EUROPEAN SKILLS & VET WEEK 2026

CEDEFOP

New careers in the green transition

Using online job advertisements to track emerging jobs and skills

POLICY BRIEF

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POLICY BACKGROUND

In this section

What is driving the green transition in the EU?

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The green transition in the European Union is a transformation, anchored in legislation and strategically coordinated, of the EU's economic model aimed at achieving climate neutrality, competitiveness and energy security. The transition is grounded in the European Climate Law, which commits the EU to achieving net zero greenhouse gas emissions by 2050, and operationalised through the European Green Deal and the related legislative packages, including the Fit for 55 package. The transition encompasses systemic reforms across energy, industry, transport, agriculture, finance and infrastructure, and it combines decarbonisation measures with changes to industrial policy and regulatory expansion.

Following increased geopolitical tensions, initiatives such as the repower EU plan have placed the green transition at the heart of strategic autonomy and energy security. The transition has come to transcend environmental goals and now encompasses comprehensive economic, regulatory and geopolitical restructuring to secure long-term sustainability, resilience and global competitiveness.

The EU has established a framework of measures to support the clean energy technology (clean tech) industry, as set out in the 2024 Net-Zero Industry Act. The act forms part of a strategic shift from climate target setting towards industrial capacity building. It aims to strengthen the EU's domestic manufacturing of key net-zero technologies, such as solar panels, wind turbines, heat pumps, batteries, hydrogen equipment and carbon capture systems. The framework also seeks to reduce external dependencies and enhance economic resilience.

Introduced in response to increased global subsidy competition and supply chain vulnerabilities, the Net-Zero Industry Act seeks to streamline permitting procedures, facilitate access to financing and set benchmarks to ensure that a significant share of clean tech is produced in the EU. The act integrates environmental objectives as the foundation of the EU's competitiveness and strategic autonomy agenda and aligns decarbonisation objectives with industrial policy and geopolitical security ambitions.

…the EU is committed to achieving **net zero greenhouse gas emissions by 2050**…

…the **transition** has expanded beyond environmental goals into a **broader sustainability and competitiveness agenda**…

…the **Net-Zero Industry** Act aims to strengthen the EU's clean-tech competitiveness through **regulatory simplification** and **investment support**…

Changing green investment has implications for jobs and skills

The EU's green transition is powered by a mix of public and private financial investment, which is a catalyst for large-scale structural transformation. On the public expenditure side, green investment is an important component of the EU's multiannual budget and the bloc's financial instruments to support economic recovery from the COVID-19 pandemic. Taken together, green investment commitments amount to several hundred billion euros over the current EU budget cycle (2021-2027). Most notable is the EUR 750 billion available through the NextGenerationEU programme, 90 % of which is channelled through the Recovery and Resilience Facility, which requires national recovery and resilience plans to allocate at least 37 % of their budgets to measures to support climate objectives. The 2021–2027 Multiannual Financial Framework, the EU's long-term spending plan, allocates a minimum of 30 % of total EU expenditure to climate action. In 2025, the European Commission introduced also a new State aid framework, part of the Clean Industrial Deal, enabling EU Member States to more readily support clean energy development, industrial decarbonisation and clean tech. Additional resources are available from cohesion policy funds; the Innovation Fund, financed by the EU emissions trading system; and the Modernisation Fund, targeting lower-income Member States. Complementary initiatives such as the repower EU plan have helped expand financing for renewable energy deployment, energy efficiency, hydrogen infrastructure and grid modernisation.

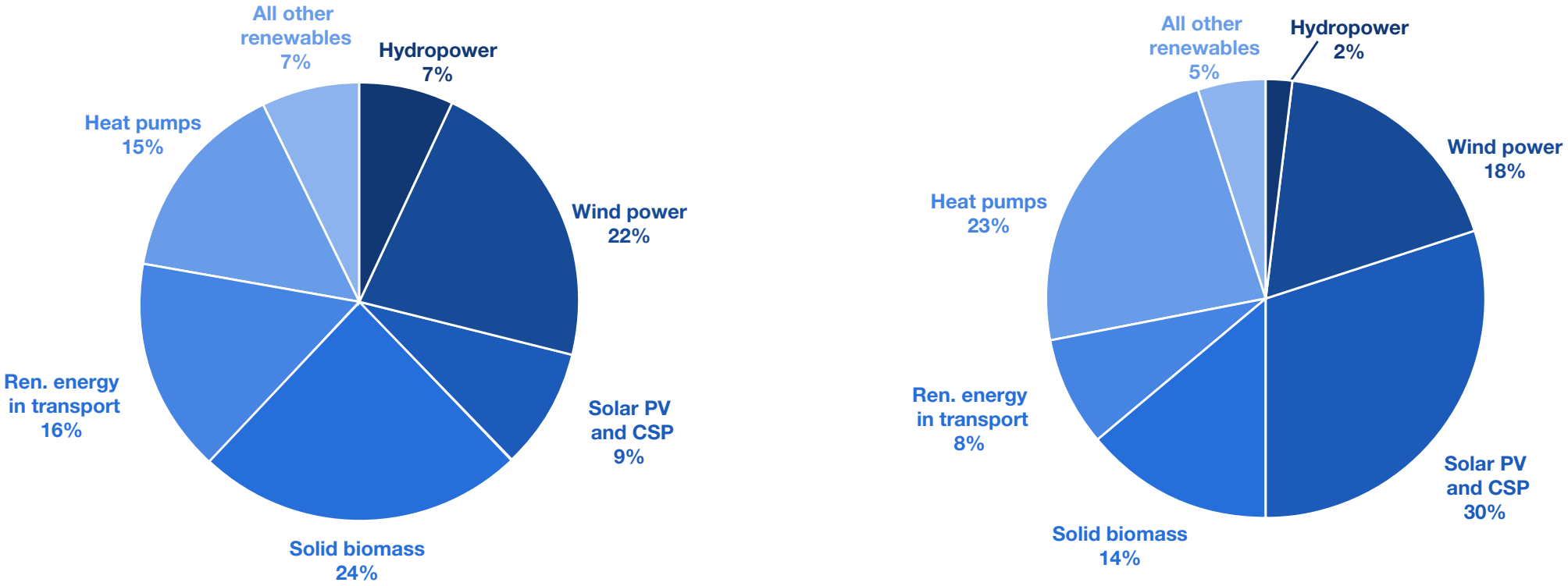
According to a European Investment Bank survey conducted in 2025, 92 % of EU firms report taking measures to reduce greenhouse gas emissions. This can entail investing in waste minimisation, energy efficiency, sustainable transport, renewable energy and/or green innovation. These green investments are already reshaping the EU labour market. Alongside the shifting priorities in clean energy investment between 2018 and 2023, there were significant changes in employment shares (Figure 1). The employment share related to solar photovoltaic (PV) power and concentrated solar power rose sharply, from 9 % to 30 % of total clean-tech employment. The share of employment related to heat pumps also increased, from 15 % in 2018 to 23 % in 2023. In skills terms, the ongoing energy transition is creating a growing demand for expertise in solar panel installation and maintenance, electrical engineering, heat pump installation and production, building retrofitting, smart grid integration, and building renewable energy systems and networks.

…green investment is **an important component of the EU's multiannual budget**…

…The EU has committed at least **30% of its 2021–2027 budget to climate-related objectives**…

…the energy transition is driving **demand for expertise** in solar panels, electrical systems, and heat pumps…

Figure 1. **Change in employment structure due to investment in clean-tech industries**



NB: The methodologies used to measure employment in 2018 and 2023 differed slightly, with a shift to measuring full-time equivalent employment from 2020 onwards. CSP, Concentrated Solar Power.
Source: EurObserv'ER.

Focus on job quality to make the green transition just

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Decarbonisation is projected to generate net job creation in renewable energy, energy efficiency and clean tech, which is part of the positive employment impact associated with the implementation of the European Green Deal. However, the employment gains are likely to be unevenly distributed across regions, sectors and skills groups (Cedefop, 2021). Job losses and falling wages for workers in carbon-intensive industries and in regions dependent on fossil-fuel industries and fossil-fuel value chains create fertile ground for political backlash and resistance to climate policy.

Meanwhile, emerging green jobs often require different skill sets, geographical mobility and up-front training investments, potentially exacerbating inequality if up- and reskilling policies are weak. Designing green transition strategies that combine environmental objectives with institutions and practices that support labour market inclusion is therefore central to economic efficiency, political stability and policy continuity.

The quality of green jobs will determine whether the green transition becomes a virtuous cycle or a source of social conflict. If green jobs systematically pay more (or offer better working conditions), workers in carbon-intensive industries have a real reason to retrain and move into green transition occupations, thereby speeding up structural change. If the reverse is true, and green jobs pay less than fossil-fuel or heavy industry jobs, workers will resist, delay or exit the labour force instead. A growing body of empirical research examining whether green jobs are 'good' jobs finds evidence of a green wage premium across countries (Figure 2). Despite this, substantial wage losses can occur following displacement from some relatively high-paying pollution-intensive occupations (Barreto et al., 2023) ([1]).

([1]) It should also be noted that Janser (2018) found a negative wage gap between green and non-green occupations.

…economic costs of the transition may trigger **political backlash and resistance to climate policy**…

…creating **high quality green jobs** is essential for a fair and socially sustainable transition…

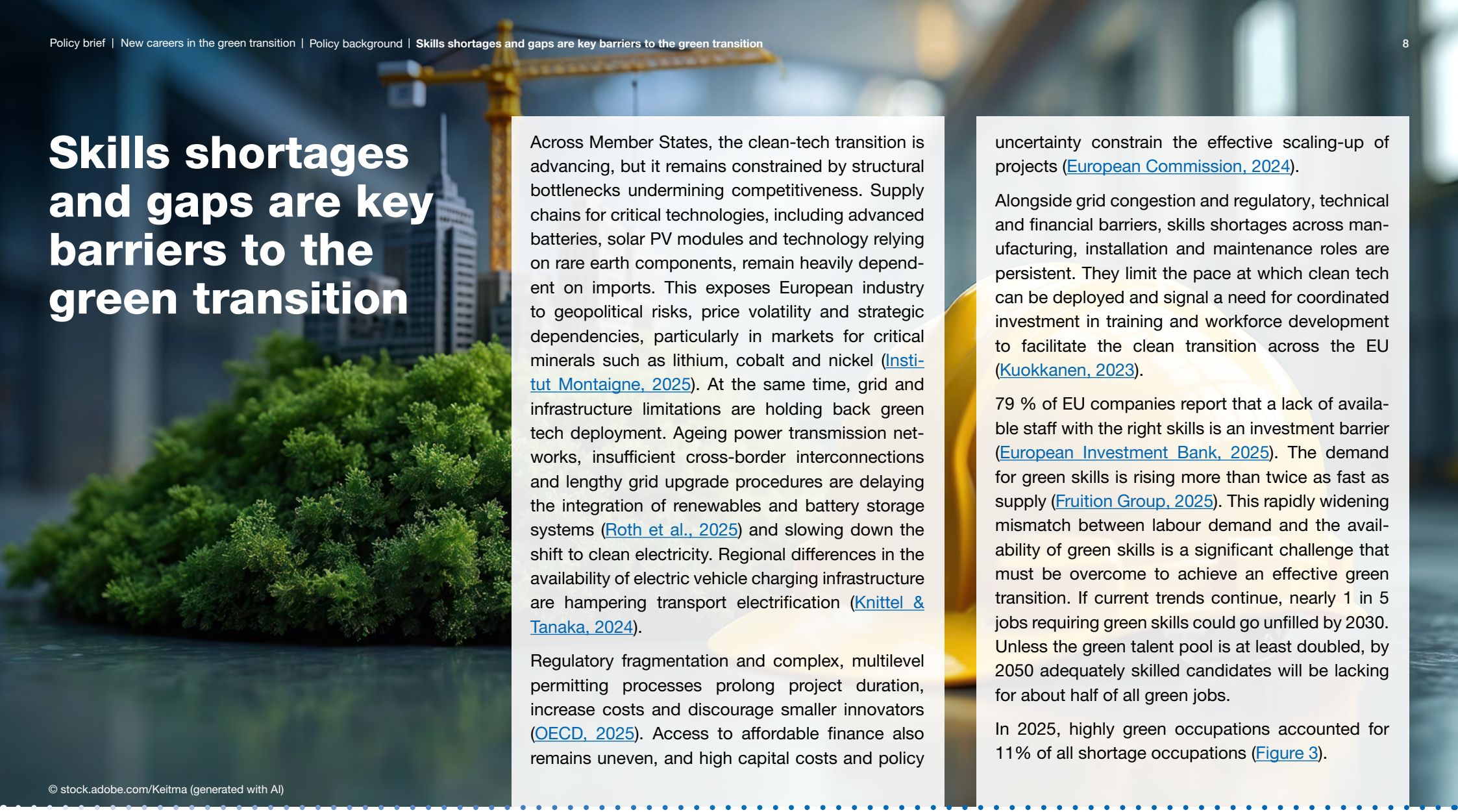
…research across countries increasingly shows that green jobs come with a **wage premium**…

Figure 2. **Average green wage premiums estimated in various studies (%)**

NB: Estimates vary by sector and occupation; Cass et al. (2026) report particularly high premiums in utilities.

Source: Cedefop.

Skills shortages and gaps are key barriers to the green transition



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Across Member States, the clean-tech transition is advancing, but it remains constrained by structural bottlenecks undermining competitiveness. Supply chains for critical technologies, including advanced batteries, solar PV modules and technology relying on rare earth components, remain heavily dependent on imports. This exposes European industry to geopolitical risks, price volatility and strategic dependencies, particularly in markets for critical minerals such as lithium, cobalt and nickel (Institut Montaigne, 2025). At the same time, grid and infrastructure limitations are holding back green tech deployment. Ageing power transmission networks, insufficient cross-border interconnections and lengthy grid upgrade procedures are delaying the integration of renewables and battery storage systems (Roth et al., 2025) and slowing down the shift to clean electricity. Regional differences in the availability of electric vehicle charging infrastructure are hampering transport electrification (Knittel & Tanaka, 2024).

Regulatory fragmentation and complex, multilevel permitting processes prolong project duration, increase costs and discourage smaller innovators (OECD, 2025). Access to affordable finance also remains uneven, and high capital costs and policy uncertainty constrain the effective scaling-up of projects (European Commission, 2024).

Alongside grid congestion and regulatory, technical and financial barriers, skills shortages across manufacturing, installation and maintenance roles are persistent. They limit the pace at which clean tech can be deployed and signal a need for coordinated investment in training and workforce development to facilitate the clean transition across the EU (Kuokkanen, 2023).

79 % of EU companies report that a lack of available staff with the right skills is an investment barrier (European Investment Bank, 2025). The demand for green skills is rising more than twice as fast as supply (Fruition Group, 2025). This rapidly widening mismatch between labour demand and the availability of green skills is a significant challenge that must be overcome to achieve an effective green transition. If current trends continue, nearly 1 in 5 jobs requiring green skills could go unfilled by 2030. Unless the green talent pool is at least doubled, by 2050 adequately skilled candidates will be lacking for about half of all green jobs.

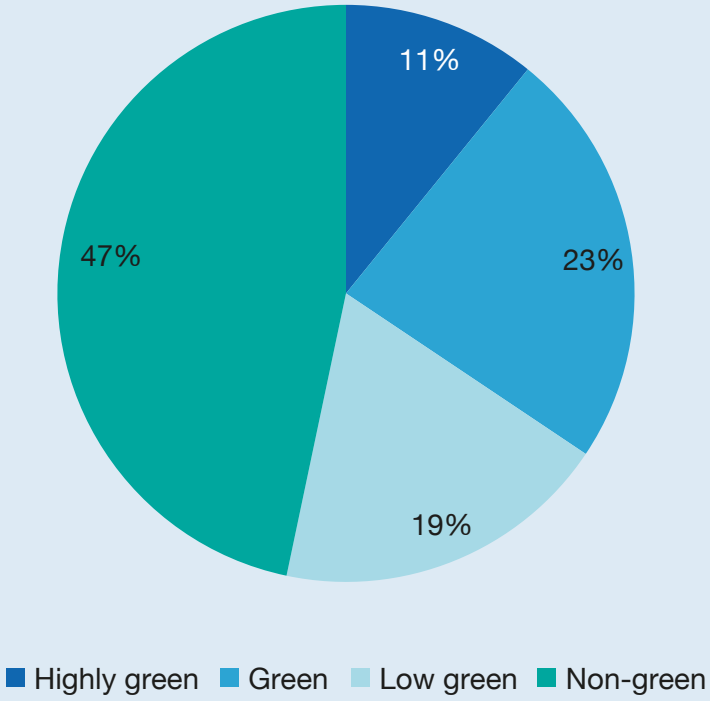
In 2025, highly green occupations accounted for 11% of all shortage occupations (Figure 3).

…**the clean-tech transition is advancing,** but it remains constrained by structural bottlenecks undermining competitiveness…

…**skills shortages** across manufacturing, installation and maintenance roles are persistent…

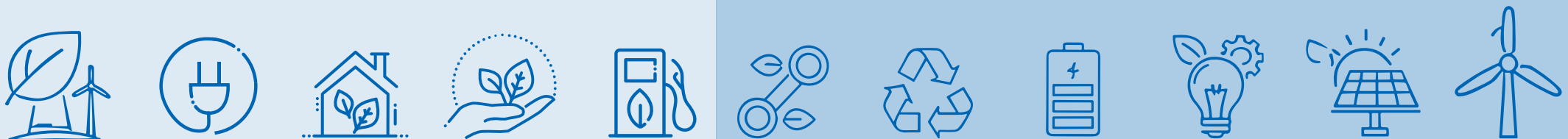
…rapidly widening **mismatch** between **labour demand** and the availability of **green skills** is **a significant challenge** in the green transition…

Figure 3. Distribution of shortage occupations by greenness (left panel) and the highly green occupations with the greatest labour shortages (right panel)

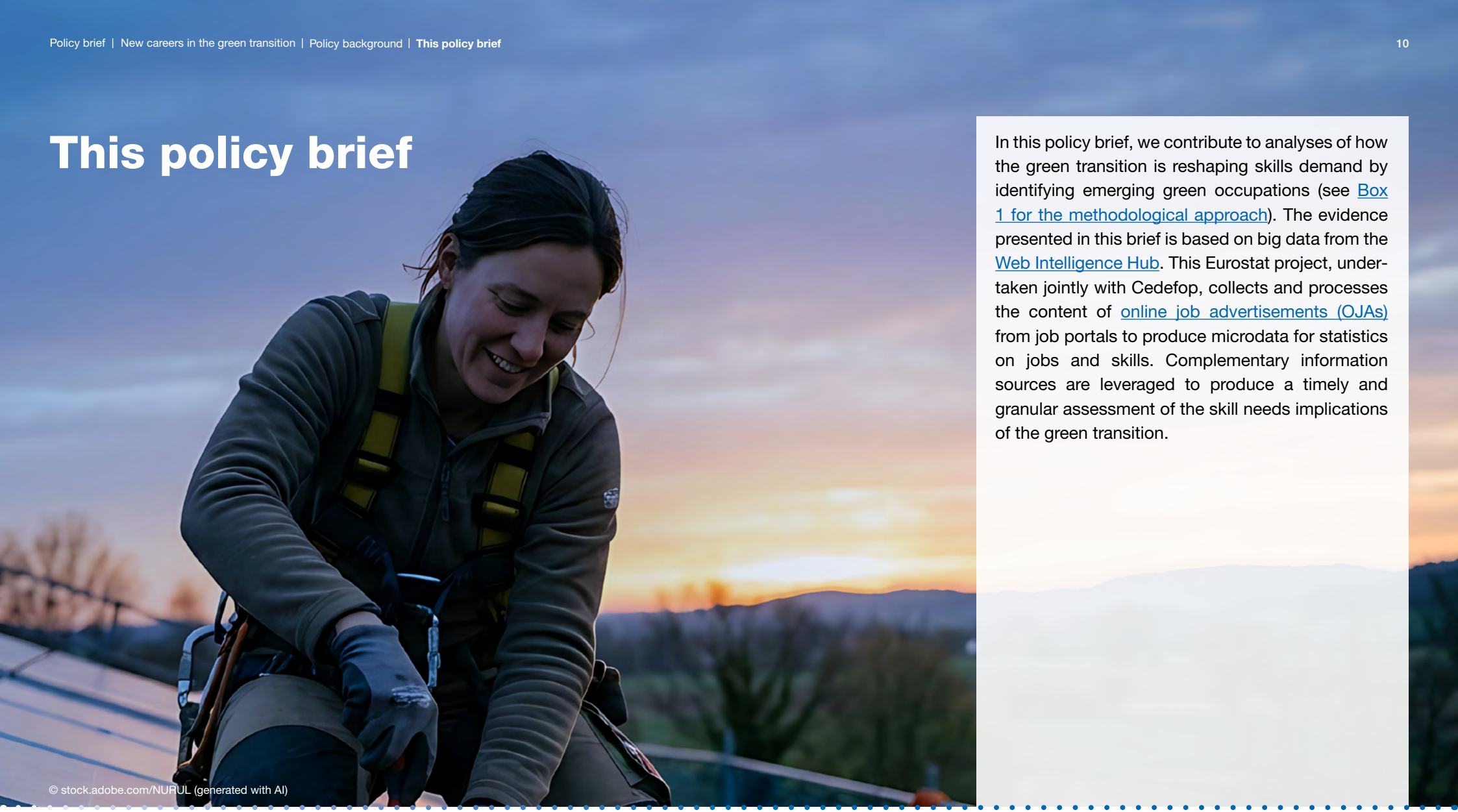


Note: The distribution of shortage occupations by greenness level, 2025.
Source: Own elaboration based on ELA shortage and surpluses in Europe report (2026).

Note: Word size reflects the number of EU countries reporting shortages in the occupation. Only occupations reported by more than three countries are displayed.
Source: Own elaboration based on ELA shortage and surpluses in Europe report (2026).



This policy brief



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In this policy brief, we contribute to analyses of how the green transition is reshaping skills demand by identifying emerging green occupations (see Box 1 for the methodological approach). The evidence presented in this brief is based on big data from the Web Intelligence Hub. This Eurostat project, undertaken jointly with Cedefop, collects and processes the content of online job advertisements (OJAs) from job portals to produce microdata for statistics on jobs and skills. Complementary information sources are leveraged to produce a timely and granular assessment of the skill needs implications of the green transition.

…we contribute to analyses of how the green transition is **reshaping skills demand** by identifying emerging green occupations…

...the evidence **is based on big data** from the Web Intelligence Hub...

…we produce **a timely and granular assessment of the skill** needs implications of the green transition…

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Box 1. Methodological approach to identifying emerging green occupations

Many job roles relevant to the green transition are currently classified as 'occupations not elsewhere classified', because they did not exist when the International Standard Classification of Occupations (ISCO) taxonomy was last revised in 2008. By the end of 2022, the share of such occupations in total green employment demand had increased to 12 % (Cedefop, 2024).

To identify emerging roles linked to the green transition, we focus on three ISCO 08 four-digit occupational groups that are not elsewhere classified (nec), namely 'Engineering professionals nec' (2149), 'Physical and engineering science technicians nec' (3119) and 'Manufacturing labourers nec' (9329). OJAs requesting staff for these roles were examined to detect new and evolving occupations by analysing the job titles. Of the more than 400 000 OJAs analysed, approximately 157 000 were for engineering professionals, 111 000 for physical and engineering science technicians and 178 000 for manufacturing labourers.

The analysis is based on job titles extracted from a representative sample of OJAs collected via the Web Intelligence Hub. Job titles in OJAs are a high-frequency indicator of emerging labour demand, and they capture how employers define and communicate roles when recruiting staff. Job titles do not fully reflect the complexity of job tasks and may vary in specificity between employers and countries. They are attractive for analysis because of the large amount of data and their near-real-time availability and the granular and forward-looking information on evolving skills requirements that they offer.

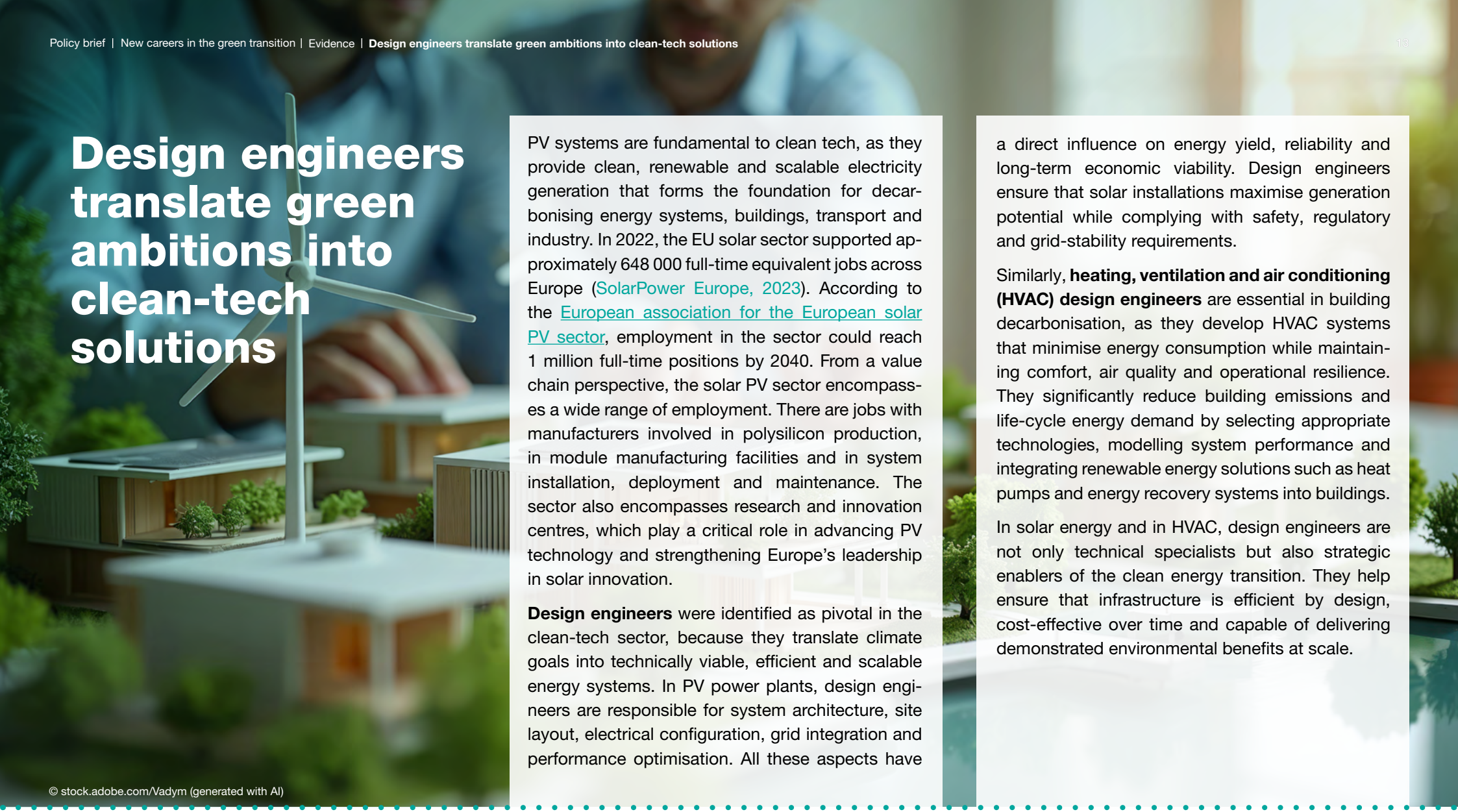
The methodological approach involved several steps. The raw text of the job titles was pre-processed to improve comparability across countries and languages. This included removing duplicates, standardising text (e.g. lowercasing, finding words' roots by trimming, removing punctuation and standardising special characters) and filtering out elements not relevant to the analysis (e.g. references to the type of contract or the location). Non-English job titles were translated into English to enable analysis across countries. Text-mining techniques were subsequently applied to structure the information contained in the job titles. Tokenisation and keyword extraction were used to identify recurring terms and green-related expressions. The titles were then grouped using similarity measures and clustering algorithms to detect emerging occupational fields, and new roles were detected through cluster analysis.

Source: Cedefop.

EVIDENCE

In this section

Design engineers translate green ambitions into clean-tech solutions



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PV systems are fundamental to clean tech, as they provide clean, renewable and scalable electricity generation that forms the foundation for decarbonising energy systems, buildings, transport and industry. In 2022, the EU solar sector supported approximately 648 000 full-time equivalent jobs across Europe (SolarPower Europe, 2023). According to the European association for the European solar PV sector, employment in the sector could reach 1 million full-time positions by 2040. From a value chain perspective, the solar PV sector encompasses a wide range of employment. There are jobs with manufacturers involved in polysilicon production, in module manufacturing facilities and in system installation, deployment and maintenance. The sector also encompasses research and innovation centres, which play a critical role in advancing PV technology and strengthening Europe's leadership in solar innovation.

Design engineers were identified as pivotal in the clean-tech sector, because they translate climate goals into technically viable, efficient and scalable energy systems. In PV power plants, design engineers are responsible for system architecture, site layout, electrical configuration, grid integration and performance optimisation. All these aspects have a direct influence on energy yield, reliability and long-term economic viability. Design engineers ensure that solar installations maximise generation potential while complying with safety, regulatory and grid-stability requirements.

Similarly, **heating, ventilation and air conditioning (HVAC) design engineers** are essential in building decarbonisation, as they develop HVAC systems that minimise energy consumption while maintaining comfort, air quality and operational resilience. They significantly reduce building emissions and life-cycle energy demand by selecting appropriate technologies, modelling system performance and integrating renewable energy solutions such as heat pumps and energy recovery systems into buildings.

In solar energy and in HVAC, design engineers are not only technical specialists but also strategic enablers of the clean energy transition. They help ensure that infrastructure is efficient by design, cost-effective over time and capable of delivering demonstrated environmental benefits at scale.

…employment in the **EU solar sector** could reach one million **full-time jobs** by 2040…

…the **solar PV** value chain generates **diverse employment opportunities**…

…**design engineers are critical** to the deployment of **clean technologies**…

Energy engineers are at the forefront of decarbonisation

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The transition to sustainable energy requires, in addition to designing and installing new technologies, reconfiguring energy infrastructure originally designed for fossil-fuel-based power generation. Without sufficient engineering capacity, the deployment of clean tech can run into delays, costs can escalate and projects can underperform, all of which jeopardises competitiveness and decarbonisation. With tasks ranging from retrofitting buildings and modernising industrial processes to integrating distributed generation and storage into the grid, (renewable) energy engineers ensure that clean tech is reliable, safe and cost-effective.

Energy engineers assess grid capacity, manage demand-side solutions, support electrification strategies and improve energy performance across sectors. They help bridge the gap between research and innovation and implementation and help translate policy targets into operational reality. Energy engineers also play a key role in compliance and risk management. Regulatory standards tighten, building codes become stricter and the workload involved in complying with industrial efficiency requirements and emissions reporting frameworks increases. As a result, organisations increasingly rely on specialised expertise to meet performance thresholds and avoid financial or legal penalties.

The technical assessments that energy engineers make underpin investment decisions by reducing uncertainty for investors. Energy engineers require a wide variety of knowledge, skills and competences. Technical skills are foundational: energy engineers require proficiency in core engineering principles relating to electrical, mechanical and energy systems to address complex, multidisciplinary challenges. Additionally, engineers must possess up-to-date knowledge of renewable technologies, including wind, solar and hydrogen power and battery storage systems, to support national energy goals and industry growth. As compliance with health, safety and environmental regulations is critical, regulatory awareness is a key competence.

Strong project management skills are also essential, particularly for managing large-scale renewable initiatives that require careful planning, coordination and oversight. Soft skills are equally important. Effective communication enables engineers to clearly convey technical information to diverse stakeholders. Teamwork fosters collaboration in multidisciplinary teams and supports innovation and problem-solving. Strong problem-solving skills help engineers adapt to emerging technologies, evolving regulations and new technical challenges as the renewable energy sector continues to expand.

…the transition to sustainable energy requires **reconfiguring energy infrastructure**…

…the technical assessments that energy engineers make underpin **investment decisions** by reducing uncertainty for investors…

…**strong problem-solving skills** help engineers adapt to emerging technologies, evolving regulations and new technical challenges…

Installers reduce the carbon footprint of homes

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According to the Intergovernmental Panel on Climate Change, the deployment of modern clean tech, including solar power systems, battery storage and heat pumps, has the potential to reduce global emissions by up to 66 % when widely adopted by homeowners and other building owners (Intergovernmental Panel on Climate Change, 2023). 10 % of Europe's carbon dioxide emissions are caused by residential heating. The clean energy transition therefore critically relies on the skilled professionals who install and implement clean energy solutions in homes and other buildings.

HVAC installers play a critical role in the clean-tech ecosystem. They ensure that heat pumps and energy-efficient heating and cooling systems are correctly sized, safely installed and optimally configured to deliver maximum performance and energy savings. As Europe and the world accelerate building decarbonisation, the HVAC installer workforce is becoming a key enabler of climate policy implementation. Alongside installing new systems and components, the tasks of the HVAC workforce also include diagnosing mechanical and electrical faults, performing system maintenance and performance checks, cleaning and adjusting equipment and carrying out emergency repairs when needed.

HVAC installers monitor system performance, maintain service records and ensure compliance with technical standards, health and safety requirements and organisational quality procedures. They must manage workplace risks, follow fire-safety and emergency procedures and maintain productivity and quality in line with professional and regulatory standards. The HVAC installer workforce is critical to ensuring that climate-control technologies operate reliably, efficiently and safely and contribute to reducing the energy use of buildings and to indoor environmental quality.

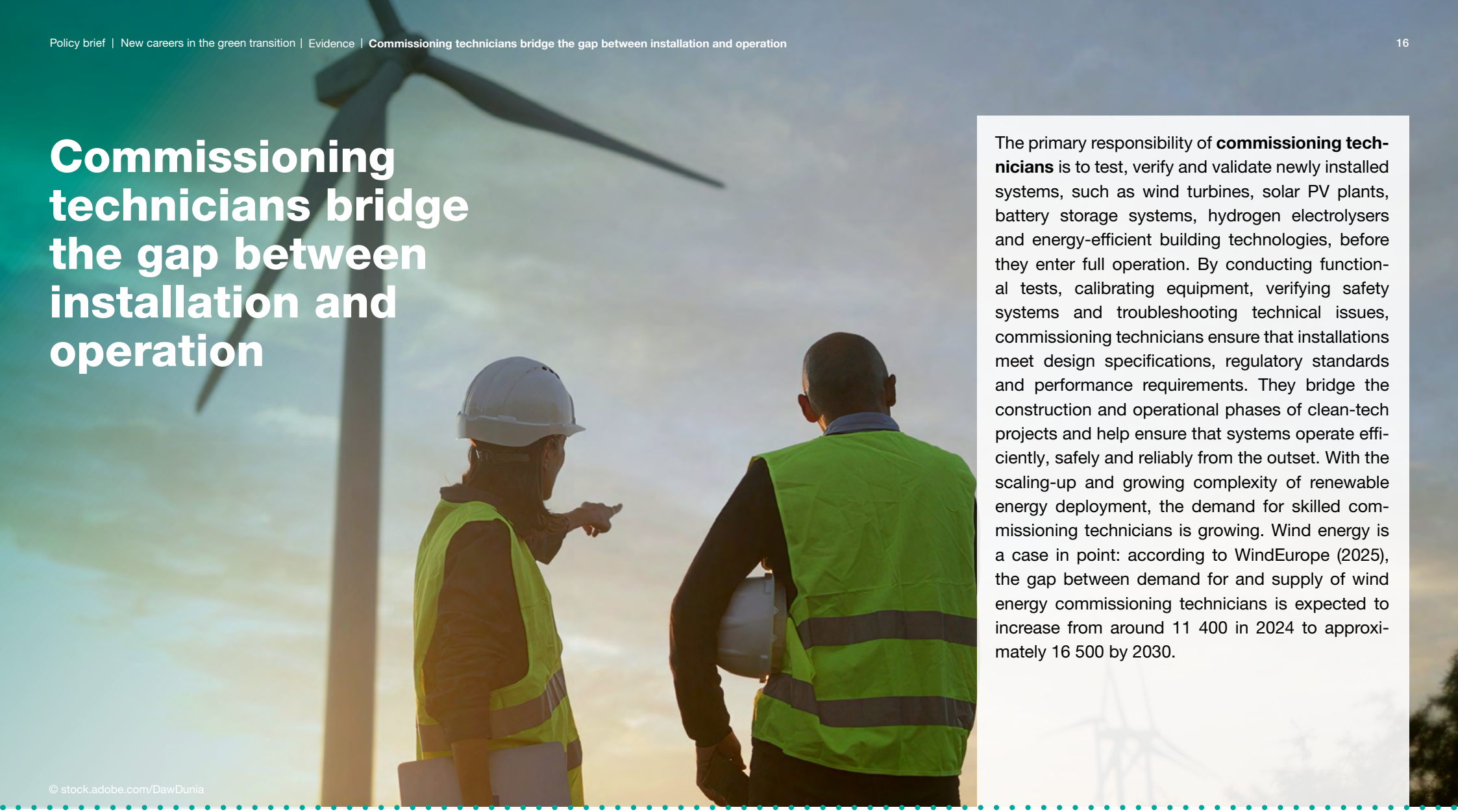
PV installers are equally essential to the residential energy transition. They are responsible for installing and commissioning solar power systems, ensuring proper system design and implementation, managing electrical connections, structural mounting and safe integration with building infrastructure and the electricity grid. PV installers verify system performance, conduct testing and maintenance, and ensure compliance with electrical, safety and building regulations. The quality of installation directly affects solar energy generation, system reliability and the long-term return on investment. As rooftop solar deployment expands across Europe, PV installers play an increasingly critical role in enabling households to actively participate in the energy transition by generating clean power and reducing the use of fossil fuels.

…the deployment of modern clean tech has the potential **to reduce global emissions by up to 66 %**…

…the HVAC and PV installer workforce is becoming a **key enabler of climate policy implementation**…

…the quality of installation directly affects **solar energy generation, system reliability and the long-term return** on investment…

Commissioning technicians bridge the gap between installation and operation



The primary responsibility of **commissioning technicians** is to test, verify and validate newly installed systems, such as wind turbines, solar PV plants, battery storage systems, hydrogen electrolysers and energy-efficient building technologies, before they enter full operation. By conducting functional tests, calibrating equipment, verifying safety systems and troubleshooting technical issues, commissioning technicians ensure that installations meet design specifications, regulatory standards and performance requirements. They bridge the construction and operational phases of clean-tech projects and help ensure that systems operate efficiently, safely and reliably from the outset. With the scaling-up and growing complexity of renewable energy deployment, the demand for skilled commissioning technicians is growing. Wind energy is a case in point: according to WindEurope (2025), the gap between demand for and supply of wind energy commissioning technicians is expected to increase from around 11 400 in 2024 to approximately 16 500 by 2030.

…the growing deployment and complexity of **clean technologies** is increasing **demand** for **commissioning technicians**…

…commissioning technicians **ensure** that new energy systems operate **safely and efficiently**…

…the gap between demand for and supply of **wind energy commissioning technicians** is expected to increase…

Clean tech requires substantial maintenance following deployment

…**maintaining** existing **clean-energy infrastructure** is as important **as deploying new technologies,** particularly as renewable energy systems scale up…

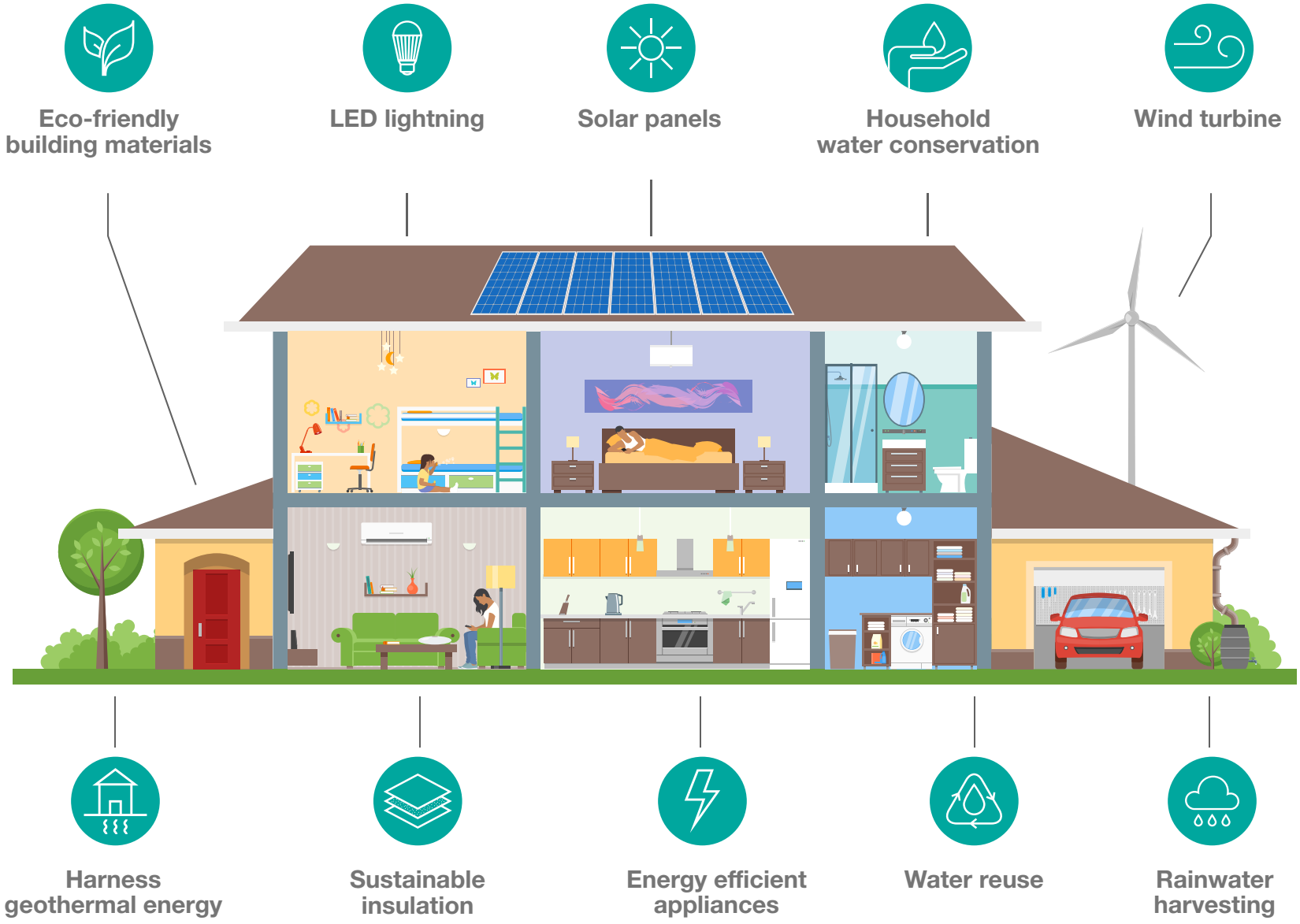
Exchanges and debates about clean tech and the energy transition often focus on system innovation and manufacturing, while less attention is paid to the role people play in maintaining these systems. **Maintenance technicians** play a critical role in ensuring the reliability, efficiency and longevity of clean energy systems, and in doing so they also support their scaling-up. As decarbonisation progresses through electrification, distributed renewables and high-efficiency building technologies, safeguarding the performance of installed systems becomes as important as deploying new facilities.

Without regular maintenance, clean tech underperforms, degrades prematurely or creates safety risks, jeopardising climate and economic objectives. Maintenance technicians secure the operational integrity of clean-tech systems (Figure 4), including HVAC systems, PV installations and heat pumps. Their expertise ensures that energy efficiency gains are realised in practice, supports system longevity and maximises the economic and environmental performance of clean energy investments.

Maintenance technicians in the clean-tech sector require a hybrid skill set combining electrical and mechanical expertise with digital literacy, safety certification expertise and system-level understanding of renewable energy technologies. As clean energy systems become increasingly interconnected and data driven, the demand for technicians capable of diagnosing, optimising and securing complex energy infrastructure is increasing. Maintenance technicians typically hold a vocational education and training (VET) qualification in electrical, HVAC, mechatronics or renewable energy systems. In addition to a formal qualification, mandatory certifications are required covering, for example, electrical safety, refrigerant handling and system-specific installation standards. As clean energy systems become more digital, data-enabled and integrated, employers increasingly require skills relating to smart controls, monitoring systems and safety compliance.

Blade technicians and **wind turbine technicians** are key maintenance professionals who ensure that wind turbines operate efficiently and reliably. Wind turbine technicians are responsible for the maintenance and repair of turbines. This includes inspecting mechanical, electrical and hydraulic systems, troubleshooting faults, replacing components and monitoring turbine performance to maintain optimal energy generation. Wind turbine technicians often work at height and perform routine inspections and repairs across the entire turbine structure. Blade technicians specialise in the inspection, repair and maintenance of turbine blades, the components that capture wind and convert it into electricity. They focus on maintaining the structural integrity and aerodynamic efficiency of blades by identifying damage, repairing cracks or erosion using composite materials and conducting testing to detect internal defects. Together, blade technicians and wind turbine technicians minimise downtime, extend turbine lifespan and ensure that wind farms generate stable and reliable renewable electricity.

Figure 4. **Maintenance requirements across a clean energy home ecosystem**



Standards and quality assurance facilitate clean-tech uptake

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…demonstrating **strong environmental performance** has become a strategic priority for many organisations operating in the EU…

Growing concern in Europe about the environmental footprint of human activities has led to comprehensive EU climate regulations, such as the Fit for 55 package and the Net-Zero Industry Act. Regulatory frameworks define what qualifies as environmentally sustainable economic activity and promote the market uptake of clean tech through incentives, streamlined permitting procedures and enhanced reporting requirements that extend across supply chains.

As a result, demonstrating strong environmental performance has become a strategic priority for many organisations operating in the EU. Interest in environmental protection at the corporate level continues to grow. Environmental management systems, which help organisations demonstrate environmental responsibility to customers, regulators and stakeholders, have become much more common.

Standards such as the International Organization for Standardization (ISO) standard ISO 14001:2015 ([1]) provide structured approaches that introduce accountability, measurable objectives and continuous improvement mechanisms into environmental management practices. In 2025, more than 116 000 such ISO certificates were issued in the EU. The top three Member States in terms of new ISO certificates issued were Italy (approximately 28 000 certificates), Spain (20 000) and Germany (10 000).

In the clean-tech sector, regulations and quality standards in force form a complex framework aimed at reducing environmental impact, fostering innovation and ensuring sustainability across products, processes and value chains. In this context, supplier quality engineering is not merely a support function but a strategic imperative. **Supplier quality engineers** ensure that critical components and materials sourced from global supply chains meet stringent regulatory and quality requirements. They mitigate the risk of product failures and uphold environmental and ethical standards throughout the life cycle of products. Through proactive supplier qualification, rigorous auditing and continuous improvement initiatives, supplier quality engineers safeguard product integrity, reduce the likelihood of costly recalls or nonconformities and help clean-tech companies maintain credibility with regulators, investors and end users**.**

Quality assurance (QA) specialists play a critical role in ensuring the reliability, safety and performance of clean tech. Their role is particularly common in solar component production. QA specialists identify quality issues in manufacturing processes and implement corrective solutions that ensure compliance with technical and regulatory standards. Their tasks include conducting routine and non-routine analysis of raw materials and air, water, soil and other environmental samples, and analysing intermediate or final products (e.g. processed materials or finished solar components). They interpret test results using established specification and control protocols and determine whether products meet release requirements. QA specialists also prepare technical documentation (e.g. deviation reports, testing protocols and trend analyses) and they evaluate analytical methods and inspection procedures with a view to strengthening them. In addition, they oversee internal, third party and customer audits and monitor production processes and equipment to ensure continued conformity with specifications.

([1]) Replaced in 2026 by ISO 14001:2026.

Cybersecurity professionals safeguard data-driven and interconnected clean energy systems

As clean energy systems become increasingly digital, data-driven and interconnected, cybersecurity resilience is integral to sector stability and subject to legal requirements under the NIS2 Directive. The clean-tech sector, including renewable generation, hydrogen production, battery storage and smart grid systems, depends on cloud computing, internet-of-things devices, remote monitoring platforms and automated control networks. Without adequate protection measures, such technologies increase exposure to cyber risks and cybercrime.

Security architects play a critical role in safeguarding grid infrastructure, protecting industrial control systems and ensuring compliance with critical-infrastructure regulations. Their expertise underpins operational continuity and protects the financial and regulatory credibility of clean-tech investments. Security architects are essential in protecting renewable-energy-powered designated critical national infrastructure but also in securing smart grids and distributed energy systems and safeguarding industrial automation systems (e.g. in hydrogen and battery storage facilities).

…**cybersecurity resilience** is integral to energy sector stability and subject to legal requirements…

…without adequate protection measures, technologies increase **exposure to cyber risks and cybercrime**…

…**security architects** are essential in protecting designated critical national infrastructure powered by renewable energy…

CONCLUSIONS

In this section

Improving skills intelligence to track trends in green occupations

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Rapid technological changes and the green transition that has been set in motion are creating new occupations and hybrid roles that are not yet captured in occupational classifications. This brief has shown that big-data-powered analysis of job titles extracted from OJA data can help policymakers detect skill needs as they are emerging in green transition jobs. Integrating such evidence into skills intelligence and governance systems and occupational classification updates and using it for programme and curriculum design and updates can help make education and training systems more responsive. Regularly updating occupational taxonomies to reflect emerging green transition roles and skills would strengthen labour market monitoring and policy design.

Cedefop's green observatory helps monitor how the transition to a climate-neutral economy is affecting jobs, skills and VET across the EU. The observatory brings together Cedefop's research and data on the implications of the green transition for employment and skills demand in occupations and sectors. The OJA data that form part of the green observatory provide crucial evidence to support policymaking and skills anticipation. The information on labour market trends, emerging occupations and changing competence requirements that the observatory presents can inspire national and regional stakeholders. Green skills intelligence gives policymakers, education providers, social partners and other skills ecosystem stakeholders a practical tool that can be used to understand how training systems and workforce development can support the transition to a more sustainable economy.

…**big-data-powered analysis** can help policymakers detect skill needs as they are emerging in green transition jobs…

…keeping **occupational taxonomies up to date** would **strengthen labour market intelligence** on the green transition…

…**green skills intelligence** is a practical tool supporting the transition to a more **sustainable economy**…

Scaling up VET for clean-tech occupations

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The rapid expansion of clean tech is increasing the demand for vocationally trained technicians and installers, particularly in the renewable energy and energy-efficient construction sectors and in maintenance services. However, many national and regional VET systems face shortages of specialised teachers and instructors, lack state-of-the art equipment and have limited capacity to rapidly scale up programmes for which labour market demand is increasing. Expanding VET capacity requires targeted investments in modern training facilities; up-to-date curricula, with learning outcomes relevant to heat pumps, battery storage, hydrogen systems and other clean tech; and stronger partnerships with industry. Expanding apprenticeship programmes and work-based learning opportunities helps ensure that learners acquire practical and labour-market-relevant skills.

Several Member States have developed clean-tech apprenticeships that combine vocational training in a classroom setting with hands-on work experience in emerging green industries. In Germany, the dual VET system has established programmes for roles such as electronics technician for energy and building technology (in partnership with Hering) and mechatronics technician for wind turbines (in partnership with Siemens Gamesa Renewable Energy). These programmes teach apprentices to install and maintain renewable energy infrastructure. In Denmark, specialised wind energy technician apprenticeship programmes, teaching recruits about turbine installation, blade maintenance and offshore operations, have been established in collaboration with Vestas, a leading company in the sustainable energy sector.

…the **clean-tech transition is increasing demand** for vocationally trained workers, but **many VET systems lack capacity**…

…**apprenticeship and work-based learning** are effective tools for **developing practical, job-ready skills for the green transition**…

…**several Member States** are already using **apprenticeships** to build clean-tech talent pipelines…

Mapping skills gaps and overlaps to facilitate career transitions

Alongside understanding skills gaps, identifying skills overlaps between occupations is critical for shaping effective and inclusive labour market transitions in support of the green transformation. Many workers already possess knowledge and skills that are transferable to emerging roles. In the clean-tech sector, facilitating occupational mobility often means targeted upskilling rather than full retraining. For example, electricians and HVAC technicians can transition into roles such as battery storage installation or wind turbine maintenance with limited additional training. In practice, this is often easier said than done. Clearly defined and formalised career pathways are often lacking, and this is a barrier to occupational transitions (Fruition Group, 2025). Systematically mapping skills overlaps between clean-tech occupations can help policymakers, training providers and employers design clearer career pathways and shorter and more efficient reskilling programmes that support career transitions.

Analytical tools leveraging large-scale CV repositories and professional profile data make it possible to analyse workforce mobility and to identify skills similarities between occupations. Such data-driven approaches are emerging in career guidance and offer added value because they use information on skills workers already possess to reveal realistic career transitions and the additional competences required. In the context of a rapidly evolving green transition, combining insights into skills required to make a transition with information about the training on offer can help policymakers streamline upskilling pathways and accelerate upskilling of workers for new roles and reskilling of the unemployed.

…understanding **skills gaps and overlaps** can support **effective workforce transitions**…

…mapping skills overlaps eases **career pathways design and upskilling**…

…**data-driven career guidance** adds value by helping workers **identify new opportunities** based on the skills they already have…

Modernising qualifications and credentials systems to enable worker mobility

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The green transition and associated labour market shifts and new skill needs require VET systems that are more flexible, responsive and accessible. An important component of modernising VET systems is developing modular and stackable learning pathways that allow workers to acquire new skills in a flexible way, to progress in their careers and to keep their human capital up to date. Short, targeted training modules resulting in a microcredential, microqualification or microskill or open badge and easily accessible recognition of prior learning can facilitate transitions between occupations and sectors. Such reforms require strong collaboration between education providers, employers and public authorities to ensure that training programmes adapt to evolving labour market needs. In addition to supporting worker mobility, flexible and inclusive VET systems reduce skills mismatches and strengthen workforce resilience in the face of economic and technological change.

Several Member States have made strides in adapting VET curricula to support the green transition. Austria has introduced a comprehensive initiative to integrate green competences into VET regulations and curricula. Similarly, in Finland, VET qualifications have recently been updated to embed green and digital competences across training programmes. Since 2025, optional modules on topics such as climate responsibility and sustainable production have been introduced at all educational levels. Ireland has launched the green skills 2030 strategy, which integrates sustainability and environmental competences into further education and training programmes. The strategy aims to embed green skills across disciplines, to update programme curricula and to support continuous professional development for instructors, to ensure that the education system provides the skills needed in the green economy (SOLAS, 2024).

…an important component of **greening VET systems** is developing modular and stackable learning pathways…

…flexible and inclusive VET systems reduce skills mismatches and **strengthen workforce resilience**…

…several Member States have made strides in adapting VET curricula and qualifications **to support the green transition**…

Supporting carbon-intensive regions

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The labour market impacts of the green transition are uneven across European regions. Areas historically dependent on fossil-fuel industries or heavy manufacturing face more job displacement. Regional workforce transition strategies are essential to enable workers to move from declining sectors to emerging clean-tech occupations. These strategies should combine the provision of retraining programmes with skills validation and other types of mobility support. Engaged local training centres, strong links between regional industrial strategies and alignment between clean-tech investment and skills policies can help ensure that new jobs benefit local communities.

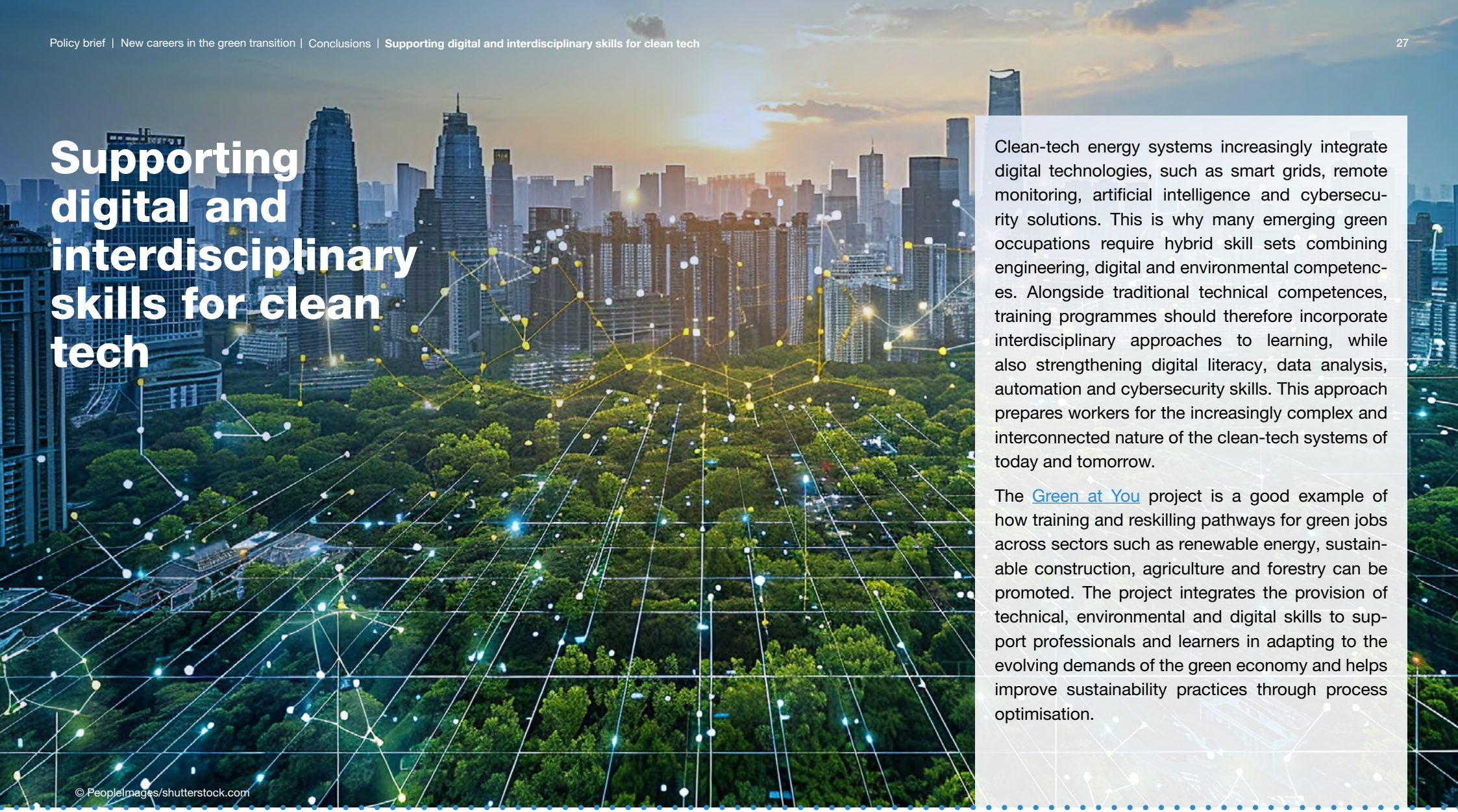
The Wielkopolskie region in Poland, where the phasing-out of lignite mining in the Konin area has triggered coordinated transition initiatives, shows how such transition strategies can work in practice. Regional authorities have launched EU programmes, funded under the Just Transition Mechanism, aimed at reskilling former mining and energy sector workers for employment in renewable energy, energy-efficient construction and modern manufacturing. Training centres and partnerships between local universities, VET schools and clean-tech companies have created new career pathways in areas such as solar installation, electrical engineering and battery technologies. These regional efforts illustrate how linking skills policies with green industrial investment can support economic diversification and contribute to a just green transition (European Commission, 2025).

…regional workforce transition strategies are essential **to enable workers to move** from declining sectors to emerging clean-tech occupations…

…strong links between **regional industrial strategies, clean-tech investment** and **skills policies** can help ensure that new jobs benefit local communities…

…regional efforts illustrate how linking skills policies with green industrial investment can **support economic diversification**…

Supporting digital and interdisciplinary skills for clean tech



Clean-tech energy systems increasingly integrate digital technologies, such as smart grids, remote monitoring, artificial intelligence and cybersecurity solutions. This is why many emerging green occupations require hybrid skill sets combining engineering, digital and environmental competences. Alongside traditional technical competences, training programmes should therefore incorporate interdisciplinary approaches to learning, while also strengthening digital literacy, data analysis, automation and cybersecurity skills. This approach prepares workers for the increasingly complex and interconnected nature of the clean-tech systems of today and tomorrow.

The Green at You project is a good example of how training and reskilling pathways for green jobs across sectors such as renewable energy, sustainable construction, agriculture and forestry can be promoted. The project integrates the provision of technical, environmental and digital skills to support professionals and learners in adapting to the evolving demands of the green economy and helps improve sustainability practices through process optimisation.

…many emerging green occupations require **hybrid skill sets** combining engineering, digital and environmental competences…

…**digital literacy, data analysis, automation and cybersecurity skills** are becoming essential for workers in the clean-tech sector…

…the **Green at You** project is a good example of **how training and reskilling pathways for green jobs** across sectors can be promoted…

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POLICY BRIEF

New careers in the green transition

Using online job advertisements to track emerging jobs and skills

This policy brief examines how the green transition is reshaping labour demand, with a focus on emerging occupations in clean energy technology and associated skill needs in the European Union. Drawing on data from online job advertisements, it identifies key roles across engineering, installation, maintenance and quality assurance that underpin the deployment of renewable energy systems. The analysis identifies a rapidly growing demand for hybrid technical and digital skills that is not being met because of persistent skills shortages, which are slowing down the transition.

While green investment is generating new employment opportunities, these are unevenly distributed across sectors and regions, and career transition training and reskilling policies are required. Strengthening vocational education and training, improving skills intelligence, modernising qualifications and credentials systems, facilitating workforce mobility and supporting carbon-intensive regions are critical to ensuring a just green transition.

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