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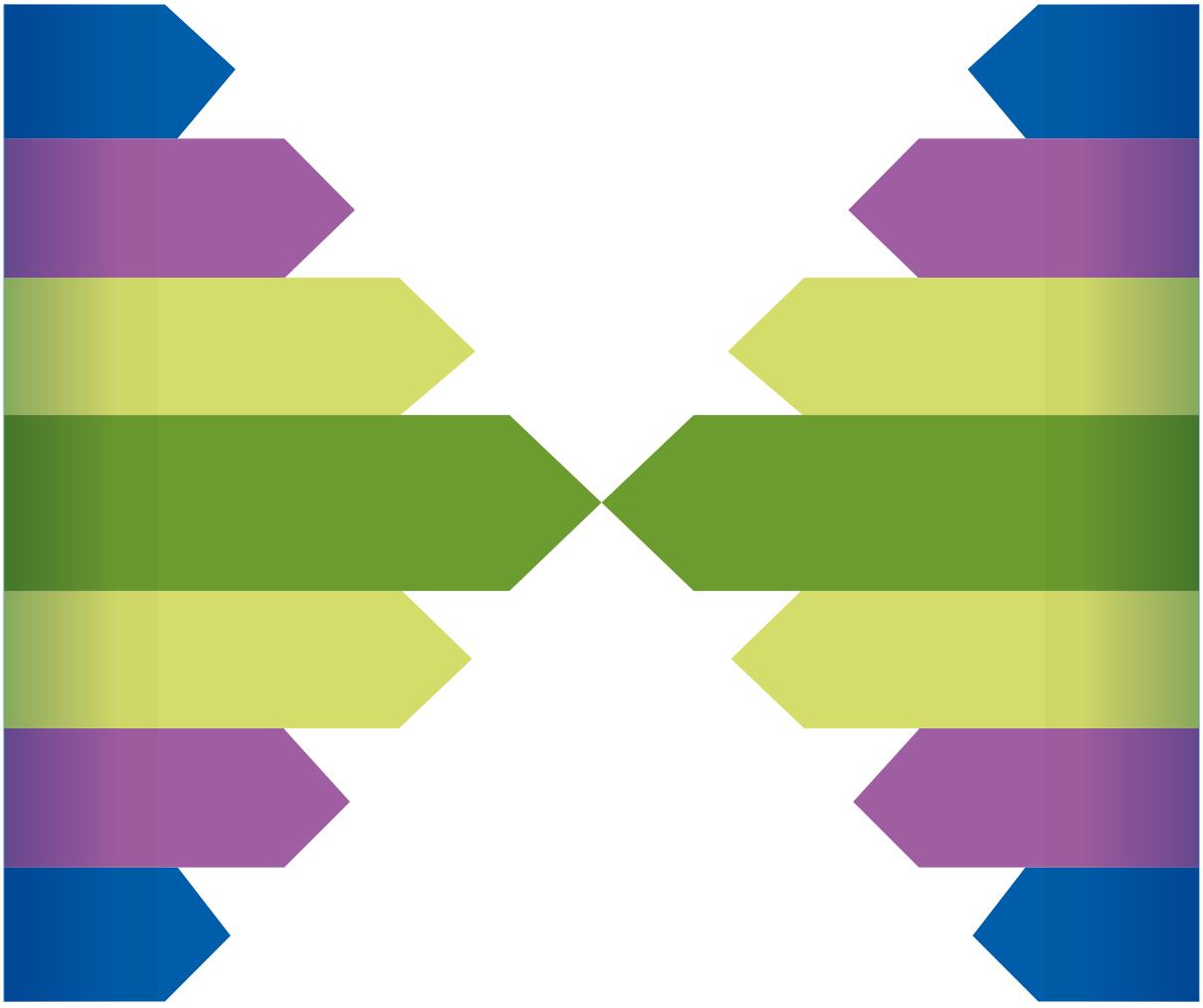
Meeting skill needs for the green transition

Skills anticipation and VET for a greener future



Cedefop-UNEVOC practical guide 4

Meeting skill needs for the green transition

Skills anticipation and VET for a greener future

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The **European Centre for the Development of Vocational Training** (Cedefop) is the European Union's reference centre for vocational education and training, skills and qualifications. We provide information, research, analyses and evidence on vocational education and training, skills and qualifications for policy-making in the EU Member States. Cedefop was originally established in 1975 by Council Regulation (EEC) No 337/75. This decision was repealed in 2019 by Regulation (EU) 2019/128 establishing Cedefop as a Union Agency with a renewed mandate.

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UNESCO-UNEVOC is UNESCO's specialized centre for Technical and Vocational Education and Training (TVET). Its activities focus on key themes in the field of TVET and are implemented in close collaboration with UNESCO Headquarters, Field Offices, Institutes and Centres, as well as through the global UNEVOC Network.

Foreword

Cedefop's skills forecast, skills surveys, the big data-powered SkillsOVATE platform, and other skills intelligence tools are essential assets in Europe's skills revolution. They shed light on labour market trends in sectors and occupations and give insight into how skills upgrading and new emerging skills transform jobs. Cedefop's skills intelligence also identifies the skills shortages and bottlenecks standing in the way of just green and digital transitions, competitiveness, innovation, and growth.

Many activities and initiatives in the 2023/24 European Year of Skills showcased that skills intelligence is a fundamental resource in the decade of skilling that Europe needs to transform its economies and societies. The ongoing development of national skills intelligence systems and approaches has helped strengthen the feedback loops between the labour market and vocational education and training (VET) and skills policy. More ambition is needed to mainstream the next generation skills intelligence and to position it as a transversal tool that supports policy objectives across various domains.

Cedefop promotes the development and use of scientifically sound and stakeholder-driven skills anticipation methods and tools. Via its work and outreach, Cedefop brings national policy makers together with skills ecosystem actors and stakeholders in regions and sectors to put good skills anticipation practices in the spotlight and to ease policy learning and innovation.

This publication is the fourth in a series of practical Cedefop skills anticipation guides for policymakers, analysts, and expert professionals. The three previous guides presented a rich mosaic of conventional and emerging methods for identifying technological change and its impact on skills. They assessed the merits and challenges of using skills forecasts, big data, and technology and skills foresight, and provided practical insight into how these methods can best be used. This fourth practical guide has a thematic rather than a methodological focus and zooms in on skills intelligence and VET for the green transition. Becoming climate neutral and sustainable requires a thorough economic transformation with impacts on employment and jobs. While skills intelligence has become 'greener' and more suited to reflecting on such impacts, translating it into VET policy and skilling measures can be challenging.

In many contexts, VET and skills ecosystem stakeholders are looking for information and inspiration. Regions, sectors and VET providers need practical know-how to prepare young learners for jobs in greener economies, to support adults in the transition to a green job, and to accelerate and scale up skilling efforts.

The guide aims at demonstrating the value of sound skills intelligence and smart governance in the context of the green transition and at showcasing how VET can make a difference in practice. It explains how skills anticipation and governance approaches can become drivers of greening and how apprenticeship, up- and reskilling, validation and microcredentials can be leveraged on the way towards a greener future. Good practice examples from all over Europe and beyond illustrate what it takes to go from green ambitions for VET and skills to policy implementation.

Cedefop is proud to release this pioneering publication together with UNESCO-UNEVOC and to jointly promote education as a driving force in sustainable development and social cohesion. Strengthening skills governance in support of the green transition is a shared ambition and in line with Cedefop's vision for VET and UNESCO's transformative vision for education. While this guide mainly considers the EU perspective, the messages and policy implications are also valuable in an international context.

Insights and examples provided in this publication complement the strategies, cases and resources UNESCO-UNEVOC and Cedefop jointly showcase in an accompanying practical guide to support the vision of a greener and more innovative VET.

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Cedefop experts Jiri Branka, Vladimir Kvetan, Joanna Napierala, Anastasia Pouliou, Adam Tsakalidis, and Ernesto Villalba contributed to parts of the publication.

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CHAPTER 1.

Anticipating skill and job trends to accelerate green transition

1.1. Skills anticipation in the green transition

The effects of climate change are increasingly evident in everyday life: long-lasting heatwaves, floods and droughts reshape societies and economies and challenge the way they operate. The EU's response to the green transition is ambitious and builds on a vision of becoming the first net-zero continent by 2050. It is in line with global initiatives for greening, such as the COPs and the UN Paris Agreement. With the European Green Deal (EGD) adopted in 2019, the EU set out a comprehensive green growth strategy. The EGD translates the Union's ambitions into objectives and targets that will massively change the way products and services are designed, produced and sold. It also calls for action to shift consumer and citizen preferences and behaviours. Flagship EGD strategies and legislation, such as the Renovation Wave and the Critical Raw Materials Act, underline the need to promote and mainstream technological advancements serving green goals.

Alongside driving deep economic transformation, becoming climate neutral and sustainable will also have major labour market impacts and transform skills needs. The effects on sectors will vary, with some sectors prepping for employment gains, while employment shrinks for others. While a variety of new occupations at different skill levels will emerge, the dynamics of change will also be felt in jobs already existing today. Green transition means that all occupations will need at least some up- or reskilling to address changing tasks and skill needs (Cedefop, 2021a).

Vocational education and training (VET) is crucial for meeting the shifts in labour demand and skill mixes the green transition brings about. Labour and skill shortages for occupations high in demand (e.g. in the renewable energy sector) require immediate action to better align skills demand and supply. With younger age cohorts shrinking, in practice this will often mean training and supporting workers to make the transition to green jobs or migration policy to attract workers who can contribute to green transition, in line with the ambitions of the EU talent pool ([1]).

At the same time, the green transition goes beyond achieving EGD and related policy goals by upscaling and mainstreaming green technologies in frontline sectors and occupations. The EU growth strategy also incorporates greening as a long-term paradigm change, which will require change in the skills and attitudes of all workers and citizens. VET systems deliver the skills to overcome short-term bottlenecks such as shortages and the skills people need to contribute to greening via learning, work and life: such roles have been termed sprint and marathon approaches (Cedefop, 2022a). VET's effectiveness in both approaches critically relies on sound and stakeholder-driven methods, systems and practices for identifying skill needs and trends. They guide decision makers in updating existing VET programmes and establishing new ones to incorporate the content and level of emerging skills needs in curricula and learning provision. A variety of well-documented skills anticipation methods and tools provides skills intelligence that can be used for such purposes (Box 1).

([1]) Agreed by the EU Council in June 2024. See Proposal for a Regulation of the European Parliament and of the Council establishing an EU talent pool.

Box 1. **What is skills anticipation and skills intelligence?**

Skills anticipation (or skill needs assessment and anticipation) is the action of evaluating current and future skill needs in the labour market in a strategic way, using consistent and systematic methods. It is the process of identifying skill gaps and shortages and evaluating the capacity of qualification systems (education and training provisions, funding schemes, etc.) to meet the needs of the economy.
Skills assessment and anticipation can take place at the national, regional, local, or sectoral level. It aims at providing a comprehensive analysis of current skill needs and the implications of past trends for the future, and information on emerging skill needs or likely future skill gaps.
This may be provided quantitatively (e.g. with reference to the changing number of people employed in an occupation, or with a certain level of qualification), or qualitatively (e.g. with reference to providing descriptive information about the changing skill profiles within jobs).

Skills intelligence is the process of identifying, collecting, analysing, synthesising and presenting quantitative or qualitative information on skills and labour market to:

- identify key trends and demands in the labour market;
- assess, anticipate and forecast skill needs;
- address skill gaps and mismatches;
- adapt provision of education and training accordingly;
- provide relevant educational and career guidance and counselling.

Skills intelligence provides insights into:

- labour market profile and trends including employment, unemployment and earnings;
- trends in skills, including skill needs, skills mismatches, skill gaps, and current and future skill demands;
- occupations including information on skills and qualification requirements, working conditions, skill shortages, remunerations;
- entry and progression routes into and through occupations, including job vacancies;
- entry and progression routes in education and training to acquire skills for an occupation, or bridge a skill gap for a specific occupation;
- lifelong guidance and career development;
- other labour market dimensions.

Source: Cedefop's Terminology online tool.

1.2. 'Greening' skills anticipation methods

The most commonly used tools for skill needs assessment and anticipation include skills forecasts, skills foresights, tracer studies, skills surveys, and big data analysis. Most of these tools are far from new, as they have been used for forward-looking policy making for decades. Driven by accelerating megatrends and European VET and skills policy priorities and targets, EU Member States have taken significant steps over recent years to strengthen their skills anticipation efforts. The resulting skills intelligence has helped forge stronger links and feedback loops between labour market and skills needs and education and training provision (Cedefop, 2024a).

Skills anticipation methods to grasp current and future skill needs linked to the green transition can leverage existing arrangements at national, regional, local, or sectoral level. Methodologies have been developed to incorporate the greening dimension into existing skills anticipation tools, systems and approaches. Where skills anticipation is still in development, the green transition can become a catalyst for innovation and speed up skills anticipation design and implementation, benefiting the economy.

Irrespective of the nature and state of play in skills anticipation, 'greening' helps address urgent challenges, such as:

(a) identifying how greening affects different sectors and/or occupations and their contribution to meeting EGD ambitions and targets, to guide efficient resource investment;
(b) designing new education and training programmes responding to greening and upscaling them;
(c) renewing and updating existing programmes to adapt to new green skill needs;
(d) identifying the need to upgrade training programmes to a higher level (e.g. VET at EQF level 5 or above);
(e) supporting companies in adjusting their business models and skills sourcing approaches;
(f) informing the public about the impact of the green transition;
(g) attracting learners and workers to key green transition occupations;
(h) increasing stakeholder awareness about the ways green transition transversally cuts through sectors and occupations.

The following presents a quick review of how the most used skills anticipation methods can be leveraged to reflect on the impacts of green transition. More detailed technical information about these methods is available from Cedefop's skills anticipation practical guides on skills surveys and skills forecasting (Cedefop, 2021b), big data and artificial intelligence methods (Cedefop, 2021c), and technology and skills foresight (Cedefop, 2021c).

1.2.1. First things first: agreeing on definitions

One of the first steps necessary for launching new skills anticipation methods embedding green transition elements or to integrate these into existing ones is to agree on the definition of 'green' terms. Stakeholders need to work together to develop a unified understanding of what is meant by jobs and skills for the green transition, green occupations, and other key concepts. Lack of clarity about the definition of occupations and skills for the green transition and the lack of a commonly agreed framework or taxonomy for green transition skills and jobs stands in the way of identifying them. In several European countries, such problems are part of the key challenges to 'greening' skills anticipation ([2]). Stakeholders active in contexts where there is no consensus on definitions can be inspired by the approach to defining green skills at European level (Box 2).

Box 2. **What are skills for the green transition?**

Skills for the green transition include skills and competences as well as knowledge, abilities, values and attitudes needed to live, work and act in resource-efficient and sustainable economies and societies. They are:

- **technical:** required to adapt or implement standards, processes, services, products and technologies to protect ecosystems and biodiversity, and to reduce energy, materials and water consumption. Technical skills can be occupation-specific or cross-sectoral;
- **transversal:** linked to sustainable thinking and acting, relevant to work (in all economic sectors and occupations) and life.

These are alternatively referred to as 'sustainability competences', 'life skills', 'soft skills' or 'core skills'.

Source: Cedefop et al. (2022).

1.2.2. Skills forecasts

Skills forecasts use quantitative or qualitative model-based projections to predict skill demand and supply in the short, medium or long term ([3]). Most EU Member States use skills forecasts to inform VET,

([2]) Cedefop ReferNet partners' input.
([3]) Definition of Skills forecast (Cedefop VET glossary).

skills, and related policies. Several smaller Member States have recently developed national forecasts or are in the process of expanding their forecast capabilities.

Skills forecast scenarios are often used to grasp the impact of the green transition. They are particularly suitable because they make it possible to model the likely impact of greening comprehensively, considering sectoral and occupational 'spillovers', economic interactions, and supply chain interdependencies alongside the more direct effects of greening. Green forecast scenarios incorporate assumptions linked to 'greening' (e.g. about regulation, targets and technological progress) in the forecast model (Box 3). Comparing a skills forecast scenario with a baseline gives an impression of the employment and skills impact of the green transition.

Box 3. **Examples of 'green' skills forecasts**

Cedefop ran a dedicated skills forecast scenario in 2020, exploring the impact of implementing the EGD on jobs and skills in the EU. Using the well-established Cedefop Skills Forecast methodology, the scenario results offered valuable insights into skills trends and the role of VET in fostering the EGD objectives and targets (Source: Cedefop, 2021a).

- In Germany, alternative scenarios that build on the macroeconomic forecast and simulation model used in the BIBB-IAB Qualification and Occupation Projections (QuBe) help identify the employment impact of the green transition. The results are used to inform national hydrogen, climate adaptation, greenhouse gas neutrality, and electromobility policy and strategies.
- In Norway, national skills forecasts capture the green transition. A 2023 report by the Committee on Skill Needs includes analysis of green transition competences and attitudes to climate change. It discusses developments in the oil, gas, and batteries sectors, and reflects on bottlenecks in education, emerging industries, lifelong learning and adjustments in the public sector.

Source: Cedefop based on ReferNet partners' input.

1.2.3. Skills foresights

Skills foresight systematically analyses future skill supply and demand, using participatory methodologies to identify how political, economic, social, technological, legal and environmental factors (PESTLE) interact and change the nature of work and skills demand. It combines qualitative and quantitative approaches (e.g. Delphi, scenarios, workshops); the wide range of stakeholders typically involved gives it a participatory character and a networking dimension. Skills foresight is a forward-looking methodology, which allows stakeholders to explore alternative ways to reach a desirable future and to reflect on the impact of existing and changing circumstances (e.g. disruption) and other factors on different scenarios ([4]). In skills foresights on VET and skills, VET institutions typically team up with sectoral or regional stakeholders, authorities, social partners and experts.

In the context of green transition, elements of skills foresight methodology, such as focus groups, scenarios-building, and Delphi-style consultation rounds, can beef up other types of data and information collection as part of an overarching analysis/study (Box 4). An example is the study undertaken by the Spanish Biodiversity Foundation (FB), the Spanish Office for Climate Change (OECC) of the Ministry for Ecological Transition and Demographic Challenge, and the Sustainability Observatory to identify training strategies that contribute to the development of skills for the green transition ([5]).

Box 4. **Examples of 'green' skills foresights**

In 2021-23, Cedefop ran sectoral skills foresights on waste management , agri-food and circular economy and one on smart and green cities. The selection of the areas of analysis was based on their centrality to achieving EGD goals,

([4]) More information on designing and launching skill foresights can be found at ETF/Cedefop/ILO (2016a).
([5]) Cedefop ReferNet partners' input.

the expected effects of the green transition on employment and skills, and the linked challenges and opportunities for vocational education and training for young people and adults. Related research, in particular work undertaken by EU institutions and in the context of EU-funded projects, also contributed to the analysis. Foresight participants – EU policy makers, academics, researchers, representatives from regional and local authorities, social partners, and others – contributed sectoral and transversal expertise.
More information on the methodology is available online.

The RISK2050 study in Luxembourg was launched in April 2022 and is a key component of Luxembourg Strategy's foresight agenda. The expected outcomes of the study are to form the basis for developing scenarios for economic transformation aimed at achieving greater competitiveness, resilience, and sustainability by 2050. Three scenarios were developed towards a strategic vision for 2050, which avoids or mitigates the threats in the scenarios and seizes their opportunities. The scenarios were consulted with the public, which was asked to provide feedback. This helped in selecting elements to be included in the strategic vision. According to respondents, to seize the opportunities and address the threats that could arise by 2050, policy should focus on training and skills development, social, political, and environmental engagement, and on adapting behaviour and consumption to reduce ecological footprints.

Source: Cedefop ReferNet partners' input.

1.2.4. **Skills surveys**

Skills surveys generate data on employers' skills needs and their human capital development strategies. If done regularly, the surveys help analyse the trends in skills needs and signal potential skills bottlenecks. Skills survey findings can be used to design and improve training provision, strengthen career guidance, evaluate skills development and matching policy, and reshape business strategies for human resource management, development and retention (ETF, Cedefop, & ILO, 2016b).

Many skills surveys with a focus on green transition aim at mapping the skill challenges faced in the shift towards circularity. They often include perceptions about becoming circular and in-place or planned activities towards more circularity. The results of such surveys can encourage action at employer, sectoral or national level. Green skills surveys may target employers in a particular sector or geographic location.

Box 5. **Examples of 'green' skills surveys**

The 2022 Swedish technology companies competence survey for the green and digital transition addressed over 1 000 CEOs and HR managers. It mapped job profiles for which demand is increasing, their skills requirements, and the megatrends that drive emerging skills needs.
Source: Cedefop, 2024a.

As part of the annual skills survey of engineering employers in the UK, in 2020, the Institution of Engineering and Technology ran a green survey among 1 010 senior decision makers. The survey collected information on skills requirements for delivering the UK Government's net-zero target by 2050.
Source: Institution of Engineering and Technology, 2021.

1.2.5. **Graduate tracking**

Graduate tracking studies can play a significant role in supporting the green transition. They ask learners to reflect retrospectively on the education or training programme they took part in and enquire about learning, employment outcomes, and the job/skill match after they exited the programme. Providers of 'green' education and training programmes benefit from graduate tracking because they provide valuable insight into their effectiveness and graduates' career outcomes in green jobs. Such information can

inform curriculum design and reform, provide insight into potentially promising new training initiatives, and help set up or strengthen partnerships with sectors and skills ecosystems.

Graduate tracking in VET can also provide strategically important information to employers in green sectors who are looking for skilled professionals. Information on career paths and VET graduate outcomes gives employers insight into the skills, qualifications, and experiences that are most in demand in the green job market. This gives them opportunities to shape and implement recruitment and workforce development strategies.

Graduate tracking can also be used to assess the preparedness of graduates who end up outside frontline green jobs, occupations and sectors, to contribute to green transition (Box 6). In Cyprus, green transition skills were incorporated in a 2022 graduate tracking survey. Analysis shows that the demand for (in jobs) and the supply of skills that enable people ' …to make decisions towards environmental sustainability and a resource-efficient society and act accordingly' are relatively low compared to other skills groups. Recognising the added value of skills intelligence powered by graduate tracking studies, several EU countries, including Croatia and Slovakia, are introducing or expanding them (Cedefop ReferNet experts).

Box 6. **Green transition skills in graduate tracking in Cyprus and Jordan**

As part of a project entitled Addressing Skills Mismatch between Education and the Labour Market, which is part of the Cyprus Recovery and Resilience Plan (RRP), the country rolled out a National Graduate tracking Survey for higher education in 2022. Alongside hard, soft and digital skills, respondents were asked to rate their green transition skills in terms of their own competence and job requirements. This makes it possible to assess over- and underskilling subjectively in different skills domains.

Source: Preliminary results of the first cycle of Cyprus' National Graduate Tracking Survey (September 2019).

In Jordan, an UNESCO tracer study report in the agriculture sector included in its assessment environmental aspects of skills and jobs. Graduates of the agriculture stream of the vocational education programmes (schools under the Ministry of Education) stated that while environmental and social issues were not ranked of high importance for Jordanian employers, the skills most in-demand referred to better use of resources, such as water use optimisation, grazing management and agricultural research (UNESCO, 2020).

Source: Tracer Study of Agriculture Vocational Secondary Education in Jordan.

1.2.6. Big data from online job advertisements

The use of Big Data/AI tools to assess and anticipate skill and jobs developments is gaining ground. In a context of rapid digital transformation (Cedefop, 2023a) and greening (Cedefop, 2024b), the added value of online job advertisement (OJA) big data is providing insight into skills dynamics in occupations. This makes it an invaluable resource for policy making, complementing more traditional skills anticipation tools, such as forecasts, foresight and surveys. Big Data can also be leveraged to monitor the green transition regionally (Cedefop, 2024c).

Extracting skills from OJAs offers insight into the profiles employers seek now (see chapter 2) and helps signal trends in skills needs in (quasi) real-time. Big Data-driven analysis can support VET's sprint towards alleviating immediate skills shortages for the green transition. Trends in job profiles and skills demand emerging from OJAs help map the medium- and long-term impact of the green transition. Trend-based information helps decision makers see how occupations and sectors are impacted by greening and how best to adjust and justify changes in VET content, curricula and provision in response (see chapter 2 and Cedefop, 2024c).

Box 7. **How Big Data/AI and online job advertisements can be used for understanding 'green' employment and skill trends**

Cedefop has teamed up with Eurostat to build the web intelligence hub online job advertisement (WIH-OJA) database. The database has been used to develop a data-driven method to map how the greening of economies in Europe impacts labour markets. This gives detailed insight into changes in occupations brought about by the green transition and makes it possible to identify the green transition skills most in demand. Key data is publicly available in a dashboard accessible via Cedefop's Skills-OVATE online web tool, about:

- green renewable energy occupations;
- greening in occupations;
- greening in sectors;
- greening in regions.

Source: Cedefop (2024b) and SkillsOVATE

Saussey and colleagues (2022) used online job advertisement data posted between 2010 and 2019 from the US to provide evidence on the characteristics of low-carbon jobs. Comparing low-carbon jobs with similar high-carbon jobs in the same occupation group, reveals important differences. A key finding is that low-carbon jobs have higher skill requirements across a broad range of skills, especially technical ones. Other findings include a declining wage premium for low-carbon jobs over time and the limited geographic overlap between low- and high-carbon jobs. The findings suggest the low-carbon transition entails potentially high labour reallocation costs because of re-skilling and earning losses and point towards a need for public investments in skills to deliver a smooth and rapid transition.

Source: Saussey et al. (2022). (Who's Fit for the Low-Carbon Transition? Emerging Skills and Wage Gaps in Job Ad Data.)

1.2.7. Sectoral level skills anticipation

With the impact of green transition varying widely between sectors, sector-level analysis lies at the core of 'green' skills anticipation. All tools and methods reviewed above can be applied at the sectoral level. Sectoral work often takes place in the context of EU-funded projects. The EU Blueprint projects on sectoral cooperation on skills focus on identifying current and future skill needs in a wide range of sectors, developing sectoral skill strategies, and expanding training options for workers. The Blueprints bring together key sectoral labour market and education and training stakeholders, policy makers and experts from research and academia. While green transition features prominently in all sectors, some of the Blueprint projects zoom in on frontline green transition sectors, such as offshore wind and maritime technology, construction, automotive, and batteries ([6]).

The Blueprint and other sectoral EU-funded projects typically rely on a variety of skills anticipation methods and tools, such as surveys, Delphi-style consultations, and stakeholder workshops. When methodologies are sound, and to some extent aligned between different sectors, sectoral approaches can be synthesised to draw a wider picture of developments within an economy and support national policy making.

Box 8. **Using 'green' skills anticipation tools and methods at the sectoral level**

In 2021, the Estonian jobs and skills forecasting system OSKA engaged in meta-research about skill needs for green and digital transition. The analysis is based on sector-specific OSKA surveys on labour and skill needs and data on ICT and green transition skill needs collected as part of the special COVID-19 survey, which were updated for the overview and coordinated with professionals in the field. See the overview (full text in Estonian), summary in English.

Source: Cedefop ReferNet partners.

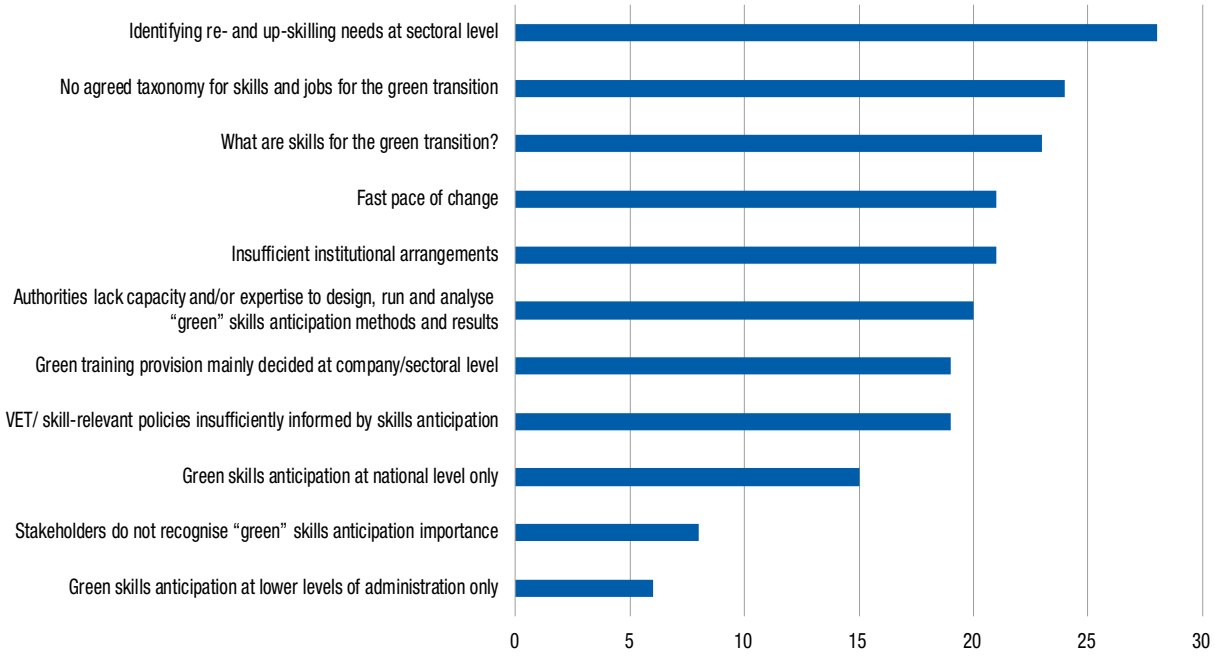
([6]) Developments and outputs of some Blueprint projects are available online.

1.3. Challenges in 'greening' skills anticipation

While skills anticipation holds a lot of promise in preparing for, implementing and upscaling the green transition, adjusting existing skills anticipation systems, approaches or tools, or developing new ones, can be challenging. Cedefop asked its VET expertise network ReferNet what they consider to be the three most pressing challenges for 'green' skills anticipation (Figure 1).

The findings are illustrative because they are not based on a representative survey and reflect opinions. They nevertheless show that difficulties in defining and measuring 'green' skills, jobs and skilling needs make it difficult to integrate green transition into skills anticipation. Difficulties in identifying sectoral skilling needs, lack of an agreed skills taxonomy, and lack of clarity about what constitute skills for the green transition, are interconnected issues that make it difficult to make progress in strengthening the links between green transition and skills provision. Lacking resources and expertise and insufficient institutional capacity are also important bottlenecks. The fact that only a minority of respondents felt that stakeholders in the country do not acknowledge the importance of 'green' skills anticipation shows how important it is to address the other challenges they identified.

Figure 1. **Key challenges for 'green' skills anticipation (number of countries)**



Source: Cedefop survey to ReferNet partners, 2023.

In practice, greening skills anticipation will mean action on multiple fronts. While investing in or expanding any skills anticipation approach or method is useful per se, no single method can give all the answers because every type of skills anticipation has its limitations. The French Onemev Green Observatory (Box 9) and evidence from other European countries suggests that diversification via strengthening and combining multiple skills anticipation sources, methods and tools fosters a better and more holistic understanding of the green transition and its skills and jobs impacts. This is a basis for crafting 'green' skills intelligence that transversally supports policy making and implementation in multiple policy domains and points people towards promising learning and job opportunities in the green economy.

Putting skills intelligence to work to accelerate the green transition requires having governance structures in place that link the national with sectoral, regional, and local levels. To put such structures in place or improve their functioning, forging partnerships, empowering stakeholders, and investing in

the capacity of subnational level skills ecosystems to contribute to and use skills anticipation is essential (see also Chapter 3).

Box 9. **Identifying and analysing green employment trends in France**

The National Observatory for Jobs and Occupations of the Green Economy (*Observatoire national des emplois et métiers de l'économie verte, Onemev*), was set up by the Ministry of Environment in 2010. It brings together a wide range of stakeholders (national ministries and agencies, public employment services, the main VET association, the national statistical institute, research bodies, and regional employment and training observatories). It analyses employment changes and trends in the green economy, looks at the role of green occupations, and reflects on what the green transition means for VET and skills.

Source: Observatoire national des emplois et métiers de l'économie verte, Onemev.

CHAPTER 2.

Unleashing the power of online job advertisements in 'green' skills anticipation

2.1. As greening progresses, capturing skills and jobs becomes more complex

The increasingly adverse effects of climate change have broadened the scope of efforts to curtail CO2 emissions everywhere, not just in frontline green sectors. Shifting from linear to circular production models (Cedefop, 2023b) and addressing the overconsumption of natural resources has impact in all sectors and regions. This is different compared to about a decade ago, when green transition was mainly about moving from fossil towards alternative fuels. Identifying 'green' occupational change was more straightforward and typically based on input-output table approaches and models aiming to understand transitions from fossil fuels to lower-carbon energy occupations (e.g. Cedefop, 2013). In much of the applied research and analysis, occupations were considered either 'green or 'non-green' or 'brown'. There were also attempts to anticipate skills for a greener economy using data on emissions to establish how much pollution different occupations generate (Bluedorn et al. 2022).

The circularity transition translates into increasing demand for 'green' skills in most if not all occupations which did not require them in the past. For example, financial analysts are increasingly asked for knowledge and expertise to interpret data on corporate practices to meet sustainable development ambitions. This helps them identify risks and opportunities for companies to make better investment decisions (Cedefop, 2023c).

Understanding employment and skills trends facilitates the identification of transition opportunities and training options that give people ways to benefit from them. This is crucial for making the green transition just and smooth (Bowen et al., 2018), a key European Green Deal policy objective. Identifying which groups of workers need up- or reskilling training requires understanding of the similarities between the skill content of emerging green jobs and 'brown' occupations which are becoming obsolete. Such information also enables the informed adjustment of programmes and curricula and gives insight into teachers' and trainers' learning needs. Analysis of jobs and skills for the green transition must consider its different meanings and impacts in regions within countries. For example, the green transition in coal regions in Poland looks very different from greening the economy in rural regions in the Netherlands.

Analysing the green transition with traditional quantitative data sources such as forecasts and surveys can be challenging. With complex and interrelated changes that affect all sectors and occupations, it is no longer possible to assume a dichotomy between green and non- green labour market segments. This makes it difficult to operationalise the take-up and labour market and skills impact of companies implementing circularity. McMahon and colleagues (2021) exposed the difficulties in estimating employment related to waste of electrical and electronic equipment in Ireland. Adding to the complexity of estimating employment in the EU circular economy, some of its activities are not represented in the sectoral (NACE) classification used in Eurostat surveys (e.g. Labour Force Survey), national accounts, and other data ([7]).

The green transition requires timely and sufficiently granular data to shape policy setting and implementation in accordance with regional, local, sectoral and occupational realities and trends (Cedefop,

([7]) Eurostat (2022). Persons employed in circular economy sectors.

2024c). Big data on skills and jobs extracted from online job advertisements are especially suitable, because they connect green and digital transition and are available almost in real-time and often at regional level (Cedefop et al., 2021) ([8]). This chapter describes how such data can be practically used, along with some key challenges in leveraging them in the best way possible.

2.2. Job definitions: understanding different shades of green

Estimates on the employment impact of the green transition vary with the understanding of change linked to transition. They are also impacted by difficulties in measuring the extent to which jobs are shaped by green technology. This is also driven by lack of consensus about which occupations can be considered 'green' (Auktor, 2020) and what criteria should be used. In applied work, tasks performed at work (see for example Janser 2018), skills needed to carry out the job, and other dimensions have been used to separate green from brown jobs (Bohnenberger, 2022). What complicates matters is that some occupations can be either classified as green or not depending on workplace characteristics. While car engineers producing electric vehicles can be considered to be in a green job, those involved in the production of internal combustion engines are not. As most occupations are likely to encompass 'green' and 'non-green' tasks or skills, measuring greenness using a continuous scale is more appropriate than binary approaches (Vona et al., 2015). There are two main approaches to identifying green occupations: top-down and data-driven.

2.3. Top-down using occupational frameworks

Occupational frameworks or classifications can be used to identify green occupations. The O*NET framework (developed by the U.S. Department of Labor, Employment & Training Administration) is often used by analysts trying to understand the greening of the economy. It provides a comprehensive list of occupations and bundles of tasks required to perform them and categorises occupations into three groups according to their importance in the green economy:

(a) green increased demand: existing occupations expected to be in high demand due to greening;
(b) green-enhanced skills: occupations expected to undergo significant changes in task content due to greening);
(c) new & emerging green: new occupations in the green economy (Vona, 2021).

Using the O*NET classification can be challenging, because the level of detail in data is often not sufficient to conduct meaningful analysis. Lacking empirical data disaggregated by sector or region makes it difficult to obtain accurate estimates of green employment. Using binary measures (green versus brown occupations) overestimates the real size of the green economy (up to five times) because occupations with higher greenness are usually less frequently observed in the economy than occupations with lower or zero greenness (Vona, 2021).

An obstacle to using O*NET in different countries is that the framework was developed for the US. It reflects developments in green technologies in the US context and is not necessarily fit for use in countries where greening is less advanced (World Bank, 2021).

The green skills in the European Classification of Occupations, Skills and Competences (ESCO) ([9]) offer an alternative to the O*NET framework for categorising green occupations. A key difference with

([8]) The discussion of strengths and limitations of using online job advertisement data for skills intelligence is described in Cedefop et al. (2021).

([9]) ESCO green skills are based on Cedefop's 2012 definition (the knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment. See also New taxonomy of skills for the green transition.

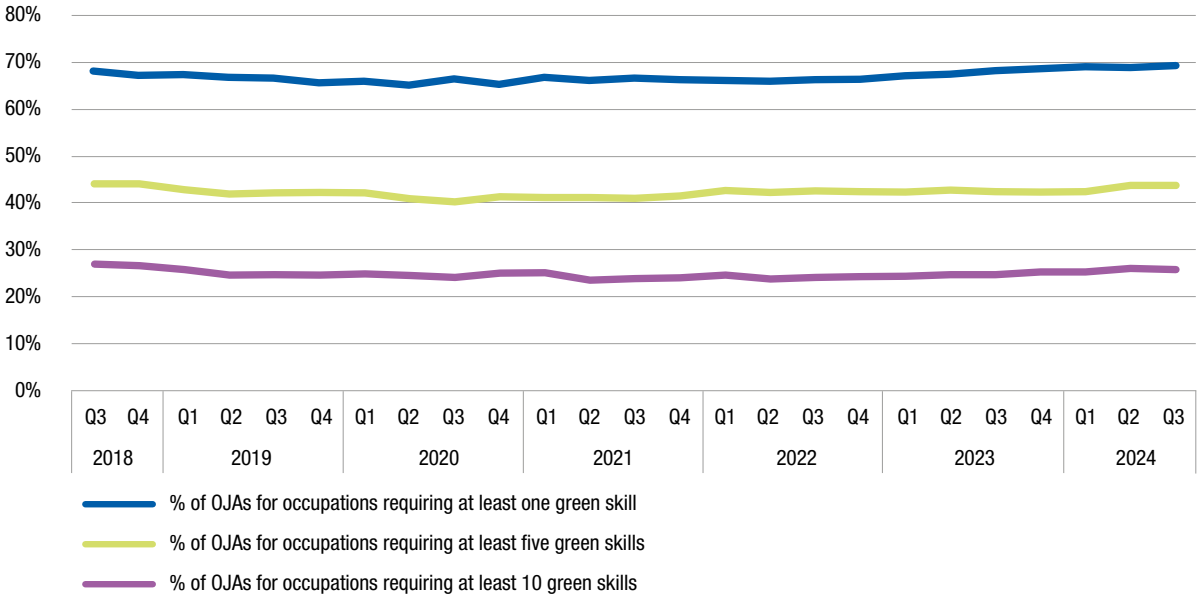
O*NET is that ESCO does not cover jobs ('set of tasks and duties carried out, or meant to be carried out, by one person for a particular employer, including self-employment', ESCO handbook, 2019, p. 13). ESCO identifies and categorises skills, competences, qualifications and occupations. ESCO 'green' skills have been categorised into:

(a) brown skills*:* knowledge and skills that increase the impact of human activity on the environment;
(b) white skills: which neither increase nor reduce the impact of human activity on the environment; and
(c) green skills: which reduce the impact of human activity on the environment (10). 571 ESCO skills and knowledge concepts were labelled as green: 381 skills, 185 knowledge concepts, and 5 transversal skills ([11]).

Box 10. **Labelling occupations as green based on skills requirements**

In ESCO, skills and knowledge concepts linked to an occupation can be essential or optional. Each 4-digit level ISCO occupation has a number of (essential or optional) skill/knowledge terms. The number of 'green skills' varies across occupations, with one third of the occupations requiring no (essential/optional) green skills at all. Analysis of online job advertisements shows that two thirds of the OJAs refer to occupations that require at least one ESCO green skill. This share drops as we increase the minimum number of green skills required for an occupation to be considered as 'green' (Figure 2.1).

Figure 2. **Share of OJAs corresponding to occupations that require (at least) a minimum number of ESCO 'green skills'**



Source: WIH-OJA. Skills-OVATE skills online vacancies.

A pre-defined taxonomy of green occupations implies that levels of greenness of tasks or skills are assumed constant 'over time', and that green skills or tasks are considered evenly distributed in occupations, regions, and sectors of the EU economy. However, green innovation, European Green Deal-driven regulation, and local drivers can affect the level of greenness. Analysis based on such a

([10]) More details on the process can be found at https://ec.europa.eu/esco/portal/news/436ed0c0-f8a3-4266-9f58-78bd178a49e0. Also, a detailed description of the structure of ESCO is available at: Three pillar structure of ESCO.
([11]) The full list of green concepts is available in the ESCO portal searching for the Green Skills Collection document.

top-down approach is also constrained by slow taxonomy updates, which hamper capturing new occupations and emerging skills. This is a main reason why emerging green jobs often end up in the 'not elsewhere classified' category.

Using classifications or taxonomies to map and analyse green transition effectively requires that they are regularly updated and revised. The O*NET taxonomy, which was updated in 2019, includes many jobs relevant to green transition that became more prominent in the past decade, such as biofuels production managers, biomass power plant managers, geothermal production managers, and wind energy operations managers. The same occupations end up as 'business services and administration managers not elsewhere classified' in the International Standard Classification of Occupations, which was last updated in 2008. In 2018-22, on average 12% of the online job ads analysed by Cedefop identified as green using O*NET was categorised as not elsewhere classified using ISCO/ESCO (Cedefop, 2024c).

2.4. Data-driven: searching 'green' skills in online job ads

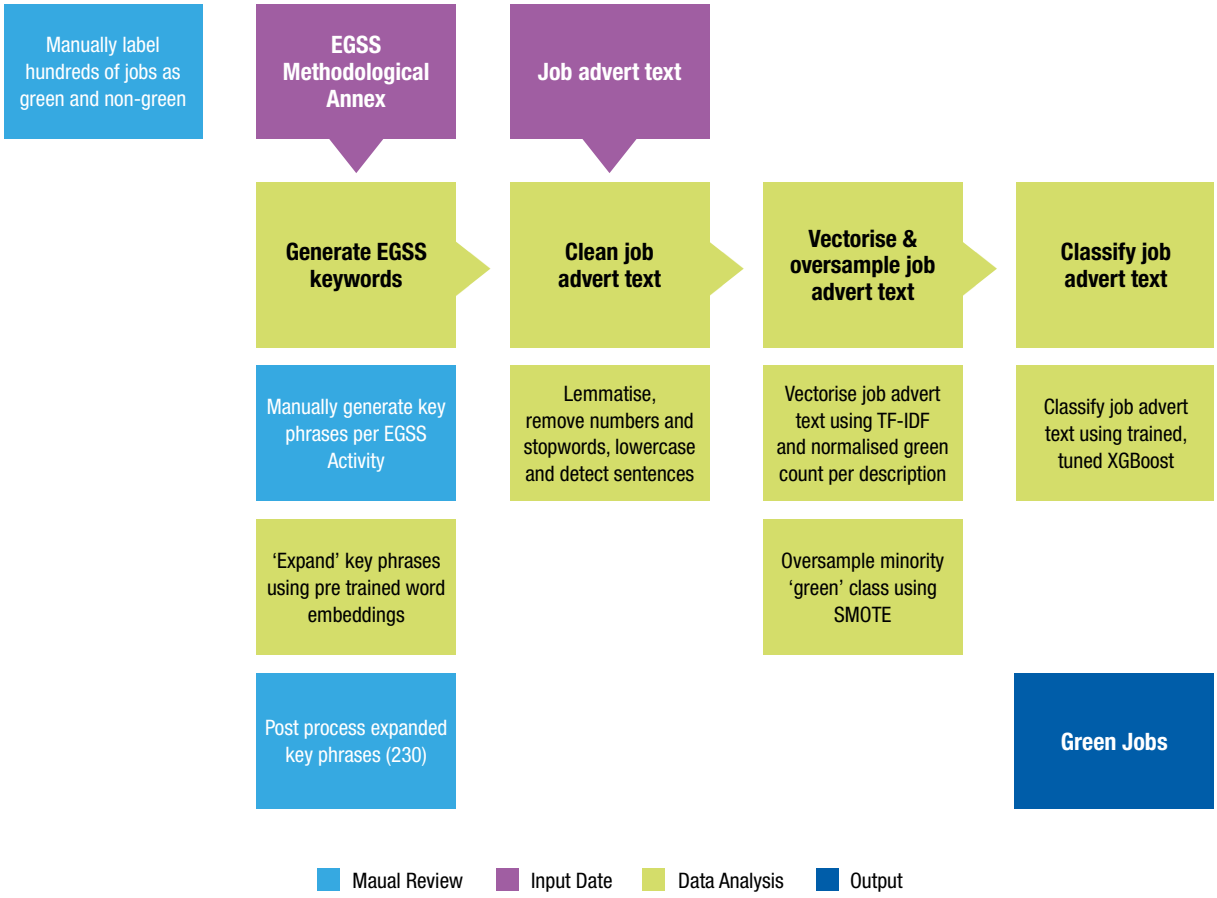
A data-driven approach can be applied to overcome the problem of not finding 'green' occupations, their 'green transitioning' over time, and/or skills because they are not reflected in taxonomies that are not up to date. Information on emerging technologies can be extracted by using text mining techniques on sources describing such technologies, such as scientific papers and reviews (Chiarello et al., 2021) and patent data. Online job advertisements (OJAs) are one of the most comprehensive data sources mapping the demand for occupations. Such data can be used to proxy job creation and to identify new emerging occupations, also in the context of the green transition (Mercorio & Mezzanzanica, 2020).

As part of its Web Intelligence Hub Online Job Advertisement (WIH-OJA) project with Eurostat, Cedefop developed a method to extract green terms from OJAs in Europe. The approach is data-driven, overcomes the problems with ontology-based extraction, and helps identify new green terms emerging in labour market demand. The crucial difference with the top-down classification or ontology-based approach is that the green occupations are defined by their skills and task content and not vice versa: a green occupation is one that must include green skills or tasks and greenness is assessed based on the skills/tasks present in online job advertisements.

The starting point of this approach is establishing a list of words. Following up on the NESTA methodology (2021) in the UK (Figure 3), which used the UN's Environmental Goods and Services Sector Accounts as a basis, Cedefop compiled a 'bag of green-related words'. It includes green technologies, tasks, roles, tools and skills, and was compiled via a review of key international frameworks and classifications with relevance to greening ([12]). Duplicates and concepts with more than two words were removed to arrive at a list of unique concepts including only unigrams and bigrams. Cedefop applied natural language processing methods on a dataset consisting of six million OJAs collected in 2019 in the UK to complement the list of green terms with lexicon variations. Experts validated the extracted terms.

([12]) The Classification of Environmental Protection Activities (CEPA 2000), the Classification of resource management activities (CReMA), IRENA Global Renewables Outlook 2020, Linkedin, EMSI, SGG Singapore, JRC GreenComp, O*NET and ESCO classifications.

Figure 3. **Visual representation of the methodology to finding green jobs in online job advertisements**

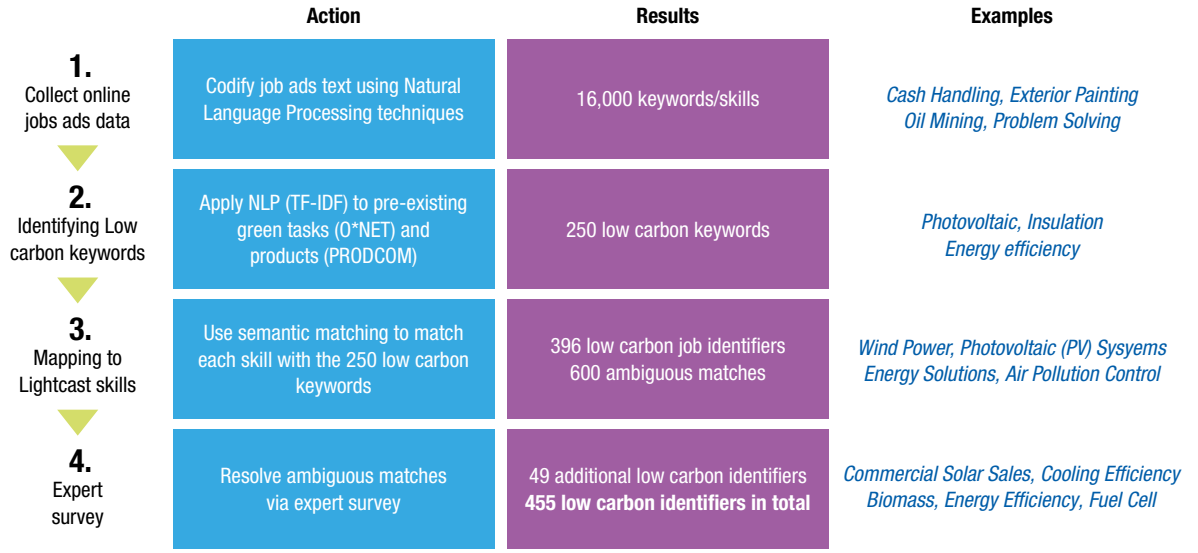


Source: NESTA: Finding jobs in green industries: methodology.

The European Training Foundation (ETF) uses a data driven OJA analysis approach with a different logic. The agency links its green skills work to European Green Deal policy areas, which define seven green skills families: Environment and sustainable tourism, Sustainable agriculture, Sustainable construction, Sustainable economy, Sustainable energy, Sustainable production, Sustainable transport. Examples of terms in the Environment and sustainable tourism skills family include environmental protection, green tourism, habitat restoration, sustainable tourism. Climate smart agriculture, conservation agriculture, aquaponics, and precision agriculture are examples of terms in sustainable agriculture and carbon neutral fuel, energy conservation, solar power, and wind generator in sustainable energy.

Saussay and colleagues (2022) compiled a list of 250 keywords to identify the skills requirements in low-carbon jobs and to compare them with those in high-carbon jobs using online job advertisements. They leveraged two classifications: the list of O*NET green tasks complemented with tasks related to CO2 mitigation and adaptation (e.g. the task 'calculate potential for energy savings') and the list of products relevant to climate change mitigation from the PRODCOM classification (e.g. vehicles with an electric motor). The identification of low-carbon jobs using OJAs (Figure 4) helped establish that such jobs have higher skill requirements across a broad range of skills, especially technical ones.

Figure 4. **How to identify low-carbon jobs using OJAs**



Source: Saussay et al. (2022), p. 3.

While using big data on skills and jobs to identify green occupations is an innovative way to reflect on greening, it is not without challenges. The number of green occupations in the economy may be underestimated for several reasons. Online job advertisements for some occupations, where their green character is obvious from the stated job title, may not specify green skills in the job description. Employers posting an OJA for a sustainability engineer will typically assume applicants have engineering skills and expect them to be ready to be responsible for ensuring compliance with environmental policies without explicitly stating such requirements. Another practical complication is that information about the 'greenness' of a job is not always included in desired skill requirements but in the part of an OJA describing corporate mission or vision: for example, 'as a company we are committed to driving energy efficiency and addressing the global emission challenge' or 'the company's mission is to create a sustainable brand that increases environmental awareness'. A Cedefop feasibility study on using online job ads to understand green employment in France, Germany, Ireland, Italy, Netherlands and the UK also pointed towards the transversal nature of skills requirements in 'green' advertisements. Requesting employees to be innovative so that they can drive and adapt to change, while not solely relevant for green transition, can play an important role in shaping it.

2.4.1. From concepts to numbers: building green indicators

Choosing sound approaches and fit-for-purpose methods to identify green jobs is a prerequisite for understanding current and future skill developments in the green transition. Once well-argued choices have been made, indicators can be developed to assess the state of play and to track progress. Indicators may vary in terms of complexity. The 'green density' indicator – the concentration of green jobs or environmentally sustainable employment opportunities within a specific labour market – is a relatively straightforward way to characterise greenness. It is defined as the proportion of jobs in the labour market that is green. When time series are available, greening trends can be made visible.

Using online job advertisement data in a bottom-up approach, offers opportunities to develop more advanced indicators that help track how greening impacts frontline green and other occupations. Commonly used indicators are:

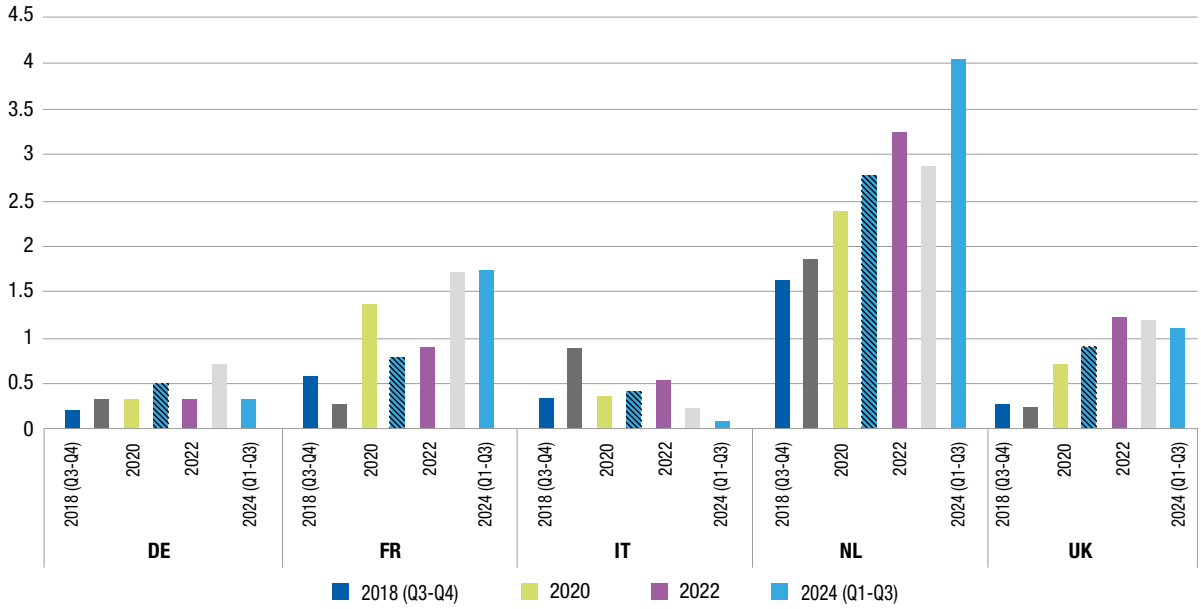
(a) green pervasiveness: the omnipresence of green skills in the OJAs calculated as the ratio of all OJAs with at least one green skill to the total number of OJAs in occupations, sectors, countries, or other

analysis categories;

(b) greenness: the share of green skills in the total number of skills in OJAs in such categories (Cedefop, 2024c).

Apart from comparing different occupations, such indicators can also point towards differences between countries within a particular occupation. Analysis of green pervasiveness in jobs for financial analysts in five countries shows that it is highest in the Netherlands (Figure 5). 4 % of advertisements posted by Dutch employers in 2024 (Q1-Q3) who are recruiting for such jobs require at least one green skill, and this share has rapidly expanded in the past few years. This suggests that greening is impacting financial analyst jobs faster in the Netherlands than in Germany and Italy, where green pervasiveness has been below 1% during 2018-24 and no upward trends are visible.

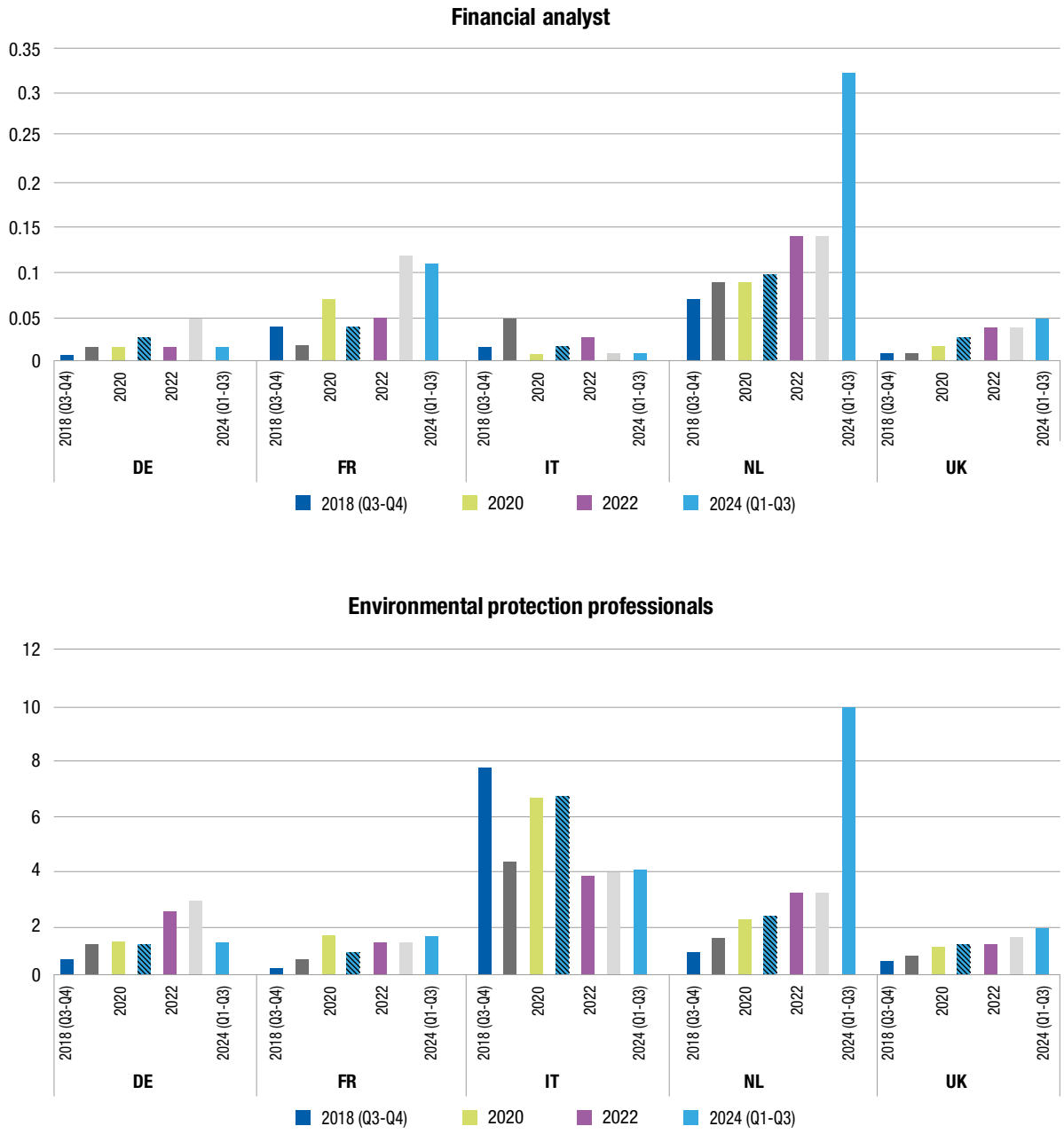
Figure 5. **Green pervasiveness in online job ads for financial analysts, 2018-24**



Source: WIH-OJA. Skills-OVATE skills online vacancies.

Comparing the 'greenness' of occupations gives insight into the degree to which the green transition impacts different types of jobs, because the indicator captures how many of the skills employers demand are green. The greenness of jobs for environmental protection professionals – a frontline green occupation – is much higher than it is for financial analysts, which is an occupation where the impact of green transition is gradually emerging (Figure 6).

Figure 6. **Greenness of occupations: financial analysts versus environmental protection professionals, 2018-24**

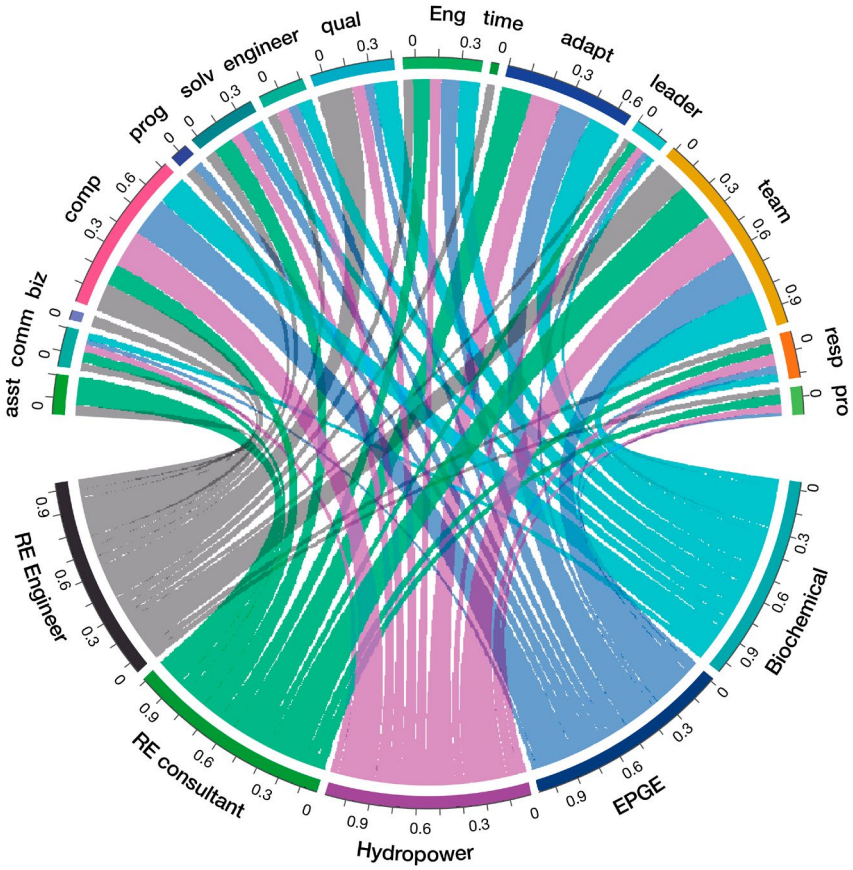


Source: WIH-OJA. Skills-OVATE skills online vacancies.

Using the ESCO taxonomy to analyse greening in occupations also makes it possible to track the skills level they require. According to Cedefop analysis of OJAs posted in 2020-22, more than half of the green-intensive jobs required high-skilled workers (Cedefop, 2023d). The importance of higher qualifications in the green transition is also obvious from earlier research on 'green' occupations using survey data. Bluedorn and colleagues (2022), for example used micro-level Labour Force Survey data from 34 economies collected between 2005 and 2019 to show that green-intensive occupations typically require higher-skilled workers than less green and more polluting occupations.

The level of granularity that online job ads data can provide offers opportunities to identify skills needs in occupations that cannot be understood easily, if at all, using other skills anticipation methods. OJA-based analysis has unprecedented value in the green transition and strengthens the evidence base for education, employment and skills policy implementation. Understanding the importance of different types of skills sets for renewable energy professionals is a case in point (Figure 7). An analysis of a sample of OJAs revealed that employers require transversal skills such as 'work in teams' (team)' or 'adaptability to change' (adapt) for biochemical engineers ('Biochemical'), electric power generation engineers ('EGPE'), hydropower engineer ('Hydropower'), renewable energy consultants/solar energy consultants ('RE Consultant'), and renewable energy engineer/solar energy engineer/wind energy engineer/Energy systems engineer ('RE engineer'). The top skills required from such professionals include: creativity to find solution to problems ('solv'), digital skills (MS office- 'comp') and also computer programming ('prog') and business ICT systems skills ('biz'). For engineering roles, alongside knowledge of engineering principles ('engineer'), the employers also emphasise the importance of skills related to defining and applying quality standards ('qual'). Some advertisements for engineers place emphasis on leadership skills ('leader'). For renewable energy consultants, communication skills ('comm') and knowledge on how to assist customers ('asst') are core components of their skills profile.

Figure 7. **Skills demanded in online job ads for renewable energy professionals**



Source: WIH-OJA. Skills-OVATE skills online vacancies.

CHAPTER 3.

Smart skills governance as an enabler of just green transition

3.1. Going green is also about investing in governance

Having mutually reinforcing skills anticipation tools and methods in place to assess and anticipate current and future labour market and skill trends contributes to green transition. Skills anticipation is vital because it translates green ambitions into skill strategies and facilitates skills policy implementation. But just this is not enough. The skills anticipation methods and tools must be fit for policy and be disseminated so that individuals, employers and other stakeholders can use it. Skills governance also plays a crucial role in linking environmental policy to ambitions in other policy domains, such as education and training, employment, active labour market, and migration and in ensuring that the skills system is responsive to labour market trends (Cedefop, 2020a).

Box 11. **What is skills governance?**

Skills governance is the process of involving stakeholders from the public, private and third sector, from different economic sectors and geographic units, in generating, disseminating and using skills intelligence to appropriately steer a wide array of policies for the purposes of balancing skill supply and demand and providing an informed basis for further economic development via targeted skills investments.

Source: Cedefop.

Cedefop's definition of skills governance has the negotiation approach between all involved actors in reflecting on and meeting the needs of the education system and of the labour market in the short-, medium- and long-term perspectives at its core. Skills governance covers a wide range of issues related to skills anticipation and matching. These include skill needs expected from those entering or re-entering the labour market, the utilisation of skills in workplaces, and future skill supply and skill demand trends. Strong skills governance enables labour market transformation and strengthens the employability of the workforce in a life cycle perspective.

A sound approach to skills governance benefits skills development and matching at all administrative levels (national, regional, local) and at sectoral level. To be effective, it must reflect context-dependent specificities, such as the existing collaboration arrangements between key stakeholders, economic and other policy targets, and culture. Particularly in the context of the green transition, including the right stakeholders can be game changing.

3.2. Greening Cedefop's skills governance framework

Cedefop's skills governance framework depicts the key pillars and parameters that constitute a robust skills governance approach. The framework distinguishes between foundations, processes, and drivers of sustainability (Figure 8). It considers organisational aspects, resources, stakeholder involvement and the use of information. Although Cedefop's skills governance framework was designed for use at national level, it can be applied at any administrative level and in sectors.

Figure 8. **Cedefop's skills governance framework**

Source: Cedefop Anticipating and matching skills.

The multidimensional and multi-level skills governance framework facilitates holistic approaches to skills development and matching. It also helps uncover the weaknesses and limitations of ad-hoc initiatives that do not forge systemic feedback loops between VET and skill policy and skills anticipation. Using the framework in the context of the green transition makes it possible to see the more fundamental shifts it brings about beyond new skills needs arising for specific occupations or specialties and can help shape holistic and stakeholder-driven approaches to greening VET, complementing comprehensive approaches of VET institutions in relation to greening (see also UNEVOC-Cedefop practical guide (Volume 1)). The wider approach enables formulating sector-specific responses that consider impacts in value chains.

But greening VET and employment via a comprehensive skills governance approach does not require reinventing the wheel. Cedefop analysis of 2023 Skills anticipation in countries shows that skills anticipation methods and tools are in place in all EU Member States – albeit at different levels of maturity and complexity – and there is at least some collaboration between key actors. The same holds for apprenticeship (Cedefop, 2021e). Apprenticeship is a good example of how governance mechanisms and existing stakeholder platforms can be used to update the content of training (i.e. new qualifications, specialties or standards) in response to the green transition.

Existing skills governance arrangements or approaches can be enhanced by introducing green elements across the board. In countries, regions, cities, or sectors where skills governance is under development, the design phase offers a promising opportunity for embedding 'greenness' into the approach.

3.3. Skill strategies: backbones of greening skills governance

To be comprehensive, approaches to shaping, renewing and updating VET should be linked to a skills strategy, policy, or plan. Such skills initiatives typically design or make explicit the process of translating skills anticipation outputs into action and offer insight into how this can be done in practice. Several EU countries use skills strategies as a compass when responding to labour market, economic, and skill trends and other developments. Several EU countries have adopted dedicated employment or skills strategies to the green transition. Examples include Austria's Just Transition Action Plan, Spain's Just Transition Strategy and National Climate Change Adaptation Plan 2021-30, and Romania's National Strategy for Green Jobs 2018-25 and its implementation Action Plan ([13]). Apart from national strategies, there are also strategies with regional focus, which promote skills development via various levers (see

([13]) Cedefop's ReferNet partners' input and Austria: greening VET – Just Transition Action Plan.

Table 1, see Chapter 5 on upskilling and reskilling for regional skill strategies for a just green transition).

Table 1. **Skills development components in regional just green transition skill strategies**

Skills anticipation and monitoring mechanisms
Meeting upskilling and reskilling needs related to just green transition/economic restructuring
Social and professional activation measures
Adapting education and training to transition challenges
Supporting entrepreneurship
Provision of in-company training

Source: Cedefop, ongoing study on the role of the socio-economic partners in skills strategies for a just green transition: a regional perspective.'

The policy measures and actions listed in Table 1 cannot be effectively implemented without structured collaboration between key actors. To make change last and adapt to it, they also require sustainable funding mechanisms and rely on well-designed processes that promote VET's adaptation capacity.

3.4. Socio-economic partners in the driving seat to green VET

Even in settings where skills governance is in place and functioning, the impact of green transition may not be fully captured via contributions of stakeholders already involved. Advancing and deepening stakeholders' involvement at all levels lies at the core of a green skills governance approach. Particularly at regional and local level, employer and employee associations are crucial actors for responsive VET systems. So are chambers of commerce or local/regional professional organisations, regional development agencies, innovation and technology parks, and associations promoting sustainable development, economic growth, and technological innovation.

Socio-economic partners' support in preparing the workforce for the green transition is critical. This does not only relate to incentivising companies to provide the necessary training and to contribute to its costs. Socio-economic partners can and need to collect and convey information on the specificities of regional labour markets, workers' needs, changes in tasks and jobs, innovation, mobility, and transitions into and between jobs. They can take up different roles in shaping and implementing skills strategies that result in a 'green'-responsive skills governance approach (Table 2). No matter what role social partners take on, putting it into practice requires structured engagement of all key stakeholders at the decision-making and at the implementation level.

Table 2. **Social partner roles in skills strategies for the green transition**

Roles at governance level	Advisory: partner(s) participate(s) in the process in the form of expressing their opinions, providing feedback, participating in consultation without any decision-making capacities
	Co-decisive: partner(s) take(s) part in decision-making process through collective agreement cooperation with other socio-economic partners. With none of the socio-economic partners having capacity to decide individually, decisions are taken collectively
	Decisive: a partner has the freedom to make a decision independently from other socio-economic partners
Roles at the technical and executive level	Promotion, awareness raising: partner(s) participate(s) in the process of the promotion, awareness raising of one or more of the six skill development components (see Table 1) in the strategy
	Provision of services: partner(s) provide services for one or more of the six skill development components of the strategy (see Table 1) funded by the strategy. Promotional activities may be also included
	Management: a partner (a) manages funding and monitors shared actions related to any of the skill development components and/or (b) funds using its own resources or designs its own activities related to any of the skill development components including providing services

Source: Cedefop's ongoing study on the role of the socio-economic partners in skills strategies for a just green transition: a regional perspective.

3.5. Power of partnership: stakeholder collaboration

3.5.1. Why does it matter?

The benefits of strong stakeholder involvement in VET and apprenticeship governance are well-documented (Cedefop, 2019; Cedefop et al., 2021). Stakeholders also play a key role in 'greening' skills governance.

Making them partners in green skills governance approaches promotes knowledge exchange, and cross-fertilisation of ideas. This helps reconcile different views and perceptions of what 'greening' means in particular settings and eases reaching consensus on a common definition of skills for the green transition. Key stakeholders need to be involved at every stage. They need timely access to information about developments in green technology, labour market and societal trends and signals, and emerging VET and skills challenges. Space and time to reflect on such trends and challenges (e.g. in skills fora or sector bodies) need to be coupled with opportunities to contribute to the design and implementation of policy measures aimed at mitigating skill mismatches and facilitating learners' and workers' choices.

By enabling structured and transparent dialogue, multi-stakeholder bodies such as sector skills councils in place in some countries ease such processes. The green transition is a technological, economic, societal and skills revolution and no single actor or stakeholder will have all the expertise and capacity needed to track and interpret rapid change and to do what it takes to stay ahead of the curve. Multi-stakeholder bodies typically bring together the State (ministries, national institutions, public employment services, regional authorities) with social partners (employer representatives, trade unions, professional chambers). They also tend to include VET providers and schools, research institutes and universities, sectoral and professional associations, organisations representing learners, and – particularly when it comes to reforming or adapting IVET – sometimes parents.

3.5.2. How can it work?

Stakeholders need to be involved at different governance levels (national, sector, region, school), across all types, forms and levels of VET (IVET, CVET, apprenticeship, higher VET). Organisations trailblazing 'greenovation' and emerging green transition sectors, such as hydrogen and batteries, also need to be involved. They play an instrumental role in reflecting on the skills implications of the pervasive greening and linked technologies for different occupations and are well-placed to advise on how they can best

be met via VET programmes (Box 12).

Box 12. **Good practice examples of stakeholder collaboration in developing VET programmes**

In Austria, adaptation of apprenticeships in relation to the green transition takes place in the context of the regular, established and structured process of programme update/modernisation. Social partners, sector representatives and external research experts contribute to the introduction of new apprenticeship programmes or update of existing ones, either programme specific updates or transversal ones affecting all programmes.
Any dual VET stakeholder (the Chamber of Commerce, the Chamber of Labour, a trade union or the ministry responsible for dual VET) can initiate the update or establishment of a new apprenticeship profession/programme. Social partners forward their proposal to the ministry responsible for dual VET. The latter usually commissions external research institutes and field experts to develop an occupational profile, regulations for in-company training and the final exam. Following discussion, the Federal Advisory Board on Apprenticeships issues an opinion/statement to the Federal Ministry of Labour and Economy, which is responsible for the workplace component of dual VET. The Ministry of Education develops the curriculum for the part-time VET school component (framework curriculum). Chambers of Commerce and Labour or other ministries and stakeholders can provide feedback on the draft training regulations (workplace) and the school curriculum before they become final.
Source: Cedefop news: Greening apprenticeship Austria.

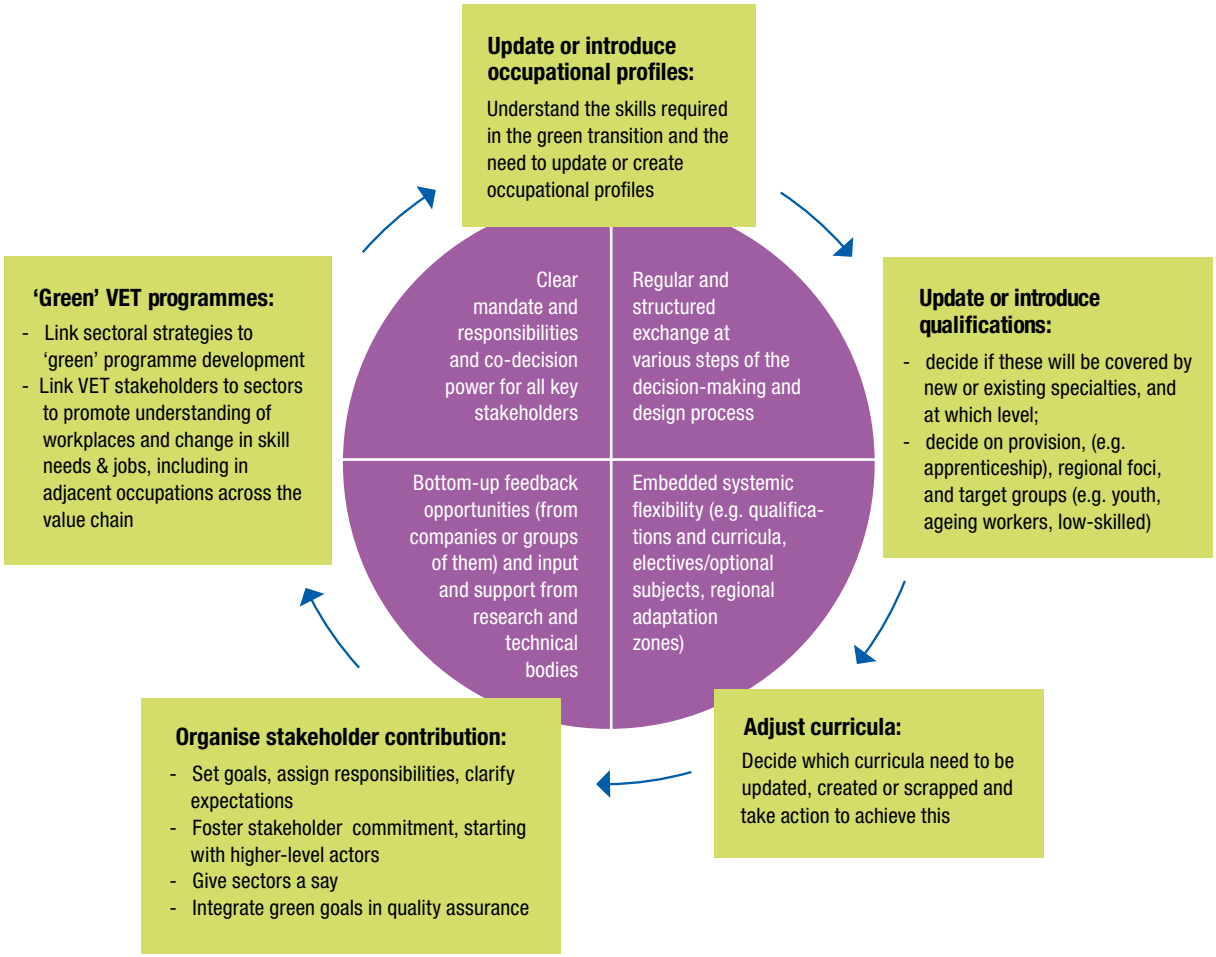
In Denmark, a new model for adult VET (Job-VEU model) mobilises a wide range of stakeholders to meet labour market and green transition skill needs better.
Private companies, education institutions, municipal job centres and labour market actors are involved in the coordination of short training programmes for employed and unemployed people. They also support disadvantaged groups such as low-qualified, and persons who belong to minorities. The Ministry of Employment and the Danish Agency for Labour Market and Recruitment are responsible for developing the legal framework and monitoring it.
The Job-VEU model comprises four phases, in which companies, job centres, sectoral organisations and social partners play a vital role.
Phase 1. Sectoral organisations and job centres monitor and identify skill mismatches at national or local level; they also track specific labour needs in companies and identify unskilled workers in need of training.
Phase 2. An agreement is reached between national and/or regional level social partners (a sectoral organisation and a trade union) on the establishment of a Job-VEU programme. This phase involves consultation between a sectoral/professional organisation and the companies aimed at fully understanding training needs.
Phase 3. Social partners and job centres draw up a project plan outlining the key elements of the new upskilling programme, which serves as a basis for selecting a VET provider.
Phase 4. Regional or national level social partners, companies and job centres screen candidate learners to ensure they are a good match with corporate needs.
Following selection of learners, a VET provider can start providing the upskilling programme. To ensure the match is right, companies participate as much as possible in information meetings, monitor learning, and maintain an open dialogue with learners throughout their upskilling programme.
Source: Cedefop. Timelines VET policies Europe: Job VEU model Denmark.

The extent of social partner involvement in skills governance typically reflects the overall state of play in social dialogue in employment, skills and VET. In settings where social dialogue is weak because roles are not institutionalised, formalised, or adhered to, greening employment and VET offers promising opportunities to systematise stakeholder involvement and make it more robust.

In several EU countries, stakeholders collaborate through standing bodies such as committees or national skills councils. Such bodies coordinate skills anticipation activities, facilitate the use of skills intelligence in VET and other policies, and promote its wider dissemination. In the context of green

transition, the effectiveness of actions based on the wide range of tasks and responsibilities they can assume depends on systemic design features (Figure 9).

Figure 9. **How stakeholder collaboration powers skills governance in the green transition**



Source: Authors.

Strengthening these design features means leveraging untapped opportunities of 'green' skills governance by giving stakeholders a stronger say. According to Cedefop analysis, social partners and other stakeholders are often given room to engage, but they do not always have joint deciding role (Cedefop's skills anticipation country reports; Cedefop, 2021e). In many countries, it is difficult if not impossible, to contribute decisively to shaping national VET schemes and apprenticeship systems, because their function is advisory or consultative. Where this is the case, the Ministry of Education and agencies supporting it, or the Ministry of Employment and the public employment services, typically take the lead in decision-making. In countries with weak governance frameworks or limited expertise, leeway or resources, stakeholder capacity building needs to be part of the process of strengthening the feedback loops between the labour market and VET provision (UNESCO & UNESCO-UNEVOC, 2021a).

Alongside authorities and social partners, sectoral, regional and other organisations with expertise on employment, greening and skills should have a place at the table when strategies are designed, plans are made, and decisions are taken. VET and apprenticeship boards or committees critically rely on the knowledge and expertise researchers and experts offer, and often lack technical capacity to collect, analyse and correctly interpret data. Employer and employee organisations are often best placed to explain what it takes to transfer greenification and technical innovation from drawing boards to workplaces.

Box 13. **Regional and local stakeholder collaboration to address green skill gaps**

The Erasmus+ project GREENOVET, involves 30 partners from Austria, Finland, Portugal and North Macedonia. It brings together regional upper-secondary and higher VET providers, local companies (large ones and SMEs), sector and employer representatives, regional governments, and regional innovation agencies. The involvement of national ministries and social partners, which are associated partners, assures coordination and coherence across government levels.
The project identifies skill gaps in relation to greening, analyses the existing educational offer, and develops new training to address these gaps.
Centres of vocational excellence (CoVE) for green innovation, embedded in local innovation and competence ecosystems support these efforts. They leverage key stakeholder knowledge, resources, and infrastructure to promote innovation and skills ecosystems, regional development, and environmental, social, and economic growth.

Source: GREENOVET skills for a Green Europe.

Systemic features, defining how VET is steered and governed, also matter. Structurally embedding flexibility in VET systems and qualifications frameworks eases the process of introducing new qualifications and curricula and renewing existing ones. Having the option to add green learning as units or modules to existing qualifications or as programme electives facilitates the process of greening VET ([14]). The qualification framework requirements shaping the development of modular approaches help ensure their quality. Social partner involvement in shaping learning options or routes that give people green transition skills and in updating overarching occupational profiles is crucial.

Box 14. **Structured multistakeholder collaboration for greening VET in the Netherlands**

In the Netherlands, the Foundation for Cooperation on Vocational Education, Training and the Labour Market (SBB) supports the adaptation of apprenticeships in the context of green transition. SBB provides a platform to education institutions and the business community to connect, and offers advice in relation to labour market needs, qualifications and vocational training, including apprenticeships.
SBB's 2022 report on Climate-related jobs in a built-up environment (in cooperation with the Employee Insurance Agency, UWV, and the Social Economic Council) identified trends and innovations linked to energy transition, circularity and climate adaptation. SBB's sectoral committee for Technology and the built environment (Techniek en gebouwde omgeving, TGO) used the findings to address the issue of providing education and training to meet the demand for sufficient qualified construction professionals.
The TGO committee identified skill categories required for professionals and analysed developments in companies and professions relying on mid-level technical skills. This helped track required adaptations to existing qualifications and map which new qualifications or programmes (e.g. climate training programmes) should be developed. The report advocates furthering the inclusion of generic, cross-sectoral skills in all qualification files within engineering and the built environment. It also argues that developments in the field of energy transition, circularity and climate adaptation need to be reflected in updates of qualification files and suggests identifying electives which have de facto become standard and to integrate them in the qualification files.
Flexibility in structuring qualifications thanks to the set-up of qualification files (as broad outlines that allow adding aspects of energy transition, circularity and climate adaptation), and the possibility for schools to interpret and adapt these files enabled VET to respond to greening, as several recently developed programmes demonstrate. Following the publication of the report, apprenticeship courses are offered for solar panel installation in cooperation with the Wij-Techniek sectoral organisation. A similar initiative exists for installation of EV charging stations, and another apprenticeship track is being designed in the field of installing technology such as heat pumps and solar panels that reduce reliance on natural gas.

([14]) For more insights on greening VET systems, see UNEVOC-Cedefop practical guide (Volume 1).

Flexibility is at the heart of the Dutch approach. Supplements to qualification files, optional subjects or certificates can be added for generic skills such as communication and collaboration and specific topics, such as smart maintenance and electrification. Education institutions and businesses can apply for certificates of new optional subjects once their labour market relevance has been demonstrated. Components of the qualification framework are made more suitable for adults by offering them as flexible, modular education or training programmes.
The report underlines that alongside flexibility in changing qualifications to keep them aligned to labour market needs, attracting more learners to VET and apprenticeships is crucial for addressing labour market shortages.

Source: van Wezel, 2023.

3.5.3. **Overcoming skills governance shortcomings in practice**

In many countries, skills governance approaches are in transition. Where they are lacking, weak or not comprehensive, skills governance level tasks and roles are shifted to the implementation level. While they cannot address all challenges, stakeholder partnerships at implementation level help skills ecosystem players maximise the effectiveness and benefits of innovation and actions.

Scaling-up of successful bottom-up approaches is often out of reach because the local or sectoral actors driving them usually do not have the capacity or the mandate to do so. Activating different stakeholder types to channel initiatives into broader sectoral, regional or national strategies can be an effective way to ensure that actions with proven effectiveness add value beyond the sector, school, city or region developing them.

The green transition offers opportunities to strengthen implementation level partnerships which build on skills governance principles, even in contexts where comprehensive skills governance is not a reality. Bringing stakeholders together to support greening apprenticeship and other types of work-based VET is useful at any level.

Companies clearly benefit from structured opportunities to team up with VET providers in their sector or region as it helps them ‘green’ their practical training offers in line with the classroom-based part of curricula. Collaboration also opens up opportunities to assess whether relatively new green elements are sufficiently reflected in curricula, in-company training plans, and teacher training. By becoming active within local ecosystems, VET actors can access information, infrastructure and modern technologies that boost their capacity to ‘green’ VET and apprenticeship training. This is particularly crucial for SMEs, which have limited stand-alone capacity to green their business and training practices.

Skills intelligence can be an important success driver in implementation level partnerships. Effectively disseminating it in user-friendly formats in sectors and regions helps overcome the ambiguity of what skills for the green transition entail and gives stakeholders an impression of the direct and indirect impact of the green transition on skills and VET. This is particularly important in areas and sectors where green transition will have major impact, as considerable employment transition and redistribution are expected, and skill shortages are already a reality (e.g. in the electricity and renewable energy sectors). In such contexts, many learners and workers benefit from the sound advice skills intelligence can provide on promising opportunities in the green economy.

CHAPTER 4.

Greening apprenticeships

4.1. Apprenticeship has greening potential built in

Apprenticeships are particularly well placed to supply skills for the green transition, being at the intersection of the education system and the labour market (Box 15). They are closely tied to the labour market and arguably the most hands-on and demand-led form of VET. Apprenticeship content can swiftly adapt to evolving labour market needs. In the context of green transition and other megatrends, apprenticeship alleviates short-term bottlenecks and fosters long-term worker employability. The dual role of apprentices (as learners and workers) and the frequent collaboration among them, their teachers and in-company trainers allow for cross-fertilisation in supporting the green transition (Cedefop & OECD, 2022). The combination of two learning venues helps apprentices develop a wider set of skills and attitudes relevant to green transition.

Box 15. **What distinguishes apprenticeship from other work(place)-based VET?**

Not all VET programmes that include some workplace period should be understood as apprenticeships. In line with the 2018 Council Recommendation on a European Framework for Quality and Effective Apprenticeships, Cedefop understands apprenticeships '…as formal vocational education and training schemes that:

- combine learning in education or training institutions with substantial work-based learning in companies and other workplaces;
- lead to nationally recognised qualifications;
- are based on an agreement defining the rights and obligations of the apprentice, the employer and, where appropriate, the vocational education and training institution, and
- with the apprentice being paid or otherwise compensated for the work-based component.'

Source: Council of the European Union (2018). Council Recommendation of 15 March 2018 on a European Framework for Quality and Effective Apprenticeships.

Cedefop research shows that apprenticeships can be adapted to contribute to greener economies and societies in various ways. Approaches to 'greening apprenticeship' extend from modular approaches typically suitable in the short term, to the introduction of green elements across subjects and occupations, or to the development of comprehensive approaches promoting lasting and profound change (Cedefop & OECD, 2022). Such approaches range from systematic and coordinated, which do not exclude bottom-up initiatives, to sporadic and uncoordinated (Cedefop, 2024b). Some initiatives implemented at small scale (e.g. in a local community or focused on one apprenticeship programme) follow a project-based logic and are often unlinked or only loosely related to national or sectoral strategies. They are set up and led by specific schools, teachers, groups of local companies or even learners themselves. At the same time, centralised, top-down initiatives target curricula, standards, and qualifications to green apprenticeships more effectively and efficiently. They can be either transversal, extending across occupations, or address specific occupations or sectors.

Experience from across Europe shows how apprenticeship can contribute to green transition by using existing governance mechanisms, and multi-stakeholder collaboration platforms to update the content of training. Cedefop analysis (Cedefop, 2021e) covering 27 apprenticeship schemes in 19 EU countries and Iceland showed that multi-stakeholder bodies enabling structured and transparent dia-

logue among apprenticeship stakeholders are the norm. They bring together the State (ministries and, in some cases, national institutions) and social partners (employer representatives, including chambers and, in most cases, trade unions).

Collaboration among apprenticeship stakeholders at all levels benefits greening. At the design and decision-making levels, such collaboration helps boards, committees or platforms adapt apprenticeship to the needs of the green economy (Cedefop, 2024b), and contribute to the effectiveness of skills governance (Chapter 3).

But it is important to make use of the unique set-up of apprenticeships to benefit from collaboration also at the implementation level, as discussed in the next section.

4.2. Greening apprenticeship: what does it take in practice?

Without comprehensive, centrally-driven approaches to greening VET, sectoral, regional and local players need to take charge to manage and adapt to the rapid and pervasive change the green transition brings about. A great share of responsibility and burden is shifted to the implementation side. However, actors at the local level often struggle to adapt. The work of Cedefop's community of apprenticeship experts shows their engagement can be challenging.

While SMEs may recognise the value and the need to adapt to greening, they may find it hard to understand how the green transition affects them and their business. Micro-companies often face difficulties in securing the resources needed to adapt apprenticeship training content and provision.

Embedding new green elements in curricula may also be challenging for local VET schools, either due to the novelty of the content or because it simply requires time and comes on top of many other tasks and priorities. The same holds for training VET teachers in new green and digital technologies and acquainting them with new curricula, teaching methods and learning materials (Cedefop, 2024b). A World Bank-UNESCO report also showed that despite the great potential of greening education, in most countries surveyed, skills for the green transition are not always part of the VET curriculum. In an examination of 100 countries, less than half had mentions of climate change or environmental themes.

Apprenticeship collaboration platforms between VET schools, professional associations, chambers, as well as NGOs and local/regional authorities or higher education and research facilities, can help overcome such challenges. They are valuable in supporting companies, trainers, and teachers and ultimately also benefit apprentices. In practice, such platforms can contribute to greening apprenticeship in four ways.

(a) **Leveraging the teacher – trainer – apprentice triangle**

Rapid technological developments driving green transition may put teachers (school settings) and in-company trainers (workplace settings) at a distance from workplace realities, expose knowledge and skills gaps, and challenge their authority. Teachers and trainers need upskilling to master technological change, and, even more so, new curricula, materials, and pedagogies (see UNEVOC-Cedefop practical guide (Volume 1); and Cedefop, 2022b). Local-level collaboration helps VET schools in adjusting training to reflect new or updated greener curricula and in preparing their teachers to work with them. This can work in practice by opening up opportunities for teachers to learn about emerging greentech from local green pioneering companies or to upgrade their knowledge via joint training programmes with in-company trainers.

Box 16. **GRAEDUCATION project**

The project restructured and expanded the curriculum for training electricians at apprenticeship schools of the Greek Public Employment Service (DYPA). German and Greek apprenticeship teachers, in-company-trainers and technical experts contributed via a moderated collaboration process. Adding technical competences in photovoltaics, network

technology and KNX/smart home resulted in a completely new curriculum. The same approach was used to redesign and 'green' the curricula for thermal and hydraulic installation technicians, mechatronics for cooling/AC technicians, and renewable energy system technicians (post-secondary) and to add interdisciplinary training modules.
Apprenticeship teachers, teachers in school-based VET programmes and in-company trainers were trained on solar cooling, cooling, ventilation and air conditioning technology, and heat pumps.
To ease the integration of green standards and new technologies into teaching and training, the Technical University of Athens and a German expert partner (HBZ) contributed their expertise.
A quantitative survey among Greek teachers and qualitative interviews with Greek companies shaped the process. Companies were also involved to improve in-house training opportunities, to stimulate dialogue between learning locations and jointly identify ways to integrate innovative green technologies into teaching practice. Ongoing dialogue with companies, which must comply with climate regulations, made the market relevance of the new teaching modules clear to all stakeholders.

Source: Steinberg and Klatt; Cedefop; OECD, 2022.

Apprentices should be given more room to shape the green transition. Opportunities to express their interest, share the knowledge they have on the topic, to experiment, and to take a leading role in the learning process are powerful change drivers. As employees and learners in a context where VET school teachers and in-company trainers frequently cooperate, apprentices can trigger cross-fertilisation between learning venues, relaying green innovation from schools to companies and vice versa in daily learning and work. As a result, in the green transition, apprentices can become change agents (Cedefop, 2022a). To take on this role, apprentices need teachers and trainers who integrate learner interests in the learning process.

Box 17. **Curricula update initiated by the interest of apprentices**

In Denmark (Copenhagen), while looking for new knowledge and skills about sustainable construction, apprentices in carpentry initiated the Apprentices for sustainability project. A group of teachers followed up by taking action to embed sustainability in the school-based part of the carpentry apprenticeship programme. Along with the basics of sustainable building methods and sustainable materials (technical, craft knowledge), apprentices were introduced to a holistic approach of building processes overarching different professions. The project has successfully embedded sustainability in regular school-based courses (*hovedforløb*) of the carpentry programme (EQF level 4 programme for carpentry for small- and large-scale construction) in one school in the Copenhagen area via classes lasting six weeks. Nearly 200 apprentices took part in an optional specialisation course in sustainable construction methods that complements the existing EQF4 qualification. The project has attracted attention, was followed by social partners in local and national training committees and has relevance for carpentry programmes across the country. It also inspired education stakeholders more broadly in the context of delivering skills for the green transition via national apprenticeship programmes and the training VET teachers need to educate apprentices. The project has been introduced in teacher training in the Copenhagen area.

Source: Bisgaard, J. (2023). Greening apprenticeships in Denmark.

(b) **Supporting SMEs in 'greening' the content of their training**

Many countries 'greening' curricula, training materials and pedagogies, either for apprenticeships or across all types of VET, introduce them centrally, ideally with the support of non-traditional stakeholders. In the case of apprenticeships, greening needs to involve the adaptation of the entire training content, not just that offered through the school-based component. However, updating the content of the workplace learning component of apprenticeships may be overlooked or underestimated, in particular when apprenticeships share curricula with other VET options.

Especially in SMEs, that often lack internal training departments and processes, connecting in-company trainers to schoolteachers is vital for updating the whole of apprenticeships in practice. In-company trainers who lack references for the workplace component may welcome guidance from schoolteachers on what to train, especially in newly emerging fields of knowledge and technology. Schoolteachers can also help in-company trainers use and adapt model training plans to steer and facilitate the development of skills for the green transition in the workplace. Such reference and guidance contribute to the comparability of learning experiences in different workplaces. This fosters trust in apprenticeship qualifications and adds value to programmes for learners and sectors.

Box 18. **VET school developing guidelines for what companies need to train**

In Bulgaria, the Mechanical and Electrical Engineering VET school in Pleven was supported to draft updated apprenticeship curricula for upper secondary programmes for electricians by integrating skills for the green transition. Once approved, the updated curricula could be applicable to all electrical technician apprenticeship programmes in the country. The initiative funded by of the EUENTIRE project. ENTIRE has also developed methodological guidelines applicable to all professions for the integration of green transition in VET curricula. The project leverages existing business-school partnerships and will develop recommendations on how business can become more actively involved in adapting apprenticeship curricula.

Source: Evtimova, P. (2023). Greening apprenticeships in Bulgaria.

Transforming the workplace into a learning venue that contributes to sustainability requires a holistic approach to organisational development encompassing all corporate levels and functions (Webber and Wittig, Cedefop; OECD, 2022). In SMEs or other organisations where such approaches are not present or only starting to emerge, players in the local skills ecosystems can kickstart corporate sustainability transformations. Increasing motivation, putting sustainability champions in the spotlight and other quick wins can promote change in corporate culture (Cedefop; OECD, 2022).

(c) **Structuring collaboration on green transition between schools and companies.**
Beyond the personal interaction of teachers, trainers and apprentices, structured collaboration between schools and companies drives the success of any apprenticeship programme. The complexity of the green transition increases the added value of collaborative mutual learning processes. Such processes give companies structured opportunities to approach schools: to request advice on how to better reflect 'greening' in apprenticeship training, and to join 'green' apprenticeship programmes as learning provider. Collaboration also helps monitor the extent to which (relatively new) green elements in curricula are being taught in workplaces and whether ambitions in in-company training plans are reflected in training practice.

Box 19. **Example of introducing new collaboration practices for skills development**

In Latvia, the development of skills for the green transition via apprenticeship links to broader national STEM ambitions. In the project Supporting employers to promote skills development in Latvia, VET stakeholders favour a three-pronged approach: developing STEM-related skills, testing new collaboration practices, and engaging employers in skills development. As the national VET budget does not yet fund new partnerships, EU funded projects are used to test them. An example is the Erasmus+ funded Platform of Vocational Excellence Water Scale-up (PoVE Water Scale-up). It brings together eight VET schools, seven Water industry professionals, four academic partners and three support partners from across Europe (NL, DE, MT, CZ, LV, EE, BE) and beyond (South Africa). The work of the platform aims at helping VET students become agile, sustainability-oriented and digitally-skilled water sector professionals and promoting the development of high-level skills for quality jobs and careers that contribute to innovation, inclusion, and sustainability.

Source: Buligina, I. (2023). Greening apprenticeships in Latvia

(d) **Engaging skills ecosystem stakeholders to support schools and companies**

Adapting training programmes and practices and engaging teaching and training staff in new tasks to adapt to the green transition requires resources from schools and SMEs. SME support structures (e.g. chambers, professional associations), feedback and guidance that local level stakeholders (e.g. higher education/research institutes, NGOs) can offer, and sharing of learning infrastructure (e.g. in sectoral training centres) strengthens the capacity to deliver quality training relevant to the green transition. Diversity in local and sectoral skills ecosystems gives apprenticeship actors access to information, expertise, infrastructure, and modern technologies, and boosts their capacity to adjust apprenticeship to green transition needs and opportunities.

Such support from skills ecosystems stakeholders can be most effective and efficient in the context of local/regional structures facilitating proactive collaboration, frequent knowledge exchange and innovation and less so if it is merely ad hoc and reactive.

Box 20. **Examples of regional or sectoral approaches**

In Croatia, the Vice Vlatkovica VET school in Zadar led the process of the development of modern, greener qualification and curricula for auto-mechatronics in the context of the regional centre of competence (RCC) in mechanical engineering (set up by the ESF project Be ready, be competent). The new qualification and curriculum are to be applied in the national apprenticeship programme, based on a new occupational standard developed by Croatian Chamber of Trades and Crafts (HOK).

Source: Franović, M. (2023). Greening apprenticeships in Croatia

In France, the Tennis Federation offers apprenticeships in its own training centres (CFAs). The federation helped VET schools introduce an initiative to improve the environmental footprint of tennis and activities around it and raised awareness about the entire tennis ecosystem. An online module (part of the ISCED 5 DEJEPS qualification) introduces apprentices to environmental principles and provides resources to apply them in practice. The initiative is aligned with the Federation's long-term vision for the sector and reflects its long-standing commitment to CSR.

Source: Pigeaud, R. (2023) Greening apprenticeships in France

The NAZUBI project (Nachhaltigkeitsaudits mit Auszubildenden 2015-19) in Germany aimed at transforming the participating companies into learning environments that promote sustainability, by developing training structures that offer access to related training topics. The project also sought to support companies with the design and implementation of sustainability audits in the context of education and training. A consortium of two universities, five companies, three VET schools in Hesse and North Rhine-Westphalia, the German Federation of Trade Unions and the Chamber of Industry and Commerce developed sustainability audits and tested them in practice with the support of learners. Companies identified company-specific audit opportunities and prepared and accompanied apprentices during the audits, so that sustainability-improvements could be identified, so giving learners experience and a say in measures and possible skills responses.

Source: Gonon in Cedefop; OECD, 2022 Apprenticeships for greener economies and societies

The regional Government of Catalonia and the VET school of Manresa (Agricultural School) led an initiative to update VET curricula to strengthen training of future managers of agro-ecological farms (2022). A joint design process, with the support of local companies of the sector, shaped the update of contents and learning outcomes. Three new content blocks were added to a qualification for Higher technician in landscaping and rural environment, and a new Agroecology and climate action occupational profile has been developed. The programme, which is offered as apprenticeship, leads to a higher IVET degree and is accessible to adults.

The update directly meets the needs of local agro-ecological producers, who had expressed the need for a higher-level qualification for agro-ecological farm managers. It also meets the needs of learners because it provides graduates with an intermediate qualification in agro-ecological production with a new option to progress towards higher VET.

The programme also helps secure the continuity of small agro-ecological production enterprises, which is a key regional challenge.

Source: Salvans, G. (2023). Greening apprenticeships in Spain.

CHAPTER 5.

Skilling adults in the green transition

The transition to a greener economy requires different skills, in newly emerging jobs and for existing jobs that are evolving. Without a suitably trained workforce, just green transition is impossible. Shaping a carbon neutral and more circular future requires strong initial VET. In particular, apprenticeships and other types of VET programmes with a solid work(place)-based component equip young learners with strong technical background, transversal skills, and attitudes; this supports VET's long-term role in supplying labour and skills for the green transition.

While IVET adaptation, renewal and reform will remain important, they are not enough. Ageing populations and shrinking youth cohorts put pressure on labour supply. Inter and intra-sectoral competition for workforce will make it challenging for employers to attract, train and retain qualified young people. Educating the young people who aspire to contribute to the green transition now and in the coming years takes time (UNESCO & UNESCO-UNEVOC, 2024). In the green transition, societies can neither wait until future workforce cohorts are sufficiently qualified nor solely depend on them. Meeting the pressing current skill needs and alleviating labour and skills shortages will strongly depend on up- and re-skilling people that are already in the workforce, so that they can transition to a greener job or contribute to greening in their current one. Different VET formats can be used to upskill and reskill adults, employed or not, in a timely and efficient manner (Cedefop, 2022a).

5.1. Crafting comprehensive upskilling and reskilling approaches for green transition

Comprehensive approaches for greening that link technological innovation, labour market trends and skills development are essential (UNEVOC-Cedefop practical guide (Volume 1) and Chapter 2 of this publication). The reality is often different. While in the context of all education levels, 18 EU Member states supported the SDG goals by subscribing to UNESCO's ESD for 2030 declaration (UNESCO World Conference on ESD, 2021), upskilling and reskilling as a response to the green transition is often not framed in dedicated overarching skills strategies. Such skilling tends to be reactive to development, innovation, growth or competitiveness strategies which focus first and foremost on economic restructuring. When strategy does not put skills development and matching centre stage, approaches for upskilling and reskilling for the green transition cannot be inclusive.

Strategies for up- and reskilling young people and adults in the green transition emerging in several European Member States in the past years illustrate the value added of comprehensive approaches (Box 21). They vary in terms of focus, targeting specific target groups, age cohorts or type of skills. Some target specific sectors or industries strongly affected by the green transition and their workforces. Others follow a target-group logic cutting across different sectors. Such strategies address segments of the workforce or the population with substantial skilling needs, such as the low-skilled, long-term unemployed, or migrants and refugees. There are also strategies or action plans aimed at developing skills for the green transition transversally.

Box 21. **Green transition VET and skills strategies in Spain, Austria and Portugal**

In 2023, the Austrian Federal Ministry for Climate Action (BMK) published the Just Transition Action Plan on training and reskilling. It has three implementation horizons: short-term (2023), medium-term, (2023-24), and long-term, (2025-30). It targets:

- The Education sector to identify new learning content and skills for Just Transition occupations and to integrate them into training programmes. This concerns including climate-relevant teaching content in existing apprenticeship programmes, and developing new reskilling, initial VET (IVET) and continuing VET (CVET) formats. The initiative also aims at promoting the continuing professional development of IVET trainers, upgrading of the technical infrastructure of vocational schools and engineering colleges, and developing new occupation profiles for electrical engineering and installation and building technology.
- Companies, employees, and jobseekers to strengthen guidance, advice, and support and to ease cooperation among labour market actors. This helps identify in-company and transversal IVET and CVET needs and supports providers in greening their IVET and CVET programmes.
- Framework conditions and compatibility to adapt and expand financing via subsidies and other funding instruments, to strengthen the identification of qualitative and quantitative needs, and to improve accessibility to IVET and CVET programmes.
- Communication via campaigns and stakeholder driven dissemination to promote Just Transition occupations and programmes preparing for them in ways that different target groups understand.

Source: ReferNet Austria, & Cedefop. (2023). Austria: greening VET just transition action plan.

In Portugal, the Green Skills & Jobs programme is part of the 2030 Energy and Climate Plan. It facilitates the training and re-qualification of unemployed people and employees in companies impacted by the green transition and increased energy costs. The programme offers short- and medium-term duration environment and energy training courses to prevent job losses, promote job retention, encourage new job creation to accelerate the energy transition. It prioritises:

- workers who are at risk of unemployment due to the integration of renewable energies in production processes, employees in the fossil fuel industry, people trapped in a situation of underemployment, and training female workers for typically male-dominated professions;
- integrating unemployed people without compulsory education attainment or in need of recognition, validation and certification of competences at secondary level.

The duration of the training courses (online or face-to-face), ranges from 25 to 375 hours. They are integrated into the national qualifications framework and can be offered as certified modular training. This gives learners opportunities to flexibly build or expand their expertise.

Source: ReferNet Portugal, & Cedefop. (2023). Portugal green skills jobs programme

The Spanish Just Transition Strategy 2020-30 is framed within the Energy and Climate Strategic Framework promoted by the Ministry of Ecologic Transition and the Demographic Challenge (MITECO) of the Spanish government. Socioeconomic partners (trade unions, employers, NGO, municipalities, public administration, citizen and professional organisations, companies) were invited to contribute to the strategy at the design stage.

The Strategy promotes skills development directly and indirectly. It facilitates active employment policies, enables measures to deliver VET programmes on sustainability, and supports personal training plans for trainers active in energy transition fields. Specific actions include mapping training needs in the energy transition, green VET programme development, reskilling for the circular economy, support for in-company training, and developing digitalisation, entrepreneurship and related soft skills among young people and women in rural areas.

Central government manages the strategy: Just Transition Institute of the National Energy, Environment and Just Transition Ministry coordinates its implementation. 75% of the cost of projects under the strategy is usually funded by the national Just Transition Fund, while the remaining 25% is funded by Regional Governments. The Strategy is deployed in eight territories strongly affected by the green transition. It prioritises creating high-quality long-term

jobs for vulnerable groups, improving local and municipal infrastructure and assets, and recovering the environment following long-term exploration.
The ministry agrees Just Transition Covenants with regional governments, which are developed with the participation of municipalities and local actors, include targets, and finance projects that contribute to Strategy implementation. The Covenants with regions encapsulate and, in some cases, replace former regional strategies.
JT Covenants fund projects that develop common local infrastructures such as tourist sights and attractions, industrial parks, watering canals, social and elderly care facilities; they finance energy and accessibility refurbishments of buildings. Other projects support green entrepreneurship via new companies, products and services, create or save jobs locally, in areas such as biomass or bio-products, or target strengthening productivity and competitiveness in companies.

Source: Cedefop, ongoing study on 'the role of the socio-economic partners in skills strategies for a just green transition: a regional perspective'

Cedefop's analytical framework for upskilling adults (Cedefop, 2020b) supports policy-makers and VET and skills stakeholders because it makes explicit what it takes to design and implement sustainable, coordinated and coherent approaches to flexible and inclusive upskilling pathways ([15]) (Table 3). The framework can be applied to shape adult upskilling and reskilling for the green transition. It helps stakeholders design strategies and action plans and turn them into comprehensive and well-articulated green transition skills development initiatives benefiting adults.

Table 3. **Cedefop's analytical framework for upskilling adults**

Decision-making:
(a) an integrated approach to upskilling pathways for low-skilled adults;
(b) a planning strategy for identification of target groups;
(c) governance (multilevel/multi-stakeholder);
(d) monitoring and evaluation.
Support:
(a) financial and non-financial support;
(b) outreach;
(c) lifelong guidance.
Implementation:
(a) a skills assessment;
(b) a tailored learning offer:
(i) leading to a qualification;
(ii) with work-based learning (WBL);
(c) validation and recognition of skills and competences.

Source: Cedefop (2020). Chapter 3: Analytical framework for developing upskilling pathways for low-skilled adults.

The framework covers the systemic features of coherent and coordinated approaches to upskilling pathways for low-skilled adults. It blends a lifelong learning perspective and a focus empowering learners and has 10 dimensions, which cover decision making, support and implementation aspects. It can be used to design new skilling initiatives supporting the green transition and to amend existing ones.

([15]) The framework builds on the 2016 Council Recommendation on upskilling adults.

5.2. Moving from national skills ambitions to regional skilling action

While implementing the European Green Deal, its linked strategies, and increasingly ambitious climate targets is expected to have an overall positive impact on employment at EU level (Cedefop, 2021a), there are considerable regional disparities in job creation. The employment impact of the green transition tends to be particularly negative in traditional industrial regions which are home to carbon-intensive industries. As these tend to be geographically concentrated, the restructuring processes accompanying green transition may lead to mass layoffs when smooth adjustment and job-transition-promoting processes are lacking. While such layoffs may not amount to significant relative employment decline nationally, their concentration poses economic and social challenges in the areas concerned.

To be successful at regional level, up- and reskilling, strategies for the green transition need regional customisation and the regional skills development perspective should feature prominently in decarbonisation, economic growth, innovation, competitiveness and other strategies and policies.

Regional strategies usually target transformation of dominant business models and production processes to support sustainability and greening. Regional strategies dedicated to skills development alone are the exception rather than the rule. At the same time, the strong regional component of green transition and the role regions play in it are strong arguments for dedicated regional strategies featuring skills development and matching components or overarching national strategies with regional differentiation.

According to Cedefop analysis of selected regional strategies supporting the green transition of local economies and societies, several features determine the extent to which strategies enable and ease skills development and (re)qualification in the context of sustainability and just green transition ([16]). These features are the integration of skills components in a transition strategy, the participation in training of displaced workers or those at risk of displacement, employer engagement in skills development processes, and the responsiveness of education and training providers to supply skills the labour market and employers' demand.

The reality is that training, upskilling and reskilling to promote employability are not always at the core of regional Just Transition strategies. Such strategies often promote shifting away from production with heavy ecological footprints and diversifying economic activities in regions, but do not always put emphasis on training and qualifying the population accordingly. To capture skills needs in the green transition and to meet them effectively, regional strategies need to be based on comprehensive approaches and include a range of skills development components (Table 4).

Table 4. **Skills development components in regional skill strategies for a just green transition**

Skill development component	Description
Skills anticipation and monitoring mechanisms	refers to (a) efforts made through the strategy to identify and anticipate skill needs, and (b) mechanisms to provide comprehensive information on demand and supply for jobs and skills needed for the green transition.
Meeting upskilling and reskilling needs related to just green transition/ economic restructuring	refers to measures/programmes/agreements at regional, cross-sectoral or sectoral levels targeting up- or re-skilling individuals to stay in employment or become employed (e.g. to acquire digital skills, transversal skills, job-specific skills, full qualifications).
Social and professional activation measures	refers to instruments dedicated to labour market interventions mitigating the negative effects of the transition besides upskilling and reskilling per se, e.g. provision of shielding support in the labour market for those excluded or at risk of exclusion affected by the consequences of the economic restructuring, guidance, childcare support and other measures ensuring career continuation or career path change etc.
Adapting education and training to transition challenges	refers to measures, initiatives addressing the education and training providers (formal and non-formal) to become active in accompanying the transition through tailored provision, in a partnership approach with, e.g. labour market actors, civil society, public authorities)

([16]) Findings based on the Cedefop study The role of the socio-economic partners in skills strategies for a just green transition: a regional perspective, ongoing in 2024.

Supporting entrepreneurship	refers to efforts supporting the creation of technology hubs, competence centres and business incubators, as well as occupational reorientation supporting diversification of the economy
Provision of in-company training	refers to measures and agreements encouraging and supporting companies to engage in providing workforce in-company training

Source: Cedefop, ongoing study on the role of the socio-economic partners in skills strategies for a just green transition: a regional perspective.

Box 22. **Examples of skill development components in regional green transition strategies**

The Regional development concept 2020 for the German Unna district focused on five areas: (1) consistent education; (2) innovative economy; (3) future-proof sectors; (4) optimised infrastructure and multimodal mobility; and (5) energy transition and climate protection. Local waste disposal and packaging companies, industry and the regional circular economy competence network (WFZruhr) initiate or participate in projects under the initiative, which targeted education and training at various levels, including upskilling and reskilling, by:

- expanding the potential of qualifying skilled workers for emerging sectors, climate-friendly construction, landscape cultivation, and in the context of the regional zero-emission mobility strategy;
- increasing further training participation among the general population and in the sectors affected by structural change, e.g. via basic digital skills programmes for the long-term unemployed;
- guaranteeing access to sustainability training for interested and eligible young people;
- optimisation of the entire 'education value chain', e.g. by expanding the measures in the Leave No Child Behind programme and the Municipal Prevention Chains.

The Slovak Action Plan for the Transformation of Upper Nitra region (adopted in 2019 and updated annually) provides a comprehensive strategic framework for the transition from coal-dependent industries to sustainable, diversified economic activities and social transformation. The Plan enables adjustments in secondary education curricula and boosts participation in secondary and dual education. It also reinforces the capacity of regional actors to requalify adults and strengthens employer involvement in such efforts.
Priority IV.4 of the action plan refers to social and professional activation of vulnerable groups, in particular older workers with (life-)long tenure in extractive industries, workers heavily exposed to the green transformation. Measures provide access to assistance and legal services and labour market support to those in mining jobs at risk find new employment.

In Poland, the 2020-30 Development Strategy of the Lower Silesian Voivodship aims at: (1) effective use of the region's economic potential; (2) improving the quality and accessibility of public services; (3) strengthening regional human and social capital; (4) responsible use of resources and protection of natural environment and cultural heritage values; and (5) strengthening of spatial cohesion of the region.
The Strategy emphasises the required adaptation of the education and training sector to the green transition. This includes shaping and developing of educational and social services; supporting innovative learning methods, introducing measures to enhance VET quality and attractiveness, promoting environmental education leveraging local resources.

In Germany, the Lusatia 2050 sub-regional Development Strategy puts emphasis on continuously strengthening networks of educational service providers, companies, research institutions, administrations and other regional education stakeholders. This fosters research and development and connects companies with education and science institutions. Actors representing employers, such as the Lusatia Region of Innovation GmbH and the Business Initiative Lusatia e.V., develop ideas and strategies to help business respond to environmental change and secure and train young talents and highly skilled professionals. Involvement of the Federation of German Trade Unions and the Trade Union for Mining, Chemicals and Energy ensures the just transition principle guides adaptation to structural change leading to high-quality job creation.

In Slovakia, the 2022–30 Programme of Economic and Social Development of the Banská Bystrica region promotes, among several other goals, employers' engagement in training. This includes the promotion of dual training or other forms of workplace training, support for the creation and development of supra-company training centres, involvement of industry experts in school-based training, cooperation between VET providers and enterprises etc. It also supports training organised by employers for employees to prepare them for changed working conditions due to changing technological processes.

Source: Cedefop, ongoing study on the role of the socio-economic partners in skills strategies for a just green transition: a regional perspective

CHAPTER 6.

Microcredentials: potential in the green transition

6.1. Understanding the basics

Green transition, digital revolution and other megatrends speed up the pace of change in economies and workplaces, drive skills upgrading and obsolescence, and transform skills profiles in jobs. Microcredentials (MCs) can be a valuable lifelong learning tool to respond to emerging and changing skills needs. They offer up- and reskilling via short learning formats, ease modular learning, and can be shaped to directly respond to labour market needs (Box 23). MCs can also be stackable, so that people can flexibly use them to attain a qualification or certification.

The term 'microcredential' is not new, and their characterising features can be part of long-standing practices. As the name implies, the amount of learning is what distinguishes microcredentials from traditional vocational or academic degrees and diplomas (see also UNESCO, 2022a). MCs give learners the opportunity to complete a small learning module relatively quickly. Microcredentials do not and cannot replace traditional qualifications (Cedefop, 2022c). Instead, they complement existing qualifications by opening up opportunities to meet new skill needs in a targeted, and flexible way. Issuing microcredentials in a digital format following standardised requirements, makes it easier to add them to credential repositories and include them in national qualifications frameworks (Cedefop, 2023e). Microcredentials are blooming in different parts of education and training systems, quite often in the non-formal or private sector. They can challenge traditional national-level approaches governing qualifications and credentials systems.

Box 23. **What are microcredentials and how can they be designed and used?**

A microcredential is the record of the learning outcomes that a learner has acquired following a small volume of learning. These learning outcomes have been assessed against transparent and clearly defined standards. Courses leading to microcredentials are designed to provide the learner with specific knowledge, skills and competences that respond to societal, personal, cultural or labour market needs. Microcredentials are owned by the learner, can be shared and are portable. They may stand alone or combined into larger credentials. They are underpinned by quality assurance following agreed standards in the relevant sector or area of activity.

According to the Council Recommendation, the following principles need to guide the development of microcredentials. They should be:

- subject to quality assurance (quality);
- measurable, comparable and understandable (transparency);
- designed as distinct and targeted learning achievements (relevance).
- designed to support flexible learning pathways;
- recognised, where possible;
- owned by the learner and stored and shared easily (portability);
- learner-centred;
- clear about the identity of the learner and other information (authentic).

The learning outcomes in microcredentials must be assessed against transparent criteria. Information and advice on microcredentials should be incorporated in lifelong learning guidance services. The Council recommendation advises EU Member States to integrate microcredentials into their employment policies and Active Labour Market Policies. Via employment services, training support measures and employment incentives, microcredentials are to be used to:

- address skills mismatches and bottlenecks in economic sectors and regions;
- upskill and reskill workers for skills and jobs in demand in the context of digital and green transition.

Source: Council Recommendation on a European Approach to Micro-credentials for Lifelong Learning and Employability (2022).

The greatest advantage of MCs is their flexibility and the short time frames they require to be earned. They are a faster pathway to gaining in-demand knowledge and expertise and are alternative or complementary to learning via traditional VET ([17]). They foster lifelong learning and the employability of people with different skill levels by quickly skilling them.

In response to the 2022 Council recommendation on microcredentials, EU Member States are adapting their VET systems by creating new formats of training provision and credentialing. More than half of them have started to incorporate microcredentials, including digital ones, in their national qualification frameworks (NQFs) or are planning to do so. NQF integration ascribes value to microcredentials and facilitates comparison (Cedefop, 2024d).

6.2. Why and how microcredentials can contribute to greening

Labour market relevance, which is one of the principles of microcredential design and delivery, stands out as a major advantage compared to traditional qualifications and degrees. Microcredentials could therefore play a role in making progress towards delivering EU green transition policy. They make it possible for VET to take up its 'sprint' role (Cedefop, 2022a) to quickly alleviate labour market pressures, facilitate worker transitions to greener occupations and sectors, or to respond to new tasks and skills required in the transition.

The learning outcomes approach shaping microcredentials aligns well with typical skills and workplace dynamics in the green transition. Instead of focusing on the inputs to learning – when, where and how it took place – this approach focuses on what an individual knows, can do and understand following a sequence of learning. While learning outcomes alone might not be enough to fully understand and compare credentials, or capture the qualities of a learning process, they provide essential insights into their content and scope. Learning outcome statements can, for example, describe competences in a manner relevant for the workplace (Pouliou, 2024).

Learning outcomes are often categorised as either transversal or occupation- or job-specific ([18]). Given that skills for the green transition encompass technical and transversal skills, this distinction can be useful when designing a 'green' micro-credential.

(a) Transversal learning outcomes can be understood as green transition supporting learning outcomes relevant to and useable in a broad range of occupations and sectors, which can also be transferred to new educational environments. They are 'learned and proven abilities which are commonly seen as necessary or valuable for effective action in virtually any kind of work, learning or life activity' ([19]). In the context of green transition, being aware of the consequences of not acting green, avoiding waste and recycling, taking a proactive stance in contributing to green priorities, complying with

([17]) ILO, UNESCO and the World Bank (2023) Building better formal TVET systems: Principles and practices in low-and middle-income countries

([18]) ESCOpedia: cross-sector skills and competences

([19]) Towards a structured and consistent terminology on transversal skills and competences: 3rd report to ESCO Member States Working Group on a terminology for transversal skills and competences (TSCs)

environmental regulation and working in ways that minimise carbon footprints are examples of transversal learning outcomes.

(b) Occupation/job-specific learning outcomes supporting green transition are usually specialised and relevant for jobs within a specific economic sector, context or occupation. These are typically central to frontline green jobs. Examples include being able to install solar technology safely, servicing electrical vehicles, or designing circular production processes.

Microcredentials are emerging in many different contexts, but they are not yet systematically integrated in many skills ecosystems. To understand possible trends in microcredentials, Cedefop built four scenarios around their possible use cases (Table 5) (Pouliou, 2024). The scenarios show how MCs can serve different skill needs and groups of learners. From the possible scenarios, demand-driven Microcredentials' appear to be most directly linked to green transition skilling needs.

Table 5. **Four scenarios for microcredentials use**

Scenario 1: Supply-driven microcredentials (as part of formal education) for further learning.	Scenario 3: Demand-driven microcredentials (examples of enterprises/ sectors)
Scenario 2: Supply-driven microcredentials for labour market entry and job setting (professional credentials)	Scenario 4: Microcredentials for vulnerable groups /groups at risk (upskilling/reskilling)

Source: Pouliou, A. (2024).

Demand-driven MCs can evolve outside of and independent from formal education and training systems. They can be offered by companies, sectoral players, or professional organisations. Employers could use such microcredentials to address skills gaps and mismatches in their companies, to respond to technological, digital, social, environmental trends (Pouliou, 2024). In the context of the green transition, the aim of such microcredentials would typically be to reskill the workforce for a particular skill set or to meet regulatory requirements. The latter takes shape as mandatory skilling in specific types of work (e.g. to extend or renew licences and permits).

The potential of microcredentials in the green transition can be particularly strong in sectors. Research into the manufacturing and retail sectors revealed a wide variety of options for individuals in different occupational areas to acquire additional knowledge, skills and competences (Cedefop, 2023f). These are particularly common for workers in sectors undergoing rapid change (e.g. ICT) or in jobs where continuous improvement is important and qualifications need regular updating (e.g. education, medicine, public service).

Thanks to their flexibility and inclusivity, particularly in strengthening professional skills, MCs can play a crucial role in key sectors for the green transition. Cedefop sectoral skill foresights on smart and green cities, waste management, agri-food and circular economy clearly show the value of microcredentials and the potential of expanding them. Microcredentials can play a role in meeting European Green Deal targets ([20]) by offering flexible, targeted and skills development opportunities. They are not a magic bullet or quick fix solution to all skills matching problems: microcredentials complement but cannot replace traditional education and training systems.

6.3. How microcredentials drive greening

With greening goals and targets becoming more ambitious in the past few years, the need to address

([20]) Microcredentials moving to centre stage.

skill needs linked to the green transition has grown. Some EU countries have worked on microcredentials to expand skilling options, often supported by often EU-funded projects. The following examples illustrate the approaches taken and demonstrate progress made in this area. They can be inspirational for policy makers, and other skills system stakeholders active at national, regional and sectoral level.

6.3.1. **Ireland**

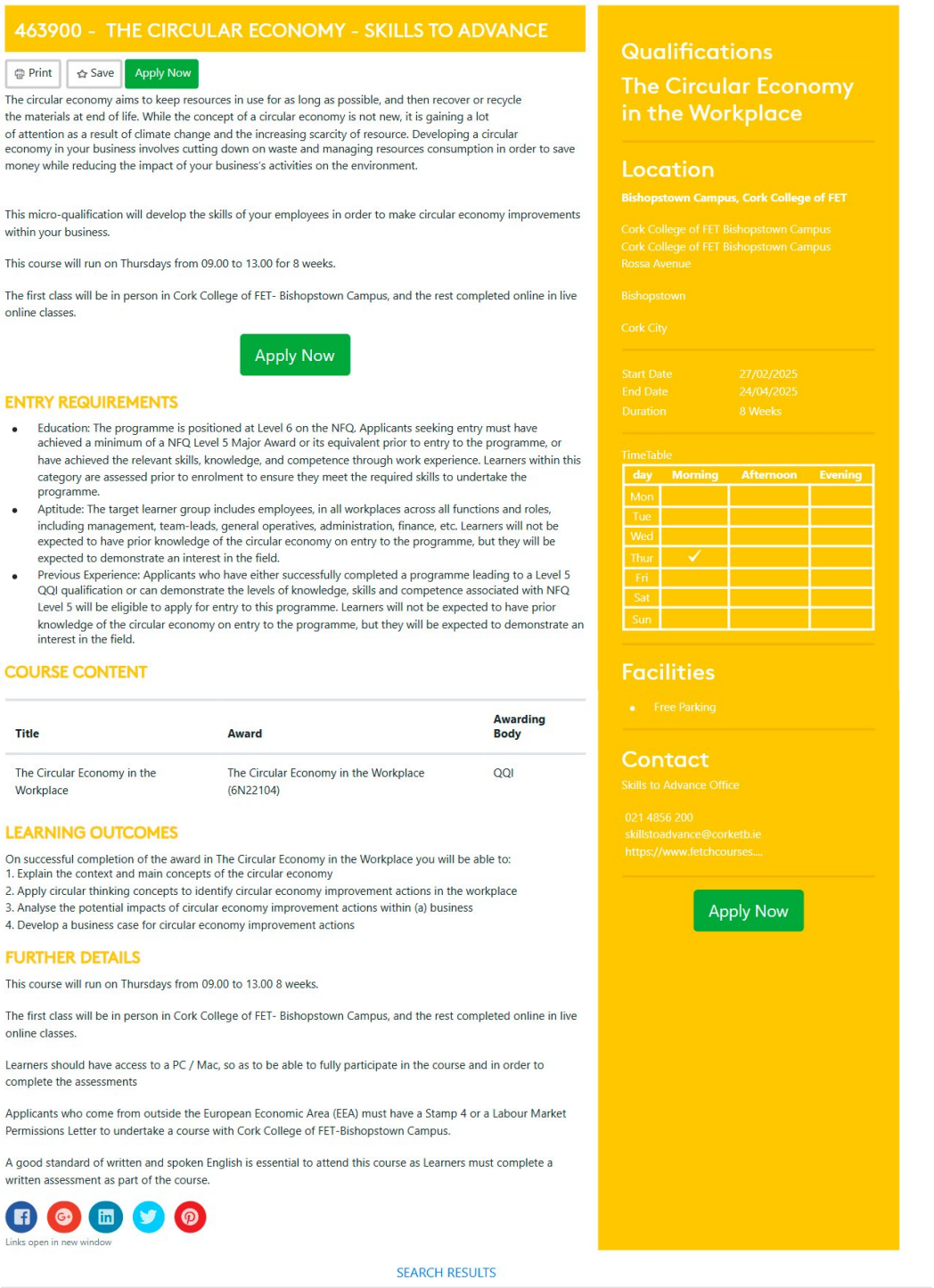
A model for Further Education and Training (FET) micro-qualifications (the national term used for microcredentials) was developed in 2021 ([21]) by the state agency responsible for Further Education and Training (SOLAS). It aimed at providing an agile response to upskilling needs of employees and enterprises via new micro learning programmes at Levels 4-6 which would be recognised as national qualifications on the Irish NQF. Green/sustainability skills were identified as a priority for the new FET Micro-Qualifications model ([22]) and rolled out nationally under the Skills to Advance ([23]) policy initiative. A review of green occupations and skills and research on green skills and sustainability helped inform provision. With no specific certified programmes promoting awareness of green skills in place, cross-occupational and cross-sectoral training opportunities were much needed. The collaborative structure and approach adopted was modelled on previous initiatives and involved an overarching working group of strategic partners and a programme development subgroup which developed the documentation for Quality and Qualifications Ireland (QQI), the validating body. In 2024, SOLAS officially launched the model and an initial suite of 24 FET micro-qualifications following a 2-year pilot with Education and Training Boards, enterprise agencies and companies. These micro-qualifications target individuals and communities and described in terms of learning outcomes (Example in Figure 10).

([21]) For more information, see Microqualifications.

([22]) A distinctive feature is that each micro-qualification is mapped to the National Framework of Qualifications and accredited by Quality and Qualifications Ireland. See the video which is outlining the key features of FET Micro-Qualifications and the other providing testimonials from SME employees.

([23]) Skills to advance. and Find a Course Course finder for the list of courses.

Figure 10. **Example of a micro-qualification offered by SOLAS**



463900 - THE CIRCULAR ECONOMY - SKILLS TO ADVANCE

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The circular economy aims to keep resources in use for as long as possible, and then recover or recycle the materials at end of life. While the concept of a circular economy is not new, it is gaining a lot of attention as a result of climate change and the increasing scarcity of resource. Developing a circular economy in your business involves cutting down on waste and managing resources consumption in order to save money while reducing the impact of your business's activities on the environment.

This micro-qualification will develop the skills of your employees in order to make circular economy improvements within your business.

This course will run on Thursdays from 09.00 to 13.00 for 8 weeks.

The first class will be in person in Cork College of FET- Bishopstown Campus, and the rest completed online in live online classes.

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ENTRY REQUIREMENTS

- Education: The programme is positioned at Level 6 on the NFQ. Applicants seeking entry must have achieved a minimum of a NFQ Level 5 Major Award or its equivalent prior to entry to the programme, or have achieved the relevant skills, knowledge, and competence through work experience. Learners within this category are assessed prior to enrolment to ensure they meet the required skills to undertake the programme.
- Aptitude: The target learner group includes employees, in all workplaces across all functions and roles, including management, team-leads, general operatives, administration, finance, etc. Learners will not be expected to have prior knowledge of the circular economy on entry to the programme, but they will be expected to demonstrate an interest in the field.
- Previous Experience: Applicants who have either successfully completed a programme leading to a Level 5 QQI qualification or can demonstrate the levels of knowledge, skills and competence associated with NFQ Level 5 will be eligible to apply for entry to this programme. Learners will not be expected to have prior knowledge of the circular economy on entry to the programme, but they will be expected to demonstrate an interest in the field.

COURSE CONTENT

Title	Award	Awarding Body
The Circular Economy in the Workplace	The Circular Economy in the Workplace (6N22104)	QQI

LEARNING OUTCOMES

On successful completion of the award in The Circular Economy in the Workplace you will be able to:
1. Explain the context and main concepts of the circular economy
2. Apply circular thinking concepts to identify circular economy improvement actions in the workplace
3. Analyse the potential impacts of circular economy improvement actions within (a) business
4. Develop a business case for circular economy improvement actions

FURTHER DETAILS

This course will run on Thursdays from 09.00 to 13.00 8 weeks.

The first class will be in person in Cork College of FET- Bishopstown Campus, and the rest completed online in live online classes.

Learners should have access to a PC / Mac, so as to be able to fully participate in the course and in order to complete the assessments

Applicants who come from outside the European Economic Area (EEA) must have a Stamp 4 or a Labour Market Permissions Letter to undertake a course with Cork College of FET-Bishopstown Campus.

A good standard of written and spoken English is essential to attend this course as Learners must complete a written assessment as part of the course.

Links open in new window

SEARCH RESULTS

Qualifications

The Circular Economy in the Workplace

Location

Bishopstown Campus, Cork College of FET

Cork College of FET Bishopstown Campus
Cork College of FET Bishopstown Campus
Rossa Avenue

Bishopstown

Cork City

Start Date 27/02/2025
End Date 24/04/2025
Duration 8 Weeks

TimeTable

day	Morning	Afternoon	Evening
Mon			
Tue			
Wed			
Thur	✓		
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Sat			
Sun			

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6.3.2. **Estonia**

Estonia's Education Strategy 2021-35 views the introduction of 'microqualifications and learning bites' as one of the most fundamental changes in education. The Strategy called for creating 'the conditions for learners to benefit from a learning pathway consisting of smaller modules (e.g. microcredentials, learning bites) and meeting their needs and abilities' and for 'greater recognition of non-formal and informal learning in formal

education' ([24]). Estonia followed New Zealand's approach to set up the quality assurance system and that of Ireland to integrate the micro-qualifications system in the national qualifications framework ([25]).

As part of an initiative to support the economy in the green transition, new microcredential programmes focused on green skills are being developed. They cover areas such as transport, energy, agriculture, food processing, construction, chemical technology, materials processing, environmental sciences and waste management (ReferNet Estonia; Cedefop, 2023).

6.3.3. Res4city project

The Res4city project aims to accelerate and mainstream the development of sustainable renewables and fuel technologies in cities via education. The project develops an innovative education programme in collaboration with stakeholders and promotes sustainability and circularity by filling the knowledge and skills gaps. A range of innovative educational micro-programmes and microcredentials for students and employees are being developed for cities, which are hubs for the green transition (Cedefop, 2022d). Micro-programmes developed as part of the project target urban communities. They include Advanced Design of Sustainable Cities, Decarbonization Strategies and Social Innovation for Cities and Communities, and the sector-specific programme Innovation in the Urban Energy Sector.

6.3.4. GREENLAB project

The Erasmus+ GREENLAB project – Greening Labour market through VET – employers' partnerships ([26]) promotes systemic reform of education and professional training via innovative approaches to enhance the skills of managers and consultants engaged in strategic areas of the green transition. It was started by a consortium of eleven partners from six EU countries. The MCs developed target learners' professional development and build environmentally conscious mindsets. Linking VET with the business world also facilitates the recognition and transferability of skills and qualifications across sectors.

6.3.5. Green at You project

The EU-funded Green at You project links to microcredential scenario 4 (Table 4). It aims to empower groups at risk of social exclusion and to expand female participation in 'green' sectors by equipping learners with the essential skills for green and digital jobs in five frontline green transition sectors: agriculture and food production, renewable energies, sustainable construction and building rehabilitation, circular economy and forestry. Building on expert input, the project identifies the skills key for jobs in these sectors and uses EU Competence Frameworks (EntreComp, GreenComp and DigComp) to identify transversal competences. The project will develop, and pilot 58 training modules supported by microcredentials and will train and improve the employability or entrepreneurship skills of 480 people at risk of exclusion in Europe: 240 face-to-face with trainers trained by the project and 240 via the Green at you MOOC ([27]).

6.3.6. MASTERY project

Aiming at making the green transition a development driver for business and communities, the MASTERY project aspires to set the standard for the integration of microcredentials to meet the growing demand for upgrading and reskilling in strategic sectors. It focuses on frontline transition sectors such as agri-food, construction, wood/furniture and manufacturing. One of the highlights of the project is the MASTERY Collection of 12 Green Skills Microcredentials, which cover a wide range of skills needed to

([24]) Estonian Education strategy 2021-2035, p.2.
([25]) Study on Possibilities for the Introduction of Micro-Qualifications in the Estonian Education System and Qualifications System Based on International Practice. In Estonian: https://www.hm.ee/sites/default/files/aruanne_mikrokvalifikatsioonid_2021.pdf
([26]) The project is funded by Erasmus+ Programme – Partnerships for Innovation – Forward-Looking Projects – Vocational Education and Training (VET).
([27]) The project builds on the results already generated by the Green Jobs Platform in Spain, providing more specific content to expand its training offer in specific subsectors and facilitating the transfer of the successful elements of this initiative to other European countries. Source: Green at you

promote sustainable practices in these sectors. Designed to be flexible and adaptable to sectoral needs, these microcredentials provide a clear pathway to professional upgrading in key areas of sustainability.

6.3.7. Green Circle: Microcredentials in the Construction Sector

The aim of the Green Circle is to identify, develop, test and assess the use of microcredentials in the context of the green transition in the construction sector. The project also demonstrates the potential for mainstreaming microcredentials in other sectors. It involves mapping job profiles, learning needs and opportunities to facilitate the development of a microcredential-based skills ecosystem. The project includes:

(a) a systematic review of existing short courses and microcredentials;
(b) a framework for the implementation of microcredentials;
(c) a catalogue of skills for the green transition;
(d) microcredential principles and open design methodology;
(e) guidelines for new forms of assessment.

Eight microcredentials have been developed and piloted in Germany, Greece, Spain and Portugal.

6.3.8. Microcredentials in Denmark

Danish employer organisation TEKNIQ cooperated with the Trade Union for Electricians, the Trade Union of Plumbers and Allied Workers and the public employment services to develop two microcredentials. They target long-term unemployed and low-qualified workers and give them opportunities to become cable and pipe fitters. The Microcredentials help meet the increased demand for these occupations the green transition is creating. The courses are offered via the Danish AMU labour market training system. Experience so far suggests the majority who are trained as cable and pipe fitters find a job with good prospects (Cedefop, 2023e).

CHAPTER 7.

Validation of prior knowledge for a just green transition

7.1. Understanding the basics

Learning outside formal education or training institutions, in non-formal and informal settings accounts for much of learning in adult life. According to Eurostat's adult education survey, almost 40% of the EU adult population participates in non-formal learning and almost 65% takes part in informal learning. Only around 7% engages in formal learning ([28]). Much of non-formal and informal learning remains out of sight. Individuals face challenges in leveraging it to ease work or education transitions. When accessing an education programme or changing jobs or careers, admission officers or recruiters are not able to 'see' non-formal and informal learning that has not been properly certified. They might also have difficulties understanding the value of certain types of certificates obtained outside formal education.

Validation is a process that makes all learning visible and gives it value (Cedefop, 2023g). It also makes an education and learning system more inclusive of learning achieved outside of school, establishes equivalencies of learning outcomes achieved through non-formal and informal learning to national qualifications and awards, and therefore allows such knowledge and skills to be more socially accepted. Pathways for further learning progression, including options for (re-) entry into formal education are additional potential benefits (UNESCO, 2022b).

Spearheaded by EU VET policy priorities and cooperation, European countries have developed and established arrangements to validate non-formal and informal forms of learning (Box 23). In the transition to the green economy, validation can play a major role: many workers have acquired skills informally through work experience but lack the proper certification or qualification to demonstrate this. While they may possess the skills and competences giving them access to new or emerging occupations in the green economy, finding their way to a new career or new jobs may be difficult because their skills and competences are not visible.

Box 24. **Definition/state of play of validation of non-formal and informal learning in the EU**

'Validation is a process of confirmation by an authorised body that an individual has acquired learning outcomes measured against a relevant standard' (Council of the European Union, 2012). It consists of four distinct phases: identification, documentation, assessment, and certification of learning outcomes. This definition was agreed by Member States in the 2012 Recommendation of the Council, helping the formulation of a common understanding across Europe (European Commission, 2020, ICF, & 3s Unternehmensberatung GmbH. 2020). The four stages allow for certain flexibility of the concept, so that it can be adapted to the specific context in each Member State and address the diverse needs of individuals.

The European guidelines on validation provide an in-depth discussion of the principles in the Recommendation and provide stakeholders with the questions necessary to design, develop, implement and evaluate validation of non-formal and informal arrangements. The guidelines have been updated three times (Cedefop, 2009, 2015, 2023).

([28]) Eurostat. (2024). Participation rate in education and training by sex, and Eurostat. (2024). Participation rate in informal learning by learning form and sex

The aim of the European inventory on validation is to inform dialogue and learning between countries and stakeholders developing and implementing validation in Europe. The inventory presents the situation in each country and includes validation arrangements for education and training contexts within labour market initiatives, such as those led by sectorial organisations, chambers of commerce or employers and civil society organisations. It also covers validation arrangements undertaken by the third sector typically led by youth, NGOs or organisations of volunteers. There have been 8 updates of the inventory so far (Cedefop, 2024e).

The latest (2023) update of the inventory (European Commission and Cedefop, 2024e) shows that, while take up and practical implementation of validation remain challenging, all EU countries have at least some validation arrangements in place. This means that there are possibilities for individuals to identify, document, assess and/or certify their prior learning in all countries for some sectors and qualifications. The inventory also reveals consolidation of the legal bases for validation, which could be interpreted as the field being ready for the next step: focus on implementation, deployment of resources, and capacity building.

The 2023 inventory update includes a thematic report on validation and the green economy (Scott, 2024). The report concludes that validation is not explicitly featured as a way to deliver on demand for green skills and is not a significant explicit component of European green transition policies. The frequent reference to upskilling and reskilling in such policies opens up opportunities to connect validation to the green transition that should be further explored.

Source: Authors.

7.2. How validation can contribute to green transition

While there are still differences among EU countries, existing validation processes can (and should) be used to enable and accelerate upskilling and reskilling for the green transition. There are three ways existing validation processes can be used for this purpose:

(a) validation as a route to obtain qualifications or certificates related to skills for green transition;
(b) validation to provide access to green transition jobs based on prior learning and experience;
(c) validation to reskill or redeploy workers in occupations or sectors where employment shrinks due to the green transition.

7.2.1. Validation as a route to obtain qualifications or certificates related to skills for green transition

Education, VET and skills policy-makers and other stakeholders respond to the green transition skill needs by adapting or developing new education programmes and qualifications. This can entail developing new full programmes, partial qualifications, additions to the curriculum in existing programmes or microcredentials (see UNEVOC-Cedefop practical guide (Volume 1) and Chapter 6 of this guide). Offering training as modules and using learning outcomes approaches to qualifications contributes to more flexible education and training systems and improves their capacity to respond to the needs of the green transition. Validation can be a route to formally access or acquire green skills via 'green(er)' certificates, reducing training duration and speeding up the process of up or re-skilling.

Box 25. **Validation to reduce programme duration**

In Ireland, a new Sustainable Farming Academy was launched at the University College Cork (UCC) Adult Continuing Education unit. UCC established a partnership with a local company in the food industry and agreed to deliver its existing Diploma programme in Environment, Sustainability and Climate to 20 participants per year. The programme duration has been reduced to one year for employees, considering they have already achieved learning outcomes

for three existing modules through in-company-training. This amounts to 50% of the duration of the entire formal programme (30 credits).

Source: Scott, 2024. 2023 European inventory on validation.

New training courses contributing to skills for the green transition can be offered by different types of providers, ranging from public education institutions to private in-company-training providers, NGOs or civil society organisations. The diversity in provision of emerging certifications may hinder understanding of their value and their level of complexity. It is important for establishing connections of the new programmes to qualification frameworks, so that the field and level of the certificate and its value can be understood in relation to formal qualifications. Portugal included four new short and medium-term courses developing skills for the green transition, targeting mainly the low-skilled and the unemployed in the National Catalogue of Qualifications in 2023. There are now courses available in solar energy, wind energy, photovoltaics, sustainable agriculture, and hydrogen. The courses allow candidates to attain and stack credits/units through validation (Scott, 2024).

7.2.2. Access to green transition jobs through validation of prior learning and experience

Some frontline green economy occupations (e.g. recycling specialists ([29]), electricians in some countries) are regulated or will be soon because the state, the sector or professional association sets specific certification or qualification requirements to carry out the work. When access to such occupations is not formally regulated by law, a sector and/or companies may require particular qualifications or certificates. Validation processes can ease access to these occupations by allowing people to demonstrate they have the required skills.

Box 26. **National validation initiatives**

In 2021, the Finnish Open Badge Factory established 'climate badges' that allowed learners to show that they have acquired climate competences contributing to community level climate action. The badges help learners show the skills and competences they have acquired in NGOs, when volunteering, or in other contexts, and enable validation in formal education and training. An employer can use the information on the badge to recruit people with particular green transition skills.

Europe's largest car parts supplier (Bosch) has allocated around EUR 2bn over the course of a decade to retrain some of its employees. Skilled workers from combustion technology are being reskilled to work in electric mobility, to limit job losses as the industry switches from combustion engines to battery technology. The identification and assessment of staff profiles and skills inform retraining.

Source: Scott, 2024.

7.2.3. Transfer to new occupations: validation to reskill or redeploy workers

Validation processes can also ease workers' transitions from one economic sector or occupation to another. This often involves workers transitioning from sectors losing jobs in the transition (e.g. parts of mining) to sectors for which green transition is a driver of growth and employment. For example, construction workers can benefit from having their skills and competences validated because it opens access to training on renovating buildings and raising energy efficiency standards in construction (Scott, 2024). Enabling just transitions for those most at risk of unemployment or task destruction helps people maintain their job, reshape it, or gain new employment. Using skillsets to guide such transitions is vital

([29]) Report on skills needs for the green transition: skills for the Green transition (development of Competence Units/Curriculum)

for the energy transition (IEA, 2023).

7.3. Using skills overlaps to guide validation processes

Skills intelligence – the result of skills anticipation – (see Chapter 1) is a good a starting point for the validation of prior learning acquired through work experience, because it identifies the skills workers in transition need to possess. Transition is moving to a 'greener' occupation or any other occupation with positive employment prospects. Big data on skills extracted from online job advertisements (OJAs) and data on skills provided by taxonomies such as ESCO can be used to guide transitions. Such data help identify skill overlaps between occupations in decline and occupations that benefit from green transition or have positive employment prospects for another reason. Mapping skills transferability eases workers' transitions and can speed up filling job positions for 'green' occupations in high demand, such as urban planners, and renewable energy professionals.

The potential of using skills data in the context of transition can readily be demonstrated using ESCO. Comparing the skills profile of a source occupation (the occupation a worker currently practices) with that of a target occupation (the occupation a worker could transition to) gives an impression of the skill similarity between the two.

The approach described can be used to reflect on how to meet increasing demand for occupations critical for the green transition, such as urban planners linked to the proliferation of smart green cities (Cedefop, 2022d). The same can be done for solar energy technicians and offshore renewable energy plant operators – examples of renewable energy occupations with high demand – and with any other occupation. Table 7.1 illustrates how this can work in practice. It shows the essential ESCO skills that are common between target occupations and several selected source occupations. Using validation processes to recognise (and when needed, certify) at least some of these shared skills can clarify in which areas training is needed and expedite workers' transitions. The increased transparency in terms of possibilities can also boost the attractiveness of occupations in shortage, shorten training duration and increase training efficiency.

Table 6. **Common essential skills between target and source occupations: selected examples**

Target occupation	Source occupation	Essential skills in common
Urban planner	Civil engineer	'synthesise information', 'think abstractly', 'demonstrate disciplinary expertise', 'interact professionally in research and professional environments', 'manage research data', 'operate open source software', 'perform project management', 'manage personal professional development'
	Geographer	'synthesise information', 'evaluate research activities', 'manage findable accessible interoperable and reusable data', 'manage research data', 'speak different languages', 'operate open source software', 'perform scientific research', 'manage open publications', 'communicate with a non-scientific audience ', 'promote open innovation in research', 'mentor individuals', 'think abstractly', 'promote the participation of citizens in scientific and research activities', 'promote the transfer of knowledge', 'use geographic information systems', 'manage personal professional development', 'apply for research funding', 'apply research ethics and scientific integrity principles in research activities', 'develop professional network with researchers and scientists', 'draft scientific or academic papers and technical documentation', 'disseminate results to the scientific community', 'manage intellectual property rights', 'integrate gender dimension in research', 'demonstrate disciplinary expertise', 'interact professionally in research and professional environments', 'conduct research across disciplines', 'perform project management', 'publish academic research', 'increase the impact of science on policy and society '

Solar energy technician	Building electrician	'install electrical and electronic equipment', 'work ergonomically', 'electrical wiring plans', 'follow health and safety procedures in construction', 'inspect construction supplies', 'test procedures in electricity transmission', 'inspect electrical supplies', 'electricity', 'use measurement instruments'
	Security alarm technician	'check compatibility of materials', 'install electrical and electronic equipment', 'work ergonomically', 'electrical wiring plans', 'follow health and safety procedures in construction', 'inspect construction supplies', 'inspect electrical supplies', 'electricity', 'use measurement instruments'
Offshore renewable energy plant operator	Fossil-fuel power plant operator	'electrical power safety regulations', 'monitor electric generators', 'electric generators', 'maintain electrical equipment', 'apply health and safety standards', 'mechanics', 'electricity'
	Power production plant operator	'electrical power safety regulations', 'monitor electric generators', 'electric generators', 'maintain electrical equipment', 'conduct routine machinery checks', 'ensure equipment maintenance', 'use remote control equipment', 'respond to electrical power contingencies', 'mechanics', 'electricity'

Source: Cedefop analysis based on ESCO data.

The occupations explored overlap in terms of soft skills and also technical ones. Examples of skills shared with Urban planners include 'manage research data', 'operate open source software', and 'perform project management' for civil engineers; 'speak different languages', 'operate open source software', 'perform scientific research', 'manage open publications' for geographers; and – for power production plant operators – 'install electrical and electronic equipment', 'work ergonomically', 'electrical wiring plans', 'follow health and safety procedures in construction' for building electricians and 'electrical power safety regulations', 'monitor electric generators'. Common technical skills, some of them job-specific, can be more easily validated compared to soft skills through existing arrangements.

Box 27. **Limitations**

ESCO offers a rich list of skills per occupation; yet, these cannot be considered comprehensive in all contexts and job situations. National/regional circumstances must be taken into account when designing workers' transitions between occupations. Assesing the ease of transition across two occupations in terms of their required skills should be treated with caution. It only captures the raw number of the ESCO-listed skills required for both occupations, making no qualitative distinction with respect to (a) the importance of the intersected (or missing from the target occupation) skills for performing a particular role, and (b) the qualifications and/or the necessary training process/time needed to transition from the source to the target occupation by acquiring a missing skill.

Source: Cedefop.

7.4. Lessons on tapping the benefits of validation

The last edition of the European inventory on validation shows that, in many countries, the legal basis for validation and the system operation is clear. More needs to be done to reach out to people and tap the full potential of validation. Research on methodologies for identifying, documenting, assessing and certifying needs to be expanded to create consensus on how to best implement validation across Europe (Cedefop and European Commission, 2024e).

Validation arrangements provide the necessary conditions to speed up the process of redeploying workers negatively affected by green transition. Starting from what workers already know and can do helps tailor training offers to training needs, reduces of time to training completion, and contributes to building a more competitive and an up-to-date work force. The European guidelines (Cedefop, 2023g) provide a blueprint of the most relevant aspects to consider in putting in place sustainable and quality

assured validation arrangements that build on existing ones. Stakeholder collaboration, particularly between authorities and labour market actors, will be central to adapting existing validation processes in line with sectoral needs.

Comparing occupations in terms of skills profiles gives insight into the similarity between different occupations. Such analysis can facilitate transitions and the training they require when some occupations are diminishing, while others are growing. By validating the skills acquired through experience, the time needed for training towards a new occupation will be reduced. This can create efficiency gains and helps cushion the negative impacts of green transition induced changes in occupations and skills requirements.

Using big data to shape transitions is promising, but the human in the loop will remain vital. Experts in skills and on occupations and sectors need to be involved in mapping skills and skills overlaps. Big data-based skills intelligence is most powerful when it is matched with findings based on other skills anticipation methods. Local needs and realities need to be considered. Finally, it is crucial to make people aware of validation opportunities, so that they can take full advantage of their prior learning and develop capacity to identify career change and progression that work for them. Career guidance practitioners play an important role in mainstreaming validation practices and leveraging their full potential in the green transition.

CHAPTER 8.

AI supporting greener VET

Artificial intelligence is reshaping vocational education and training and having transformative labour market impacts. While not many countries have embarked on systematic approaches to integrating AI solutions across VET, several initiatives have emerged. Such initiatives often train teachers or trainers in AI or use the technology to update programme content and teaching tools.

However, the transformative potential of AI is even more far reaching. AI can be used in skills anticipation to identify emerging skill and job needs (Cedefop, 2021c) and to reform or update curricula. It can also improve accessibility, facilitate innovation in learning processes, personalise training content and delivery (Cedefop, 2024b). AI also supports the integration of new tools that support new tasks and roles related to the green transition, such as the example of system analysts (Cedefop, 2024c).

When it comes to updating VET to meet green transition skills needs, AI can be a strong ally. The technology offers broad opportunities to make VET more responsive to pressing and, in some cases, frequent changes linked to emerging green technologies and their implementation, and developments in regulatory frameworks for sustainability. It also enables shifts towards circular production models and more eco-friendly consumer behaviours. Leveraging the benefits of implementing AI in VET and education and training more broadly brings responsibility. Before AI implementation, education and training institutions must reflect on their use of AI in programmes to ensure that they are ethical, fair, diverse and driven by investment in sustainable development (Shiohira, 2021).

8.1. Using AI to 'green' training content and better prepare teachers

The green transition means that VET needs to adapt to and address skill needs. Such action may be linked to emerging greener technologies and business models companies have introduced on their own initiative, customer preferences evolving towards more sustainable products and services, or regulatory change that affects how companies operate and do business. Such changes and their implications for skills can be reflected in VET content by renewing occupational profiles, introducing new qualifications and training standards, or updating existing ones.

Identifying, correctly interpreting, and keeping up with sustainability-driven skills trends is a major challenge for VET stakeholders: at the design level, where such trends need to be promptly and correctly translated into policy, updated or new qualifications, curricula, and teacher training, and at the implementation level, where VET providers and companies need to adapt VET delivery. Lacking coherent guidance on how to facilitate VET adaptation and renewal often frustrates efforts by VET stakeholders, teachers and in-company trainers.

Box 28. **National initiatives for AI in education**

In Luxembourg, the National Education Training Institute (IFEN) started offering conferences and seminars about AI and related tools as part of its ICT teacher training course offer in March 2023. In the 2023/24 school year, the institute introduced massive open online courses (MOOCs) and blended learning formats to supplement face-to-face AI teacher training. The IFEN's AI teacher training courses include:

- chat about ChatGPT and AI;
- demystifying AI and ChatGPT;
- AI, ethics and future-proofing the classroom;
- introduction to generative AI: using ChatGPT to optimise teacher preparation.

Some secondary schools have requested IFEN to offer tailor-made training courses focusing on AI in ICT and in other domains such as art, and language teaching. IFEN also offers on-the-job support delivered by trainers specialising in digital skills to help teachers familiarise themselves with the use of AI tools.

Source: ReferNet Luxembourg, & Cedefop (2024) Luxembourg: AI training for teachers.

In Germany, the programme for digitalisation in inter-company vocational training centres of the BIBB developed the SilA project (simulation-based and immersive learning). The project develops and implements practical learning and work experience based on AI for agriculture training. The project team developed digitally supported demonstrators that enable standardised, hands-on practice of dehorning and on-farm emergency slaughter (OFES) without direct animal contact. This helps prospective farmers learn how to handle farm animals in ways that minimise stress for them.

Source: ReferNet Germany; Cedefop (2022). Germany: virtual reality, AI and other digital technologies in VET.

An Australian Framework for Generative AI in Schools was released for consultation in mid-2023 to guide teachers and students on how to use GAI tools in a safe, responsible, and ethical way. Following the approval of the framework by all education minister, AI, including ChatGPT, is allowed in all Australian schools from 2024 onwards. The Framework seeks to guide the responsible and ethical use of generative AI tools in ways that benefit students, schools, and society, supporting school leaders, teachers, support staff, service providers, parents, guardians, students and policy makers.

Source: Australian Framework for Generative Artificial Intelligence (AI) in Schools.

There is no comprehensive evidence on the extent to which AI supports VET teachers, but initial indications are positive. Teachers seem to welcome the opportunities AI offers in supporting them when it comes to updating programme content and tools, because the technology helps them better manage their limited time and the many different roles beyond teaching. A call for evidence of the UK government showed that teachers using Generative AI reported it freed up time and enhanced teaching effectiveness. According to a survey conducted by Oxford University Press, 68% of school teachers in the UK and 69% of English language teachers in Europe acknowledge the benefits of AI in education. While they are aware of risks, such as learners not recognising errors, plagiarism, and over-reliance on devices, UK and European teachers point towards two major benefits of generative AI:

(a) its support to ease workload: 'Teachers using GenAI tools in their role felt they were able to save time by automating tasks. Quicker lesson planning, scheduling, note-taking, marking, content creation and report writing led to significant time savings for some (though time was still required to check and edit outputs). As a result of saving time on tasks by using GenAI, some reported spending more time doing work that they believed to be 'more impactful' (Department for Education, 2023), and
(b) its potential for personalisation and adaptation to individual learners or learner groups. In a landscape of significant shortages of teaching staff, the potential of AI for lightening the load of the already stretched teaching workforce is increasingly acknowledged.

Reshaping programme content and curricula so that they stay aligned with industry trends and

regulatory requirements starts with analysis of labour market trends, job postings and legislative documents to identify skills in demand (Chapter 1). AI can assist VET stakeholders in using the results of labour market and skills analysis to include learning objectives related to sustainability via qualifications and training standards updates. Practically, this can work by requesting an AI prompt to identify what needs to be added or updated to a curriculum (Box 8.2). AI can support subject matter experts in this process, but not replace them. Generative AI can also help teachers and in-company apprenticeship trainers integrate green elements in course materials to reflect evolving regulation and industry standards and emerging technologies. It can also provide insight into how adult training courses supporting transition can be designed. To aid teachers and trainers to take informed decisions on course content and learning methods, using and interpreting GenAI tools and input must become part of teachers' and trainers' initial and continuous educational programmes.

Box 29. **Examples of using generative AI to shape VET for the green transition**

Prompt: identify what needs to be added to the secondary vocational training curriculum of electrical engineers in relation to smart grid

Response: to prepare electrical engineering students effectively for the evolving demands of smart grid technology, the secondary vocational training curriculum should include the following key components.

1. Introduction to smart grids
   – Basic concepts and definitions.
   – Differences between traditional grids and smart grids.
   – Benefits and challenges of smart grids.
2. Smart grid technologies
   – Advanced metering infrastructure (AMI).
   – Distributed energy resources (DERs) integration.
   – Energy storage systems.
   – Electric vehicle (EV) integration.
3. Communication and data management
   – Communication protocols and standards (e.g. IEC 61850).
   – Cybersecurity measures for smart grids.
   – Data analytics and management for grid optimization.
4. Smart grid components and architecture
   – Smart sensors and devices.
   – Grid automation and control systems.
   – Microgrids and their management.
5. Renewable energy integration
   – Solar, wind, and other renewable energy sources.
   – Grid-tied and off-grid systems.
   – Impact of renewable energy on grid stability and reliability.
6. Regulations and standards
   – National and international standards for smart grids.
   – Regulatory frameworks and policies.
7. Practical training and simulations
   – Hands-on training with smart grid technologies.
   – Simulation tools for grid management and optimization.
   – Case studies and real-world applications.
8. Project-based learning
   – Capstone projects focused on smart grid solutions.
   – Collaboration with industry partners for practical experience.

Incorporating these elements will ensure that students are well-equipped with the knowledge and skills needed to work with smart grid technologies and contribute to the modernisation of electrical power systems.

Source: Conversation with Copilot ([30]), 2.8.2024

Prompt: Can you suggest some activities or tools for a course that helps adult learners become more familiar with city planning and waste management.

Response: That sounds like a fantastic initiative! Here are some simulations and activities that can help adults explore city planning and waste management:

a. City Planning Simulations and Activities

1. SimCities: This simulation uses data-driven models to help urban planners anticipate the impact of urban development programs. It allows users to predict effects on land valuation, employment patterns, and transportation mode choices, making it a valuable tool for understanding the complexities of city planning
2. City-Building Games: Games like **Cities: Skylines**, **SimCity**, and **Pocket City** offer immersive experiences in urban planning. These games allow users to design and manage cities, dealing with challenges like traffic congestion, pollution, and resource management[2].
3. Digital Twins: These are virtual replicas of physical cities that can be used for scenario planning. They help in public engagement, zoning, and development, and can assist in reaching local climate resilience, economic development, and housing goals[3].

b. Waste Management Simulations and Activities

1. Waste Management Simulation Software: Tools like **Solid Waste Management Simulation (SWMS)** allow users to simulate waste collection, transportation, and disposal processes. These simulations can help in understanding the logistics and economics of waste management.
2. Interactive Workshops: Conduct workshops where participants can engage in activities like waste audits, recycling challenges, and designing waste reduction plans. These hands-on activities can provide practical insights into waste management practices.
3. Virtual Reality (VR) Experiences: VR simulations can offer immersive experiences in waste management, allowing users to explore recycling plants, landfills, and composting facilities. This can be a powerful way to visualize the impact of waste management decisions.

Source: Conversation with Copilot ([31]), 2.8.2024

8.2. Using AI to personalise training for sustainability

Younger cohorts of learners tend to be more interested in sustainability related matters and more motivated to reflect such interests in their vocational education and training and career choices. This is an asset AI can help expand. Using AI to personalise core programme aspects such as curricula and syllabi in line with learner interests helps tap the full potential of the young generation's contribution to

([30]) Sources used by copilot: Sources used by copilot:
- Modernizing the Smart Grid Course Program – IEEE Innovation at Work;
- MSc Electrical Power and Smart Grids – University of Exeter;
- Free Power Engineering Tutorial – Smart Grid Technologies;
- Electrical Power Grid Modernization: Smart Grid Concepts;
- Conceptual understanding of electrical circuits in secondary vocational ....;
- New engineering qualifications for 14- to 16-year-olds – GOV.UK;
- Admission – WBSCTVESD;
- The Electrical Engineering Degree Guide: Pathways and Potentials;
- Competency based curriculum electrician – DGT;
- Conceptual Understanding of Electrical Circuits in Secondary Vocational Engineering Education

([31]) Sources used by copilot:
- SimCities: Designing Smart Cities through Data-Driven Simulation;
- The 15 best city building games to play today | GamesRadar+;
- Smart City Digital Twins Are a New Tool for Scenario Planning.

the green transition.

This also applies in the context of up and reskilling adults to strengthen employability and career prospects in economies the green transition transforms. Chapter 6 showed how recognition of prior learning and validation can shorten training duration and help adults get (re)qualified faster. Coupling this with AI tools that tailor the adult training to the learner backgrounds, profiles, limitations, and strengths, further improves the efficiency and effectiveness of up- and reskilling.

AI is the most recent addition to the portfolio of digital technologies such as augmented reality (AR) and virtual reality (VR) that help create engaging and immersive training experiences (Cedefop, 2024b). AI supports simulations, which help learners associate with the content of training because they are placed at the centre of a scenario that has personal meaning for them. An example is creating a digital replica of a real-life location which helps learners understand how climate change will impact a region (Rolnick et al., 2022). This strengthens motivation and makes learners eager to maximise the acquisition of knowledge about greening through their VET programme.

Simulations also give learners the opportunity to practice their technical skills in virtual environments, which is risk-free, saves resources and help learners and teachers pay more attention to the components of learning that they find more interesting or challenging.

Box 30. **AI-powered VET innovation in Germany**

The German Federal Institute for Vocational Education and Training (BIBB) and the German Office for International Cooperation in Vocational Education and Training (GOVET) have extensively researched integrating AI into vocational training. Their work focuses on developing AI-driven tools that automate competence assessment and personalise training, demonstrating substantial improvements in training outcomes and efficiency.

Source: TVET and AI: Crafting the Future of Vocational Training.

The InnoVET KI B3 project run by BIBB integrates AI in initial and continuing VET. A central task in the project is to identify which teaching content on AI is relevant for VET. AI specialists and managers must be educated and trained to be able to assess the potential of digital techniques in the VET learning process. The project aims at integrating the required competences into VET programmes. Three newly developed qualifications (ZQ) at EQF 5/6 level, integrate the topic of AI into initial and continuing VET.

Source: ReferNet Germany, & Cedefop. (2022). Germany: virtual reality, AI and other digital technologies in VET.

AI has also been used to adapt training material and texts to the specific needs and backgrounds of learner groups. For example, VET teachers can use an AI prompt to adapt the text of a module to the language knowledge level of adult migrants or refugees who are still learning the language. In a similar vein, AI can help in-company trainers customise training materials they use to train staff with experience in new green technologies and tools to the knowledge and expertise level of younger and less experienced apprentices or interns.

On top of personalising training per se, AI can also offer personalised career advice, based on learner interests, prior knowledge, experience profile and labour market opportunities. This facilitates the work of career guidance practitioners, because AI provides additional insight that helps them better support people in making personal learning and career choices.

Box 31. **Example of an AI prompt providing advice for green transition careers**

Prompt: I am 15 years old living in Ireland. Would a career as an installer of photovoltaic panels be promising? Can I get qualified as a photovoltaic panel installer through an apprenticeship?

Response: A career as a photovoltaic (PV) panel installer in Ireland looks quite promising! The renewable energy sector is growing rapidly, and there's a strong demand for skilled professionals in this field. Ireland is committed to increasing its renewable energy capacity, which includes solar energy, making it a great time to enter this industry.

You can indeed get qualified as a PV panel installer through various training programs and apprenticeships. Many training providers offer courses that cover both theoretical knowledge and practical skills needed for installing solar panels safely and efficiently. For example, the QQI Level 6 courses in Micro Solar Photovoltaic Systems Implementation and Electrical Installation and Commissioning of Micro Generators are popular options.

Additionally, apprenticeships are a great way to gain hands-on experience while learning from experienced professionals. You can look for apprenticeship opportunities with companies that specialize in solar panel installations or through industry associations like the Irish Solar Energy Association (ISEA).

If you're passionate about renewable energy and enjoy working with your hands, this could be a very rewarding career path for you! Do you have any specific questions about the training or the job itself?

Source: Conversation with Copilot ([32]), 2.8.2024

([32]) Sources from copilot:
- Solar Panel Installation Training and Certification In Ireland;
- Domestic Solar PV Course | Chevron Training;
- QQI Domestic Solar PV Course – Find a Course;
- Irish Solar Energy Association;
- Bing search: photovoltaic panel installer apprenticeship Ireland;
- Nusolas Ltd.;
- Solarfix NI Ltd.;
- Micro Solar Photovoltaic Systems Implementation – Metac Training;
- Bing search: career prospects photovoltaic panel installer apprenticeship Ireland;
- Ryan Energy;
- Solar Panel jobs in Ireland – Indeed;
- 21 Solar Panel Installation Jobs – 29 July 2024 | Indeed.com.

Acronyms

AI	artificial intelligence
Cedefop	European Centre for the Development of Vocational Training
CoVE	centres of vocational excellence
CVET	continuing vocational education and training
EGD	European Green Deal
EQF	European Qualifications Framework
ESCO	European Classification of Occupations, Skills and Competences
ETF	European Training Foundation
GenAI	generative AI
ICT	information and communication technology
ISCO	International Standard Classification of Occupations
IVET	initial vocational education and training
MCs	Microcredentials
NACE	statistical classification of economic activities (Nomenclature statistique des activités économiques dans la Communauté Européenne)
OJA	online job advertisement
O*NET	Occupational Information Network
PESTLE	political, economic, social, technological, legal and environmental factors
RRP	Recovery and Resilience Plan
SDG	Sustainable Development Goals
SME	small and medium-sized enterprises
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-UNEVOC	UNESCO – International Centre for Technical and Vocational Education and Training
VET	vocational education and training
WIH-OJA	web intelligence hub online job advertisement

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EN

Meeting skill needs for the green transition

Skills anticipation and VET for a greener future

Cedefop-UNEVOC practical guide 4

This publication, the fourth in a series of practical Cedefop skills anticipation guides, was developed in collaboration with UNESCO-UNEVOC. It focuses on skills intelligence and VET for the green transition.

The guide highlights the value of sound skills intelligence and smart governance in supporting the green transition, showcasing how VET can make a practical impact. It explains how skills anticipation and governance can drive greening efforts, and how apprenticeship, upskilling, reskilling, validation, and microcredentials can contribute to a greener future.

Good practice examples from Europe and beyond illustrate how to translate green ambitions for VET and skills into policy implementation.

The insights and examples in this publication complement the strategies and resources jointly showcased by UNESCO-UNEVOC and Cedefop in an accompanying guide, further supporting the vision of a greener and more innovative VET system.

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