES educational curricula will be more comprehensive, responsive, and aligned with the evolving needs of learners, preparing them to excel both academically and in their future careers.

The 2023 skills forecast in section 4 showed Information and Communication as the fastest growing sector, while in the countries participating in the CERES project, Business and Administration will have more job creation due to employment change. The key competences analysis identified the need for entrepreneurship, green, and digital skills to adapt the workforce to a changing environment (European Commission, 2016b) (European Commission, 2020).

Furthermore, the competence frameworks reviewed helped identify the most adequate competences relevant to the CERES project and classify them into four main categories: Resilience and Soft, Entrepreneurship, Green, and Digital transition skills. Within each skill category, distinct areas are identified, and specific competences are defined and detailed. This categorization will be the foundation for the development of the CERES curricula.

In addition, most of the proficiency levels of VET curricula of the countries participating in the CERES project go up to EQF level 5, highlighting the need for professional certificates to align with EQF levels 6 and 7. Recognizing the evolving demands of the professional landscape, it is imperative to strategically focus the CERES curricula on EQF levels 6 and 7 to ensure a nuanced and comprehensive approach to competency development. As a result, by including an HE approach in the curricula, its classification at this level underscores its unique and distinct nature, which goes beyond the typical VET offerings.

In this sense, the following subsections will present the EQF level selected for the CERES curricula (sub-section 6.1) as well as the competences selected related to the Personal, Social, and Learning-to-learn Competence Framework (LifeComp for personal-social skills), the Entrepreneurship Competence Framework (EntreComp for entrepreneurship), the Sustainability Competence Framework (GreenComp for sustainability and CE competences), and the Digital Competence Framework for citizens (DigComp for digital proficiencies), respectively from sub-section 6.2 to 6.5.

6.1 Definition of Skill Levels According to EQF and NQF

Considering their distinctive content and goals, the CERES curricula will align with EQF levels 6 and 7 (Table 13). The curricula aim to provide a comprehensive approach that combines foundational knowledge with advanced competences, including those related to CE principles, entrepreneurship, and digital technologies. By falling within EQF level 6, the curricula will provide a solid grounding and introduce fundamental concepts of CE, entrepreneurship, and digital technologies. Considering EQF level 7, the curricula will delve deeper into these critical areas, fostering advanced competences and enabling participants to navigate the complexities of a rapidly changing world, where these competences are increasingly vital for success in both academic and professional domains.

Table 13 EQF 6 ad EQF 7

Level	Knowledge	Skills	Responsibility and autonomy
EQF 7	<ul style="list-style-type: none"> - Highly specialized knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research - critical awareness of knowledge issues in a field and at the interface between different fields 	Specialized problem-solving skills are required in research and/or innovation to develop new knowledge and procedures and to integrate knowledge from different fields	<ul style="list-style-type: none"> - manage and transform work or study contexts that are complex, unpredictable, and require new strategic approaches - take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams
EQF 6	Advanced knowledge of a field of work or study involving a critical understanding of theories and principles	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	<ul style="list-style-type: none"> - manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts - take responsibility for managing professional development of individuals and groups

6.2 LifeComp and Entrecomp: Resilience and Soft skills

Resilience is a fundamental quality that empowers individuals to bounce back from setbacks, adapt to change, and thrive in the face of challenges. It encompasses the ability to persevere through adversity, maintain a positive mindset, and strength to navigate uncertainties. In the professional context, individuals often intertwine resilience with a repertoire of soft skills, including interpersonal, communication, and EI.

Soft skills are the interpersonal attributes that enable effective collaboration, communication, and problem-solving. They contribute significantly to workplace success by fostering positive relationships, teamwork, and adaptability. Together, resilience and soft skills form a dynamic combination, empowering individuals to withstand the pressures of a dynamic work environment.

Therefore, a comprehensive review of the EntreComp and LifeComp frameworks further refined the understanding of the resilience and soft skills needed in the CERES curricula. EntreComp underscores the importance of fostering an entrepreneurial mindset and encourages creativity, innovation, and adaptability. The LifeComp framework reinforces the idea that learning is a lifelong journey. This perspective serves for the curriculum design, promoting a culture of continuous learning and critical thinking.

Moreover, in selecting the competences and considering the gap identified for VET, the review focused on descriptors to allow the acquisition of advanced skills aligned with EQF levels 6, 7, and 8. For these EQF levels, the emphasis on resilience and soft skills becomes paramount. Individuals should demonstrate a deep understanding of the respective fields and showcase high resilience in facing complex challenges. Additionally, possessing refined soft skills, such as effective

communication, EI, and adept interpersonal abilities, is integral. In essence, to develop the CERES curricula aligned with EQF levels 6 and 7, cultivating resilience and soft skills is key in shaping individuals who can excel academically and professionally.

As a result of the review, the soft skills category has been strategically divided into three distinct areas: personal and social (derived from the LifeComp) and resources (derived from the EntreComp framework). Each of these areas corresponds to a set of specific competences, and each competence is associated with a detailed descriptor, outlined in Table 14 below.

Table 14 Resilience and soft skills: Main areas and Descriptors

Area	Competence	Descriptor
Personal	Self-regulation	P1.3 Nurturing optimism, hope, resilience, self-efficacy, and a sense of purpose to support learning and action.
	Flexibility	P2.2 Understanding and adopting new ideas, approaches, tools, and actions in response to changing contexts. P2.3 Managing transitions in personal life, social participation, work, and learning pathways while making conscious choices and setting goals.
	Wellbeing	P3.1 Awareness that individual behavior, personal characteristics, and social and environmental factors influence health and well-being. P3.3 Adopting a sustainable lifestyle that respects the environment and the physical and mental well-being of self and others while seeking and offering social support.
Social	Communication	S2.1 Awareness of the need for various communication strategies, language registers, and tools adapted to context and content. S2.2 Understanding and managing interactions and conversations in different socio-cultural contexts and domain-specific situations. S2.3 Listening to others and engaging in conversations with confidence, assertiveness, clarity, and reciprocity in personal and social contexts.
	Collaboration	S3.1 Intention to contribute to the common good and awareness that others may have different cultural affiliations, backgrounds, beliefs, values, opinions, or personal circumstances. S3.2 Understanding the importance of trust, respect for human dignity and equality, coping with conflicts, and negotiating disagreements to build and sustain fair and respectful relationships. S3.3 Fair sharing of tasks, resources, and responsibility within a group, considering its specific aim, eliciting different views, and adopting a systemic approach.
Resources (Entrecomp)	Self-awareness and self-efficacy	Learners can compensate for their weaknesses by further teaming up and developing their strengths.
	Motivation and perseverance	Learners can stay focused on their passion and keep creating value despite setbacks.

6.3 EntreComp and GreenComp: Entrepreneurship Skills

Entrepreneurial skills encompass a dynamic set of attributes that empower individuals to identify opportunities, take calculated risks, and transform innovative ideas into tangible ventures,

emphasizing a proactive mindset, creativity, and a willingness to adapt in the face of uncertainty. Effective problem-solving, strategic thinking, and a keen sense of initiative are integral to entrepreneurial skills. In a rapidly evolving global landscape, stakeholders increasingly recognize entrepreneurial skills as essential for fostering innovation, driving economic growth, and cultivating a mindset of continuous learning and adaptation across various domains.

At EQF levels 6 and 7, entrepreneurial skills are highly significant, representing a fusion of academic prowess and practical insight. At these levels, individuals should not only master advanced knowledge in their respective fields but also exhibit entrepreneurial dexterity. This entails identifying opportunities, navigating complexity, and applying innovative thinking to real-world challenges. At EQF level 6, learners are encouraged to cultivate foundational entrepreneurial skills, laying the groundwork for future professional endeavors. Moving to EQF level 7, a deeper integration of entrepreneurial skills is expected, requiring individuals to conceive innovative solutions and strategically implement and manage projects. The emphasis on effective communication, strategic thinking, and leadership at these levels reflects the broader recognition that entrepreneurial skills are pivotal for success in diverse academic and professional contexts, fostering a mindset of innovation, adaptability, and proactive engagement with the evolving landscape. Moreover, communication and leadership abilities are crucial in facilitating collaboration and resource mobilization to bring ideas to fruition.

Further refinement and clarification of these competences were achieved through a thorough review of the EntreComp framework. As a result, advanced-level descriptors aligning with EQF levels 6 and 7 were selected. Three areas with a corresponding set of specific competences and detailed descriptors were defined (Table 15).

Table 15 Entrepreneurship Skills: main areas and descriptors

Area	Competence	Descriptor
Ideas and opportunities (Entrecomp)	Spotting opportunities	Learners can seize and shape opportunities to respond to challenges and create value for others.
	Creativity	Learners can transform ideas into solutions that create value for others.
	Vision	Learners can use their vision to guide strategic decision-making.
	Valuable Ideas	Learners can develop strategies to make the most of the value generated by ideas.
	Ethical and sustainable thinking	Learners act to make sure that their ethical and sustainability goals are met.
Into action (Entrecomp)	Taking the initiative	Learners can look for opportunities to take the initiative to add or create value.
	Planning and management	Learners can refine priorities and plans to adjust to changing circumstances.
	Coping with uncertainty, ambiguity, and risk	Learners can weigh up risks and make decisions despite uncertainty and ambiguity.

	Working with others	Learners can build a team and networks based on the needs of their value-creating activity.
	Learning through experience	Learners can improve their abilities to create value by building on their previous experiences and interactions with others.
Resources (Entrecomp)	Mobilising resources	Learners can define strategies to mobilize the resources they need to generate value for others.
	Financial and economic literacy	Learners can make a plan for the financial sustainability of a value-creating activity.
	Mobilising others	Learners can inspire others and get them on board for value-creating activities.

6.4 GreenComp: Skills for the Green Transition

Green competences, often called sustainability or environmental competences, are skills and knowledge areas that focus on fostering environmentally conscious practices and principles. Green skills encompass a set of abilities and knowledge tailored to address environmental sustainability challenges and promote eco-friendly practices.

Green competences have gained prominence across various sectors in today's context of increasing environmental awareness and the imperative for sustainable development. Individuals possessing green competences will contribute to sustainable solutions, address environmental challenges, and participate in the global effort to build a greener and more resilient future. As the global emphasis on environmental responsibility grows, the demand for green skills continues to rise, making them essential for individuals and organizations.

Regarding EQF levels 6 and 7, green skills will represent a sophisticated integration of academic knowledge and practical expertise in environmental sustainability. Individuals at these levels will understand the complexities of green practices and actively apply and innovate within these principles. At EQF level 6, learners should develop foundational green skills for future contributions to sustainable practices in different sectors. As individuals progress to EQF level 7, a more profound mastery of green skills involves the application of advanced knowledge to address complex environmental challenges. The emphasis on green skills at these levels reflects the evolving importance of sustainability across diverse academic and professional domains, preparing individuals to contribute meaningfully to a more environmentally conscious and resilient global community.

After completing the review of the GreenComp, the attention turned to the targeted identification of competences that are particularly pertinent to the CE domain by utilizing the specific keyword "circular economy" to identify and extract relevant competences systematically closely aligned with the principles and practices of the CE. As a result of this focused identification, a dedicated category labeled "Green Transition" was established. This category is strategic for developing CERES curricula, emphasizing integrating competences related to CE practices. The specific competences within the "Green Transition" category are detailed in the table below (Table 16), offering a comprehensive reference for the CERES project.

Table 16 Green Transition Skills: main areas and descriptors

Area	Competence	Descriptor
Embracing complexity in sustainability (Green Comp)	System thinking	To approach a sustainability problem from all sides, to consider time, space, and context to understand how elements interact within and between systems.
	Critical thinking	To assess information and arguments, identify assumptions, challenge the status quo, and reflect on how personal, social and cultural backgrounds influence thinking and conclusions.
	Problem framing	To formulate current or potential challenges as a sustainability problem in terms of difficulty, people involved, time, and geographical scope, to identify suitable approaches to anticipating and preventing problems, and to mitigate and adapt to existing situations.
Envisioning sustainable futures (Green comp)	Future literacy	To envision alternative sustainable futures by imagining and developing alternative scenarios and identifying the steps needed to achieve a preferred sustainable future.
	Adaptability	To manage transitions and challenges in complex sustainability situations and make decisions related to the future in the face of uncertainty, ambiguity, and risk.
	Exploratory thinking	To adopt a relational way of thinking by exploring and linking different disciplines, using creativity and experimentation with novel ideas or methods.
Acting for sustainability (Green comp)	Political agency	To navigate the political system, identify political responsibility and accountability for unsustainable behavior, and demand effective policies for sustainability.
	Collective action	To act for change in collaboration with others.
	Individual initiative	To identify the potential for sustainability and actively contribute to improving community and planet prospects.

6.5 DigComp: Digital skills

Digital skills encompass diverse competences essential for navigating the contemporary technological landscape. These skills go beyond basic computer literacy, encompassing proficiency in utilizing digital tools, platforms, and technologies. Key aspects of digital skills include information literacy, the ability to critically assess and interpret digital information, and proficiency in using software applications for diverse purposes. Adaptability and a continuous learning mindset are integral to digital skills in the rapidly evolving digital era. Digital skills include coding, data analysis, cybersecurity, and digital communication. Individuals with robust digital skills will leverage technology for professional tasks and contribute meaningfully to the digital transformation shaping various industries and sectors.

Regarding EQF levels 6 and 7, digital skills become indispensable, representing a sophisticated integration of advanced knowledge and practical expertise in navigating the digital landscape.

Individuals at these levels will improve foundational digital literacy and proficiency in complex digital tools and technologies. At EQF level 6, learners will develop a more comprehensive understanding of digital skills, laying the groundwork for more advanced applications enabling the digital transition. At EQF level 7, knowledge of digital skills will involve assessing and applying digital information critically, engaging in advanced data analysis, and contributing to digital transformation. The emphasis on digital skills at these levels reflects the evolving importance of technology across diverse academic and professional contexts, preparing individuals to be leaders in the digital era.

DigComp provides a blueprint for enhancing digital literacy and fluency to design courses that empower students in digital skills. After reviewing the DigComp, the selection of competences considered the highly specialized proficiency level aligned with EQF level 7. The selection process also included competences facilitating the green and digital transition, enabling efficient environmental data management, supporting informed decision-making for sustainable practices, and driving innovation and productivity across various sectors. The acquired competences will empower individuals to leverage technology to optimize resource use, monitor environmental impact, and implement eco-friendly solutions. As industries embrace digital technologies, individuals with robust digital skills are better equipped to navigate and contribute to this evolving landscape. The specific competences within the "Digital skills" category are detailed in the table below (Table 17), offering a comprehensive reference for developing the CERES curricula.

Table 17 Digital Skills: main areas and descriptors

Area	Competence	Descriptor
Communication and Collaboration	Sharing through digital technologies	Create solutions to complex problems with limited definitions related to sharing through digital technologies. Integrate my knowledge to contribute to professional practices and knowledge and guide others in sharing through digital technologies.
	Engaging citizenship through digital technologies	Create solutions to complex problems with limited definitions related to engaging in citizenship through digital technologies. Integrate my knowledge to contribute to professional practices and knowledge and guide others in engaging in citizenship through digital technologies.
	Collaborating through digital technologies	Vary using the most appropriate digital tools and technologies for collaborative processes. Choose the most appropriate digital tools and technologies for co-constructing and co-creating data, resources, and knowledge.
Digital content creation	Copyright and licenses	Create solutions to complex problems with limited definitions for applying copyright and licenses to data, digital information, and content. Integrate my knowledge to contribute to professional practice and guide others in applying for copyrights and licenses.
	Programming	Create solutions to complex problems with limited definitions related to planning and developing instructions for a computing system and performing a task using a computing system. Integrate my knowledge to contribute to professional practice and knowledge and guide others in programming.

Safety	Protecting the environment	<p>Create solutions to complex problems with limited definitions related to protecting the environment from the impact of digital technologies and their use.</p> <p>Integrate my knowledge to contribute to professional practice and knowledge and guide others in protecting the environment.</p>
Problem Thinking	Identifying needs and technological responses	<p>Create solutions to complex problems with limited definitions using digital tools and possible technological responses and adapt and customise digital environments to personal needs.</p> <p>Integrate my knowledge to contribute to professional practice and knowledge and guide others in identifying needs and technological responses.</p>
	Creatively using digital technologies	<p>Create solutions to complex problems with limited definitions using digital tools and technologies.</p> <p>Integrate my knowledge to contribute to professional practice and knowledge and guide others creatively using digital technologies.</p>
	Identifying digital competence gaps	<p>Create solutions to complex problems with limited definitions related to improving digital competence, find self-development opportunities, and keep up-to-date with new developments.</p> <p>Integrate my knowledge to contribute to professional practice and knowledge and to guide others in identifying digital competence gaps.</p>

KEY TAKEAWAYS

This section outlines the comprehensive approach to categorizing and determining proficiency levels for competences in the CERES curricula. The 2023 skills forecast emphasizes the growth of the Information and Communication sector, while Business and Administration will experience increased job creation in CERES project participant countries. Key competences identified include entrepreneurship, green, and digital skills to adapt to evolving job demands. The CERES competency maps categorized skills into Resilience and Soft, Entrepreneurship, Green, and Digital transition skills, forming the foundation for the CERES curricula. The curricula will target EQF levels 6 and 7, combining foundational knowledge with advanced competences in CE principles, entrepreneurship, and digital technologies. The competences selected align with EQF levels 6 and 7, emphasizing advanced skills in resilience, entrepreneurship, green practices, and digital proficiency. EntreComp and LifeComp frameworks highlight resilience and soft skills as crucial for academic and professional success. Entrepreneurship skills, detailed by EntreComp and GreenComp frameworks, emphasize innovation and adaptability. GreenComp focuses on sustainability and CE competences essential for addressing environmental challenges. DigComp outlines digital skills crucial for navigating the technological landscape, emphasizing adaptability and continuous learning. The strategic categorization and alignment with proficiency levels ensure the CERES curricula's relevance, responsiveness, and preparation of learners for evolving academic and professional landscapes.

7 CERES Competency Maps

This section summarizes the selection and analysis of competences from the single frameworks described in section 6. It presents a visual summary of the competences to be used as a reference in constructing the CERES educational offering. Moreover, this section builds the competency maps of the CERES project, offering individual career development in VET and HE.

7.1 The CERES Competences

Table 18 serves as a comprehensive reference to summarize the competences identified for the CERES project. Within this table, the delineation includes four overarching categories, eleven distinct areas, and a detailed breakdown of 38 competences. This comprehensive summary provides a holistic overview, serving as a strategic guide for the dynamic design and refinement of CERES curricula. Including these competences ensures a nuanced consideration of various facets, fostering a well-rounded and tailored approach to skill and knowledge development within the CERES educational journey.

Table 18 Summary Competences CERES

Entrepreneurship	Ideas and opportunities (Entrecomp)	Spotting opportunities	Digital Technologies	Communication and Collaboration	Sharing through digital technologies	
		Creativity			Engaging citizenship through digital technologies	
	Into action (Entrecomp)	Vision		Digital content creation	Copyright and licenses	Collaborating through digital technologies
		Valuable Ideas				Programming
		Ethical and sustainable thinking				Safety
	Taking the initiative	Problem Thinking		Identifying needs and technological responses		
Planning and management	Creatively using digital technologies.		Identifying digital competence gaps			
Coping with uncertainty, ambiguity, and risk						
Working with others						
Learning through experience						
Resources (Entrecomp)	Mobilizing resources	Green transition	Embracing complexity in sustainability (Green Comp)	Problem framing		
	Financial and economic literacy			Envisioning sustainable futures (Green comp)	Future literacy	
Mobilizing others	Adaptability		Exploratory thinking			
Embracing complexity in sustainability (Green Comp)	System thinking		Acting for sustainability (Green comp)	Political agency		
	Critical thinking			Collective action		
				Individual initiative		
Resilience and Soft skills	Personal	Self-regulation	Green transition	Embracing complexity in sustainability (Green Comp)	Problem framing	
		Flexibility			Envisioning sustainable futures (Green comp)	Future literacy
		Wellbeing				Adaptability
	Social	Communication		Acting for sustainability (Green comp)	Exploratory thinking	
		Collaboration			Political agency	
	Resources (Entrecomp)	Self-awareness and self-efficacy			Collective action	
	Motivation and perseverance	Individual initiative				

7.2 CERES Competency Maps Visual

Recognizing the ever-evolving nature of the CE domain, the CERES Competency Map (Figure 5) has been conceived to exhibit flexibility and adaptability. It is a dynamic process aiming to accommodate evolving trends and good practices. This framework forms the foundational cornerstone to build and deploy the CERES curricula and learning materials, equipping the target audience with the means to acquire and enhance these essential skills. As a result, the approach remains responsive to the evolving demands and opportunities in the CE domain.

Moreover, integrating the CE as a transversal theme underscores its importance across the framework, ensuring that the principles of circularity are interwoven seamlessly throughout the competency maps, fostering a holistic understanding and application of circular practices. The structure of the two competency maps (VET and HE) is characterized by a foundation of four CCs augmented by Specialized Modules (SMs) tailored for HE and VET. This dual approach acknowledges the diverse learning needs of students pursuing different educational paths. Furthermore, the development process will be guided by four overarching skills categories — entrepreneurship, green, digital, and soft skills — providing a structured framework for shaping the CCs. Notably, creating SMs for HE and VET will be enriched by insights from WP1, incorporating inputs for further development. This sequential and collaborative approach ensures a nuanced and well-informed development process, aligning the competency maps with the evolving needs of learners and the broader educational landscape.

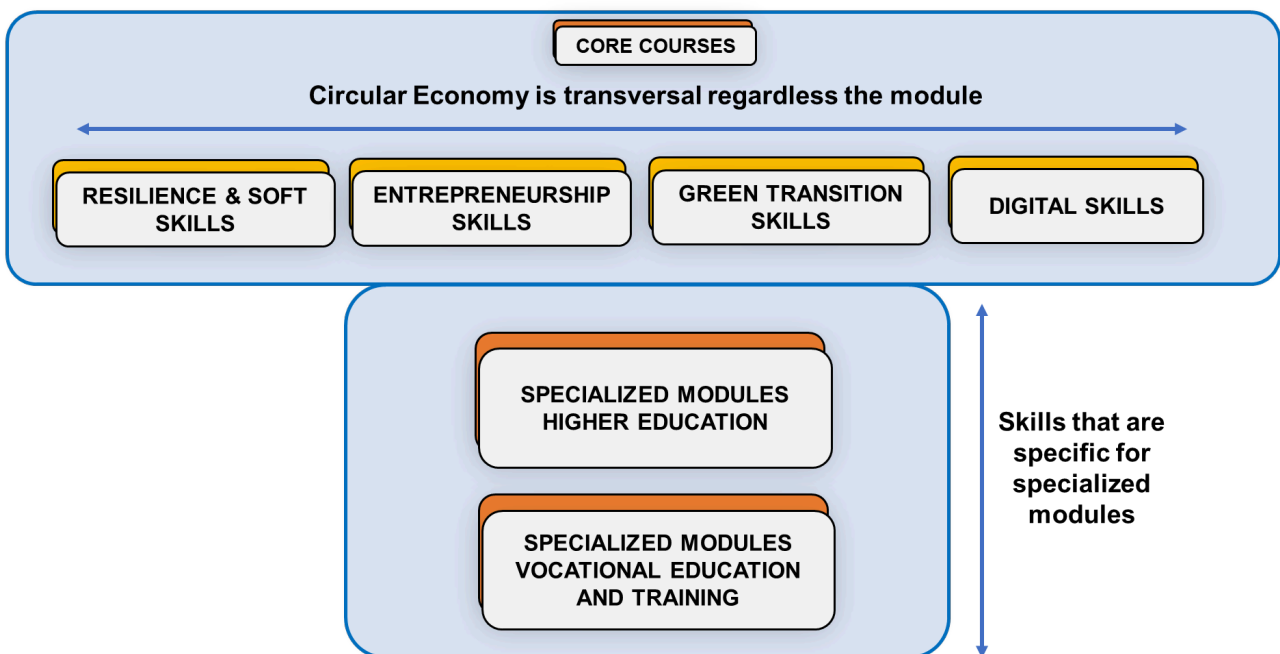


Figure 5 CERES Visual Competency Maps

8 Certification

All curricula and training materials developed within the CERES project will be assessed and certified. The CERES consortium will design a Certification Scheme (CS) containing principles, requirements, and the appropriate assessment criteria. The CS will provide a complete picture of the certification and the assessment methods. It will ensure that:

- a. All learning outcomes mentioned in the curricula and training materials are being developed to the appropriate EQF level (EQF level between 6 and 7), and
- b. The training materials are of the appropriate quality standard, offering the necessary knowledge, skills, and competences for the expected learning outcomes.

Moreover, the CS will address the assessment process, including criteria for the selection and nomination of an Assessment Committee (AC) that will have the responsibility for the assessment of curricula and training materials and the certification process, including the selection and nomination of the Certification Committee (CC) who will have the responsibility to validate the assessment procedure and award certification.

8.1 Certification of Individuals

Certification for persons is one means of assuring that the certified person meets the requirements of the CS. Confidence in the respective certification schemes for persons is achieved through a globally accepted assessment process and periodic re-assessments of the competence of certified persons.

CERES will develop a CS for the assessment and certification of individuals. CERES CS will include principles, requirements, criteria, and the process for the certification and re-certification of individuals. The contents of the CS will align with ISO/IEC 17024:2012 Standard, Conformity assessment — General requirements for bodies operating certification of persons and to the Skills Certification Framework that will be developed within the project.

More specifically, the CS will contain guidance and information for candidates to be certified for the following:

- the application and the process of assessing the persons for obtaining the certification;
- the criteria for initial certification;
- the requirements for renewing certification and re-certification;
- the Evaluation, Grant, Use, Maintenance, Suspension, and withdrawal of Certification;
- the responsibilities of certified individuals;
- criteria for personnel involved in the certification activities;
- confidentiality and impartiality.

Certification of individuals will be granted for a specific period, and afterward, recertification will occur.

Different assessment and certification procedures will be developed for the different skills at the different levels. Micro-credentials will help the certification of small, tailored learning outcomes. The CS that will be developed for the assessment and certification of individuals will be designed to assign micro-credentials to enable individuals to fill the skill gaps they need to succeed in a fast-changing environment.

9 Conclusions

D2.1 offers a comprehensive review and analysis of existing definitions and standards in various policy documents and recommendations linked to European learning and qualification and competence frameworks. Based on them, it lays the groundwork for creating the innovative CERES competency maps, including a dedicated focus on circularity-related competences and aligning with the EQF, NQF, and micro-credentials to foster cross-country recognition, ensuring a global perspective on CERES required skills and qualifications.

The in-depth analysis of the European competence frameworks performed in D2.1 has proven instrumental in identifying and categorizing the necessary skills for CERES competency maps. The job market overview and analysis of the skills needed helped better understand the workforce's evolving demands and trends and identify the future leading roles. The review of Lifelong learning provided a nuanced understanding of eight key competences, bringing the imperative for digital and entrepreneurship skills to the forefront. These key competences laid the ground for VET, aligning mostly with EQF levels 4 and 5, making clear that to continue with the educational path for professionals, supporting the development of recognized certifications at EQF levels 6 and 7 in VET is essential.

D2.1 methodology thus facilitated the definition of CERES proficiency levels and the selection of four overarching skill categories: entrepreneurship skills, green skills, digital skills, and resilience and soft skills, for establishing the CERES comprehensive skill set. The CERES necessary skills are identified and categorized into eleven distinct areas, each representing a specific facet crucial for comprehensive skill development. Moreover, the detailed breakdown reveals 38 competences that will play a pivotal role in guiding the nuanced and compelling design of the CERES curricula (D2.2).

The alignment with the EQF levels ensures CERES curricula are comprehensive, meeting foundational knowledge requirements and advanced competences. Moreover, considering micro-credentials will support recognizing and validating CERES skills and learning experience. D2.1 also recognizes CE as a transversal topic across competences requiring a holistic integration of CE principles throughout the entire set of skill categories.

Incorporating CCs and SMs tailored for HE and VET will reinforce the commitment to addressing the unique learning needs of individuals pursuing distinct educational paths. As the CERES project evolves, developing CCs and SMs for HE and VET will actively consider the results of D1.1 (literature review, market analysis, survey, and interviews) to enrich CERES curricula. This forward-looking approach guarantees that the modules will be refined and tailored to meet learners' evolving needs, staying alongside emerging trends and challenges. These considerations will support the development of a dynamic, adaptable, inclusive educational framework.

Finally, the D2.1 approach ensures that CERES's educational offering aligns with the European Skills Agenda and endorses the European Education Area 2025 goals, providing inclusivity and accessibility in education and training. The alignment with NQFs and the strategic incorporation of professional qualifications for recognition promote coherence and reflect a shared vision for enhancing educational mobility and fostering international collaboration. It sets the stage for a dynamic and responsive educational approach, aligning with the evolving demands of the professional landscape and ensuring the relevance and adaptability of the CERES project in the future.

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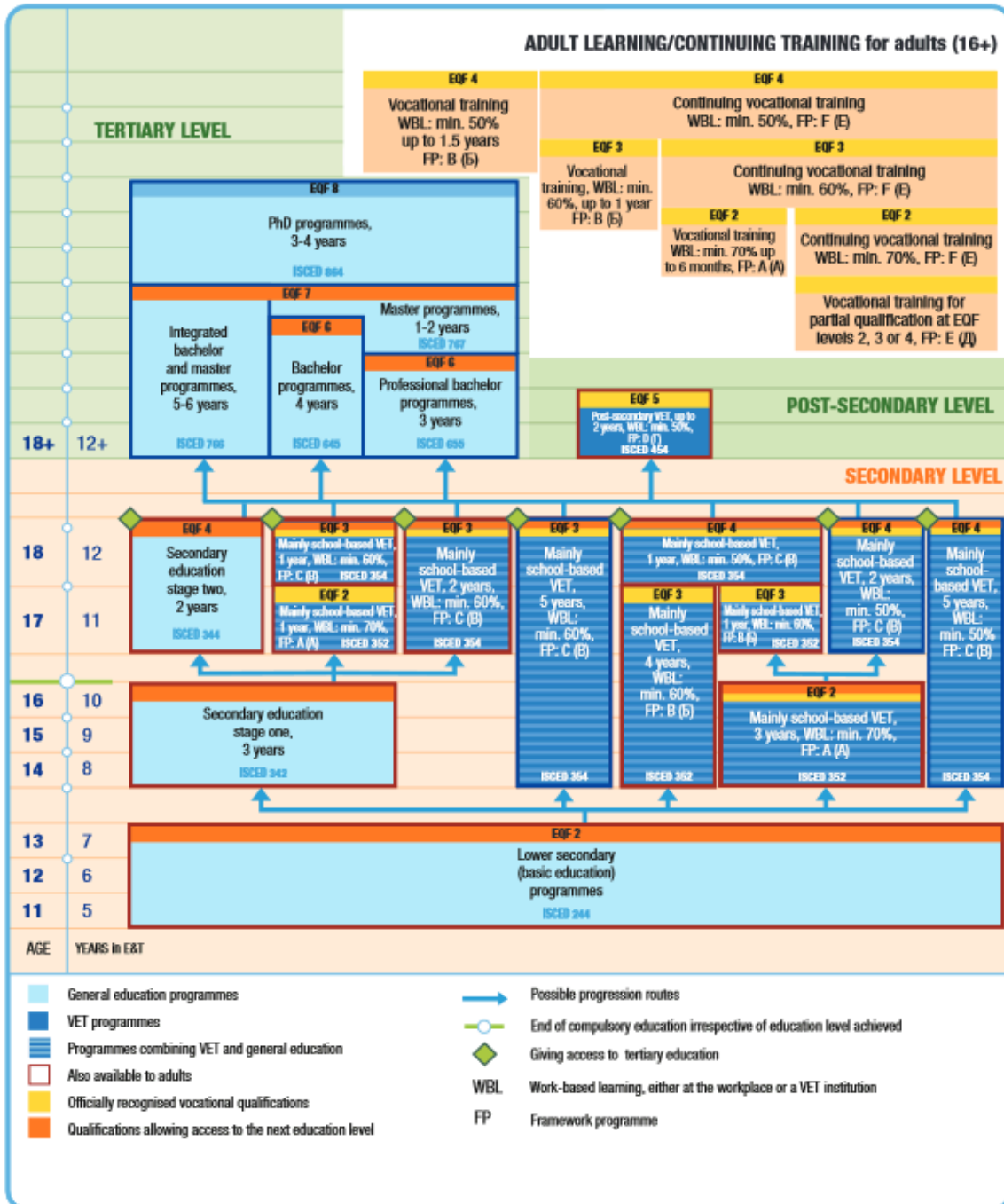
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Annex 1: Vocational Education and Training System Chart

Bulgaria

VET in the Bulgarian education and training system

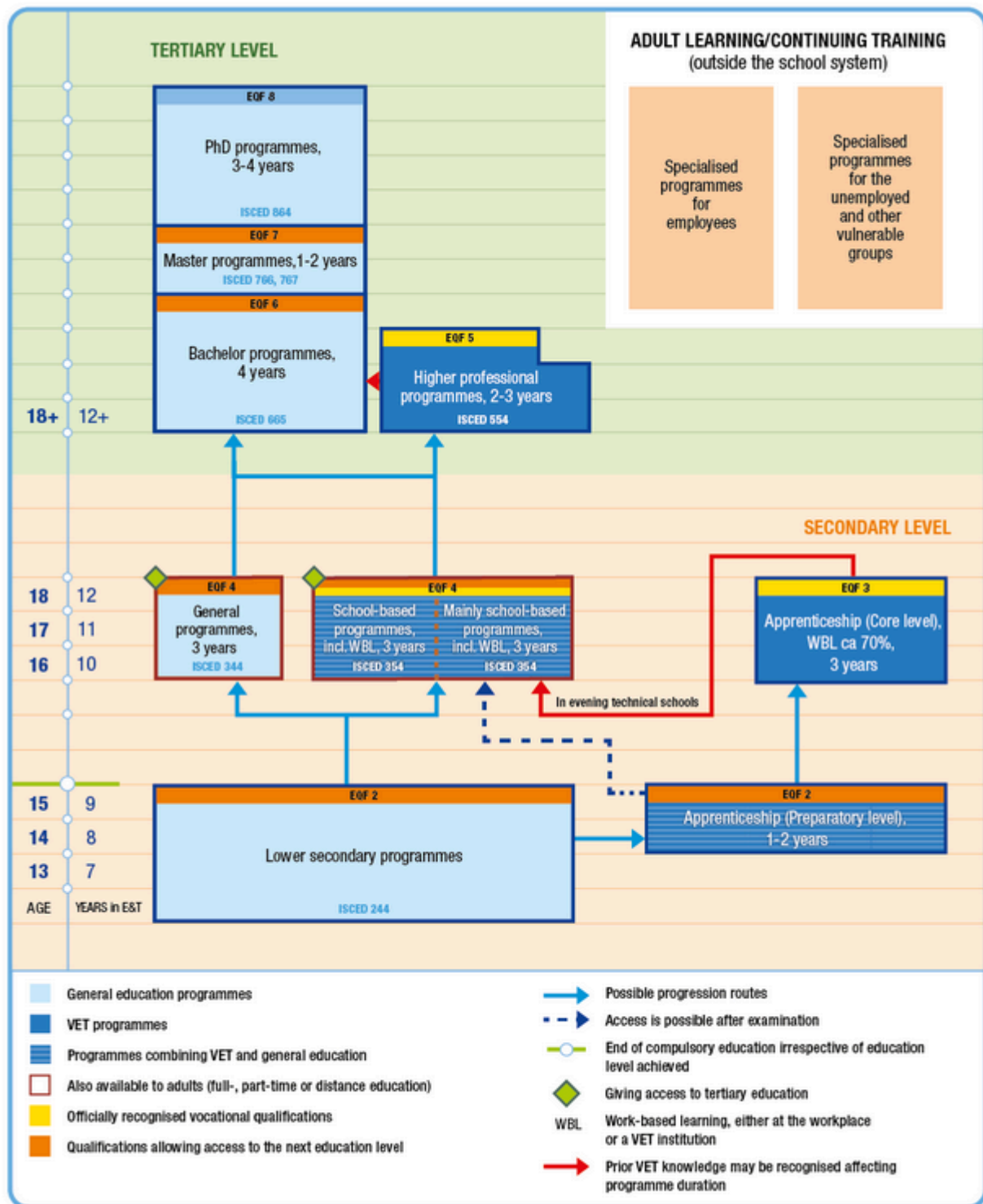


NB: ISCED-P 2011.

Please cite as: Cedefop; ReferNet Bulgaria (2022). VET in the Bulgarian education and training system. In: Cedefop; ReferNet (2022). *Vocational education and training in Europe* (database). www.cedefop.europa.eu/en/tools/vet-in-europe

Source: <https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/bulgaria-u2>

Cyprus



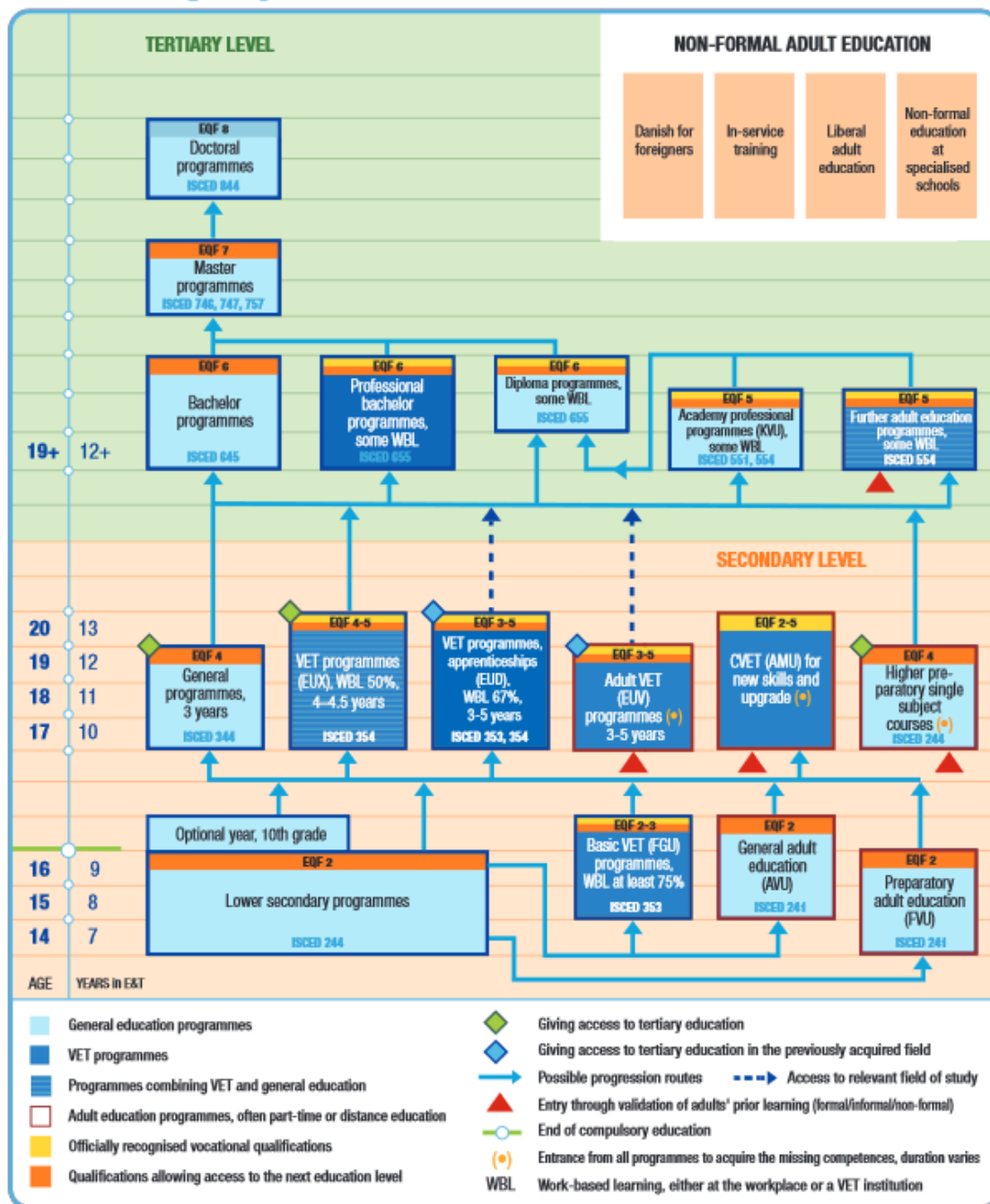
NB: ISCED-P 2011.

Source: Cedefop and ReferNet Cyprus, 2022.

Source: <https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/cyprus-u2>

Denmark

VET in the Danish education and training system

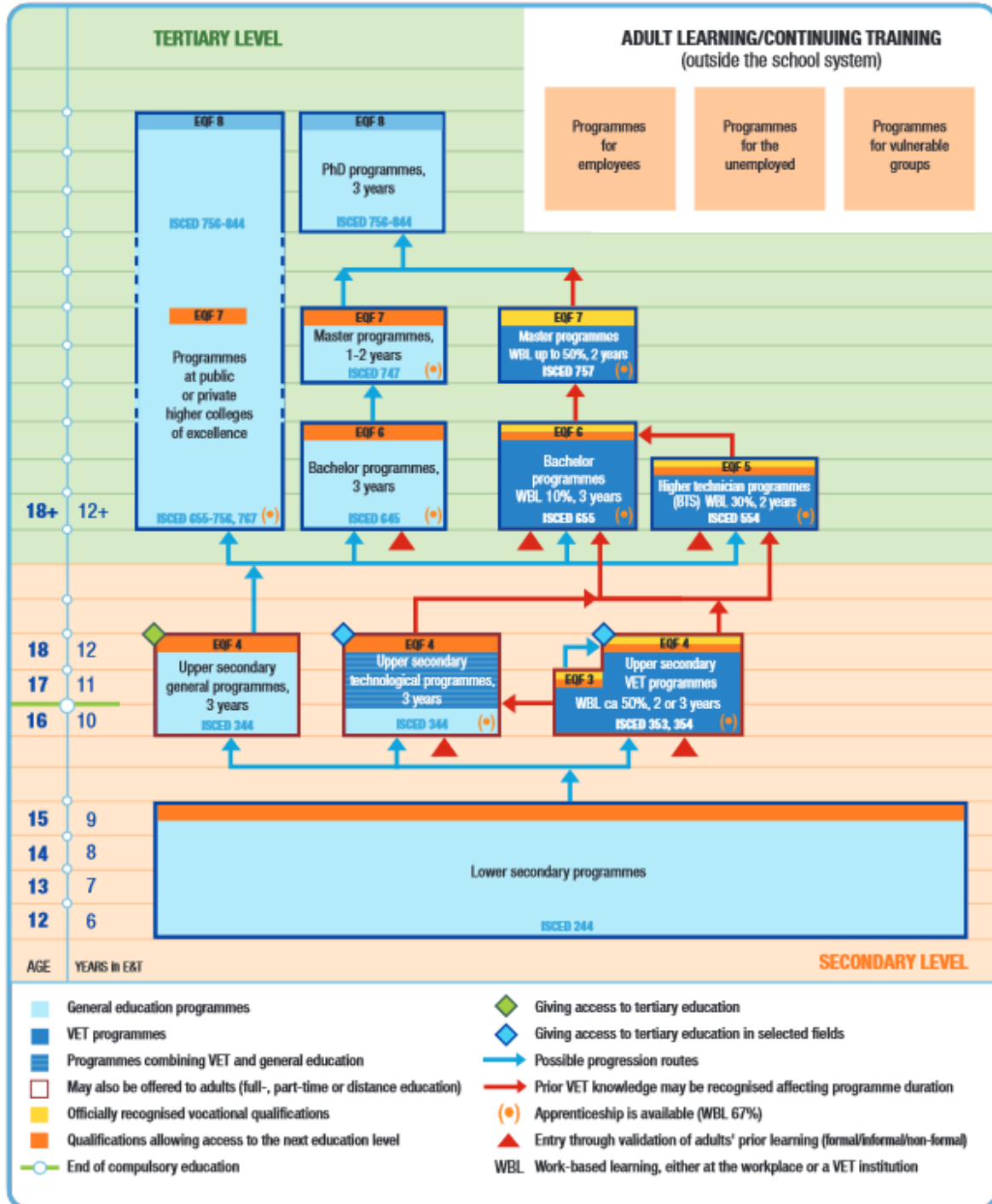


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Source: <https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/denmark-u2>

VET in the French education and training system

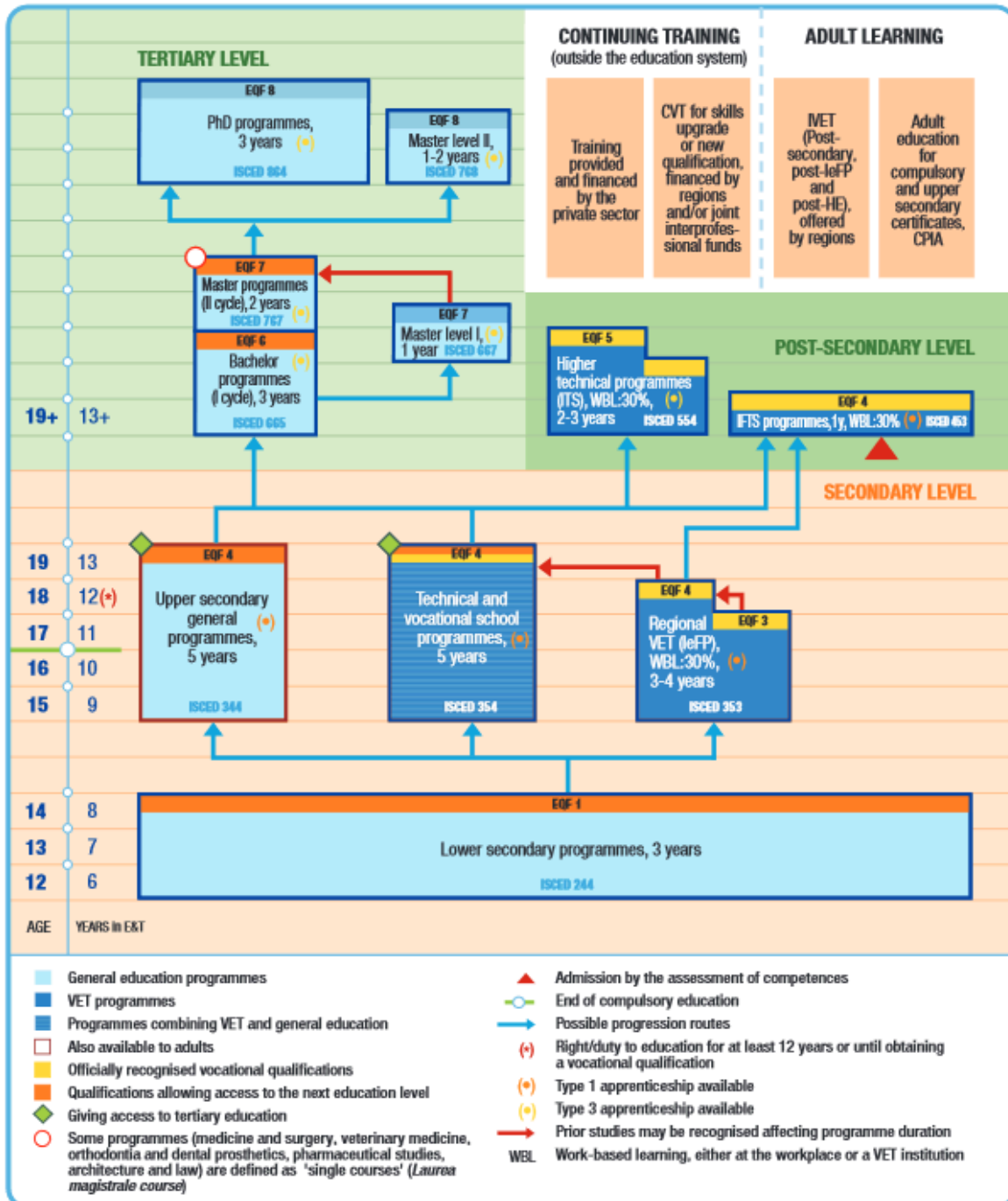


NB: ISCED-P 2011. The French qualifications framework is not linked to European qualifications framework level 1; vocational qualifications have not been established at level 2.

Please cite as: Cedefop; ReferNet France (2022). VET in the French education and training system. In: Cedefop; ReferNet (2022). *Vocational education and training in Europe* [database]. www.cedefop.europa.eu/en/tools/vet-in-europe

Italy

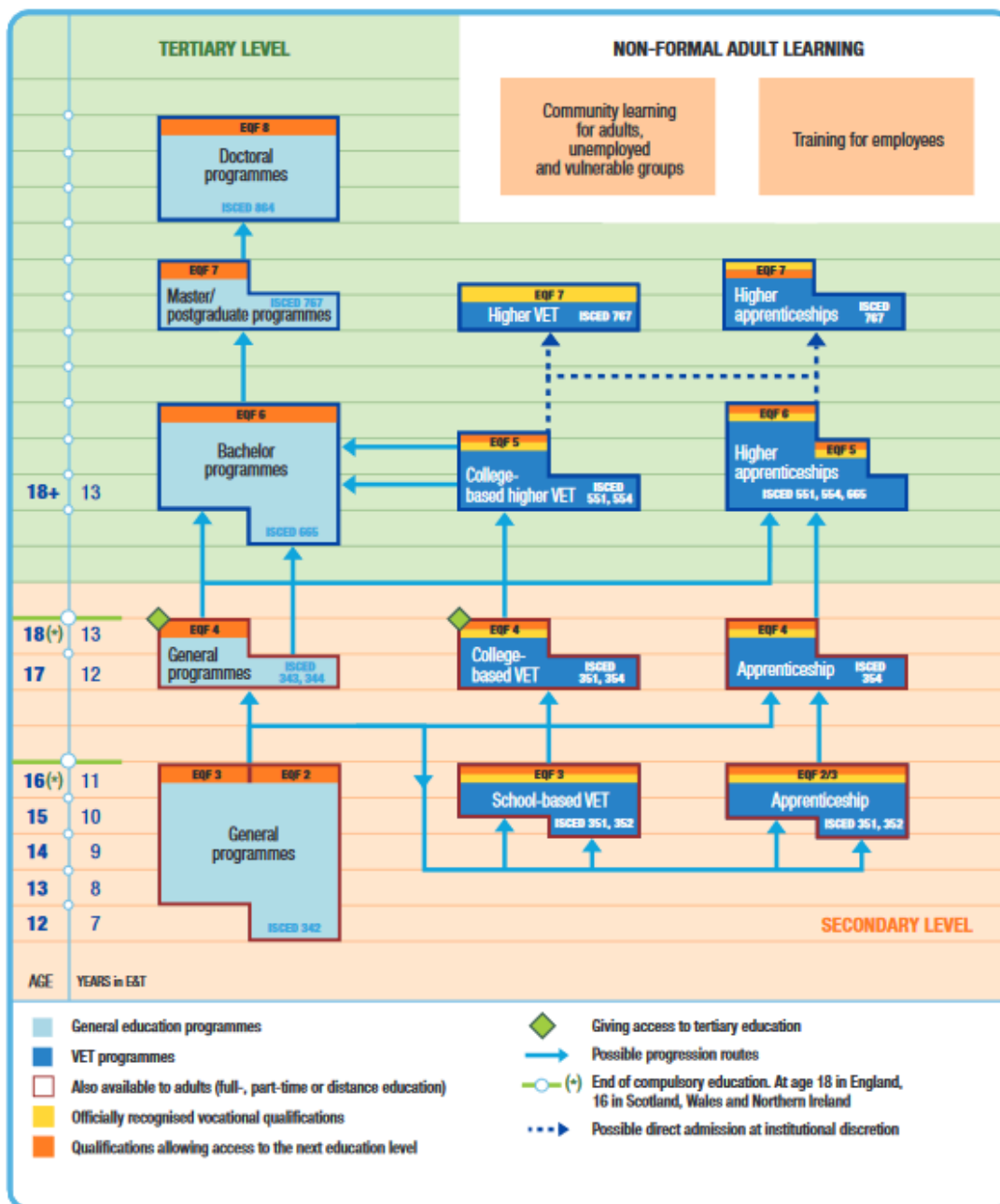
VET in the Italian education and training system



NB: ISCED-P 2011.

Please cite as: Cedefop; ReferNet Italy (2022). VET in the Italian education and training system. In: Cedefop; ReferNet (2022). *Vocational education and training in Europe* [database]. www.cedefop.europa.eu/en/tools/vet-in-europe

Vocational education and training in UK



NB: ISCED-P 2011. ISCED classification based on the 2018 mapping of UK classifications by the Department for Education. Source: Cedefop and ReferNet UK, 2019.

Annex 2: Skills Forecast per Country

Bulgaria

According to the skills forecast 2023, Bulgaria (Cedefop, 2023h), like other EU countries, experiences the impact of an aging population on its labor force. This leads to increased participation rates across most age groups. Between 2020 and 2035, Bulgaria's total employment labor force is projected to decrease by 6%, while the EU-27 is expected to see a 3% increase. Bulgaria's participation rate is forecasted to rise by 2%, despite a projected 9% decrease in population. This decrease is slightly lower than the previous rate of 10% observed between 2005 and 2020. The aging trend in Bulgaria is more pronounced compared to the EU-27 average. All age groups between 25 and 64 are expected to experience a decline in population from 2020 to 2035, following patterns observed in younger cohorts in previous periods. Participation rates for age groups between 20 and 64 are anticipated to grow significantly, ranging from 5 to 14 percentage points. However, compared to the EU-27, younger age groups below 34 starts with lower participation levels and the female participation rates are projected to increase more than male rates with a 3 percentage point increase.

Employment outlook:

In the period of 2020-2035, despite a projected 6% shrink in total employment, the Manufacturing, Business & other services (0.4-0.8% PA) and Non-marketed services (0.4-0.5% PA) sectors are expected to see growth. On the other hand, employment in Primary & utilities sectors, which account for 20% of the total employment in Bulgaria (in comparison to the EU-27 of 6%), is forecast to decline by around 5-6% pa, and employment in Construction in Bulgaria is forecast to fall by around 0.5% over the same period.

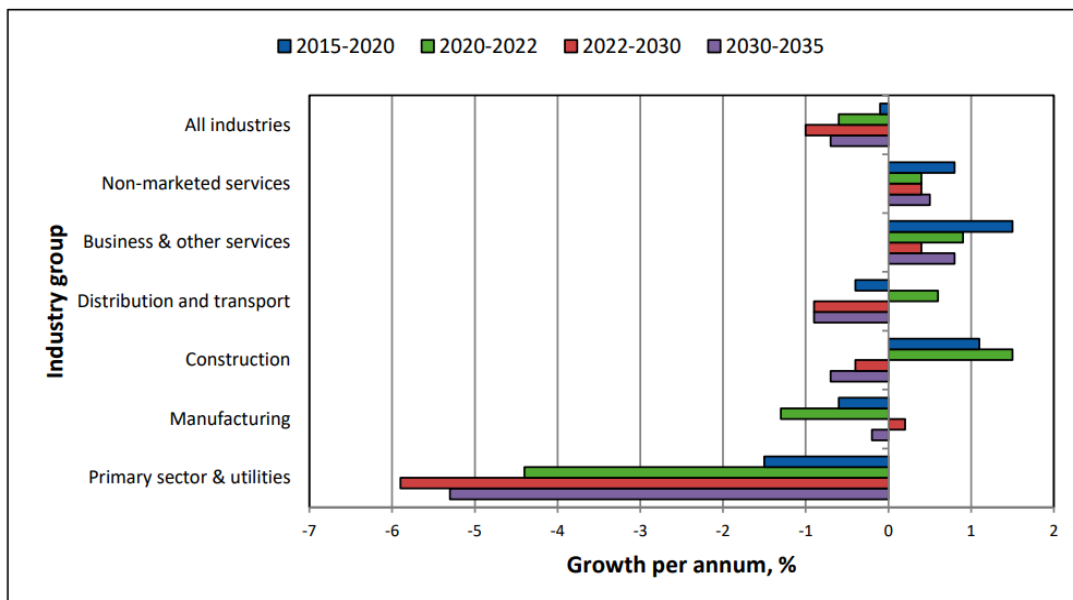


Figure A 1 Employment growth by broad sector of economic activity, 2015-35 Source: Cedefop 2022 Skills Forecast

Growth:

Media and research & development, market research & other professional services, computer programming & information services, real estate activities, and architectural & engineering services are expected to be among the fastest growing sectors, while at the same time non-market services are increasing through the ageing of the population, which is also increased by return (retirement) migration and migration of retired people from other EU countries.

Within the Distribution & transport sector, which accounts for 3.5% of total employment, the sub-sector of Accommodation & catering services is forecast to grow relatively strongly. Agriculture accounted for 17% of total employment in Bulgaria in 2020. Within the same broad sector, employment in electricity is forecast to grow over the whole forecast period. Although total Manufacturing employment is forecast to see little growth over 2022-30 and to decline over 2030-35, some sub-sectors are forecast to see relatively strong growth over these periods, including electrical equipment, textiles & leather, rubber & non-metallic mineral products and motor vehicles.

Job openings from 2020-2035:

Many job openings in this period stem from the replacement demand in the skilled manual category, caused by the contraction of the labor in those fields. Considering both new/lost jobs and replacement needs, drivers & mobile plant operators are projected to have the highest number of job openings. Similarly, sales workers, protective services workers, and personal service workers among skilled non-manual workers are projected to have many job openings despite a decline in the total number of jobs. On the other hand, laborers in the skilled manual category are expected to see job expansion as well as a high demand for replacements.

Among high-skilled non-manual occupations, business & administration associate professionals are projected to have a considerable number of new jobs and strong replacement demand, followed by information & communications technology professionals to a lesser extent. However, many sub-occupations within high-skilled non-manual occupations are expected to experience a decline in total jobs, which is partially compensated by replacement demand requirements.

Considering the projected decline in employment in the agricultural sector, relevant occupations will see job losses, with the largest decline in job openings projected for market-oriented skilled agricultural workers due to a significant contraction in total jobs. Agricultural, forestry & fishery laborers, as well as market-oriented skilled forestry, fishery & hunting workers, are also expected to have few overall job openings or even a decline during this period.

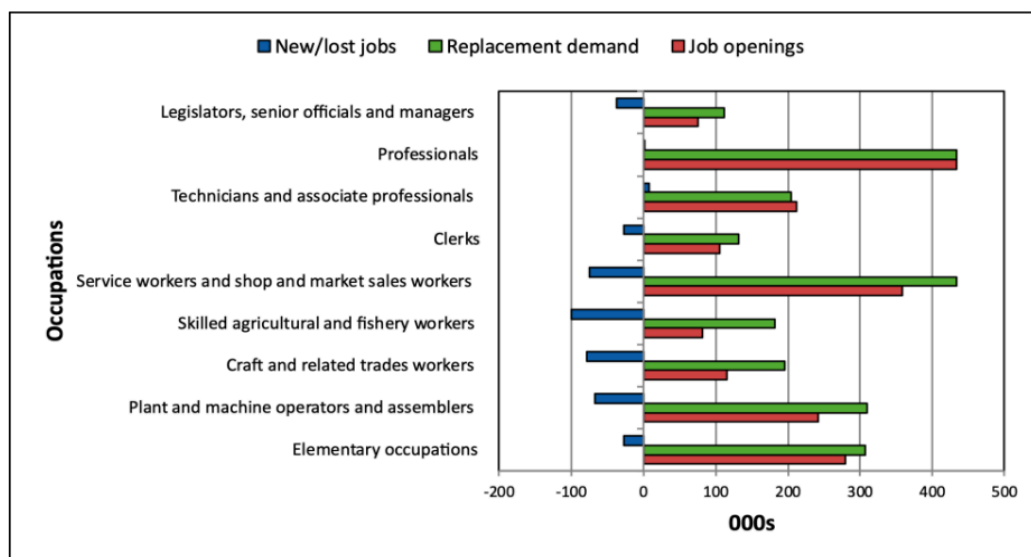


Figure A 2 Job openings by broad occupational group, 2020-35 Source Cedefop Skills forecast

Drivers to change:

The employment landscape in Bulgaria is undergoing changes in both occupational specialization and industry size. This is resulting in an increase in the share of associate professionals and certain types of professionals, such as business professionals, administrative and commercial managers, customer services clerks, and building and related trades workers. However, further efforts are needed to ensure growth in professional occupations like health professionals and teaching professionals, despite the positive impact of industry size. High and medium-skilled occupations such as health associate professionals, legal, social, cultural, and related associate professionals, and customer services clerks could benefit from these trends.

Assemblers can expect an increase in employment due to the positive impact of occupation-specific factors outweighing the negative effects of industry size decrease. Overall, there is an expected decrease in occupations, particularly high-skilled occupations such as senior officials and legislators, managers in services, professionals, and associate professionals in science and engineering. Intermediate occupations like agricultural workers and workers in metal, machinery, and electrical trades may also weaken. However, lower-level occupations are expected to increase, except for a significant decline in the group of agricultural, forestry, and fishing workers.

Demand and supply of skills:

Approximately half of the job openings in Bulgaria are projected to require a high qualification, which is slightly below the EU average of 56%. A smaller portion of job openings will require a medium qualification (46%), while only 5% will require a low qualification. Bulgaria is gradually increasing the presence of highly qualified individuals in the labor market, with their share expected to rise from 34% in 2022 to 39% by 2035. This increase will primarily come at the expense of older workers with lower and medium qualifications. The share of medium qualified workers is anticipated to decrease from 55% in 2022 to 52% in 2035, while the share of low qualified workers is expected to decrease from 11% to 9%. Although the trend aligns with the EU-27 average, Bulgaria's shift towards higher qualifications, particularly in the period of

2030-2035, is slower in comparison, and it is also projected to maintain a higher proportion of medium qualified workers.

Cyprus

Cyprus's total labor force is projected to grow by just over 17% from 2020-35, outpacing the EU-27's expected 3% increase. The total participation rate in Cyprus is forecasted to rise by 3 percentage points, compared to the EU-27's 1 pp increase. While the total population in Cyprus is expected to grow by 12% over 2020-35, the 20-34 age group will decline, and those aged 35-54 and 65 and above will see strong growth.

Participation rates for all age groups in Cyprus, except those aged 20-24, are forecasted to grow by 3 pp or more from 2020-35. Notably, the decline in the participation rate for those aged 20-24 reflects an increase in pursuing further education.

Although male and female participation rate differences in Cyprus are generally smaller than the EU-27 average, female rates are forecasted to increase more than male rates. Overall, the total participation rate for females is expected to increase by 4 pp, while for males, it is projected to increase by 1 pp over 2020-35.

Employment outlook and sectoral employment trends:

Cyprus is expected to experience employment growth surpassing the EU-27 average, though at a slower pace than observed during 2015-19. The projection indicates a slight rebound in Cyprus' employment, with a forecasted growth of just over 1% annually, compared to the EU-27's 0.2-0.3% growth over the same period.

Figure A1 indicates that all broad sectors in Cyprus are projected to experience employment growth between 2015 and 2035. Manufacturing and Construction are expected to lead with the strongest growth rates of 1.8% and 1.4% per year, respectively, during the period 2022-30. The other sectors are forecasted to have an average employment growth of around 1% per year during the same timeframe.

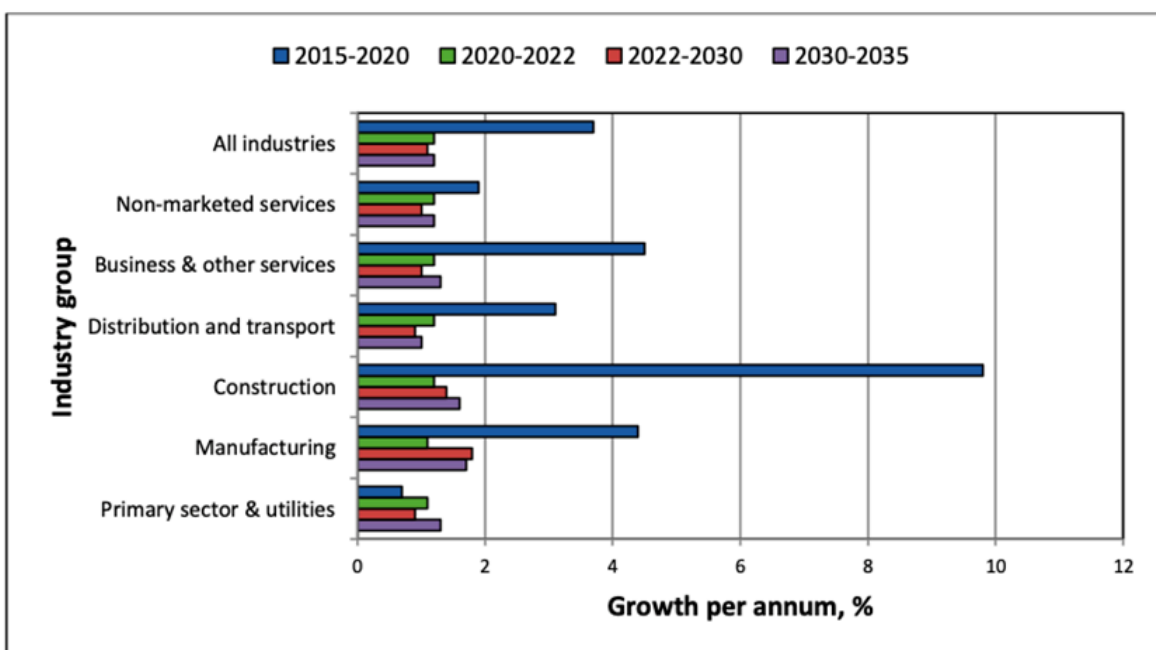


Figure A 3 Employment growth by broad sector of economic activity, 2015-2035 (Source; Cedefop 2022 Skills Forecast)

In manufacturing, robust employment growth is anticipated, primarily propelled by the food, drink & tobacco, basic metals & metal products, electrical equipment, optical and electronic equipment, other machinery and equipment, motor vehicles, and other transport equipment sub-sectors, each expecting a 2% annual growth from 2022-30. The largest sub-sector, food, drink & tobacco, constitutes just over 3% of total employment in Cyprus.

Within Business and other services, employment growth is forecasted in market research & other professional services, computer programming and information services, telecommunications, real estate activities, and research and development, each expecting a growth of 2% pa or more over 2022-30.

In the Primary sector and utilities, the electricity sub-sector is projected to experience significant growth, while the agriculture sub-sector, accounting for 3.4% of total employment in Cyprus in 2020, is expected to see a slight decline in employment over the same period.

Non-marketed services, particularly the health and education sub-sectors, are anticipated to witness relatively strong employment growth from 2022-30.

Total job openings from 2022-2035:

Cedefop skills forecasts assess total job openings by occupational group, comprising net employment change and replacement needs. Net employment change reflects new job creation or losses due to sector/occupation expansion or contraction. Replacement needs stem from workforce departures due to retirement or career shifts. Replacement needs often yield more job opportunities than new jobs, even in declining occupations (e.g., agricultural workers), as aging workers necessitate replacement.

Figure A2 illustrates total job openings by broad occupational group from 2022-35, indicating positions needed to fill new/lost jobs and those requiring replacement workers. All broad occupations are forecasted to see some increase, with Professionals experiencing the largest expansion. Replacement demand, especially for Service workers & shop & market sales workers, is expected to contribute significantly to job openings, followed by Professionals.

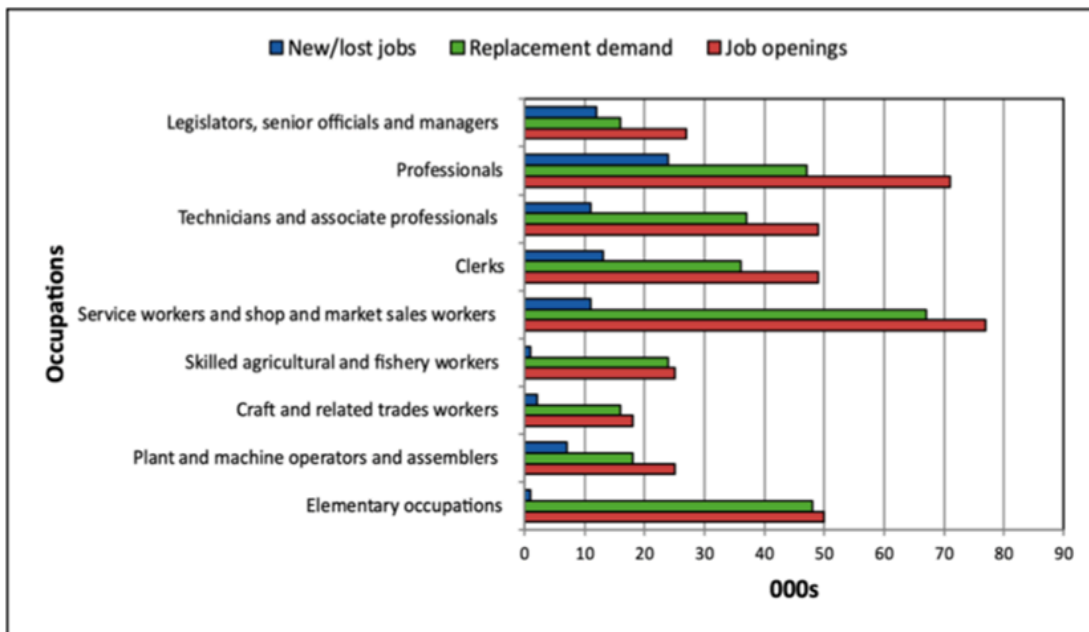


Figure A 4 Job Openings by broad occupational group 2022 – 2025 Source: Cedefop 2022 Skills forecast

At a detailed level, skilled non-manual occupations like sales workers, personal service workers, and general and keyboard clerks are anticipated to have the most job openings, aligning with the growth in sectors such as accommodation and catering and wholesale and retail trade. Business and administration associate professionals are expected to lead in job openings among high-skilled non-manual occupations due to strong replacement demand.

Teaching professionals are forecasted to have a substantial number of job openings, attributed to government investment in education and the growth of private educational institutions. Skilled manual occupations, particularly building and related trades workers, are expected to provide a significant number of job openings due to replacement needs and the construction sector's growth. The elementary occupation of cleaners and helpers is also projected to offer many job openings across various sectors of the economy. Overall, the forecast indicates an increase of 81,000 new jobs, with replacement demand accounting for 311,000, resulting in a total of around 390,000 job openings.

Figure A3 illustrates the evolving qualification distribution in the Cyprus and EU-27 labor force revealing that Cyprus is progressively increasing its share of higher-qualified workers, projected to rise from 49% in 2022 to 58% by 2035. This shift is mainly attributed to the gradual replacement of older, low-qualified workers. The share of low-qualified workers is expected to decrease from 13% in 2022 to 5% in 2035, while the share of medium-qualified workers remains stable (38% in 2022 to 36% in 2035). In comparison to the EU-27, Cyprus is anticipated to maintain a higher share of higher-qualified workers.

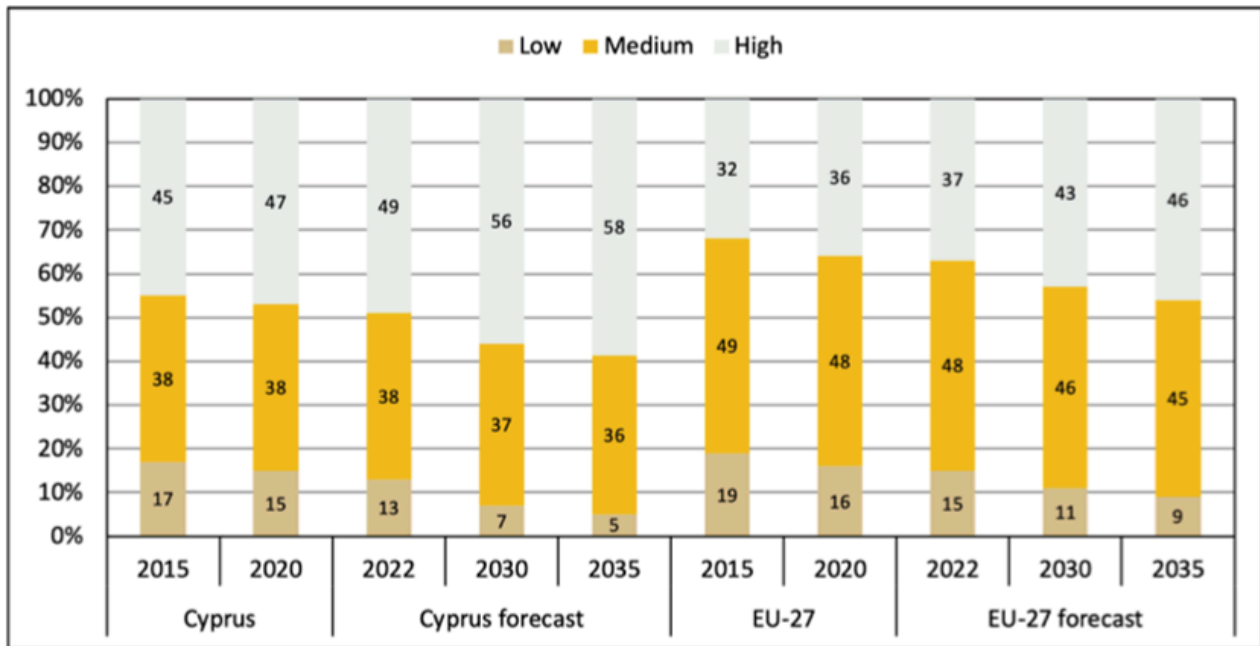


Figure A 5 Evolving qualification in Cyprus. Source Cedefop 2022 Skills Forecast

The rise in higher-educated workers, influenced by Cypriot secondary graduates pursuing further education, may lead to shortages, especially in medium and lower-qualified roles, causing hiring challenges. Notably, Crafts, Plant and machine operators and assemblers, Skilled agricultural & fishery workers, and Service workers and shop & market sales workers are expected to experience higher hiring difficulties, prompting Cypriot employers to seek foreign workers. Professionals and Legislators, senior officials, and managers still face high hiring requirements despite lower hiring difficulties.

Denmark

According to the skills forecast for Denmark for 2023 (Cedefop, 2023j), employment is forecast to grow slightly faster (0.2-0.3% percentage annually) than the EU-27 average (0.1-0.3% pa), albeit at much slower rates than seen over 2015-19 (1.5% pa). From 2021 - 2035, the employment growth is expected to be 4.31%, above the EU's expected increase of 3.4%.

The total labour force in Denmark is projected to increase by just under 6% over 2020-35, which is faster than the growth of around 4.5% seen over the previous 15 years. This compares with an expected increase in the labour force of just under 3% over 2020-35 for the EU-27.

Regarding sectoral employment trends, the only broad sector that is expected to see positive and relatively strong growth in employment over this period is Business & other services, which is forecast to grow by around 1.5% pa over 2022-35. Manufacturing is the only other broad sector that is not forecasted to see a decline in employment over the whole forecast period, but even here, growth is forecasted to be weak. Non-marketed services are expected to see a very slight decline in employment over this period, while the remaining three broad sectors are forecast to shrink by around 0.5% pa. In terms of sub-sectors, the growth in Business & other services is forecast to be driven by growth in computer programming & information services, real estate activities, research and development, telecommunications, architectural & engineering services, and legal, accounting, and consulting services, all with growth of more than 2% pa over 2022- 30. Within manufacturing, where the sub-sectors tend to be smaller, growth in employment is

forecasted to be driven by electrical equipment, other transport equipment, and other chemicals. Within the Primary sector & utilities, only electricity is forecast to see positive and relatively strong growth in employment over the whole of the forecast period.

The most significant number of job openings (taking both new/lost jobs and replacement needs together) are generally expected to be in high-skill occupations such as business & administration associate professionals, science & engineering associate professionals, business & administration professionals, teaching professionals, health professionals, and science & engineering professionals. Among these, only teaching professionals are forecast to see a decline in jobs, which is easily compensated by replacement demand. Some skilled non-manual occupations, found primarily on services, such as personal care workers and personal service workers, are also expected to provide many job openings – in the case of personal care workers a fall in jobs is compensated by high replacement demand. Although skilled manual occupations, primarily found in manufacturing and construction, are still expected to provide some job openings, this is mainly due to replacement needs rather than through job expansion. Among elementary occupations, labourers in mining, construction, manufacturing & transport are expected to provide significant job openings, thanks to a large growth in jobs and replacement demand.

Changes in the level of specialisation within occupations mainly characterise the occupational composition of employment in Denmark. The overall effect of occupational change depends on several factors that need to be considered together. Increasing digitisation and moves toward a service-oriented economy, including within manufacturing, will lead to a greater use of higher-level occupations at the expense of medium and some low-level occupations. With few exceptions, such as assemblers, drivers, and mobile plant operators, intermediate occupations are expected to decrease significantly.

Share of qualifications. Denmark's percentage of people with high-level qualifications is expected to increase from 2022 (reaching 51%), becoming the largest qualification group at the expense of workers with medium qualifications. The share of the medium-qualified labour force will decrease to 38% in 2035. The percentage of those with low levels of qualification is expected to drop from 15% in 2022 to 12% in 2035. In Denmark, the share of the labour force with high qualifications is expected to reach a higher level than the EU-27 average. While the level of low qualified is expected to fall within the EU-27, the Danish share is expected to remain some way above this average. The supply of workers with medium and high qualifications is expected to be sufficient to meet the corresponding demand, while the supply of workers with low qualifications is expected to be below the demand for those, which might lead to the need for some more qualified workers to fill positions requiring low qualifications.

France

According to the Skills Forecast 2023 for France (Cedefop, 2023k), France's **labor force** is evolving due to an aging population and rising participation across age groups. From 2020 to 2035, the total labor force will grow by 5.5%, slower than the previous 7.5% growth. In contrast, the EU-27 expects just under 3% growth. France's participation rate remains constant, differing from the EU-27's 1% rise. Population growth is forecasted at 5.5%, a decrease from just over 8% from 2005-2020. While the 15-19 and 30-59 age groups in France are projected to decline, other age groups will increase, aligning with past trends. Female participation rates are anticipated to rise more than males, with a 1% increase for females and a 1% decrease for males over 2020-35.

Employment in France is forecast to increase in three out of the six broad sectors, only declining in the Primary sector & utilities (by just over 1% pa over the whole forecast period) and manufacturing (-0.4% pa over 2022-30 and remaining static over 2030-35). Employment growth is forecast to be strongest in Construction (around 1% pa), followed by business and other services and non-marketed services (around 0.5% pa for both). Employment in distribution & transport is forecast to remain broadly static over 2022-35.

Growth: Business & other services, especially research & development, architectural & engineering services, and legal, accounting & consulting services, are expected to grow by 1% or more annually from 2022-2030. Non-marketed services will increase due to health services. At the same time, distribution & transport will substantially grow in accommodation & catering services, accounting for over 4% of total employment in France in 2020. Despite an overall decline in jobs in the Primary sector & utilities, electricity supply is expected to show slow growth, contrasting with a substantial reduction in agriculture. The manufacturing, food, drink & tobacco, and motor vehicles sectors are anticipated to experience notable growth, offsetting declines in other sub-sectors.

Jobs opening 2020 to 2035. Most job openings stem from the need to replace retiring or transitioning workers. Craft & related trades workers Service workers & shop & market sales workers anticipate declining jobs, while several others foresee minimal growth. All groups anticipate substantial replacement demand. Professionals, Technicians & associate professionals are expected to experience notable job expansion and replacement demand. Overall, the total job openings are projected to be nearly 20 million, with high-skilled non-manual occupations making a significant contribution, especially in production & specialized services managers, business & administration associate professionals, science & engineering professionals, and teaching professionals. Additionally, sales workers, skilled manual occupations like drivers & mobile plant operators, and building & related trades workers are predicted to account for a significant share of job openings. Conversely, elementary occupations, excluding cleaners & helpers, are expected to see fewer openings, with some experiencing job contractions and reduced replacement demand.

Drivers of occupational change. Rising specialization in sectors will reshape job composition in France, emphasizing occupation-specific impacts and a rise in professionals, managers, technicians, and associate professionals. Specializations also lead to evolving work forms management. High-skilled roles like scientists, engineers, and business professionals will benefit, while others may decline due to occupational changes and industry shifts. Automation, digitization, and a service-oriented economy will boost high-level occupations at the expense of some mid and low-level jobs. Only specific lower-level roles like cleaners are expected to increase. Overall, the shift favors growth across disciplines, particularly high-skilled ones.

Demand for and supply of skills. The projection for increased higher education in France is expected to persist, although the extent remains uncertain. Forecasts indicate a substantial increase in job openings, notably for high-qualification roles, surpassing the EU-27 average by 11 percentage points. Production and specialized services managers, Business and administration associate professionals, and Cleaners and helpers will have the highest job openings. Over 2022-2035, France foresees shifts in the labor force qualifications. The share of high-level qualifications is projected to reach 60%, surpassing medium qualifications at 38%. Low qualifications will decline. The movement towards higher qualifications in France indicates potential challenges in filling lower-level positions, potentially causing a skills demand-qualification mismatch.

Italy

According to the skills forecast for 2023, employment in Italy is forecast to grow slightly slower than the EU-27 average and at much slower rates than seen over 2015-19 (Cedefop, 2023I) (Figure 6). Across the forecast period, employment in Italy is forecast to grow by around 0.2% pa compared with growth of about 0.2-0.3% pa for the EU-27. The total Italian labour force is estimated to increase by about 2.5% over 2020-35, which is a lower value compared to the expected increase in the EU-27 (almost 4% over the previous 15 years).

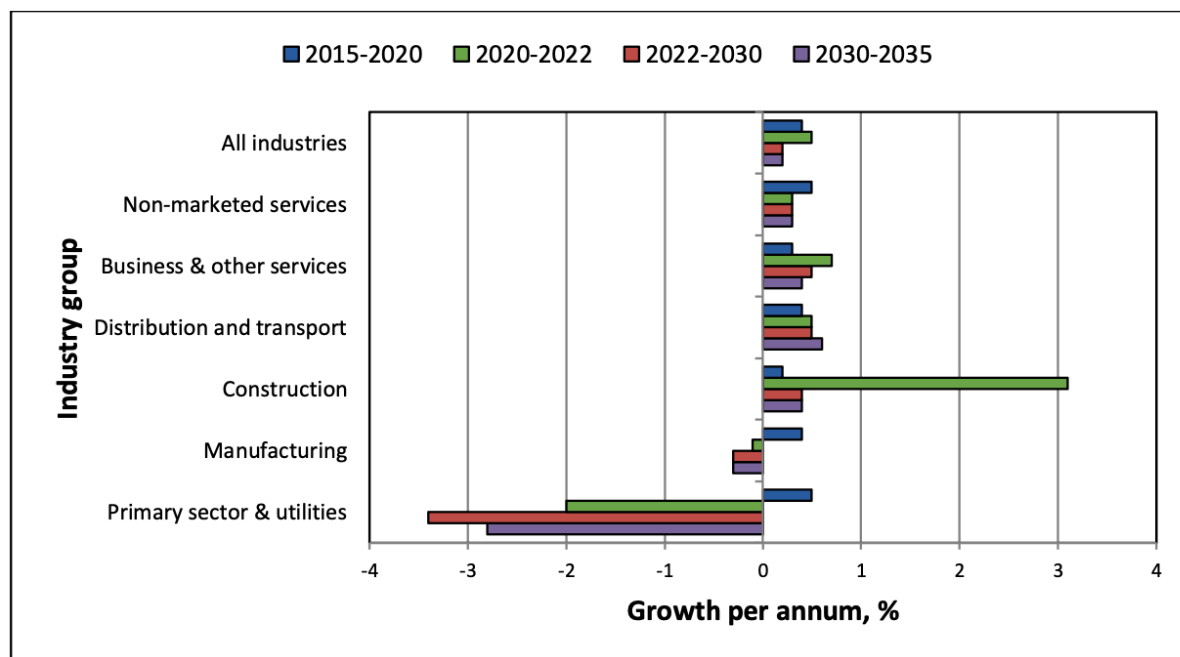


Figure A 6 Labour Force Italy 2020 – 2035 Source: Cedefop 2022 Skills forecast

The growth in Italian employment is expected to be led by growth in Distribution & transport, Business & other services, and Construction, which are all forecast to grow by around 0.5% pa.

Employment in Non-marketed services are forecast to grow by around 0.3% pa.

However, employment in Manufacturing is forecast to fall by around 0.3% pa, while employment in Primary sector & utilities is forecast to fall sharply, by around 2.5-3.5% pa.

In terms of sub-sector, employment growth in Business & other services is forecast to be driven by growth in research & development, computer programming & information services, real estate activities, media, architectural & engineering services, and other service activities, all with growth of more than 0.7% pa over 2022-30.

Within Distribution & transport, employment growth is forecast to be driven by accommodation & catering services, water transport, air transport, and land transport, all with a growth of 0.5% pa or above over 2022-30. Within Non-marketed services, employment growth is expected to be driven by the sub-sector of health, while public administration & defence is forecast to see a decline in employment of 0.5% pa over 2022-30.

Although employment in Manufacturing is generally forecast to decline, the sub-sector of optical & electronic equipment is forecast to see employment growth of 0.6% pa over 2022-30. The fall in employment forecast for Primary sector & utilities is expected to be driven by a strong fall in

employment in the relatively large (accounting for 3.7% of total employment in Italy in 2020) agriculture sector.

Total job openings are expected to be greatest for Professionals and Technicians & associate professionals, accounting for 24% and 18% of total job openings, respectively.

In recent years Italy has experienced an outflow of highly qualified workers towards other EU Member States, with workers looking for better employment and higher wages.

Although the increase in employment is expected to focus on occupations requiring high-skilled workers, it won't be enough to accommodate the greater supply of highly skilled workers within the labour force. Two factors explain this phenomenon. The first is that education choices are often misaligned with labour demand, resulting in some young adults being educated in fields (mainly humanities) where there is low demand. So they end up working in low-skill jobs, generating the phenomenon of overeducation. The second is that the wage premium for education is relatively low in Italy compared to other European countries, especially for technical high-skill education (STEM), with the result that the few graduates in these disciplines often apply for jobs abroad.

United Kingdom

The last Cedefop skills forecast for the UK was performed in 2018 before the UK left the EU. Since then, the UK economy has been impacted by the Covid pandemic the economic shock of both Brexit and the invasion of Ukraine. The following section provides a brief overview of the content of the 2018 Cedefop report with further augmented details from sector-specific reports in the UK where available (Cedefop, 2018).

According to the Cedefop 2018 Skills Forecast, employment growth in the UK was predicted to continue to be higher (9.7%) than the EU average (6%). The UK's population was expected to increase by around 10%, leading to an increase in the labour force of about 8% between 2016 and 2030. There was an anticipated increase in the overall working-age labour supply due to the rise in the overall population and working age.

While employment was expected to grow, some sectors were expected to decline. The manufacturing sector was expected to decline overall, and the engineering subsector was expected to experience a 4% increase in employment from 2016 to 2021. Employment in construction was predicted to decline with a potential rebound after 2021, but overall, there will be a decline of 10% by 2030. The business and other services sector was expected to experience the greatest growth in employment forecast at 18% in 2030.

In the UK, most job creation was expected to come from replacing existing workers. 9 out of 10 jobs were expected to be replacement jobs in Professionals, Services, and Shop Workers. Sales workers have the largest openings overall. Other sectors predicted to have relatively higher numbers of job openings were labourers in mining, construction, manufacturing, and transport; legal, social, cultural, and related professionals; and health professionals.

Employment growth was predicted to come from growth in the businesses and services sectors, with managerial posts benefiting. Clerical roles were predicted to decline the most with the growth in automation. Automation was also expected to impact trades such as electronics, handicrafts, printing, metal, and machinery workers.

Growth sectors expected to increase occupations are health associate professionals, mining, construction, manufacturing, and transport.

Of the job openings, 49% require high qualifications, 46% medium qualifications, and 4% low qualifications. Most of these high-level qualifications stem from the expected openings in business and professional occupations, but many other highly skilled jobs will be required in the personal care professions. The need for higher-level qualifications is expected to grow faster than the EU.

The demand for highly and medium-qualified workers is expected to exceed supply, while low-qualified workers will be in surplus.

This section also reviewed the Skills Imperative 2035¹ to provide an update to CEDFOP. It states that there is currently limited understanding of the combination of essential employment skills that will be needed, their relative importance, and how to develop them in England. To fill this evidence gap, a Nuffield-funded research study, ‘The Skills Imperative 2035: Essential skills for tomorrow’s workforce’ investigates:

- which essential employment skills will be most needed in 2035,
- what will their likely supply be, and where will the gaps be,
- which occupations and workers are most at risk of not having these skills,
- which skills will affect workers' need to develop to transition into new employment opportunities, and the role of educators and employers in helping to prepare young people and workers for the future labour market.

The following sections draw upon their first published working paper, a comprehensive literature review of the skills most needed for work in future.

The report cites universally acknowledged megatrends shaping employment: technological advancements (administration, automation, and AI); demographic changes (aging populations); growing labour market inequalities; and the green agenda. The Covid-19 pandemic has also profoundly impacted life and work globally, and the UK is adjusting to new economic conditions following departure from the EU. The Economy 2030 Inquiry – a collaboration between the Resolution Foundation and the London School of Economics, funded by the Nuffield Foundation – which is exploring the impact of Covid-19, Brexit, technology, and Net Zero transition, acknowledged that the next ten years will be a ‘decisive decade’ for the UK economy.

The working paper identifies the key UK and international trends that will impact employment in 2035, as described in the table below.

Growth (sector)	Declining sectors	Clusters of occupational growth
Health, social and personal care, Education, Professional services,	Administrative and secretarial Manufacturing/production Retail/cashier work	Data and AI, Engineering and cloud computing,

¹ Taylor, A., Nelson, J., O'Donnell, S., Davies, E. and Hillary, J. (2022). The Skills Imperative 2035: what does the literature tell us about essential skills most needed for work? Slough: NFER.

<p>Sales and business development, Creative, digital and design, Green economy, Information and communication, Natural and applied sciences.</p>	<p>Agriculture Business administration/finance</p>	<p>People and culture, Product development, Sales, marketing, content, The care economy and The green economy.</p>
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Annex 3: Competences in Higher Education Programs from academic partners

This section offers a comprehensive overview of the existing competences within HE programs across each of CERES' academic partner institutions. This thorough exploration is essential to acquire a deep understanding of the qualifications that form the project's foundation.

Up to three illustrative examples for each topic were selected to facilitate meaningful comparisons. This review aims to identify and document the following key elements:

- **Level or Target Group:** Whenever possible, we categorized qualifications according to their alignment with the EQF or NQF or specified their intended target groups.
- **Quality Assurance:** We scrutinize the presence of any validation mechanisms, such as assessments, certifications, or certificates of completion, that serve to attest to the quality and credibility of the courses.
- **Workload:** We quantitatively assess the total hours or ECTS required for each qualification, providing insights into the depth and scope of the educational programs.
- **Profile:** Qualifications are classified based on their specific subject field(s) of learning or the broader aggregation of qualifications from various disciplines that share a common emphasis or purpose. This approach helps to distinguish, for instance, between applied vocational studies and more theoretical academic pursuits.
- **Learning Outcomes:** We outline the expected learning outcomes, encompassing knowledge, skills, responsibilities, and autonomy. These learning objectives offer a comprehensive perspective on what learners can anticipate achieving through their academic pursuits.

Denmark

Course/Module	Circular Economy and Technology Assessment
Level	Course in 4th semester at Bachelor of Sustainable Design
Quality	The learning (pass/fail) is assessed through an oral exam concerning the semester project.
Workload	5 ECTS - 138 hours
Profile	The teaching combines lectures, assignments, group work, and presentations and supports the work on the semester's project.
Learning outcomes	<p>Knowledge related: 1) mapping of business models and the interaction between value proposition, customer and used relations, internal activities, and resources, etc. 2) analysis of the organizations societal context and competition 3) business models with different variants of product ownership and service 4) CE as a strategy for extending product life, recycle resources 5) national and international regulations to stimulate CE as part of product development and development of business model.</p> <p>Skills related: 1) implement analysis of social practices and LCAs to identify and describe the environment of a product system 2) identify opportunities for design strategies that can expand the product life, increase product utilization, and increase recyclability as a part of product-service system 3) sketch new business models and evaluate their environmental potentials and conditions for their realization</p>

	Competences related: 1) evaluate the environmental and business potentials of changing a product system based on CE principles 2) analyze necessary changes of social practices to implement the changes of a product system 3) develop an implementation plan for developing and changing product-service systems to reduce environmental effects 4) plan collaboration with external actors on development of a design and strategy proposal
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Course/Module	Potentials and challenges of circular economy as sustainability strategy in businesses and cities (2018 and 2019, cannot be seen if it is repeated)
Level	Ph.D. course
Quality	
Workload	5 ECTS - 138 hours
Profile	The course introduces potentials and challenges to the circular economy from a business and urban perspective. Theoretically, the course integrates product, value chains, social practices, user-oriented innovation, and governance theories.
Learning outcomes	Three types of re-design processes are discussed, which are necessary to consider when developing circular economy business models within specific institutional and regulatory contexts: 1) re-designs of products and services based on considerations about necessary changes in roles of products, users, services, infrastructure, etc. 2) re-designing value chains both up-stream and down-stream and 3) internal organizational redesign of the business organization to integrate environmental concerns in product and strategy development. From an urban perspective, different roles in developing and supporting the circular economy are introduced: 1) Public planning, 2) Public infrastructures, 3) Public procurement, 4) Public building and construction, and 5) Local business development.

Course/Module	Summer School in Applied Circular Economy
Level	PhD students, Academics (postdoc, professor, etc.), Professionals (consultancy, industry, etc.)
Workload	5 ECTS - 138 hours
Profile	Problem-based learning is a teaching model of learning by doing and reflection. It applies a hybrid (online + physical) and flipped classroom approach where materials (readings, videos) are provided to the students in advance. The time spent together is used for course activities such as intensive group work, problem-defining and solving applied to real-world cases, practical exercises, and discussions.
Learning outcomes	Basic and advanced elements of the circular economy methodological landscape are covered, for a mixed audience. Module 1. Circular Economy, From Theory to Practice , introduces different theoretical approaches to the circular economy and their respective critiques. It discusses narrowing, slowing and closing resource flow - especially on the inner circles of the circular economy and how the potential for circular improvements is identified. The module includes group exercises where theories of circular economy are applied to the analysis of a case study. Module 2. Circular Business Models And Strategies explores the diversity in circular business models, primarily focusing on the inner circles. The relevance of including new

	<p>types of actors in these business models is discussed, and various real-world case studies are presented to the students. Moreover, generic principles and strategies can be applied in the design and innovation process to ensure more circular outcomes, i.e., narrowing, slowing, closing, and regenerating resource flows. The module includes group exercises where a circular business strategy is designed for a specific case study.</p> <p>Module 3. Life Cycle Assessment Of Circular Business Strategies is a hands-on module to learn LCA developing and evaluating circular economy strategies. It covers theoretical elements of LCA, from life cycle thinking to the computational structure of LCA, and practical elements such as using LCA software, interpretation, use of results in developing life cycle management strategies, and communication of results. The module includes group exercises where LCA is applied to evaluate a circular strategy for a specific case study.</p>
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Course/Module	Sustainable design
Level	MSc in Engineering
Quality	written or oral examinations of courses and projects
Workload	120 ECTS - 3300 hours
Profile	<p>2-year full-time engineering education with particular emphasis on design and innovation of sustainable solutions. The programme includes interdisciplinary components to satisfy the need for combining methods from social science and technology studies with technical subjects and design practices. The programme allows students to understand, stage, and carry out innovative processes leading to the design and implementation of sustainable products, services, and socio-material system solutions through the involvement of relevant actors. It is PBL-based, meaning it combines courses and projects every semester. Courses: Design in organisations, Production Systems, and Sustainability, Design for Sustainability, Sustainable Transitions, Market Creation and Entrepreneurship, Concept Driven Change.</p>
Learning outcomes	<p>Knowledge in chosen areas and based on the highest international level of research within the following areas: sustainable design, sustainable transitions, innovation, and organizational change processes, designerly thinking.</p> <p>Skills: can identify critical problems and structure strategically defined problem formulations that will open for the development of design projects to produce intended sociotechnical changes for sustainability (PBL), Master engineering and science-related methods, methods from innovation studies, and methods from socio-technical analysis of organizations and systems, Can critically consider theories and methods, develop new models for sustainable technological innovation, and, in collaboration with networks of different actors, further elaborate these into plans of action, Can discuss and communicate professional and scientific issues regarding sustainable innovation and strategic design for sustainable transitions with technical experts, decision-makers, senior executives, government officers, NGOs, and various users, Can stage and facilitate collaborative technology, service, and system design processes involving various actors, including end-users.</p> <p>Competences: can stage and facilitate work and develop projects that require dealing with complexities and uncertainties that require new solutions, Can independently initiate and complete professional and disciplinary collaborations and take professional responsibility and leadership within collaborative design and transition processes,</p>

	<p>Can independently take responsibility for own professional and cross-disciplinary development within the scientific fields of design, transitions, technology innovation, and sustainability,</p> <p>Can assess the strengths and limitations of his/her competences, identify the need for new competences, and acquire them to improve continuously.</p>
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Course/Module	Sustainable Products and Services
Level	Course on an MSc level
Quality	Written or oral exam
Workload	5 ECTS - 138 hours
Profile	<p>Lectures, workshops, seminars, assignments, etc.</p> <p>Lectures include Principles of Eco-design, Regulatory Aspects of Products and Services, Creativity Workshop, Introduction to LCA, Life Cycle Inventory, etc.</p>
Learning outcomes	<p>Knowledge of the scientific theoretical and methodological basis of key analytical tools for environmental assessment of products,</p> <p>Have thorough knowledge of key concepts in eco-design of products,</p> <p>Knowledge of creativity in the eco-design process,</p> <p>Basic knowledge of consumption practices and consumption volumes,</p> <p>Knowledge of regulatory aspects for the development of sustainable products.</p> <p>Skills: can plan and carry out independently the quantitative life-cycle-based environmental assessment of a given product,</p> <p>Can shift from qualitative to quantitative representations of product systems, select and gather relevant data and information needed to calculate impact estimates for the product,</p> <p>Can think creatively and include elements of critical reflection in the eco-design of a product,</p> <p>Can analyse and describe the eco-design process by using relevant theories and empirical investigations,</p> <p>Can organise eco-design procedures for a specific product</p> <p>Competences: Can creatively develop solutions for the ecodesign of products that take into account the products' life cycle perspective,</p> <p>Can interpret quantitative and qualitative environmental assessment results and use them in a product improvement and design context.</p>

Course/Module	Innovative Communication Technologies and Entrepreneurship (ICTE)
Level	MSc in Engineering
Workload	120 ECTS - 2 years
Profile	<p>The programme is structured in modules and organised as a problem-based study.</p> <p>Courses include Services and Platforms, Communication Systems, Innovation and Business Models, Internet Technologies and Service Architectures, ICT Service Development: Design and Architectures, Identity and Access Management, User Experience and Computer Ethics, Advanced ICT Solutions, Managerial Economics and Entrepreneurship, Sustainable Digital Transformation, etc.</p>

<p>Learning outcomes</p>	<p>Knowledge of information and communication technologies (ICT) that, in selected areas, is based on the highest international research</p> <p>Understands the relevance of the needs of the end users, their use of ICT, and the mechanisms that influence the user experience and the acceptance of new technologies</p> <p>Understands the importance of innovation, creativity, and entrepreneurship for ICT solutions and services</p> <p>Understands and can reflect, on a scientific basis, on the technical, organizational, and market-related drivers in the convergence of ICT, as well as the interplay between technology, market, and user issues</p> <p>Holistic understanding of the environment of ICT services and solutions: Scenarios of use, target users, stakeholders, business aspects, and societal implications at large</p> <p>In-depth knowledge of service enablers, personalization, and the use of context information for the enrichment of services</p> <p>In-depth knowledge and understanding of principles and technologies related to privacy, trust, computer ethics, and identity and access management</p> <p>Knowledge of state-of-the-art network technologies, Internet technologies, and service architectures, e.g., Internet of Things, cloud architectures, heterogeneous networks, distributed systems, and Application Programming Interfaces (APIs)</p> <p>Knowledge of machine learning algorithms and their application</p> <p>Knowledge of ICT standards and standardization processes and their significance from a commercialization and market perspective</p> <p>Understands the importance of public and non-governmental governance structures for the development and use of ICTs</p> <p>In-depth knowledge and understanding of ICT-related business models and cases</p> <p>In-depth knowledge of economic concepts and tools relevant for preparing a market analysis</p> <p>Skills: can identify scientific problems within the field of ICT</p> <p>Can evaluate and select among scientific theories, methods, and tools, and – on a scientific basis – advance new analyses and solutions within applied ICT</p> <p>Can efficiently communicate research-based knowledge and discuss professional and scientific problems with both peers and non-specialists</p> <p>Can produce scientific writing: Articles, reports, documentation, etc.</p> <p>Can apply scientific methods, tools, and general skills within the field of ICT</p> <p>Can identify and select among relevant standards, technologies, and methods for development of ICT solutions and services</p> <p>Can assess the market, ethical, and regulatory framework for the application of the technologies</p> <p>Can develop innovative services, applications, and solutions at a conceptual level, which are relevant from a user perspective</p> <p>Can develop concepts, prototypes, or demonstrators of viable ICT solutions and services based on an in-depth analysis of user requirements, technology, and market issues, using state-of-the-art methods, technologies, and tools, and addressing computer ethics, privacy protection, and identity management</p> <p>Can apply machine learning techniques to analyse and process data as part of a service</p> <p>Can assess the implications and business potential of new ICT solutions and services and develop viable business models and strategies</p> <p>Can prepare a business plan with a detailed financial analysis for introducing an ICT solution or service.</p> <p>Competences: can manage work and develop situations that are complex, unpredictable, and require new solutions</p> <p>Can independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility</p> <p>Can independently take responsibility for own professional development and specialization</p>
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	<p>Has competences in project work and problem-based learning in a global/multicultural environment</p> <p>Can mediate collaboration and information exchange between development and business-related functions in organizations.</p> <p>Has competences in innovation and entrepreneurship that can be used to transform the potentials of new ICT and media technologies into new solutions and services with an engineering approach</p> <p>Can contribute creatively and innovatively to propose and develop new ICT services/solutions respecting and challenging established legal rules and design principles.</p> <p>Has competences in business development with a holistic perspective based on a thorough understanding of the interplay between technology, market, and users in ICT and media</p> <p>Has competences in innovation and entrepreneurship that can be used to formulate strategies exploiting the potentials of new ICT and media technologies with an engineering approach.</p>
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Course/Module	Innovation, Entrepreneurship, and Business Models
Level	BSc in Economics and Business Administration
Quality	Written or oral exam, Individual examination. 7-point grading scale
Workload	5 ECTS - 138 hours
Profile	Connecting theory with practice using various real-life examples and cases
Learning outcomes	<p>Knowledge of key concepts and theories about innovation, entrepreneurship, and business models.</p> <p>Key issues within innovation, entrepreneurship, and business models and the ability to identify, define, and reflect on these.</p> <p>The actions taken by various companies concerning innovation, entrepreneurship, and business models exemplifying these.</p> <p>Skills in identifying theoretical and practical issues within innovation, entrepreneurship, and business models.</p> <p>Applying relevant theories concerning understanding and analysing a practical issue within innovation, entrepreneurship, and business models.</p> <p>Presenting issues and solutions with various target groups.</p> <p>Competences in accepting responsibility for own learning and professional development within innovation, entrepreneurship, and business models.</p> <p>Independently planning and performing analyses of relevant issues within innovation, entrepreneurship, and business models.</p>

Course/Module	Corporate Entrepreneurship, Management and Technology
Level	Course at MSc study
Quality	The grading of the course is based on individual oral examination. A prerequisite for entering the oral examination is the delivery of individually written Learning Logs with reflections on all course lectures. Active class participation is a necessity for being able to develop a successful learning log.

Workload	5 ECTS - 138 Hours (Lecture: 18 hours, Asynchronous materials (slidecast, podcast, etc.): 2 hours, Exercises, workshops, and seminars: 6 hours, Preparation time: 109 hours (reading, online material, writing learning logs, preparation for the exam, etc.)
Profile	The course covers theoretical and practical insights through lectures, discussions, and case assignments.
Learning outcomes	<p>Knowledge of central concepts, models, and frameworks related to corporate entrepreneurship, technology, and innovation</p> <p>The role and impact of corporate entrepreneurship, management, and technology in organisations.</p> <p>High-impact innovation processes and how to organize them in and around companies in interaction with relevant actors in the business environment.</p> <p>Skills in identifying and analysing corporate entrepreneurship, management, and technology challenges in organizations.</p> <p>Identifying relevant external actors and networks to consider in pursuing corporate entrepreneurship.</p> <p>Choosing relevant theories, methods, and tools in analysing corporate entrepreneurship management and technology issues.</p> <p>Competences in auditing, evaluating, and contributing to the design of the innovative capabilities of an established organisation.</p> <p>Navigating in contexts of corporate entrepreneurship, management, and technology given the complexity, politics, and emergent nature of the processes.</p> <p>Developing conceptual solutions to established organizations' challenges when attempting to organise corporate entrepreneurship, management, and technology.</p>

Italy

Course/Module	Circular Economy Business Models - POLIMI
Level	EQF level 7
Quality	The course is assessed with: (i) a written exam with open-ended and case-based questions; (ii) an oral exam, evaluating the understanding of the concepts and the ability to sustain a business discussion on Circular Economy.
Workload	5 ECTS
Profile	<p>The course aims to guide the learner on the theme of Circular Economy through a deliberate alternation of practical cases and application examples to a more theoretical view of the phenomenon. The core of the course is the design and evaluation of business models, either of established companies willing to embrace the new paradigm or of start-ups and new ventures born on a Circular Economy idea.</p> <p>Particular attention will be paid to the pervasiveness of the paradigm, with examples and good practices relating to several business sectors.</p>
Learning outcomes	Students will learn: (i) the core meaning of Circular Economy in the business environment, being able to properly recognize and distinguish circular business models from "green," "esg" or "sustainable" business models; (ii) the tools and frameworks to design and evaluate a circular business model, in different industries; (iii) the tools and frameworks to analyse the context and the ecosystem around a circular business model, with particular reference to the role of regulations and digital technologies in enabling circularity.

Course/Module	Digital Technologies And Sustainable Development - Polimi
Level	EQF level 7
Quality	Attending students will be assessed through a summative evaluation approach considering presentation, essay, or design proposal and participation. Non-attending students will also be asked to deliver the essay and take an oral examination on a bibliography, both agreed upon with the teachers.
Workload	6 ECTS
Profile	Students are expected to understand and reflect on emerging technologies and sustainable development and their mutual influences. The course will be organized in thematic seminars with guests. Each topic will be investigated through a seminar comprehending an expert lecture, a students' group presentation (flipped classroom), and an open discussion. Seminars will cover several aspects of digital technologies concerning sustainable development and will be articulated in two areas as follows: <ul style="list-style-type: none"> - Ethics, society, and digital data - Smart Governance for sustainable development at the community level
Learning outcomes	Students will acquire the following competences: <ul style="list-style-type: none"> - Knowledge and understanding: analyzing environmental and social impact of emerging technologies; - critical reflection and making judgments: knowing and applying contemporary critical approaches to evaluate the achievement of different sustainable development goals; taking a personal stand in the public debate on digital innovation; - communication skills: working in teams, presenting proposals autonomously and in groups, discussing with experts and peers.

Course/Module	Entrepreneurship And Design For Sustainability - POLIMI
Level	Master - EQF level 7
Quality	<ul style="list-style-type: none"> ● Master's Diploma from POLIMI Graduate School of Management ● 1st Level University Specialising Master Degree from Politecnico di Milano ● Master of Science from Skema Business School (in case of eligibility)
Workload	60 ECTS
Profile	This programme cuts across many management domains, including entrepreneurship, business, innovation, technology, and social sciences. Students will acquire expertise in: <ul style="list-style-type: none"> ● Sustainability; ● Corporate Social Responsibility; ● Design for Sustainability; ● Business Modelling for social impact; ● Sustainable Innovation.
Learning outcomes	This Master teaches students how to create, craft, and launch new ideas, leveraging design approaches. But more importantly, with this programme students will also acquire

	the methodology and tools to generate ideas and transform them into new projects or companies that will reconcile care for the planet with profit.
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Course/Module	Master in Circular Economy - POLIBA
Level	EQF 7 Level
Quality	Postgraduate Master's Diploma from POLIBA's Department of Mechanics, Mathematics and Management
Workload	One year - 60 ECTS
Profile	<ul style="list-style-type: none"> ● CE, Sustainability, and Circular Business Models ● Ecodesign ● Industrial Symbiosis and Circular Supply Chains ● LCA, waste management ● Platforms for CE, environmental assessment, certification, regulations and standards ● Remanufacturing and demanufacturing ● CPS for smart, sustainable manufacturing ● Energy management and CE ● Leadership and CE

Course/Module	Environmental Management of Production Systems
Level	EQF 7 level
Quality	Master Degree course - Management Engineering
Workload	6 ECTS
Profile	<ul style="list-style-type: none"> ● International standards and regulations (ISO 14000). ● Environmental Management Systems design and actuation. ● Environmental Performance Evaluation ● Environmental labels ● Life Cycle Assessment ● Integrated Environmental Authorization for Plant and Best Available Techniques. ● Multi-criteria analysis. Environmental impact assessment (EIA).
Learning outcomes	Getting a lifecycle perspective of products, services, and systems and knowing principles of environmental performance evaluation of production systems and methods and tools for industrial eco-efficiency.

Course/Module	Mobility systems and environment
Level	EQF 7 level
Quality	Bachelor Degree course - Civil and Environmental Engineering

Workload	6 ECTS
Profile	<ul style="list-style-type: none"> ● Traditional propulsion systems and environmental externalities ● Transport decarbonization: traditional and alternative ● Fuels; electric vehicles (engines, characteristics, and performances); batteries for electric vehicles (types, charging techniques); hybrid vehicles (types and configurations); hydrogen and fuel cell vehicles (types and configurations). Non-exhaust emissions of electric and fuel cell vehicles. Overall impacts for comparing vehicle types: Life Cycle Assessment (LCA). ● Intervention strategies for sustainable mobility: Mobility as a Service (MaaS).
Learning outcomes	<ul style="list-style-type: none"> ● Intervention strategies necessary to mitigate the environmental externalities of transport. ● Acquisition of basic and technical-scientific knowledge on the peculiar characteristics of the different sustainable transport modes and on the local and global environmental impacts of traditional and innovative propulsion types.

Course/Module	Business and Sustainability
Level	EQF 7 level
Quality	Master Degree course - Management Engineering
Workload	6 ECTS
Profile	<ul style="list-style-type: none"> ● Ecosystem. Economic activities and ecosystem. Circular view of the economic system. Environmental ● Externalities. Sustainable development. Input-output models for the environment. ● Sustainability and the company: Corporate Social Responsibility (CSR) ● Corporate Social Responsibility. Stakeholder theory. Circular economy production models. ● Multi-Attribute Group ● Decision Making for materiality analysis. Eco-design and Life Cycle Assessment (LCA).
Learning outcomes	<ul style="list-style-type: none"> ● Awareness about the relationships between production on the one hand and environment and society on the other hand. ● Which role do companies play, and how can they adapt to reduce their environmental impact and create value for society, possibly operating in connection with other companies?

Course/Module	Green Product Strategy and Sustainable Consumption
Level	EQF 7 level
Quality	Master Degree course - Management Engineering
Workload	6 ECTS
Profile	<ul style="list-style-type: none"> ● Sustainability and green innovation

	<ul style="list-style-type: none"> ● Green product strategy ● Green product development and eco-design ● Sustainable consumer behaviour ● Sustainable purchase behaviour by consumers in terms of perceptions, purchase intention, and willingness to pay a premium price for green products
Learning outcomes	<ul style="list-style-type: none"> ● sustainability and green innovation; green product strategy; sustainability-oriented marketing; ● green product development process, eco-design, sustainable consumer behaviour.

Course/Module	Sustainable Technologies for wastes and reclamation
Level	EQF 7 level
Quality	Master Degree course - Environmental Engineering (Taranto Pole)
Workload	12 ECTS
Profile	<ul style="list-style-type: none"> ● Regulatory framework ● Integrated systems for waste management ● Material recovery from construction and demolition waste ● Valorization of biodegradable organic waste ● Valorization of combustible waste ● Innovative approaches for contaminated site characterization ● Implementation of site remediation technologies ● Sustainable remediation technologies ● Securing and remediation of former landfills ● Sustainability in solid waste management and contaminated site remediation.
Learning outcomes	<p>Sustainable and innovative technologies for:</p> <ul style="list-style-type: none"> ● treatment of waste from urban and industrial activities: reduction, reuse, recovery of secondary raw materials and energy, disposal; ● characterization, risk analysis, safety, remediation, and environmental restoration of contaminated sites.

Course/Module	Sustainable Chemistry for Construction
Level	EQF 7 level
Quality	Bachelor Degree course - Building Engineering
Workload	6 ECTS
Profile	<ul style="list-style-type: none"> ● Definition of sustainability, ● impact of human activity on the environment, circular economy as a model of sustainable development ● Recyclable materials. ● Materials of biological origin. ● Materials for the valorization of waste and recovery of carbon dioxide. ● Photocatalytic materials for construction ● Chemical risk in the construction sector.

	<ul style="list-style-type: none"> • The new product labeling and safety data sheets • Tasks that expose to chemical risk in construction • Specific products, how to work safely • Calculation of the chemical risk index on the construction site
Learning outcomes	<ul style="list-style-type: none"> • The main productions of circular materials in the life cycle of a building. Properties and chemical characteristics of a recyclable material • The CHEMICAL RISK in handling CHEMICAL PRODUCTS on a construction site. • How to work safely on a construction site and monitor the chemical risk index.

Course/Module	Corporate Accounting and Sustainability
Level	EQF 7 level
Quality	Module of a Master Degree course - Mechanical Engineering
Workload	9 ECTS
Profile	<ul style="list-style-type: none"> • Shared value, sharing economy, benefit corporation, società benefit. • Organizational models for the firm (D. Lgs 231/01) and approaches for economic value analysis. • Audit and sustainability reporting.
Learning outcomes	<ul style="list-style-type: none"> • Integrating sustainability within business strategies and processes, addressing the needs and expectations of the market and society, and enhancing human, natural, and financial capital.

Course/Module	Continuous Improvement of Sustainable Manufacturing Processes
Level	EQF 7 level
Quality	Master Degree Course - Management Engineering
Workload	12 ECTS
Profile	<p>The Sustainability Issue</p> <ul style="list-style-type: none"> • The sustainability paradigm: definitions, principles, dimensions. Industrial ecology. Sustainable Development Goals and the quadruple helix model. IPAT equation. Innovation and sustainability. I Green New Deal nel mondo. L'agenda 2030 Europea. • Quality, Continuous improvement, and the sustainability paradigm: The sustainability transfer function. Function modelling • Sustainable manufacturing paradigms: Sustainable processes, products, and services; environmentally conscious manufacturing; sustainable production systems. • Life-cycle thinking, green and sustainable engineering. <p>Measuring Sustainability: Measurements systems: sustainability metrics, indices, indicators, and performances; key performance indicators.</p> <p>Assessment Approaches:</p> <ul style="list-style-type: none"> • Modelling techniques: Material, Energy, and Waste process flow modelling.

	<ul style="list-style-type: none"> • Sustainability assessment: life-cycle inventory and impact assessment; standards and maturity models for sustainability assessment (GRI, SASB; KCDPE; HKEX guide) ecological footprint; environmental-impact- analysis; Life-cycle Inventory; Hybrid life-cycle approaches <p>Exergetical analysis of activities and manufacturing processes.</p> <p>Reporting And Communicating Sustainability:</p> <ul style="list-style-type: none"> • Normative approach to sustainability. Communication of sustainability. • Technical reporting of research results. <p>Sustainability Deployment</p> <p>Technological Approaches</p> <ul style="list-style-type: none"> • Sustainability of Manufacturing Processes: n-R's approach. Clean manufacturing technologies: design and implementation approaches. Demanufacturing processes. <p>Energy-Efficient Manufacturing</p> <ul style="list-style-type: none"> • Sustainability of Smart Manufacturing Systems: Smart Sustainable Manufacturing (Machine Learning, Big Data, Data Mining, Cyber-Physical System, Digital Twin). Changeable Manufacturing. • Sustainability of Products: Sustainable materials. life-cycle design; axiomatic design; design for X (sustainability, environment, de-manufacturing); functional approach to design; eco-quality functional design; requirement analysis; biomimicry. <p>Scientific Approaches</p> <ul style="list-style-type: none"> • Scientific thinking • Sustainable System Engineering: System theory and analysis. Requirement engineering. Kaizén. <p>Environmental conscious quality function deployment.</p> <ul style="list-style-type: none"> • Scientific experimental approach for decision-making: Sources of variation. Probability and fuzziness. • Experimental design and planning: complete factorial, fractional design, moisture design, orthogonal arrays; • nested design. EVOP. ANCOV A. ANOM. Principal Component Analysis. Response Surface Methodology. • Continuous Sustainability Improvement & Innovation • Case Studies • Best Available Technologies. • Product Dematerialisation: Product Service Systems. Demanufacturing. • Sustainability of renewable energy production systems. • Sustainable manufacturing technologies. Sustainable materials. • Optimal machining conditions based on sustainable principles. Energy/Exergy analysis of manufacturing technologies. • Lubricating approaches in machining: metalworking fluids innovation; minimum quantity lubrication; Cryogenic Machining; Near-dry lubrication; new tool coatings. • Smart manufacturing for sustainability.
Learning outcomes	<ul style="list-style-type: none"> • Knowledge of the sustainability issues of manufacturing technologies and production systems and sustainable development • Ability to analyze real systems through systemic and holistic approach. • Ability to carry out an overall analysis of the impact on the life cycle of a process from the point of view of analysis of the flows of matter and energy and exergetic.

Course/Module	Sustainable Manufacturing Processes and Technologies
Level	EQF 7 level

Quality	Master Degree Course - Energetic Engineering
Workload	6 ECTS
Profile	<p>1. Manufacturing sustainability:</p> <ul style="list-style-type: none"> - Manufacturing processes and the main factors of production: materials and energy. Manufacturing and sustainability. Production systems and their sustainable management. Sustainable Development Goals. - International assessment and standardization methods on production sustainability. - The paradigms of intelligent production for sustainability: 4.0 and 5.0. <p>2. Technological process model:</p> <ul style="list-style-type: none"> - Criteria for modeling manufacturing processes and their critical variables. Functional analysis of a manufacturing system: the main and secondary performances. - Digital modeling of production systems: formal modeling, ontologies, digital twins. - Cyber-Physical System and Cyber-Physical Social System <p>3. Sustainability of manufacturing processes and technologies:</p> <ul style="list-style-type: none"> - Manufacturing sustainability of conventional processes (chip removal, welding, plastic deformation, heat treatment). - Manufacturing sustainability of unconventional machining (additive, laser, bio-based). - Demanufacturing processes. Sustainable materials: from recycling, biomaterials, etc. <p>4. Sustainability assessment:</p> <ul style="list-style-type: none"> - Life Cycle Inventory and Life cycle assessment. Measurement of the ecological footprint of a process: carbon and water footprint. - Impact indicators and databases for evaluation: Maturity Models. - The emergy. Exergetic analysis of manufacturing processes. Exergo-economic analysis of manufacturing processes

Course/Module	Sustainability of building systems + Building Information Modeling
Level	EQF 7 level
Quality	Master's degree Course - Building Systems Engineering
Workload	12 ECTS
Profile	<p>Sustainability of Building Systems</p> <ul style="list-style-type: none"> ● The Sustainability Paradigm. Environmental, social, and economic sustainability. The Ecological ● Footprint and the biocapacity of the planet. The Theory on Developmental Limits. ● Sustainable Development and Building Industry. From the energy crises of the 1970s to the environmental emergencies of 2000. The orientation of buildings: bioclimatic theory and the theory of the eliotermic axis. Typological solutions and technologies. ● Project, life cycle, building process. Sustainability of processes and building systems: embodied energy, consumption in use, residual performance potential, recyclability. The durability of building components: useful life and reliability. ● Circular building process. Waste from construction and demolition. Building Automation for Sustainability. Reconfigurability and reversibility of buildings. ● Sustainability assessments. The Protocollo ITACA - Categories and Criteria for Evaluation Areas: Site Quality, Resource Consumption, Environmental Load, Indoor Environmental Quality, Quality of Service. Evaluations according to the L.E.E.D. method. Life Cycle Assessment Evaluations. Minimum Environmental Criteria. <p>Building Information Modeling</p>

	<ul style="list-style-type: none"> • The approach to Building Information Modeling. The information model is the evolution of the project with the CAD. BIM's purpose for the construction phase. The BIM for the life cycle management of the building. The Level Of Development. The dimension of the BIM. Interoperability of software and information. The Employer Information Requirement. • The 3D models. 3D Model Building. Quality assurance: BIM validation, clash detection, code checking. • Scheduling Jobs in the BIM. Finding model attributes allows time management in the work phases and the overall programming. • Costs and economic evaluations in BIM. Definition of economic attributes in the model. Building performance analysis using the BIM model. • BIM for as-built and Facility Management.
<p>Learning outcomes</p>	<p>Sustainability of Building Systems Carry out environmental sustainability assessments of buildings through the integrated calculation of criteria and using national and international methods and protocols. Application of Protocollo Itaca to the design of new buildings and the redevelopment of the existing ones.</p> <p>BIM: Carry out the modeling of buildings to have all of the information to develop work planning, economic evaluations, building performance analysis, and govern the phase of construction and life cycle management.</p>

Annex 4: Key Competences per Country

This Annex offers a comprehensive overview of the existing competences within the VET systems across each CERES partner country. This holistic examination aims to provide a thorough understanding of qualifications within the context of our project. To facilitate effective comparison and analysis, we have reviewed various documents, extracting and identifying various key elements, including:

- **Level or Target Group:** Where feasible, we have categorized qualifications according to the EQF or NQF or defined the intended target groups.
- **Quality Assurance:** We have assessed the presence of any validation mechanisms such as assessments, certifications, or certificates of completion that vouch for the quality and credibility of the courses.
- **Workload:** We have quantified the total hours or ECTS required for each qualification, providing insights into the depth and scope of the programs.
- **Profile:** Qualifications are classified based on either their specific subject field(s) of learning or broader clusters of capabilities. These clusters often share a common focus, such as applied vocational studies or more theoretical academic endeavors.
- **Learning Outcomes:** We have outlined the expected learning outcomes, encompassing knowledge, skills, responsibilities, and autonomy. These learning objectives provide a comprehensive view of what learners can expect to achieve through their educational pursuits.

Bulgaria

This section provides an overview of VET's key competences in Bulgaria (Kovachev et al., 2016).

Key Competence	Mathematics, Science, and Technology
Level	Equivalent to EFQ4
Quality	These competences are assessed via an external assessment for all students who have completed 12th grade.
Workload	It is defined in the documentation for professional education.
Profile	While the national lifelong learning strategy 2014-20 (2014) promotes the acquisition of all key competences by all citizens, but not specifically in VET, Public education law regulates the development of national qualification standards, including mathematics, informatics, and information technologies.
Learning outcomes	<ul style="list-style-type: none"> • Improved key competences in mathematics, informatics, and information technologies. • Ability to use mathematical and digital content, information, ideas, and processes to meet training and work needs. This includes understanding numbers, patterns, shapes, and space, as well as mathematical language, symbols, techniques, and ways of thinking used to achieve specific goals (European Commission, 2022).

Key Competence	Digital competences
Level	Equivalent to EFQ4
Quality	In June 2015, the national online assessment of digital competences of 10th-grade students was piloted with 1001 learners from 15 schools (including VET). The assessment has two modules: an online test with ten automatic assessments and solving practical tasks.
Workload	It is defined in the documentation for professional education according to the State educational standards.
Profile	Digital competence is mentioned as a key competence in the national lifelong learning strategy 2014-20 (2014) (not specifically for VET) and the strategy for effective implementation of ICT in education and science 2014-20 (2014).
Learning outcomes	<ul style="list-style-type: none"> • Improved digital competences. • Collecting, storing, monitoring, and using information; Conducting studies, investigations, and tests; maintaining records; managing, evaluating, processing, analysing, and monitoring information and projecting outcomes (European Commission, 2022).

Key Competence	Learning to learn
Level	Equivalent to EFQ4
Quality	The new preschool and school education law will contribute to developing learning-to-learn competence by creating appropriate physical, psychological, and social environments for skills development. This support includes providing career guidance to students aimed at both effective learning and education career management.
Workload	It is defined in the documentation for professional education.
Profile	The national qualification standards contribute to developing the broad spectrum of skills constituting the competence of learning to learn.

Learning outcomes	<ul style="list-style-type: none"> • Improved competences. • Show a positive attitude towards new and challenging demands that can only be met via lifelong learning (European Commission, 2022).
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Key Competence	Interpersonal, intercultural, and social competences, and civic competence
Level	Equivalent to EFQ4
Quality	Public education law regulates the development of national qualification standards for philosophy.
Workload	It is defined in the particular documentation for professional education.
Profile	National Lifelong Learning Strategy 2014-20 (2014) promotes the acquisition of key competences for all citizens but not specifically for VET learners. National qualification standards for general education preparation are compulsory for learners in vocational gymnasiums. Training is provided in the school subjects ethics and law (in the 10th grade), philosophy (in the 11th and 12th grade), and world and personality (in the 12th grade). In the draft VET syllabus (programmes with intensive English), civic education is included as a separate school subject in the 11th and 12th grade programmes. VET graduates must sit the matriculation exams in the Bulgarian language and literature and can opt for philosophy as a second exam.
Learning outcomes	<ul style="list-style-type: none"> • Improved competences. • Skills and competences relating to the ability to interact positively and productively with others. This is demonstrated by communicating ideas effectively and empathetically, coordinating one's objectives and actions with those of others acting in ways structured according to values, ensuring the well-being and progress of others, and offering leadership (European Commission, 2022).

Key Competence	Entrepreneurship
Level	Equivalent to EFQ4
Quality	Entrepreneurship competence is assessed implicitly through general and specialized learning outcomes during the certification exams.
Workload	In the draft VET syllabus (programmes with intensive English), a separate school subject, entrepreneurship, is included in the eighth-grade programme.
Profile	National Lifelong Learning Strategy 2014-20 (2014) promotes the acquisition of all key competences for all citizens but not specifically in VET. In September 2015, the Minister for Education approved a new syllabus for training through work (dual training). Dual training was introduced in vocational gymnasiums based on amendments (2014) in VET law. The syllabus for the Transport Technics Technician qualification at EQF level 4 stipulates that the training hours for obligatory or optional vocational training subjects in grades 11- 12 may be used for the development of entrepreneurial attitudes and skills in training enterprise.
Learning outcomes	<ul style="list-style-type: none"> • Improved competences in entrepreneurship. • The development, organization, and management of one's business venture (European Commission, 2022).

Key Competence	Cultural expression
Profile	National Lifelong Learning Strategy 2014-20 (2014) promotes the acquisition of all key competences for all citizens but not specifically in VET. Competence is promoted by including cultural themes in the Bulgarian language and literature, foreign languages, philosophy, history and civilisation, and other subjects.

Learning outcomes	<ul style="list-style-type: none"> • Improved competences. • Express and interpret ideas, experiences, and emotions creatively. Adopt an openness to learning from different cultural and artistic expressions (European Commission, 2022).
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Cyprus

This section provides an overview of the key competences in VET in Cyprus (Korelli & Mourouzides, 2016).

Key Competence	Maths, Science and Technology
Level	Upper secondary VET, mathematics is a compulsory general education subject - EQF 4
Quality	Continuous school-based assessment is carried out for individual subjects, such as mathematics or technology. Mathematics is a compulsory subject and comprises tests and final examinations that are centralized and common for the last year of studies. Students' attitude, effort, participation, interest, willingness, persistence, oral and written work, and homework are also considered. Assessment provides feedback on students' progress and reinforces learning and motivation. It determines whether students meet a specified level according to the objectives of the curriculum, identifies problem areas for remedial work, and validates the effectiveness of the teaching program.
Workload	Four 45-minute lessons per week in the theoretical and two periods in the practical VET track. In the second and third years, students may opt for two additional periods of mathematics per week but with a distinct syllabus for the theoretical and the practical directions.
Profile	The 2014-20 lifelong learning strategy promotes the acquisition of competences in maths, science, and technology (digital competences), through the development of new curricula.
Learning outcomes	<ul style="list-style-type: none"> • Ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations. Building on a sound mastery of numeracy, the emphasis is on process, activity, and knowledge. • Mathematical competence involves, to different degrees, the ability and willingness to use mathematical modes of thought (logical and spatial thinking) and presentation (formulas, models, constructs, graphs, charts). • Competence in science refers to the ability and willingness to use the body of knowledge and methodology employed to explain the natural world to identify questions and draw evidence-based conclusions. • Competence in technology is viewed as applying that knowledge and methodology in response to perceived human wants or needs. Competence in science and technology involves understanding the changes caused by human activity and responsibility as an individual citizen.

Key Competence	Digital competence
Level	Upper secondary VET EQF 4
Quality	For ICT, CISCO-CCNA Networks, or the various technological subjects. Assessment is continuous and consists of tests and final examinations. The final examinations in the CISCO-CCNA Networks subject are carried out online by the CISCO Networking Academy.

	Students' attitude, effort, participation, interest, willingness, persistence, oral and written work, and homework are also considered.
Workload	An introductory ICT course (two 45-minute weekly lessons) is compulsory in the first year of upper secondary VET. ICT courses are optional for all specialisations in the second and third years. The theoretical VET track also offers the specialisation of computer engineering.
Profile	The 2014-20 lifelong learning strategy promotes the acquisition of digital competences by developing new curricula.
Learning outcomes	Involve the confident and critical use of information society technology for work, leisure, and communication. Basic skills in ICT underpin it: the use of computers to retrieve, assess, store, produce, present, and exchange information and to communicate and participate in collaborative networks via the Internet.

Key Competence	Learning to learn
Level	Upper secondary VET EQF 4
Quality	No assessment
Profile	<ul style="list-style-type: none"> - Ability to pursue and persist in learning and to organise one's learning, including through effective time management and information, individually and in groups. - This competence includes awareness of one's learning process and needs, identifying opportunities, and overcoming obstacles to learn successfully. - This competence means gaining, processing, and assimilating new knowledge and skills and seeking and using guidance. - Learning to learn engages learners to build on prior learning and life experiences to use and apply knowledge and skills in various contexts: at home, at work, in education, and in training. Motivation and confidence are crucial to an individual's competence.
Learning outcomes	<ul style="list-style-type: none"> ● Prepare students for further learning and to analyse and solve problems in everyday life. ● The application of theoretical knowledge and the enhancement of existing knowledge through technological subjects contribute to acquiring the learning to learn competences. ● VET curricula help students acquire competences to learn and equip them with the capacity to adjust in dynamic and unpredictable situations, to search for, select, assess, interpret, and make optimal use of information

Key Competence	Interpersonal, intercultural, and social competences, and civic competence
Level	Upper secondary VET EQF 4
Quality	No assessment
Workload	The subject of history and civic education is compulsory (one 45-minute lesson per week).
Profile	The subject of history and civic education is compulsory. Education for peace, intercultural education, democratization and participation in public affairs concepts are

	interdisciplinary and embedded in all secondary education schools' curricula, programmes, and activities, including VET.
Learning outcomes	<ul style="list-style-type: none"> ● Assume various roles in life, such as that of the responsible, active, democratic, and productive citizen, that of the parent, that of the leader, that of the advisor, etc.; ● Act freely and independently, exercise their critical thinking, and be willing to accept constructive criticism from others; ● Learn to respect and implement universal values and principles; ● Develop their decision-making skills and competences, as well as the necessary attitudes for active and educated participation, cooperation, and leadership at the place of work and in society in general; ● Learn to accept and cooperate with other ethnic groups in the context of a multicultural society; ● Participate effectively in various working groups and to exchange knowledge and experiences constructively.

Key Competence	Entrepreneurship
Level	The Ministry of Education and Culture, together with Junior Achievement Worldwide, Junior Achievement Cyprus, and the University of Nicosia, have implemented the programme in upper secondary VET since 2013/14 - EQF 4
Quality	The Junior Achievement Young Enterprise programme helps students learn how to take a business idea from concept to reality, form their real enterprise and discover how a company functions. They elect a board of directors from amongst their peers, raise share capital, and market and finance a product or service. At the end of the programme, they present a report and accounts to their shareholders.
Profile	Workshops in woodcraft, furniture making, industrial design, services, applied arts, clothing, etc. promote entrepreneurship through learning about legal aspects, costs, pricing, start-up, organisation, and administration of an enterprise.
Learning outcomes	<ul style="list-style-type: none"> ● Ability to turn ideas into action. It includes creativity, innovation, risk-taking, and the ability to plan and manage projects to achieve objectives. ● Supports individuals, not only in their everyday lives at home and in society, but also in the workplace in being aware of the context of their work and being able to seize opportunities, and is a foundation for more specific skills and knowledge needed by those establishing or contributing to social or commercial activity. This should include awareness of ethical values and promote good governance.

Denmark

This section provides an overview of the key competences in VET in Denmark (Cedefop, 2023j).

Key Competence	Math, Science, and Technology
Level	Upper secondary VET
Quality	Suppose the main programme of the VET-programme contains one of the five courses (Math, Physics, Chemistry, Technology and Science). In that case, it can – by drawing out – be a subject of an examination.

	<p>For EUX – a combined VET and upper secondary education, Math is mandatory at C-level as a minimum and is subject to examination. Depending on the type of EUX, several subjects can be selected at levels C, B, or A, and they will all be a subject for examination. EUX final examination comprises six subjects at levels C, B, and A, so by drawing a number of the five subjects mentioned, it can be the subject of examination. It is especially the EUX-programmes directed towards engineering, construction, and architecture where math and science subjects are largely represented.</p> <p>The Danish OECD PIAAC-report 2013 has presented a picture of the level of competences concerning reading, numeracy, and problem solving with ICT. On a scale of 0 to 500, people with a VET background scored 261. The first round of PIAAC was completed in 2008-13; the second round was completed in 2016.</p>
Profile	<p>It is a general endeavor in VET that courses, e.g., Maths, Physics, Chemistry, Technology, and Science, are taught in combinations and integrated with other courses. The teaching in the five courses differs because the specific educational context forms it. Holistic teaching is commonly applied. As an example, the VET-programme for carpenters could integrate Math and Physics in a practical task where students are asked to build a playhouse.</p>
Learning outcomes	<ul style="list-style-type: none"> • National curricula regulate the key competences in VET. • The key competences in math, science, and technology are covered by following courses in the basic programmes (GF1 and GF2) and in the main programmes: Maths, Physics, Chemistry, Technology, and Science.

Key Competence	Digital competence
Level	Upper secondary VET
Quality	<p>As part of the strategy for the Digital VET college, the Information Technology course is optional in VET. Learners can choose to pass an examination in this subject.</p> <p>EUX programme GF2 (the basic part) contains the course Information Technology.</p> <p>The Danish OECD PIAAC report (2008-2013 and the second round in 2016) has presented a picture of the level of competences concerning reading, numeracy, and problem-solving with ICT.</p> <p>In 2015, the Danish Evaluation Institute conducted a study presenting how ICT is used in upper secondary VET. The study was done for the Ministry of Education to support the implementation of the Strategy for the Digital VET colleges.</p>
Profile	<p>Information technologies are of the highest priority in the Danish VET system. It is a basic endeavor to integrate digital technologies in all subjects and the VET college's general management. This also applies to a single student's educational plan for VET college and companies in the dual system. Blended learning, flipped classrooms, and social media are all integrated into VET college's daily life. As an example, at Food College Aalborg, teachers work with the Bookless class to use and explore new teaching methods and new materials (virtual information sources) through the use of tablets in the classroom, make students' learning better visible, and improve the cooperation, connection, and interaction between student, work placement and VET college, etc.</p>
Learning outcomes	<ul style="list-style-type: none"> • National curricula regulate the key competences in VET. • Digital competence is an integrated part of the whole VET education but is also a basic course in Information Technology.

Key Competence	Learning to learn
Level	Upper secondary VET
Quality	According to the curricula, assessments generally focus on the ability and competence of Learning to learn, and for the two courses – Psychology and Organisation- there can, by drawing out, be a specific examination.
Profile	It is a general endeavor in VET to develop a supportive and secure environment that provides learners with the best opportunities for learning to learn. This is also done by creating young and adult campus environments. Apart from that, two courses are specifically relevant: Psychology and Organisation.
Learning objectives	<ul style="list-style-type: none"> • National curricula regulate the key competences in VET. • Learning to learn is addressed as a general endeavor in many of the curricula by stressing the importance of students' self-evaluation and portfolio work. This is also embedded in the national framework of the learner's personal educational plan.

Key competence	Entrepreneurship
Level	Upper secondary VET (also at all levels of the education system)
Quality	<p>In pedagogical practice, the general endeavor is that entrepreneurship and innovation are integrated into the holistic project work when courses are melted into a transversal unit and will be assessed as part of the general assessment of the project.</p> <p>In the course Innovation, there can – by drawing out – be a specific examination concerning the key competence of Entrepreneurship.</p> <p>For EUX – a combined VET and upper secondary education – Innovation and entrepreneurship is normally an integrated part of the other courses taught and play an integrated role in the examination of those.</p>
Profile	Entrepreneurship is part of the courses Profession/Business 1, 2, and 3 and in the general course Innovation. VET's general endeavor is to use didactics and organisational methods to promote entrepreneurship. Teachers are being trained (10 ETCS-point module at EQF-level 6) to create the right environment and further promote entrepreneurial competences to support young entrepreneurs at the VET colleges in Denmark.
Learning outcomes	<ul style="list-style-type: none"> • VET must give the students an education that provides them with innovative and entrepreneurial thinking and future work, including establishing self-employment and meeting the labour market's need for an innovative and creative workforce.

France

This section provides an overview of the key competences in VET in France (Cedefop, 2023k).

Key Competence	Mathematics, Science and Technology
Level	Upper secondary VET. - NQF 4

Quality	The assessment is defined at the national level as for all the general subjects of the vocational qualifications.
Profile	The Mathematics Strategy 2014 includes ten key measures in three focus areas: mathematics curricula tuned with the modern world, teachers who are better trained and given better support to ensure the success of their students, and giving mathematics a new image.
Learning outcomes	The acquisition of competence is provided through the general mandatory syllabi for VET programmes, mainly managed by the Education Ministry.

Key Competence	Digital competence: Computing
Level	Upper secondary VET - NQF 4
Quality	The assessment of digital competence is defined at the national level for all general subjects in VET. Moreover, since 2001, the Ministry responsible for the national education issues to VET learners the Computing and Internet Certificate (B2i).
Profile	The LSE study shows that nearly six out of 10 students master the organisation of a digital document and navigation on a website. However, four students out of ten struggle to understand writing on a digital medium, either because of a lack of expertise or because of difficulty in remembering or being attentive
Learning outcomes	<ul style="list-style-type: none"> • The certificate certifies the level students acquire in mastering multimedia tools and the internet.

Key Competence	Learning to learn: Methods and tools for learning
Level	Technological and vocational upper secondary schools - NQF 4 In the vocational path, teachers promote key competences through practical training courses. Learners alternate study and work periods or internships in a professional environment. The basics of methods and tools for learning are given during compulsory education for up to sixteen years.
Profile	It allows students to develop their key competences and strengthen their working methods, e.g., through methodological workshops. For this purpose, examples of modules (e.g., managing stress for improved learning, learning to argue, and developing one's memory) are available on the national portal of educational professionals.
Learning outcomes	<ul style="list-style-type: none"> • The certificate certifies the level students acquire in mastering multimedia tools and the internet.

Key Competence	Entrepreneurship: Sense of initiative and entrepreneurship
Level	Vocational baccalaureate - NQF4

Quality	A national Youth Initiatives exam is organised annually by the Ministry of National Education to reward the best enterprise creation projects.
Profile	Two courses cover this competence in the vocational baccalaureate: economics-law and economics-management. 5% of entrepreneurs are under age 30. Since 2006, the number of new enterprises by young people has tripled. The Agency for the Creation of Enterprises (APCE) published a study on enterprise creation by youngsters below 30. The study shows that 34% of upper secondary students (including VET) and university students wish to create their own enterprises.
Learning outcomes	<ul style="list-style-type: none"> No specific national strategy exists for entrepreneurship education. Depending on the curricula, entrepreneurship education is integrated as a cross-curricular objective; it exists on its own as a specific topic only for tertiary education.

Italy

This section provides an overview of the key competences in VET in Italy (M. & M., 2016).

Key Competence	Maths, Science and Technology
Level	EQF level 4-5
Quality	The national institute that evaluates the education and VET systems (INVALSI) (9) methodologically supports and guides providers that issue the certificates. It also provides teacher training, guidelines, and methodological support for assessing competences and online support, including regular surveys, assessment tools, methodology, and analytical information on learning outcomes by the VET provider.
Workload	EU key competence three is promoted as a stand-alone component both at the level of standards and curricula. Example 1 details training time dedicated to developing this competence within a three-year training pathway to achieve a professional operator qualification for construction (EQF 3). Regarding the national qualification system, the compulsory education certificate (EQF 2) formally certifies the level achieved regarding the mathematical and scientific-technological cultural axe.
Profile	Mathematical skills and the third one related to scientific-technological skills refer to the EU No three key competence. Competences related to mathematical skills and scientific-technological skills are intended as basic competences.
Learning outcomes	<p>Making calculations, also by using computer applications and charts; Comparing and analysing geometric figures, identifying relationships;</p> <ul style="list-style-type: none"> Identifying strategies for problem-solving; Analysing and interpreting data by deduction and reasoning (scientific-technological skills); Observing, describing, and analysing natural phenomena by understanding the concepts of systems and complexity; Based on experience, analysing phenomena linked to the transformation of energy; Contextualising awareness of the potential and limitations of technology.

Key Competence	Digital competence
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Level	EQF level 4-5; Apprenticeship
Quality	The national institute responsible for evaluating the education and VET systems (INVALSI) (9) methodologically support and guides providers issuing certificates. It also provides teacher training, guidelines, and methodological support for assessing competences and online support, including regular surveys, assessment tools, methodology, and analytical information on learning outcomes by VET provider.
Workload	Decree No 81/2015 within the Jobs Act framework reviewed the system. Now, apprenticeships (contract) can be divided into three groups aimed at 1) achieving a qualification and/or professional diploma apprenticeships (upper secondary school diploma and the certificate of higher technical specialisation) for young people aged 15-25; 2) skills upgrading for young people aged 18-29, who learn and achieve a professional qualification; 3) higher education (including Ph.D.) and research for young people aged 18-29. The first type (1) involves the achievement of key competences, as defined in the D.M 139/2007. The second type (2): 120 hours of formal training per year of contract duration, of which 40 hours are dedicated to basic and transversal skills, including digital competence.
Profile	Digital competence (EU key competence No. 4) is intended as a transversal area. Digital competence is also included in the national key competence No. 3 Communication (the ability to represent events, concepts, and procedures using different languages and IT and multimedia devices).
Learning outcomes	<ul style="list-style-type: none"> Digital competence (EU key competence No. 4) is intended as a transversal area. However, it is quoted explicitly in the first cultural axe language skills, in terms of using and producing multimedia texts, but also in the mathematical skills in terms of making calculations by using computer applications and charts, as well as in the scientific-technological skills 'awareness of the potential and limitations of technology.

Key Competence	Learning to learn
Level	EQF level 4
Quality	The national institute that evaluates the education and VET systems (INVALSI) (9) methodologically supports and guides providers that issue the certificates. It also provides teacher training, guidelines, and methodological support for assessing competences and online support, including regular surveys, assessment tools, methodology, and analytical information on learning outcomes by the VET provider.
Profile	EU key competence No. 5 is addressed within the historic and socio-economic area of competence, together with the EU KC No. 6 and 7, regarding transforming ideas into actions by improving knowledge and awareness—the ability to identify personal and professional learning opportunities.
Learning outcomes	<ul style="list-style-type: none"> Autonomy, responsibility, differentiation. Transversal competence within the set of nationally defined key competences (it is No 1). At the national level, learning to learn is intended in terms of the ability to self-organise learning, identify, choose, and use different sources and methods of information and learning (formal, non-formal, and informal), also following personal timing, strategies, and methods of both working and/or studying.

Key Competence	Entrepreneurship
Level	EQF Level 4-5; Apprenticeship
Quality	The national institute that evaluates the education and VET systems (INVALSI) (9) methodologically supports and guides providers that issue the certificates. It also provides teacher training, guidelines, and methodological support for assessing competences and online support, including regular surveys, assessment tools, methodology, and analytical information on learning outcomes by the VET provider.
Workload	Apprenticeships (contract) can be divided into three groups aimed at 1) achieving a qualification and/or professional diploma apprenticeships (upper secondary school diploma and the certificate of higher technical specialisation) for young people aged 15-25; 2) skills upgrading for young people aged 18-29, who learn and achieve a professional qualification; 3) higher education (including Ph.D.) and research for young people aged 18-29. The first type (1) involves the achievement of key competences, as defined in the D.M 139/2007. The second type (2): 120 hours of formal training per year of the duration of the contract, of which 40 hours are dedicated to basic and transversal skills, including entrepreneurship
Profile	EU key competence No. 7 relates to the expected outcomes in the fourth cultural axe history and social skills. The EU key competence No. 7 also fits the key citizenship competences No 2) planning and 6) problem-solving.
Learning outcomes	Problem-solving and ability to organise and manage the working environment with high autonomy and responsibility.

United Kingdom

This section provides an overview of the key competences of VET in the UK (Torjus, 2016).

Key Competence	Competences in Maths, Science and Technology
Level	EQF4
Quality	Maths and science are compulsory up to key stage 4 (age 16) in schools that follow the national curriculum. Unsatisfactory maths grades in examinations at 16 mean that students must continue studying at the next stage in their education. Functional skills in maths are offered as an alternative, if better suited.
Profile	The STEMNET organisation works throughout the UK to encourage young people to pursue science, technology, engineering, and maths courses and careers. Maths is incorporated into vocational courses by building exercises and applying the teaching to numerical problems, e.g., calculating the ratios for weights of ingredients in a cookery class. There are courses for teachers of further education to become qualified in teaching mathematics and to aid the professional development of mathematics teachers.
Learning outcomes	<ul style="list-style-type: none"> Teacher courses aim to improve the availability and quality of maths teachers in further education colleges;

	<ul style="list-style-type: none"> Wales: Demonstrate collection and interpretation of information involving numbers, completing calculations, interpretation and presentation of results; Scotland: Ability to use graphical information and numbers (Scotland).
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Key Competence	Digital competence
Level	FE, Apprenticeship level EQF4
Profile	<p>Further Education Learning Technology Action Group (FELTAG) recommends that managers, trainers, leaders, and teachers have digital technology capability to develop their role within their organisations and support staff professional development.</p> <p>Computing/Information communication technology (ICT) is compulsory until key stage 4 in schools that follow the national curriculum. Providers of vocational courses are required to offer post-16 students study programmes, including ICT if they are directly relevant to the occupation or sector.</p> <p>ICT can be included in vocational courses through internet research, word processing, spreadsheets, creating websites, etc.</p> <p>Scotland: ICT must be included in modern apprenticeships.</p> <p>Wales: Digital literacy has replaced ICT as the Essential Skill Wales qualification.</p>
Learning outcomes	<ul style="list-style-type: none"> Using appropriate software to solve problems, using ICT to learn effectively, and using computing to process and manage information. Wales: Courses will teach digital responsibility, information literacy, productivity, collaboration, creativity, and learning.

Key Competence	Learning to learn
Level	FE, Apprenticeships – EQF4
Profile	<p>This competence is primarily taught in the further education sector, but apprenticeships must demonstrate students have gained Personal Learning and Thinking Skills (PLTS). A qualification is available in Improving own learning and performance (IOLP). There are training programmes for teachers that help deliver the PLTS.</p> <p>Scotland: The core skill of problem-solving must be incorporated into apprenticeships.</p> <p>Wales: teachers must specialise in a subject and be able to teach students to learn how to learn. Learning to learn is not an essential part of apprenticeships, but the inclusion of it must be considered based on relevance to the course.</p>
Learning outcomes	<ul style="list-style-type: none"> FE: Independent study and learning, teamwork, peer interaction, using feedback and learner voice. Apprenticeships: must demonstrate PLTS Skills; independent enquiry, creative thinking, reflective learning, teamwork, effective participation, and self-management. IOLP: Develop strategies to learn more effectively. Take responsibility for their learning, set goals, plan and review progress, etc. Scotland: Thinking skills developed by remembering, understanding, applying, evaluating, and creating ideas or knowledge.

Key Competence	Interpersonal, intercultural, and social competences, and civic competence
Level	FE, Apprenticeships – EQF4

Quality	Recommendations were made for creating a framework to define, assess, and develop soft skills – social/cooperative skills throughout education and work.
Profile	England: Citizenship is a compulsory subject in national curriculum schools from ages 11-16. Education providers will be inspected to ensure the provision of personal and employability skills and teach the ability to be physically and emotionally fit. There are also considerations on how to avoid extremism and radicalisation, abuse, bullying, and grooming. Ethical, social, and personal issues, as well as responsibilities as a citizen and part of society, are also areas which inspectors will check are included.
Learning outcomes	<ul style="list-style-type: none"> ● England: Covers societal and political issues, the justice system, volunteering, and personal finance. Equip students with the ability to explore issues critically, weigh evidence, debate, and make reasoned arguments. ● Scotland: Skills developed such as working with others, asserting oneself, being a good team learner, empathising with others, being open to other ways of thinking, assuming responsibility for tasks, evaluation of contribution. The core skill of problem solving must be included in apprenticeships, this entails critical thinking, planning, organising, reviewing, and evaluating topics such as citizenship, sustainable development, and international education developed. ● Wales: Working with others - key skill: plan work with others, develop collaboration, check progress, review work with others. Welsh baccalaureate includes a skills qualification that involves critical thinking, problem-solving, planning, and organising. Personal and social education prepares learners to be socially effective by developing self-esteem and self-respect, living safely, and preparing for choices. Empowerment to participate as a citizen locally, nationally, and globally; attitudes to sustainable development and global citizenship; and preparation for adult life challenges and choices.

Key Competence	Entrepreneurship
Level	Mostly FE courses - EQF4
Quality	BTEC diplomas, Higher National Certificates, and Foundational degrees
Profile	It can include work experience or practical projects. Some FE colleges provide extracurricular activities such as enterprise competitions and events.
Learning outcomes	<ul style="list-style-type: none"> ● Teach enterprising skills, management, and employer engagement; ● Scotland: Recognising need and opportunity, influencing and negotiating, evaluating risk to aid decision-making; taking the initiative and working with others, self-awareness and having an open mindset, modern world view and resilience, adaptability and determination; and meeting expectations; ● Wales: Understanding the world of work is a key focus.