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CEDEFOP

Growing green

How vocational education and training can drive the green transition in agri-food

POLICY BRIEF

POLICY BACKGROUND

In this section

Agri-food needs to adapt to climate change while reducing emissions

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The agri-food sector is a major source of greenhouse gas (GHG) emissions and air pollutants in the EU; at the same time, it is heavily affected by climate change. More frequent and more severe extreme weather events such as droughts, floods, cold spells, and heatwaves will pose challenges for food producers. Crop yields can increase with higher temperatures and CO_2 levels in the atmosphere, but only with appropriate nutrient levels, soil moisture and sufficient water availability.

Farmers and food producers will be challenged to adapt their practices and technologies in response to climate instability and to the increased risk of infectious diseases and pests caused by climate change. Projections suggest EU regions will be affected very differently by climate change: agriculture in northern Europe is expected to benefit from it, while most southern European regions will be negatively affected (EEA, 2019).

Worldwide, the agri-food sector generates around one-third of all GHG emissions. Between 1990 and 2019 its share in global emissions fell by 10 percentage points, but in Europe the share increased (from 24% to 31%) (Tubiello et al. 2022). More than half of all emissions in the agri-food sector in Europe occur pre- and post-production and food retail is the main contributor in most Member States (Figure 1). Global food miles – the emissions linked to food transport – amount to 19% of total food-system emissions: this suggests that the growing consumption of plant-based foods will not help reduce the environmental impact of food production if it is not coupled with a shift towards more local production (Li et al., 2022). Efforts to reduce emissions should go hand in hand with adaptation to climate change and becoming more resilient to its impacts.

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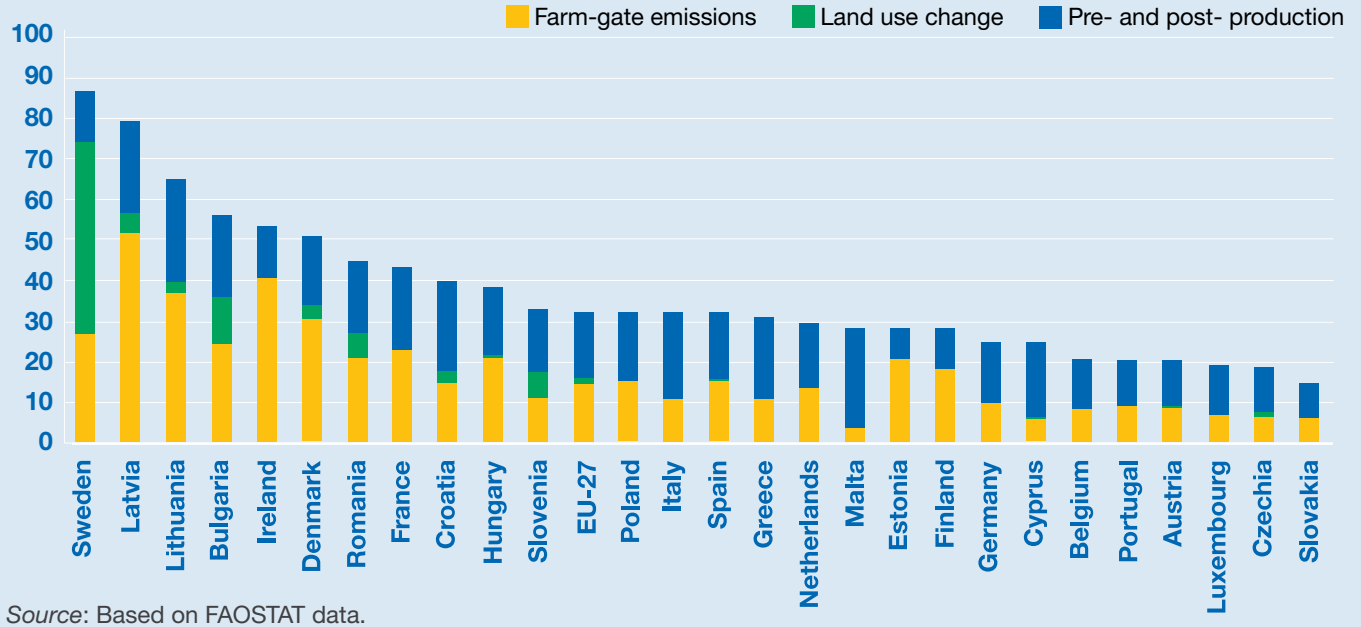
...EU regions will be affected very differently by climate change; agriculture **in northern Europe** is expected **to benefit**, while most **southern** European regions will be **negatively affected**...

...the **growing consumption of plant-based foods** will not help reduce the environmental impact of food production **if it is not coupled with a shift towards more local production**...

Figure 1. **Share of agri-food systems in total human-induced emissions (%) in EU Member States (2019)**



Source: Based on FAOSTAT data.

Box 1. **What is the agri-food sector?**

The agri-food sector is the combination of activities undertaken in the agriculture and food manufacturing sectors with links to the wholesale and retail distribution of food and drink. The sector includes agriculture, horticulture, and food and drink processing and also activities in their value chains, ranging from agricultural production to food manufacture and consumption. Wholesale and retail trade of food and drink, although more loosely connected, are sometimes viewed as part of agri-food.

Providing a job to an estimated 13.6 million people in the EU-27 in 2019, the sector accounted for about 7% of EU employment. Employment is concentrated in agricultural smallholdings and small and medium-sized enterprises (SMEs). In 2016, 2 in 3 EU agricultural holdings were less than 5 hectares in size, and 57% of food manufacturers employed fewer than 250 employees (compared to 50% across all manufacturing) in 2019. The agricultural part of agri-food has many family workers and people holding other jobs outside the sector (e.g. weekend farmers), although there are large-scale producers as well. The sizeable seasonal/temporary workforce is often engaged in low-wage, precarious employment and has many migrants.

Agri-food critically contributes to reaching European Green Deal targets

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Making the agri-food sector more sustainable is pivotal for achieving European Green Deal (EGD) ambitions. Anticipating the expected adoption of the legislative framework for sustainable food systems by the European Commission end of 2023, policy documents such as the Biodiversity strategy for 2030, the European industrial strategy, and the long-term vision for the EU's rural areas already provide targets and directions for future change in the sector.

The Farm-to-fork strategy (F2F) – one of the flagship initiatives of the EGD – aims to reduce the environmental and climate footprint of the EU food system and to reverse biodiversity loss via nature conservation. The redesigned EU food system F2F envisions helping reduce food waste and ensuring that food is sufficient, nourishing, and affordable to all citizens. Competitiveness of farming and food production, and farmers receiving a fair share of economic returns are also crucial objectives.

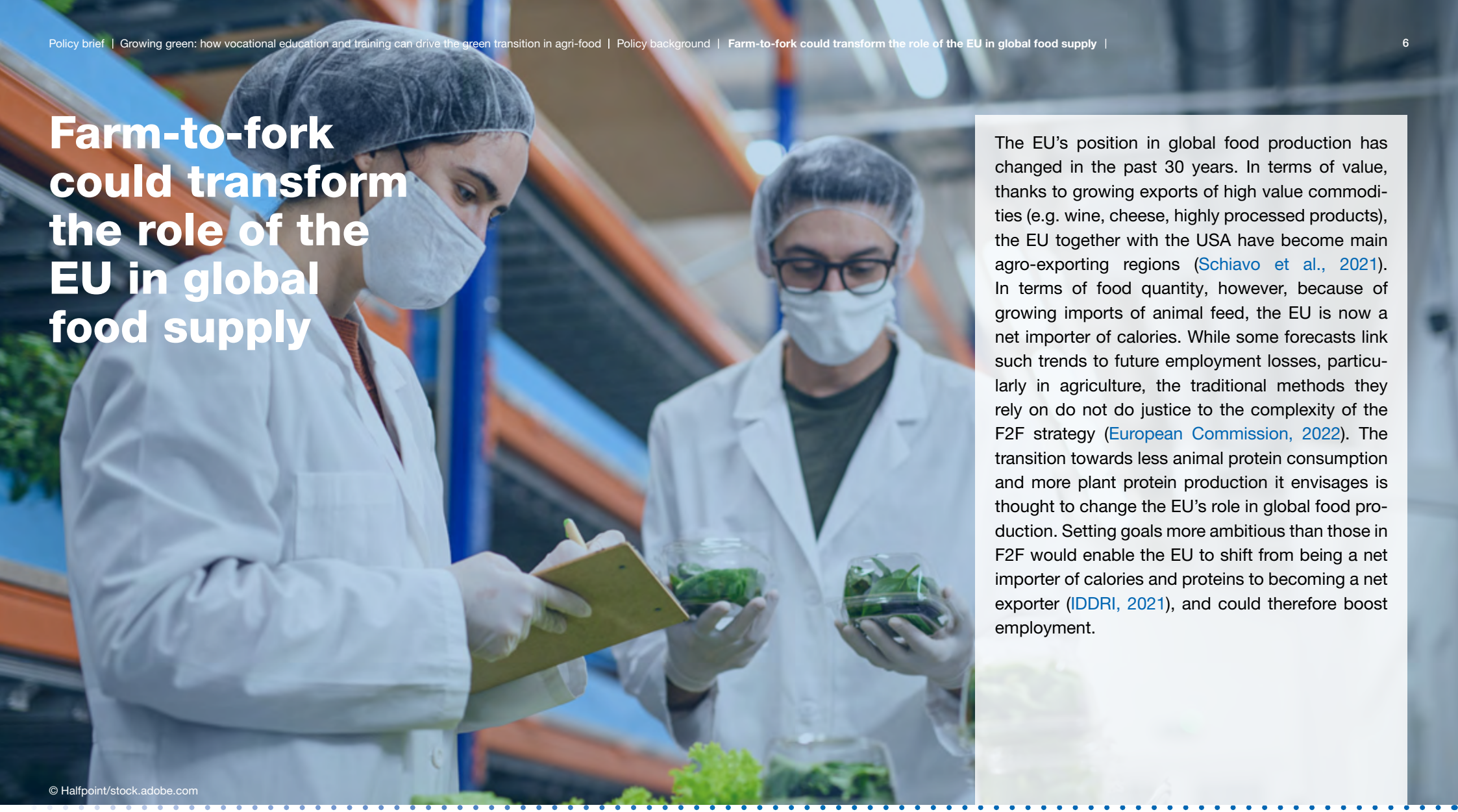
The new Common agricultural policy (CAP) sets goals for 2023-27, and – similar to F2F – is expected to contribute to achieving the EGD ambitions. Conditioning financial support to sustainability and climate friendly farming practices and standards, it paves the way for a fairer, greener and more performance-based agricultural policy. Involvement and commitment of food producers, processors, retailers, and consumers will be decisive in turning EGD ambitions for the agri-food sector into progress.

...the **Biodiversity strategy for 2030,** the **European industrial strategy,** and the **long-term vision for the EU's rural areas** provide targets and directions for future change...

...the **Farm-to-fork strategy** aims to **reduce the environmental and climate footprint** of the EU food system...

...the new **Common Agricultural Policy** (CAP) paves the way for a **fairer, greener and more performance-based agricultural policy**...

Farm-to-fork could transform the role of the EU in global food supply



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The EU's position in global food production has changed in the past 30 years. In terms of value, thanks to growing exports of high value commodities (e.g. wine, cheese, highly processed products), the EU together with the USA have become main agro-exporting regions (Schiavo et al., 2021). In terms of food quantity, however, because of growing imports of animal feed, the EU is now a net importer of calories. While some forecasts link such trends to future employment losses, particularly in agriculture, the traditional methods they rely on do not do justice to the complexity of the F2F strategy (European Commission, 2022). The transition towards less animal protein consumption and more plant protein production it envisages is thought to change the EU's role in global food production. Setting goals more ambitious than those in F2F would enable the EU to shift from being a net importer of calories and proteins to becoming a net exporter (IDDRI, 2021), and could therefore boost employment.

...thanks to growing exports of high value commodities, the **EU together with the USA** have become **main agro-exporting regions**...

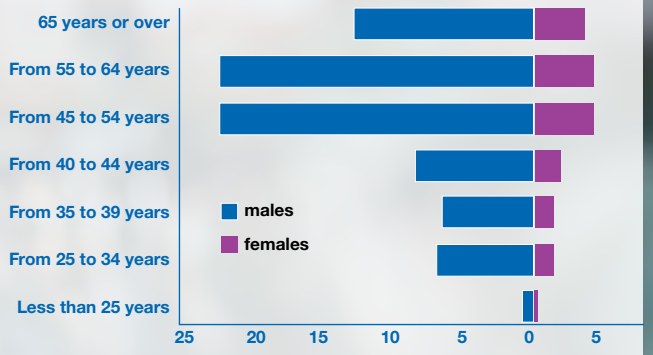
...transition towards **less animal protein consumption and more plant protein production** will likely **change the EU's role in global food production**...

...**setting more ambitious goals** would help the EU become a **calorie and protein net exporter** and could **boost employment**...

Generational renewal: an 'old' but ever-present challenge

Most young people are not attracted to living in rural areas and to jobs with strenuous working conditions, low income and long working hours. Generational renewal, particularly in the agriculture part of the agri-food sector, remains challenging. In 2020 only 1 in 3 farm managers was 40 years old or younger (Figure 2). The new CAP continues to address this problem via financial incentives for new entrants. Policy initiatives (such as the skills partnerships fostered in the EU Pact for Skills) and new technologies can contribute to making jobs in agriculture more attractive. For example, precision agriculture can provide entrepreneurial (hi-tech) career opportunities to Europe's youth.

Figure 2. **Farm managers/holders by age group and gender (2020)**



Source: Eurostat (ef_m_farmang).

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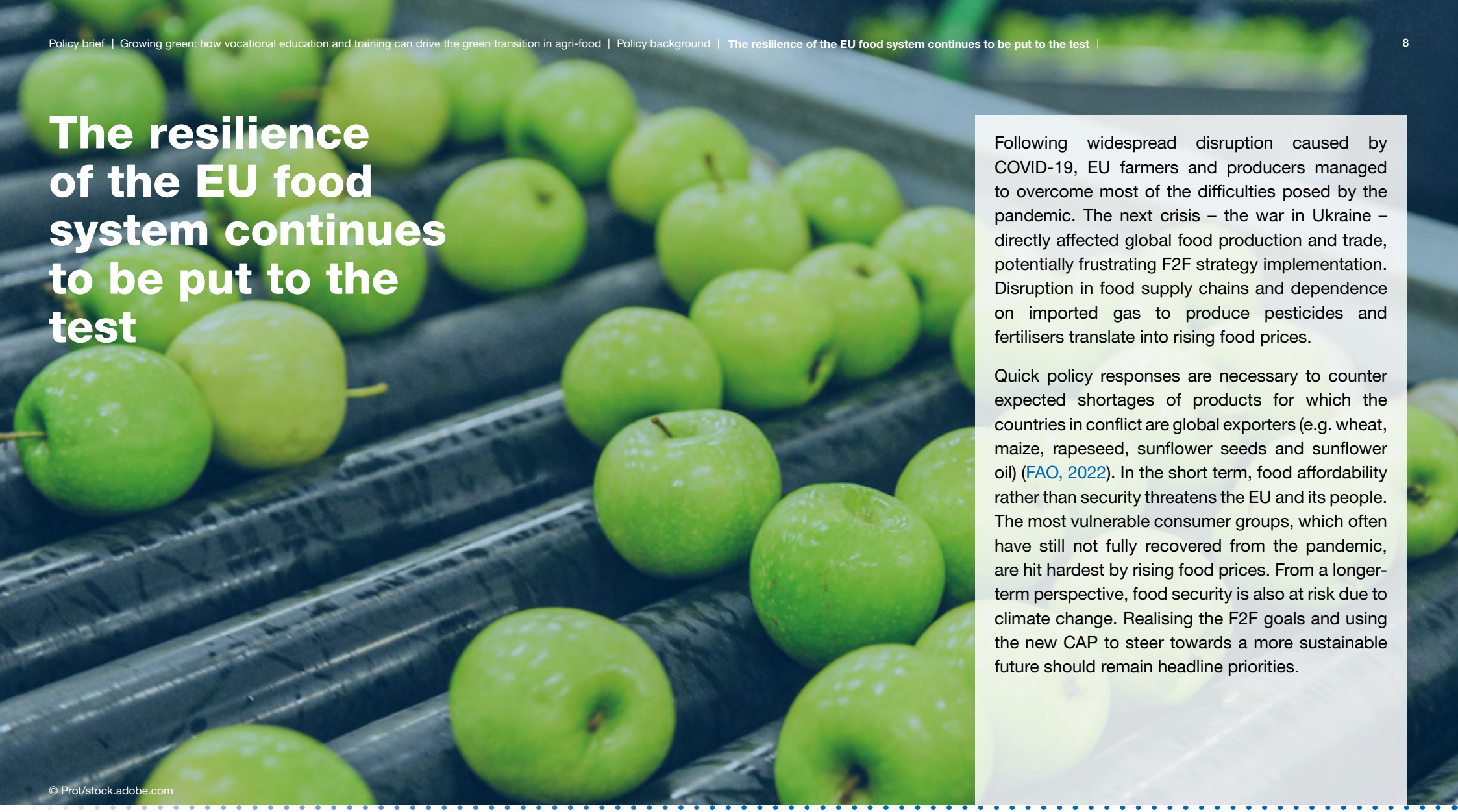
The resilience of the EU food system continues to be put to the test



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Following widespread disruption caused by COVID-19, EU farmers and producers managed to overcome most of the difficulties posed by the pandemic. The next crisis – the war in Ukraine – directly affected global food production and trade, potentially frustrating F2F strategy implementation. Disruption in food supply chains and dependence on imported gas to produce pesticides and fertilisers translate into rising food prices.

Quick policy responses are necessary to counter expected shortages of products for which the countries in conflict are global exporters (e.g. wheat, maize, rapeseed, sunflower seeds and sunflower oil) (FAO, 2022). In the short term, food affordability rather than security threatens the EU and its people. The most vulnerable consumer groups, which often have still not fully recovered from the pandemic, are hit hardest by rising food prices. From a longer-term perspective, food security is also at risk due to climate change. Realising the F2F goals and using the new CAP to steer towards a more sustainable future should remain headline priorities.

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Innovation fosters resilience and drives the agri-food transition

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Innovative solutions limiting agri-food's dependence on energy, energy-intensive imports and animal feed imports can help make agri-food systems more resilient (EPRS, 2022). Advanced technologies are also essential for enabling the agri-food industry to increase its efficiency while limiting the environmental impact of its activities. Past automation waves affecting routine tasks such as fruit picking and crop sensing have had a negative impact on employment, mainly replacing low-skilled jobs. Employment is forecast to continue shrinking, despite boosts for some occupations (Figure 3).

Farm-to-fork promotes the uptake of a broad range of high-tech-driven farming practices, such as precision farming, soilless farming (e.g. hydroponics), and vertical farming in cities and their outskirts. Technology will also play a role in developing novel food ingredients (e.g. new sources of protein such as insects and synthetic proteins). Digital technology is expected to help food producers cope with the adverse effects of climate change. Such technology enables smart monitoring with sensors (photonics), intelligent planning, disease control, and soil conservation.

Increasing the capacity of agri-food workers to adopt technology will be a critical success factor in realising EGD ambitions and will boost the demand for digital and advanced technological skills (EC 2020). Initial vocational education and training (IVET) and continuous vocational education and training (CVET) will need to address a variety of emerging skill needs in the sector. The challenges facing the agri-food sector require a multi-disciplinary response. Demand for people qualified in STEM (science, technology, engineering and mathematics) subjects, especially those related to biology, biochemistry and chemistry, will increase; so will engineering and IT skills for *Farming 4.0* and continuous flow processes in food manufacturing. Many of these skills will be high-level ones used by people employed in managerial and professional occupations. Not only technical occupations (such as engineers, computer and data scientists, agronomists, biochemists, meteorologists and statisticians), but also sales- and export-related occupations will become more important in shaping the future of the sector.

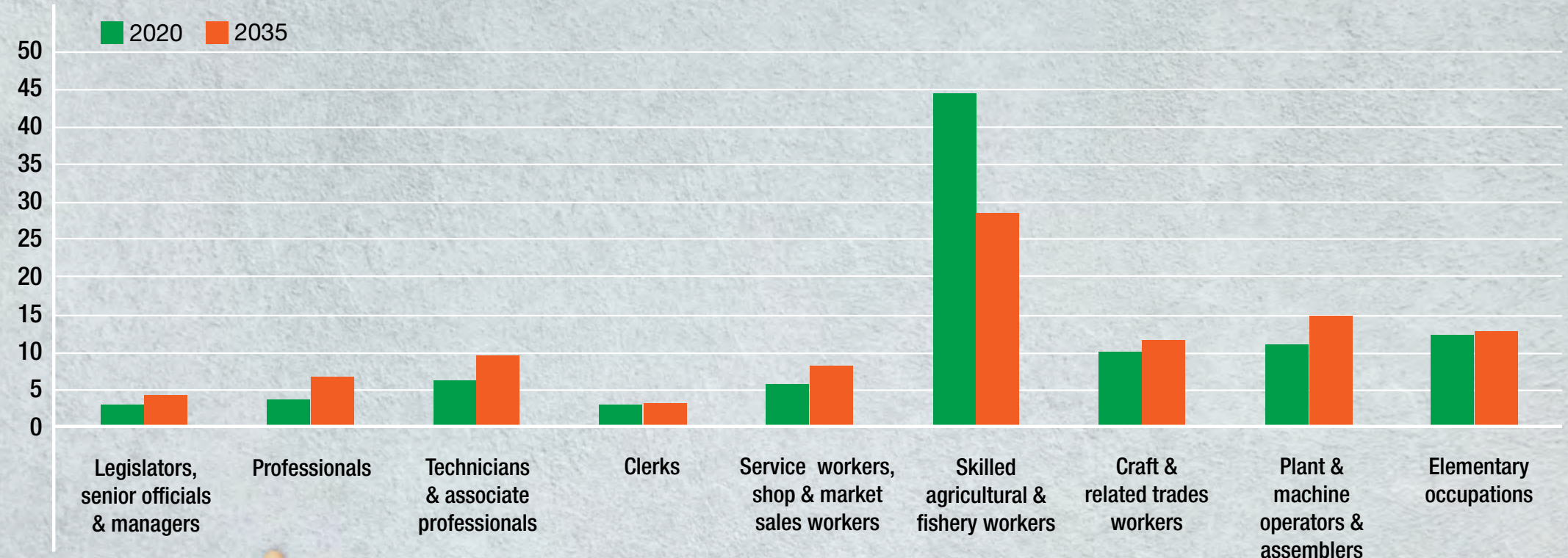
A Cedefop skills foresight study on agri-food aimed at providing expert insight into how expected developments in the sector change future skills needs and how VET systems will need to adapt to address them (Box 2). This policy brief presents the main results.

...**limiting agri-food's dependence on energy**, energy-intensive imports and animal feed imports can help make **agri-food systems more resilient**...

...**digital technology** is expected to help food producers **cope with the adverse effects of climate change**...

...**initial and continuous vocational education and training** will need to address a **variety of emerging skill needs** in the sector...

Figure 3. **Current and future employment by occupation in agri-food**



Source: Cedefop skills forecast database, own calculations.

Box 2. **Explained: Cedefop foresight on agri-food**

Cedefop's foresight on agri-food explored the implications of the implementation of the EGD on skills and the role of vocational education and training (VET) for jobs in the sector (*). It was part of a series of green foresight studies that also covers smart and green cities, the circular economy and waste management. More detailed information about the agri-food foresight study and a list of contributing experts are available here.

In the first online workshop, experts were asked to look towards the future (2030 and 2050) and to identify the occupations/skill profiles that will enable the agri-food sector to accommodate the changes the EGD requires. They also explored how VET can be leveraged in developing the identified skillsets. The results from the first workshop discussions were used to develop a two-round Delphi-style survey. The first-round questionnaire was designed to gain more insight into the issues raised in the workshop and to assess the extent to which there was consensus around them among the experts.

The results of the first round were used to design the second round, which focused on the role VET might play in meeting the skill needs identified in the first round. In the final workshop, Cedefop reported the findings from all stages of the foresight study to the experts, who discussed and validated them. Full results will be published in a Cedefop 2023 report alongside the results of the other three foresights.

(*) Spill-over effects in other sectors were not explored.

Source: Cedefop.

EVIDENCE

In this section

From hydroponics to empathy: emerging skill needs in agri-food

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Looking to the future, experts expect agri-food to be transformed by global warming, new pests and diseases (often linked to globalisation), the expanding circular economy, and new energy and carbon footprint regulation. Increasing emphasis on protecting biodiversity and championing local production (reducing food miles) are seen as policy megatrends shaping agri-food's future. Shifting consumer choices and growing awareness of sustainable consumption and production will amplify trends towards more sustainable packaging, diets, and food sources. Using algae and insects, as well as legumes, as alternatives to traditional protein sources, such as fish and meat, will likely become much more mainstream than today.

Automation and robotisation, new production processes and methods, blockchain, artificial intelligence (AI), and digitalisation and connectivity more broadly will drive change and accelerate innovation. Agri-food experts taking part in Cedefop's foresight were convinced that the following major innovations will radically change the face of agri-food, making the sector look very different from today:

- increased adoption of high technology and regenerative technology farming;
- farming processes relying less on resources (soil, space, and water);
- more industrial and intensive farming;
- more waste-based and less crops-based production of bio-fuels;
- large scale adoption of organic farming techniques;
- a shift towards circular business models in food production.

Innovation-driven trends, regulation, and meeting policy targets (e.g. increasing the share of organic farming) require a wide range of skills (Figure 4). These showcase the multi-faceted environment for agri-food and suggest that realising F2F strategy goals requires nothing less than a skills revolution in the sector.

By 2030 employment in start-ups is expected to increase, so employment will likely be spread across a much wider range of activities than today. The share of young people in employment will need to grow to accommodate such trends.

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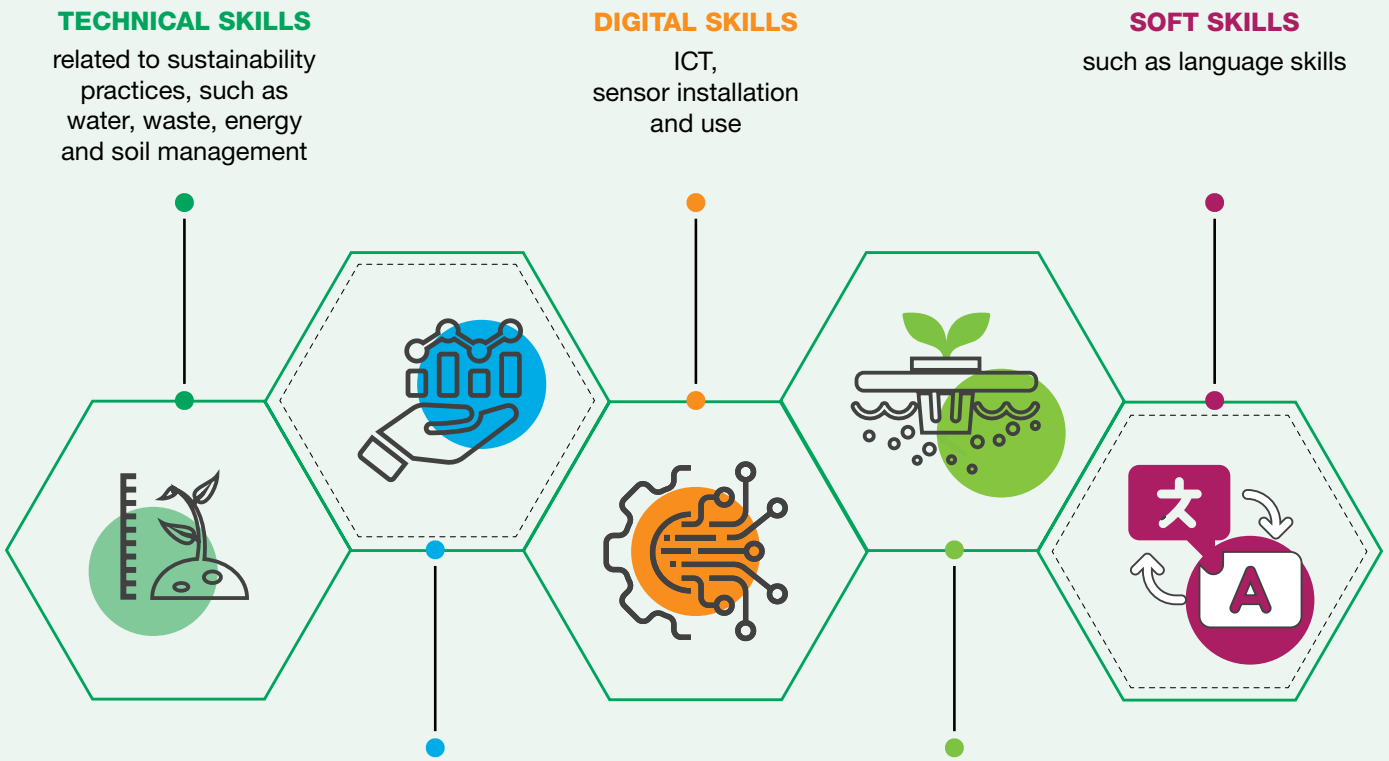
...realising **Farm-to-fork strategy goals** requires nothing less than **a skills revolution in the sector**...

Beyond the skills to implement and manage change, young people also need to be resilient: to anticipate future change, to discover new opportunities and markets, and to respond to new demands and changing customer preferences. Such resilience skills will also be crucial for other groups in the agri-food workforce.

Looking beyond 2030, current trends spearhead the growing importance of soft skills (marketing, entrepreneurship, and interacting with consumers). Technological innovation and changing consumer preferences, which eventually are likely to be taken up in regulation, may expand demand for technical and other skills needed in organic farming and producing new types of proteins. Energy and waste management skills can safely be considered key enablers up to 2050, as a circular way of living, producing and consuming will be a sine qua non in the transition to greener economies and societies.

Figure 4. **Future skill needs in the agri-food sector**



Source: Cedefop foresight in agri-food.

Attracting more young people to address skill shortages

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Alongside developing the skills agri-food needs in the coming years, the sector also needs to address challenges linked to its ageing workforce, by attracting more skilled people and by expanding the diversity of supply (e.g. more women in agriculture). Experts pointed towards prominent skill shortages (Figure 5) arising from the lack of young people interested in the sector and the rapid pace of technological change, particularly for:

- data analysis skills;
- skills for installing and using sensors;
- entrepreneurship skills;
- skills needed in hydroponics or aeroponics;
- empathy/skills required in adopting a human-centred approach to human resource management.

To make the agri-food sector more attractive for young people and encourage future skills supply, experts considered career guidance with practical information on agricultural and food manufacturing jobs essential. Education and training design, curricula and delivery can support such efforts. Integrated programmes covering the agriculture and food manufacturing sectors can help put the agri-food sector on young learners' radar. Hands-on learning, the hallmark feature of VET, can give young people realistic insight into what jobs in agri-food are all about.

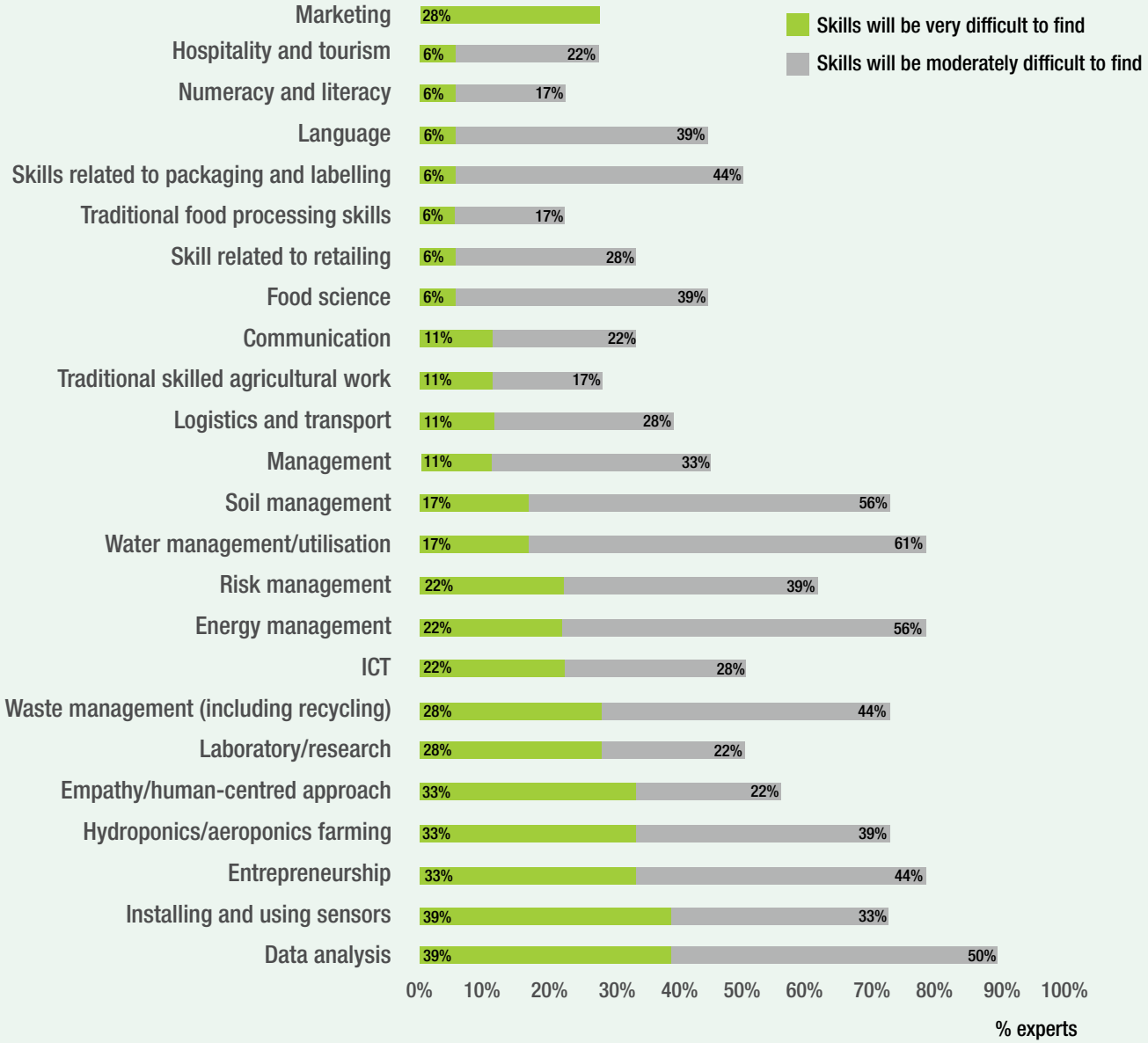
Developing and reforming apprenticeship schemes and other work-based learning pathways should be a priority for the sector and the stakeholders in the skills ecosystems surrounding it. Some experts pointed out that completely new programmes and curricula at higher level (e.g. masters and doctorates) would need to be developed. Other policy priorities most experts consider important in attracting young people to the sector include improving information, launching attractiveness campaigns, and establishing career-oriented apprenticeship programmes:

- designing new transversal programmes on sustainability and digitalisation and more specific ones for bio-based production, sustainable and urban farming, and waste management;
- establishing or strengthening sector-relevant progression opportunities in education so that workers in agri-food sector can pursue higher education;
- ensuring close integration of classroom-based and practical hands-on learning;
- fostering stakeholder collaboration to ease reaching consensus on the content of training provision;
- championing soft skills related to digitalisation, communication and teamwork as essential complements to hard ones;
- facilitating agri-food businesses' access to public and private funding (particularly for SMEs).

...**to address challenges** linked to its ageing workforce, **attracting more skilled people** and **expanding the diversity of supply** is key...

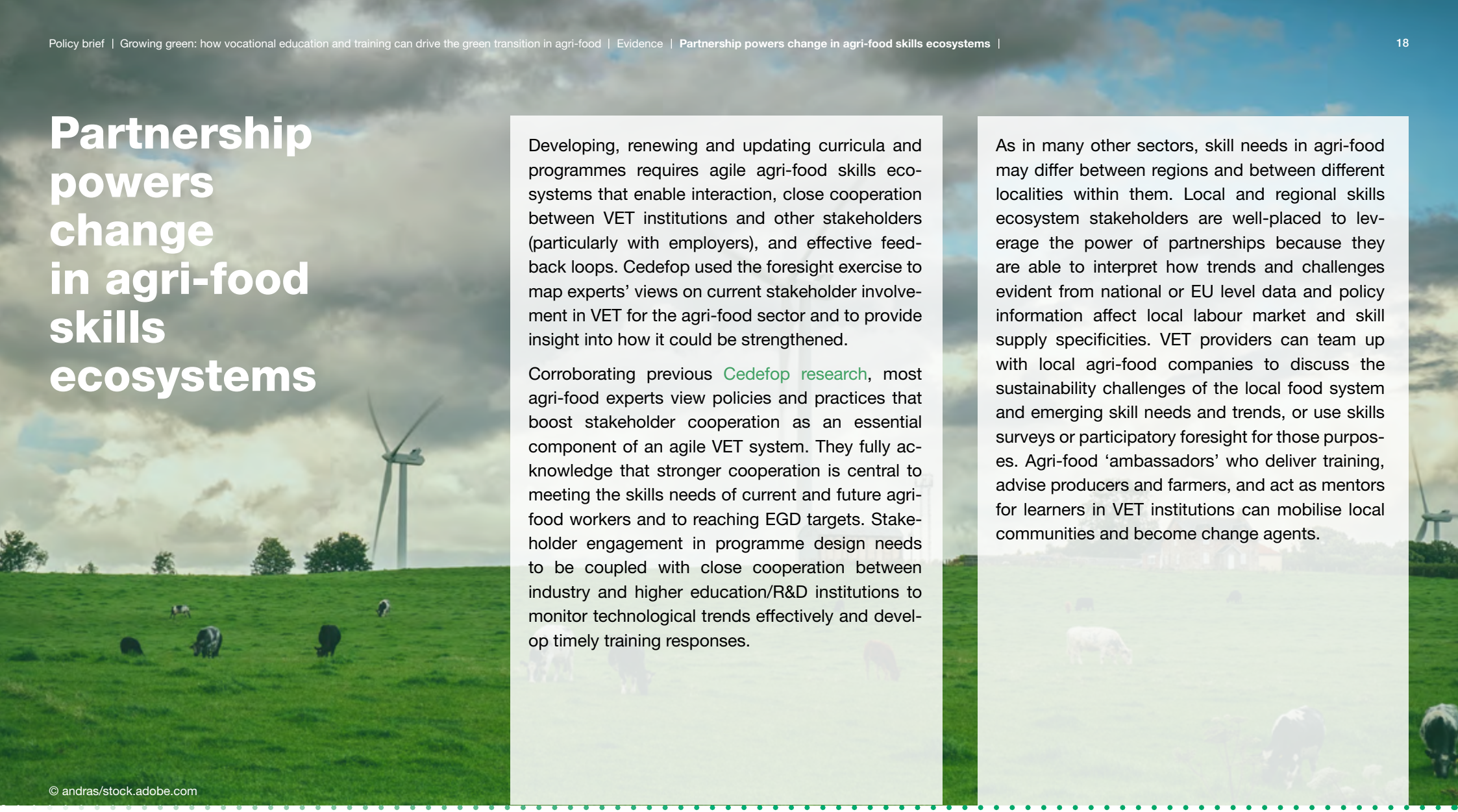
...**integrated programmes** covering agriculture and food manufacturing can help **put the agri-food sector on young learners' radar**...

Figure 5. **Difficulty in finding skills: expert assessment (%)**



Source: Expert assessment in Cedefop green foresight in agri-food- survey: round 2.

Partnership powers change in agri-food skills ecosystems



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Developing, renewing and updating curricula and programmes requires agile agri-food skills ecosystems that enable interaction, close cooperation between VET institutions and other stakeholders (particularly with employers), and effective feedback loops. Cedefop used the foresight exercise to map experts' views on current stakeholder involvement in VET for the agri-food sector and to provide insight into how it could be strengthened.

Corroborating previous Cedefop research, most agri-food experts view policies and practices that boost stakeholder cooperation as an essential component of an agile VET system. They fully acknowledge that stronger cooperation is central to meeting the skills needs of current and future agri-food workers and to reaching EGD targets. Stakeholder engagement in programme design needs to be coupled with close cooperation between industry and higher education/R&D institutions to monitor technological trends effectively and develop timely training responses.

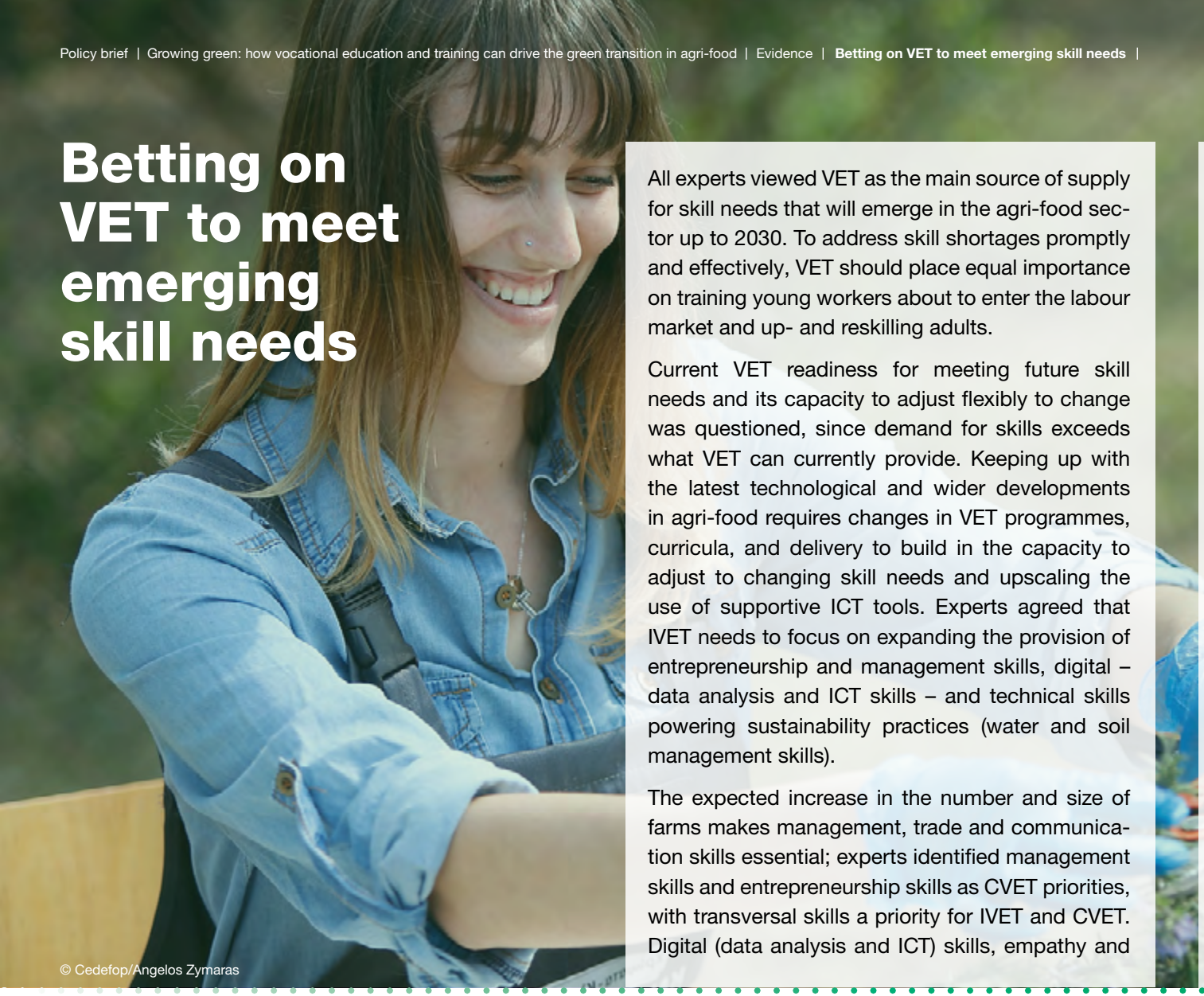
As in many other sectors, skill needs in agri-food may differ between regions and between different localities within them. Local and regional skills ecosystem stakeholders are well-placed to leverage the power of partnerships because they are able to interpret how trends and challenges evident from national or EU level data and policy information affect local labour market and skill supply specificities. VET providers can team up with local agri-food companies to discuss the sustainability challenges of the local food system and emerging skill needs and trends, or use skills surveys or participatory foresight for those purposes. Agri-food 'ambassadors' who deliver training, advise producers and farmers, and act as mentors for learners in VET institutions can mobilise local communities and become change agents.

...updating curricula and programmes requires **agile agri-food skills ecosystems** that enable **close cooperation** between VET institutions and other stakeholders...

...**stronger cooperation** is central to **meeting the skills needs** of current and **future agri-food workers** and to reaching EGD targets...

...**agri-food 'ambassadors'** who deliver training, advise producers and farmers, and act as mentors **can mobilise local communities**...

Betting on VET to meet emerging skill needs



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All experts viewed VET as the main source of supply for skill needs that will emerge in the agri-food sector up to 2030. To address skill shortages promptly and effectively, VET should place equal importance on training young workers about to enter the labour market and up- and reskilling adults.

Current VET readiness for meeting future skill needs and its capacity to adjust flexibly to change was questioned, since demand for skills exceeds what VET can currently provide. Keeping up with the latest technological and wider developments in agri-food requires changes in VET programmes, curricula, and delivery to build in the capacity to adjust to changing skill needs and upscaling the use of supportive ICT tools. Experts agreed that IVET needs to focus on expanding the provision of entrepreneurship and management skills, digital – data analysis and ICT skills – and technical skills powering sustainability practices (water and soil management skills).

The expected increase in the number and size of farms makes management, trade and communication skills essential; experts identified management skills and entrepreneurship skills as CVET priorities, with transversal skills a priority for IVET and CVET. Digital (data analysis and ICT) skills, empathy and human-centredness were also vital.

Weak commitment to training among employers and lack of training participation among employees are hurdles to skill development. CVET faces pressing challenges in upskilling and reskilling the agri-food workforce: increasing worker and employer engagement (for example via financial and non-financial training incentives), organising training that can be combined with work; and creating more awareness about training opportunities relevant to the agri-food sector and its workforce. Persuading SMEs to engage more in training and delivering more training in rural areas are particularly challenging. Other CVET challenges include customising it to local or regional needs and strengthening the links between providers and employers in local skills ecosystems. To overcome the challenges and meet the Farm-to-fork strategy targets, the following skills policies would be beneficial:

- offering/expanding adult apprenticeships;
- giving learners access to learning opportunities that boost entrepreneurial skills;
- providing/mainstreaming blended (online and in-person) learning;
- expanding certification/qualification opportunities (including microcredentials).

...**VET** should place equal importance on **training young workers** about to enter the labour market and **up- and reskilling adults**...

...**IVET** needs to focus on **powering sustainability practices** by expanding provision of **management, digital and technical skills**...

...**persuading SMEs** to engage more **in training** and delivering more training in rural areas are challenges **skill policies** can address...

CONCLUSIONS

Alongside innovation, change in agri-food will be driven by regulation, technological progress and changing consumer preferences. These trends reinforce one another and are likely to transform the agri-food sector in terms of processes and products. Inevitably there is uncertainty about the speed of change and about what the future will look like, especially beyond 2030.

Nonetheless, experts agree that a range of core skill needs must be satisfied, no matter which developments will turn out as decisive in shaping the future of the sector. Similarly, there is consensus about how VET can become better prepared to meet emerging skill needs and address skill gaps, for example by working more closely with employers and other key stakeholders.

In many respects, the foresight findings point towards the importance of doing what it takes to make skills ecosystems and the institutional and practical arrangements they are made of more conducive to effective governance of skills anticipation. From this perspective, the outlook can be optimistic, because the skills which will be required and the arrangements, mechanisms, and support measures which need to be in place to ensure they are effectively delivered are clear. It is imperative to ensure that VET investment, development, and reform proceeds in time and swiftly to avoid having skill shortages constrain the development of the agri-food sector and frustrate attaining the goals the EU has set for it.

In conclusion, the following aspects are essential for tapping the full potential of VET in satisfying future skill needs in the agri-food sector.

01 FOCUSING ON SUSTAINABILITY, BUSINESS AND SOFT SKILLS, AND ENERGY MANAGEMENT

As policy and practice veers towards a sustainability-driven approach to agri-food, entrepreneurship and marketing skills will become more important. This can be interpreted as the trend towards more sustainable food production spilling over into business models and work organisation. New business ventures will be needed to produce foods more sustainably (e.g. using new sources of protein). Marketing and communication skills will be needed to promote new foods and educate the population about their environmental and health benefits. A focus on energy management will help agri-food production reduce resource and energy consumption and its carbon footprint.

...**a range of core skill needs must be satisfied**, no matter which developments will turn out as decisive **in shaping the future of the agri-food sector**...

...**closer cooperation** with employers and other stakeholders can help **VET become better prepared** to meet emerging skill needs and address skill gaps...

...**VET investment, development, and reform** should proceed to avoid **skill shortages** constrain the development of the agri-food sector...

02 CHAMPIONING 3R VET: RESPONSIVE, RESOURCEFUL, RESILIENT

The war in Ukraine highlights the importance of agri-food being able to respond to shocks and disruption. VET systems need to be resilient and have built-in capacity to adapt quickly when skill needs change. The conflict also puts in the spotlight individual resilience and the role VET can play in giving people the skills to adapt quickly to changing labour market and skill needs.

03 NAVIGATING THE SKILL TRENDS THE WAR HAS SET IN MOTION

The impacts of the invasion of, and war in, Ukraine are potentially wide ranging for agri-food. The conflict and its economic fall-out has focused attention on sustainability, particularly on making energy production more sustainable. It looks as if food production will become increasingly concentrated in Europe. The entrepreneurial opportunities this creates can only be fully tapped with sufficiently available communication, marketing and persuasion skills, because these are essential in convincing consumers to buy locally produced foodstuffs. More production of food in Europe can drive up demand for skills also required in other sectors, leading to more competition between sectors looking for the same skillsets. This may make it more difficult for agri-food companies to source the skills they need, increasing the pressure on the human resource management professionals that work for them. Such challenges may require investment in HR skills. This will be even more pressing when consumers demand relatively low-cost products, because skill shortages will, other things being equal, drive costs up unless production efficiency or labour productivity can be increased.

04 MAKING AGRI-FOOD JOBS MORE ATTRACTIVE

Despite the forecast long-term trend of declining employment in agriculture, substantial replacement demand can be expected given that the workforce is ageing. This will lead to many new job openings to 2030. Awareness raising should complement efforts to make VET more accessible, relevant and agile, to

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attract people to work in agriculture and the agri-food sector more broadly.

05 BENEFITING FROM MODULAR LEARNING TO MEET SKILL NEEDS

Modular training courses give companies in the agri-food sector and their staff opportunities to address particular skill needs flexibly. Microcredentials can become a driver of change, as they contribute to mainstreaming modular provision of skills training, which in turn can facilitate training take-up.

06 PROMOTING COMPREHENSIVE SKILLS GOVERNANCE

A collaborative approach to managing skills demand and supply drives VET's capacity to meet the needs of agri-food employers and their staff. As in other sectors, partnership allows skill ecosystems to respond more easily and swiftly to emerging skill needs. Alongside national authorities, regional/local stakeholders must be involved in VET programmes and curricula to ensure that VET provision meets their needs. In some circumstances, capacity building may be necessary to help stakeholders forge, form and use such partnerships.

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Green Observatory

Cedefop Green Observatory **(Cedefop GO)** includes Cedefop's work on the **implications of the green transition on jobs and skills** across sectors and occupations in the EU

For more information on **Cedefop GO** visit the theme page

POLICY BRIEF

Growing green
How vocational education and training can drive the green transition in agri-food

Making the agri-food sector more sustainable is pivotal in achieving European Green Deal (EGD) ambitions. EU regulation, innovative high-tech farming approaches, shifting consumer choices, and more circular business models in food production will radically change the sector and transform skill needs. This policy brief reports on a Cedefop skills foresight study which looked at the occupations and skills that are essential to a more sustainable and resilient agri-food sector and the role vocational education and training can play in support.

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