ETF Working together Learning for life

European Training Foundation

THE FUTURE OF SKILLS IN ETF PARTNER COUNTRIES

Cross-country reflection paper: a multifaceted innovative approach combining Big Data and empirical research methods

THE EU AGENCY SUPPORTING COUNTRIES TO DEVELOP THROUGH LEARNING

Disclaimer

This report was prepared for European Training Foundation - ETF by Fondazione Giacomo Brodolini Srl SB and Erre Quadro Srl.

PREFACE

Since 2020, the ETF has conducted multiple studies ('Future of Skills' studies) to examine how various drivers of change – both technological and non-technological – are affecting occupations and related skill needs in selected sectors and countries, and how education and training systems are adapting to these evolving needs. This has led to identifying (emerging) future skill needs in the chosen sectors, through a combination of traditional research methods and innovative Big Data mining. The methodology is a step forward in the use and analysis of data and fills an important knowledge gap by complementing traditional empirical methods of research. The sectors we analysed include agri-tech in Israel, automotive in Türkiye, agri-food in Morocco, energy in Albania, Tunisia and Egypt, healthcare in Ukraine, construction in Armenia and platform work in the Eastern Partnership countries, the Western Balkans, the South Mediterranean and Central Asia.

The studies on the future of skills in different economic sectors focus on the evolving skills needs and occupations driven predominantly by technological innovations but with a keen eye on non-technological developments. They do not evaluate potential shifts in the volume of employment and skills demand. However, they do offer qualitative information on occupations, identifying the skills that individuals working in the sectors will increasingly need to acquire. Additionally, the studies provide insights into how companies are adapting to technological changes and developing the necessary skills. They demonstrate how the supply of skills is keeping pace with progress across economic sectors. Ultimately, the studies aim to raise awareness about the changing skills demands, identify drivers of change, and stimulate discussions among policy makers and practitioners in the field so that the findings can be further used and applied to adapt education and training provision.

Data analytics and AI are revolutionising the way we comprehend labour markets and skills demands. The ETF Future of Skills studies employ a combination of traditional research methods (such as desk research, data analysis and interviews) and big data text-mining techniques. Despite certain limitations, text-mining of big data yields new insights and real-time information on recent trends. When integrated with other methods –including interviews with key stakeholders and companies, statistical analysis of skill trends, and more – it serves as a potential tool for identifying emerging skills needs and determining their implications for education and training provision, and reskilling workers within companies.

Fondazione Giacomo Brodolini srl SB and Erre Quadro srl collaborated with the ETF to conduct the economic sector studies across various countries. A team of international and national researchers from each country was brought together to carry out these studies, in addition to the ETF's team of experts. This cross-country report was authored by Riccardo Apreda, Liga Baltina, Terence Hogarth and Panagiotis Ravanos and was coordinated by ETF expert Francesca Rosso, with key input from Ummuhan Bardak and Abdelaziz Jaouani. The report was peer reviewed by Cristiano Cagnin and by Rita Sciarra and Valentina Calderon Mejia from UNDP.

This report thoroughly documents the methodology we developed, the research process and presents the findings in a comprehensive manner. This is because the ETF aims to raise awareness about changing skills needs in developing and transition countries, with the aim to support skills policy reform and ultimately contribute to national growth and development. The findings not only increase awareness of all stakeholders in partner countries, be they researchers, practitioners, or policymakers. They also offer valuable insights, particularly concerning the capacity of the education and training system to adapt to shifting skills demands and to prepare workers for the new jobs and occupations that are likely to emerge.

Lastly, the ETF would like to express its gratitude to all the relevant public and private institutions and individuals in the countries we analysed for sharing information and their perspectives, as well as for actively participating in the ETF's online consultations and discussions over more than three years of work. Special thanks are extended to partner institutions such as the United Nations Industrial Development Organization (UNIDO) and the European Bank for Reconstruction and Development (EBRD), which have been partnering with ETF in the implementation of some selected case studies, as well as to the EU Delegations in the different countries, which have assisted in the research and the dialogue with national bodies. Such an extensive research project would not have been feasible without their support and contributions.

CONTENTS

Tables

Figures

EXECUTIVE SUMMARY

ETF Methodology

In 2019, ETF embarked upon developing a methodology designed to provide detailed evidence of emerging skills needs in its partner countries. Given concerns about the pace of technological change and its capacity to transform the jobs people undertake, the primary focus was on identifying the (technical and non-technical) skills people will increasingly need in the future. While skills analysis often focuses on the changing content of existing jobs, some of those jobs might not exist in the future. This prompted ETF's interest in determining the skills needs and how they will ultimately be combined to serve the jobs of tomorrow.

The resulting multi-faceted methodology – hereafter referred to as the ETF methodology – is centred on implementing natural language algorithms to extract information on emerging skills needs in selected sectors across various countries from patent and bibliographical databases. The methodology is a step up in the use and analysis of data, which fills an important knowledge gap by complementing traditional empirical methods of research. Indeed, the main advantage of text mining is the ability to swiftly search a large number of information sources. Although data may be dispersed across numerous documents, algorithms can uncover hidden patterns and emerging phenomena that may go unnoticed through manual search techniques. By correlating concepts and extracting trends, the methodology detects weak signals and identifies emerging trends. Most importantly, it is designed to readily provide granular level information on emerging skills needs for use in policy development.

Process for identifying emerging skills needs using conventional and data science methodologies

Background analysis – identification of key issues and skill needs → Data science – identification of emerging skill needs → Fieldwork with stakeholders and companies to validate and expand upon findings → Revise background analysis to identify likely future skill needs

Applying the methodology

The text mining element is enclosed within a more traditional approach to skills analysis. Initial analysis involves reviewing the literature and collating key statistics (national labour force survey, international databases and secondary sources). Upon completing the data science part, we conducted semi-structured interviews with employers and other key stakeholders to validate the findings, gather additional information on emerging skills needs, and identify how sectors will need to respond to meet their future skill needs. This then feeds into the compilation of the final report.

Conceptually, the ETF methodology is grounded in understanding the drivers of skills demand especially, though not exclusively, technological ones. By identifying the drivers of change it is possible to search for the skills which are associated with those drivers. In practice, this means that it is possible to identify groups of technologies and then locate the skill sets which are associated with the respective technology groups. In this way, technology is no longer treated as a black box. Other 'non-technological' drivers of change, such as demographics, macroeconomics and the environment are also factored into the analysis.

In summary, text mining can identify drivers of change and the technologies propelling that change forward, uncover the skills associated with the drivers and technologies, and then identify the jobs where those skills are likely to be required using ESCO.

The methodology was tested, improved and applied in a series of case studies undertaken in selected countries and sectors as follows:

- **Israel** – Agri-tech
- **Morocco** – Agri-food
- **Tunisia** – Energy
- **Albania** – Energy
- **Türkiye** – Automotive
- **Ukraine** – Healthcare
- **Armenia** – Construction
- **Egypt** – Energy

Key findings from eight case study countries

The studies showed that human capital is a central driver across sectors for sustainable economic growth and social well-being. Improving people's skills is a key factor for adaptability and innovation. It is also one of the most effective antidotes to growing inequality and increasing anxiety about the future. With this in mind, human capital development needs to become a central element in sectorial and industrial policies, as skills are key to growth and development. As new skills demands emerge due to technological, green, demographics, economics and political factors, developing and transition countries need to ensure that the workforce is prepared to grasp new opportunities and upskill and reskill, when needed, to perform new tasks.

The results revealed the following high-level findings:

Applying the methodology:

1. The methodology has been tested in countries with very different socio-economic contexts and in different sectors. It produced valuable, granular findings in all cases. This shows that the methodology can be applied to all economic sectors and all countries, regardless of their level of development.
2. The methodology has been improved over time to integrate trends beyond technological change, which proved to be essential in driving new skills demand. At present, the methodology has the potential to scan many different drivers of change in the sectors, including economic, societal, political, demographic, greening and others. Over time, the methodology has also been enhanced to reflect national specificities, which was made possible through specific Big Data analysis scanning national patents and related documents) and in-depth discussions with national companies and stakeholders. Understanding each country's particular path to development at the sectoral level is crucial for acknowledging differences in capacity to respond to change and meet resulting skills needs.
3. The methodology produces granular information about current and future skills needs. In doing so, it paves the way for greater alignment between the labour market and education and training systems, allowing time for them to adapt.
4. There is potential for further improvements to the methodology. These include, for instance, additional analysis of online job vacancies to gather more comprehensive information about current skills demand. A more thorough mapping of education and training provision in the sectors could also be added, to further customise the policy recommendations on skills anticipation and development.
5. Tailoring the outputs of the methodology to resonate with the country is essential for ensuring even more accurate use. By focusing even more on the specific needs and contexts of each country, the ETF methodology can more effectively influence the actions of potential users and target groups.

6. From a cost-benefit perspective, the methodology proved to be very successful, as it generated findings in a very limited time frame (4 to 6 months for each country), and with relatively limited investments. In particular, data generated from Big Data analysis is often available within a few weeks. This opens the possibility to continuously updating findings from Big Data sources with very limited resources.

Findings on skills for the future in different economic sectors:

7. The ETF methodology and its implementation provide valuable insights into drivers of change, and sector-by-sector skills demand analysis. In particular, the analysis of technical skills by sector reveals **commonalities in skills demands** across countries for a given sector. For instance, the energy sectors in Albania and Tunisia both highlight common skills needs related to renewable energy technologies, particularly solar power. While country-specific nuances exist, such as Albania's dependence on hydro-electricity and Tunisia's reliance on fossil fuels, there is a degree of convergence in their technical skills needs moving forward. Agri-tech and agri-food sectors in Israel and Morocco exhibit similar findings as they shift towards precision farming and improved water management strategies. The ETF methodology's granular analysis identifies specific skills demands, such as precision farming skills in agriculture-related sectors or sensor-related skills in energy.

8. Technologies driving future skill demand show commonalities across sectors, particularly in the **demand for digital skills** such as AI/robotics and data collection/analysis. Technical skills related to digitalisation, such as the use of sensors, are common across almost all sectors. The adoption of digital technologies opens doors to data analysis, which improves the production system efficiency and creates a demand for these skills in various industries.

9. Factors influencing technology adoption include exposure to competition, climate change and environmental concerns, and finding alternative sources of energy. The automotive sector, for instance, operates within global supply chains and markets, leading to a need for efficiency improvements in line with international competitors.

10. Uncertainties surrounding technology adoption stem from macroeconomic instability and the availability of necessary skills for implementation and exploitation of new technologies. These issues were flagged as significant in all countries and sectors covered by the study.

11. The studies also show a common trend shaping different economic sectors, which relates to **sustainability**, with particular reference to reducing energy consumption and waste levels. This is a core skill requirement in the energy sector, where the shift to harnessing renewable energy sources was underway across all countries, but it was also evident in the agriculture, automotive and construction sectors.

12. Across sectors, we found that **many new jobs** will emerge, only a **few old jobs will disappear**, but especially that most jobs will be done in a different way. The **specific tasks within jobs will change**, and so will the skills needed to perform these tasks. For instance, among new jobs we saw an emerging need for 'translators', not in language but in technologies, between machines and people (Türkiye), and other new types of jobs such as nutritionist engineers or experts in intellectual property, food transformation and processing, or metrology (Morocco).

13. Many new occupations are not listed in the ESCO database yet, as it is difficult to keep pace with the speed of technological advances: this is the case, for instance, of aviation safety specialists, flight control engineers, telemetry engineers and autonomous vehicle robotics drone architects (Israel)

14. We also found old jobs that are already done in a different way (and will further change): this is the case for agronomists, who will be requested to possess a wider range of knowledge that includes precision agriculture techniques such as sensor deployment and management, and data interpretation. The concept of being a farmer itself may be changing, with new technologies leading to a complete change in employment in the sector.

15. Many emerging skills needs relate to **engineering and technical roles**, with some sector-specific variations, such as healthcare's focus on imaging-related skills due to advances in diagnostic technologies.

16. However, the need for new skills extends beyond highly skilled occupations; the study demonstrates that in every sector, and to varying degrees, **both medium- and low-skilled professions** are also required to expand their skill sets. The impact of technological advancements is not limited to **technical jobs** either; business and sales roles are affected to a certain extent as well. Ultimately, all categories of workers are essential for the widespread adoption of innovative solutions.

17. Common skill demands across sectors include **greening and digitalisation**, which involve installation and use skills. These skills are in demand across agriculture, automotive, construction, and energy sectors and probably in many other sectors not covered by the study.

18. The studies also showed a tendency to search for backgrounds which are vertically specialised in a specific technology or area but have the capacity to apply it transversally over different jobs, with a horizontal knowledge of many disciplines, (a characteristic defined by companies as a **'T-shape'" profile** – i.e. having extensive expertise in more than one subject). Results also showed that the level of competence required by each worker will increase and become broader, shifting the occupational structure towards more highly skilled backgrounds.

19. The **adoption of a multidisciplinary approach** combining specific sectors (such as agricultural sciences with medicine, computer science or other fields) and the **integration of functions across the value chain** (e.g. with technicians also working in business development, customer care, sale, and dealing with suppliers, therefore needing soft skills as well) came up as prominent across the board. Workers in the future will have to not only be proficient in one discipline but will need to have extensive knowledge of another as well.

20. **Job descriptions** become **more fluid and change constantly, as will the related skills**.

21. Country-specific skills needs reflect the unique characteristics of each country's work sectors and strategic **decisions made by governments**, with some nuances. For example in Armenia, there is a specific need for earthquake-resilient construction due to the country's geological conditions.

22. **Soft skills** emerge as a common factor across all sectors, highlighting their importance alongside technical skills in adapting to the changing labour market landscape. The emphasis on soft skills is paramount, as it equips workers with the necessary tools to adapt to the rapidly changing needs of the workplace. Developing strong soft skills not only enhances individual effectiveness but also fosters resilience and agility, crucial attributes in navigating the dynamic landscape of today's professional environments. The soft skills most sought after include teamwork, communication, empathy, collaboration, open-mindedness, flexibility, curiosity, entrepreneurship, responsibility and persistence.

Key messages and implications for policy:

From a policy perspective, there are several key messages that emerge from the study pertaining to skills policies.

- International innovation strategies across diverse countries and economic sectors has revealed a notable trend. They demonstrate that developing and transition countries have embarked on a trajectory of innovation, characterised by an active role in shaping innovations rather than merely adopting them from external sources. In several instances, the substantial volume of patents filed by these countries attests to a significant level of innovation, signifying the potential for fostering national growth and development.
- Crucially, the pivotal role governments play in this context cannot be overstated. Government agencies play a central role in steering research and development initiatives and influencing the strategic directions of various sectors (both in developing and developed economies). Their decisions and actions wield considerable influence over the innovation landscape, determining the priorities and objectives that guide innovation within these countries. Consequently, it is

apparent that proactive involvement by governments is a linchpin for the independent innovation pursuits of developing and transition countries.

- The evolving landscape of new skills demands across the various economic sectors and countries presents a multifaceted scenario of **both risks and opportunities**. On the one hand, the rapid pace of change in skills requirements can pose significant risks, particularly when existing workforces are not adequately prepared to meet these demands. This skills gap can lead to reduced productivity, increased unemployment and economic inefficiencies. Companies openly say that skills gaps are one of the key elements that can hamper further growth. Additionally, it may exacerbate inequality and social disparities, as those with obsolete skills struggle to adapt and access opportunities. However, on the positive side, this dynamic environment offers numerous opportunities for growth and development. Countries and individuals that adapt swiftly to evolving skills sets can seize new economic prospects. In particular, occupations linked to technology, digital marketing, and green industries hold the potential for substantial job creation and economic expansion. Embracing these changes and promoting lifelong learning can empower individuals to thrive in the rapidly changing job market. The research reveals that this is particularly true in the case of countries that are in a development or transition stage.
- **High quality and relevant initial education and training** remain key to equipping people with the foundation and technical skills needed on the labour market. Young people will need strong key skills to be prepared for possible changes in their personal and professional life. They will need strong basic and transversal skills, as well as theoretical knowledge and professional skills. Soft skills such as creativity, adaptability and critical thinking are key features of 'human labour' as opposed to robots and must be incorporated into teaching curricula. Learning to learn, digital and entrepreneurial skills, and languages, social and civic competence become vital to ensure resilience and adaptability, a successful life and active citizenship.
- At the same time, the growing emphasis on **upskilling and reskilling** underscores the need for it to be accorded equal importance alongside initial education to accompany quick and constant transformations. In particular, special attention needs to be given to adults, whether they are in work, unemployed or inactive. People will experience more frequent transitions between old and new skills, between education, training and work, and between jobs. Adult learning – in the context of a comprehensive strategy that promotes lifelong learning – becomes crucial, as far more people will need to have affordable access to opportunities to update and upgrade their skills and learn new skills at different stages in their lives. They will need flexible provision of education and training, visibility of their skills, and career guidance. This means seamless learning pathways from early childhood throughout adult life and a system for lifelong learning that bridges different environments (at school, in the workplace, online, and in the community). With learning taking place throughout life and in a variety of situations, an open and accessible system for validation and recognition of prior learning (informal and non-formal) is also required. This also means drawing evidence from Active Labour Market Policies as a valuable source of information on the impact of different programmes, shedding light on effective interventions. Programmes that prove successful in supporting adults, women, and young people in the labour market can be replicated and mainstreamed, contributing significantly to shaping targeted strategies for skills development in diverse demographic groups.
- As new skills demands emerge, there is an urgent need to modernise education at all levels, with a particularly **critical focus on initial and continuing vocational education and training**. The transformative impact of technology on industry demands a workforce that is not only prepared for new jobs but also equipped with the agility to perform an array of tasks associated with technological advancements. Modernising VET programmes (including initial VET) is essential to bridge the gap between traditional skill sets and the digital competency required in today's workplaces. As more and more prominent demand for highly skilled technicians emerges across sectors, there is a need to create new VET streams or to adapt existing ones so that new technologies, new know-how and new skills are included in VET curricula. By integrating emerging technologies and fostering adaptability, VET (both in the form of IVET and CVT) can empower people to navigate the ever-evolving job landscape, fostering economic resilience and individual career progression but also a country's innovation and growth.

- Across countries and sectors there is a concerning trend where skills shortages persist, often stemming from the insufficient practical know-how and sector-specific knowledge exhibited by recent graduates. Many graduates, despite their theoretical foundation, face challenges when applying their skills to real-world scenarios, which prompts employers to seek additional training and orientation to fill the gaps. This discrepancy between educational preparation and the specific needs of industries highlights the imperative for universities and colleges to update their curricula and teaching methods. A comprehensive approach that **combines theoretical learning with practical exposure and industry-specific insights** can help address this critical issue. This translates into a preference for work-based-learning including apprenticeships and traineeships to ensure that workers possess the practical skills employers require and are more quickly operational. Moreover, it emphasises the importance of collaboration between schools and employers to ensure that graduates are not only equipped with academic knowledge but also with the practical skills essential for success in their chosen fields. By doing so, countries can (at least partially) bridge the gap between education and the workforce, ensuring that recent graduates are better prepared for the dynamic demands of the labour market.
- **Teachers and trainers** play a pivotal role in harnessing the potential of technology in education and training. They serve as the bridge between digital tools and the acquisition of knowledge and skills, guiding learners through the ever-expanding landscape of technological resources. In rapidly evolving contexts, teachers' training is key to ensure that students are equipped with the skills they need in light of the new emerging technologies in the different sectors.
- It is essential to address coordination failures and foster an integrated approach involving employers, educational institutions, training providers, and skills policy makers in identifying and resolving work sectors' skill-related challenges. Establishing **robust public-private-partnerships (PPPs)** is critical for skills systems to effectively adapt to and embrace the rapid changes in the labour market.
- Last but not least, to effectively bridge the gap between education and the rapidly evolving labour market, it is essential to implement a **systematic monitoring framework** for identifying emerging skills needs at the sector level. By establishing a robust and ongoing mechanism (such as Sector Skills Councils – SSCs) for gathering, analysing, and disseminating data on changing skills requirements, educational and training bodies can stay attuned to the real-time demands of various industries. This approach not only enhances the responsiveness of education and training but also provides vital insights to policymakers and stakeholders. In doing so, it ensures that these systems are equipped to proactively adapt what they offer, thus empowering individuals with the relevant skills needed to secure employment and thrive in a rapidly changing and technology-driven workforce.

The added value of the ETF methodology is the granular level of analysis, which allows for a detailed examination of specific skills demands across sectors and countries, as well as its forward-looking approach that anticipates medium-term changes in the labour market. It provides timely information that can assist a range of key stakeholders and policy makers on national skills structures to address the variety of factors that stand in the way of skills supply responding to skills demand. This possibility of regular updates could contribute to the much-needed flexibility, resilience and agility of education and training systems in facing the very fast changes. The findings can help different stakeholders to shape education, training and employment policies or, as in the case of youth policy, to make informed decisions. The findings can also help start a dialogue at a national level to boost innovation and support an innovation-enabling environment aimed at ensuring inclusive lifelong learning systems.

Ultimately, the study underlines the importance of **acting individually**. Shaping the future is about people and investing in people is more important than ever. Human capital is a central driver for sustainable economic growth and social well-being. Improving people's skills is a key factor for adaptability and innovation. It is also one of the most effective antidotes to growing inequality and increasing anxiety about the future. Public policies for human capital development are essential in managing change, following a people-centred and inclusive model of lifelong learning.

1. INTRODUCTION

The European Training Foundation (ETF)'s Future of Skills research programme provides information about emerging skills needs in selected sectors across its partner countries. It adopts a multi-faceted approach that combines quantitative, qualitative, and data science techniques to identify those skills that are likely to be increasingly in demand over the short- to medium-term as new products, new production process technologies, and new ways of working become commonplace. Results are presented here from sector studies conducted in Albania, Armenia, Egypt, Israel, Morocco, Tunisia, Türkiye and Ukraine. The methodology devised to identify emerging skills needs is a novel one designed to provide an agile means for undertaking skills anticipation at either the national or sectoral level. This is seen as important given the importance attached to skills in many national economic development plans and strategies.

Skills are seen as both a driver and a constraint on economic growth and societal development. Where skills in a society are well matched to demand, they can facilitate growth, but where there are mismatches (however defined) they can inhibit economic progress and limit individuals' life chances (European Commission, 2020). This has placed a heavy burden on skills anticipation systems to identify emerging skills needs. A task made all the more difficult by the green and digital transitions that have the potential to transform the world of work through creating new jobs that require new skills, and bringing about changes in the skill content of existing jobs. There is also the risk of some skills obsolescence that, in its most abject form, results in job loss (Nedelkoska and Quintini, 2018; Pouliakas, 2018). Even in countries where there is ready access to a wide range of skills data, skills anticipation can prove to be difficult because some change is disruptive and difficult to predict, such as the effects of digitalisation on work or, as in the case of COVID-19, it emerges out of the blue. This implies that skills anticipation needs a degree of agility if it is to respond in a timely manner to events in the labour market and global economy. With this in mind, the European Training Foundation (ETF) has developed a new, multi-faceted approach to skills anticipation for use in its partner countries. The approach makes use of qualitative and quantitative techniques, including those associated with data science (Big Data analysis), to provide potentially unique insights into emerging skills demands. It does so in a way that allows information to be swiftly processed to provide the much-needed agility skills anticipation that systems require to address, amongst other things, the twin digital and green transitions taking place against a backdrop of global geo-political tension and concomitant economic uncertainty. It is also designed, as will be explained in detail in subsequent chapters, to make efficient use of sometimes scarce information on skills.

It is important to remember that skill is a difficult concept to measure (Attewell, 1990; Green, 2013). Human capital theory tends to view skill as something that is accumulated through education, training, and work experience and that receives a monetary reward in wages. An individual's wage represents the return on their investment in skills or the marginal utility from obtaining an additional skill (however defined). This has tended to focus attention on years of education, qualification and occupation as proxy measures of human capital. Though imperfect, these measures have been regarded as the best available to capture an individual's investment in their human capital. That these data are readily available in many datasets makes their use all the more attractive. However, it needs to be borne in mind that qualifications provide a measure of skills or knowledge acquired but not necessarily used in the workplace, and occupation tends to be a broad grouping of jobs that have more in common with one another than with other occupations. Depending upon the level of occupational disaggregation available, one might be looking at a broad range of very different jobs within a single occupational group such as, say, 'managers'. This tends to limit the policy discourse to, if the example of 'managers' is once again used, broad transversal management skills.

More recently, the skills requirement approach has sought to further develop the measurement and analysis of skills. This recognises jobs comprise a range of tasks that necessitate the use of specific skills that can be measured by level, importance, and frequency of use. This type of approach has been used in surveys such as PIAAC and the European Skills and Jobs Survey (Cedefop 2022, 2015). Questions are asked about a range of different tasks and the skills, both cognitive and non-cognitive, to develop a much more detailed picture of the skills people require in different jobs.

Analyses that depend on occupation, qualification level, or occupational skill requirements rely upon a mix of administrative and survey data for information. Data collection is often costly and takes time to provide results. Moreover, the classifications they use are sometimes outdated given that occupational and qualification classifications are not reviewed frequently. This makes identifying new and emerging skills or jobs difficult. That said, analyses that use occupation and qualification and which rely on administrative or survey data are vitally important in that they provide a framework for quantifying both the supply of and demand for skills, albeit at a fairly high level of aggregation. With the application of data science techniques, principally that of natural language processing or text mining, granular information about the specific tasks and skills that are required in a given a job (not occupation) or related to specific new technology is now much more readily available (Cedefop. 2021; Mezzanzanica and Mercorio, 2019). As such, it becomes much more feasible to spot both new skills and new jobs. Data that were previously out of the skills researcher's reach because of the amount of time and effort required to manually extract and code information are becoming increasingly commonplace in skills analysis. While data science indubitably offers something new to skills anticipation, being able to identify the scale and structure of skills demands still relies on more traditional approaches, as does understanding how businesses implement change and succeed (or otherwise) in finding the skills they need. No one approach can answer every question, but in combination they provide a potentially powerful analytical approach. This is the essence of the ETF's methodology to understanding emerging skills needs in its partner countries.

The results have important implications for policy making. Over a relatively short space of time, skills anticipation has moved from providing aggregate information on changes in the number of people working or expected to work in occupations typically at ISCO one- or two-digit level to providing more information on the cognitive and non-cognitive skills requirements across a range of jobs. It has since gone on to provide detailed insights into the technical skills required in particular jobs and how these are being transformed by various drivers of change affecting the labour market. Policy makers and vocational education and training (VET) providers, now have a much clearer picture of skills demand and how it is likely to change over the short- to medium-term at a level of disaggregation that would have been considered impossible just ten years ago. The ETF's approach also draws attention to the factors that facilitate or inhibit the supply of skills that are predicted to be in demand. Taken as a whole, the ETF's approach potentially provides valuable detailed labour market skills intelligence of use to a wide variety of groups, including:

- policy makers responsible for education and training;
- employers and their representative organisations;
- labour market intermediaries providing information, advice and guidance (including public employment services) to:
  - jobseekers;
  - adult workers looking to develop their skills and careers;
  - young people making decisions about the skills they need to acquire to enter and progress in the labour market;
- education and training providers responsible for planning the provision of programmes and courses.

The value of providing this information should not be underestimated. If one takes the European Union as an example, the importance attached to improving the quality of skills supply so that it simultaneously promotes social inclusion, confers economically valuable skills on individuals, responds effectively to the digital and green transitions, and improves member state and EU-wide competitiveness is readily acknowledged across a range of policy documents such as the 2020 European Skills Agenda for Sustainable Competitiveness, Social Fairness and Resilience. Being able to achieve these goals (as is explicitly acknowledged in the European Skills Agenda) is dependent upon being able to, in the first instance, diagnose emerging skills needs. This needs to be done in a way that provides labour market skills intelligence, at an appropriate level of granularity, to allow policy makers, and other key education and training stakeholders to make informed, effective decisions. This means providing information on the scale, content, and importance of specific skill sets to be supplied through initial and continuing VET and the education system more generally.

In the remainder of this report we provide a synthesis of the results from the ETF's Future of Skills study. Chapter 2 provides an overview of the methodology, its application across sectors and countries, and how it was refined in the light of experience. Chapter 3 provides a synopsis of the drivers of skills demand. This is followed by a summary of emerging skills demands in Chapter 4. Chapter 5 then turns to the value-added provided by the methodology and its capacity to identify common and divergent skills needs across sectors and countries, and how education and training providers need to address these. Finally Chapter 6 provides a conclusion.

2. AIMS, OBJECTIVES AND BROAD METHODOLOGICAL APPROACH

The ETF commissioned a series of studies that sought to identify emerging skills needs across a range of sectors in some of its partner countries (see Table 1). The overall aim was to identify the emerging skills needs in each of the sectors so that policy makers and education and training providers would be better placed to respond to those needs. Conceptually, skills demand is seen as something that is derived mainly from employers' product market strategies which, in turn, tend to result from the confluence of various external factors (such as technological change, economic and labour market conditions, consumer preferences, etc.), employers' own strategic choices (i.e. their preference for certain forms of work organisation), and path dependency (the influence of past decisions). The study addressed the mix of inter-related factors that shaped skills demand, as set out below.

1. The drivers of skills change in each sector. This looked at how various external factors, such as technological change and innovation, were shaping the demand for skills in that sector.
2. Identifying the skills changes taking place in the sector as organisations adapted to the various external factors that influenced their production (and the processes in place to ensure that those skill needs are met).
3. Giving pointers for policy, especially with respect to how education and training provision can better meet emerging skills needs.

As will be elaborated on below, the study adopted a future-oriented approach in that it sought to identify the technologies – and associated skills needs – that were likely to come on stream over the next few years.

Table 1. Countries and sectors included in the study

	Country	Sector
1.	Israel	Agri-tech
2.	Morocco	Agri-food
3.	Tunisia	Energy
4.	Albania	Energy
5.	Egypt	Energy
6.	Türkiye	Automotive
7.	Armenia	Construction
8.	Ukraine	Healthcare

A mixed method approach was used in the study combining quantitative, qualitative and data science techniques. In practice, we put into practice a five-step research design, summarised below in Box 1.

Box 1: Steps in the study's mixed methods approach

1. Review of existing reports and analyses on the sector, its production and consumption patterns and related national policy framework.
2. Analysis of employment statistics in the sector to reveal the current position in terms of labour and skills demand.
3. Big data analyses using text mining techniques to capture data on technological change and associated skills needs from a variety of sources (e.g., patents, scientific papers, policy papers, etc.).
4. Comparing and matching the list of relevant technologies extracted from text mining to the related occupations and skills listed by the ESCO occupational database (see Glossary) using semantic matching algorithms.
5. Focus group discussions with key stakeholders and bilateral semi-structured interviews with selected stakeholders and companies in the sector to verify and refine the results of the previous steps.

Source: ETF

The first two steps involved reviewing background evidence on employment and skills relevant to the sector we were looking at. In practice, this involved providing information on economic, labour market, and skills trends for the country as a whole, over time, along with an explanation of the observed trends, especially the extent to which a country's existing potential of human resources was being sufficiently utilised. This provided the contextual setting for a more detailed analysis, which included providing statistical information on employment levels and skills demand, along with information that explained the sector's performance over time. These steps were completed by drawing on the literature relating to a sector in a specific country and official statistical data on employment and skills. Wherever possible, we provided comparisons with the EU average for a reference against which to gauge a sector's performance. National researchers were able to access a wide range of information that was sometimes available only in the language(s) of the country concerned. National Statistical Offices also provided bespoke tabulations, usually in relation to skills demand in the sectors.

The first two steps of the research were also used to outline the definition of the sector. Each sector in Table 1 can be readily identified with reference to one or two standard economic sectors as defined by Europe's classification of industrial activities (NACE). In some cases, there was a need to combine a range of sectors, as was the case in agri-food and health and social care (the latter also included medical equipment manufacturing).

The first part of the study represents a fairly standard approach to undertaking sector-based skills studies. The text mining approaches used in the third and fourth steps marked the novel aspect of the study. The main advantage of text mining is the ability to search a large number of information sources quickly. Here, the focus was upon patent data and scientific papers. Patents and scientific papers are easy to access and are structured sources, which facilitates information extraction. Although information may be scattered over many different documents, algorithms are able to discover hidden patterns and emerging phenomena that might not be detected by manual search techniques. By correlating concepts and extracting trends, it picks up on weak signals and identifies emerging trends. We text mined the European Patent Office's Espacenet database of registered patents and scientific papers stored in bibliographic databases (e.g. OpenAire).

In summary, the text mining was able to identify technologies driving change in the respective sectors, and then find links between the technologies and specific skills needs. As the research developed, it was possible to look at a wider range of drivers than solely technological ones (i.e. non-technological ones). The text mining element of the study also provided a future-oriented aspect to the study. Patents, for example, tend to be registered where organisations wish to protect the products and processes they are about to introduce. As such, they can provide insights into emerging skills needs. This may be contrasted with a web-scraping of job advert data that provides information on the skills required in jobs currently rather than in the future. Arguably, from a skills anticipation perspective, the future is more important than the past or the current situation.

The final step in the study was a qualitative one. Qualitative research was undertaken with key stakeholders in the sector, including employers, to obtain their views on emerging skills needs and how skills supply had or would need to adapt if future skills needs were to be met. This was undertaken through focus groups with a range of stakeholders (government policy makers, industry and trade union representatives, experts on the sector, etc.) and bilateral semi-structured interviews with selected employers. These were typically employers that had been at the forefront of introducing new products and/or production processes in their sector in order to gain an insight into how relatively high levels of innovation leads to specific skills needs. In other words, it gives an insight into the skills needs that might arise if more employers were to raise their product market strategies to that of above average performers. The focus group event actually had a double function; as it was also used to validate the initial findings from the study, thus providing valuable feedback.

As the study progressed across the eight countries, the methodology was further refined to address limitations that emerged during the analysis and to extend its applicability to various sectors and national contexts. Specifically, the text mining approach evolved in four main directions:

1. Capturing innovation not related to technological advancements: the range of concepts the software can identify has been broadened to encompass all types of change, innovation, best practices and new policies.
2. Addressing more traditional sectors with lower technological input: analysing scientific papers led to the extraction of information on socio-economic and non-technological drivers of change in these sectors. Furthermore, it became evident that even in traditional sectors the majority of changes in skills demand still originate from the arrival of new technologies, e.g. in construction, the use of management software, new materials, and novel construction techniques are transforming the entire sector, significantly increasing the need for additional skills and professions.
3. Tackling data scarcity: for some countries, national patents are limited in number. Consequently, the analysis expanded to encompass worldwide inventive activity with specific focus on the most important exchange zones for the given country (i.e. the EU for ETF-partner countries), as innovation occurs globally and technologies with clear economic, competitive, or technical advantages over existing methods will eventually be introduced in any country. The only variable is the timeframe for take up. While the methodology is robust in its results, the implication for the labour market in cases of limited inventive activity nationally is that many of the new technologies needed to advance the economy will likely be imported from abroad, affecting the internal capacity to generate new skills.
4. Tailoring results to country-specific characteristics: we paid close attention to extend data collection to national journals and patent offices, as well as additional data sources such as trademarks. In later studies, we introduced a new weighting parameter to draw out the technologies and professional skillsets that correlate more with the sub-sector in terms of future planning. We estimated values by combining data mining, desk research and stakeholder feedback.

The fieldwork phase and direct feedback from stakeholders supported all four of the above areas, particularly in gauging the extent to which new trends and paradigms are adopted and the timeframe.

It is worth mentioning the methodological modifications necessitated by the COVID-19 pandemic. Travel restrictions led to online interviews, enabling researchers to reach a larger number of companies than before. The new global situation generated both challenges and opportunities, leading to a demand for additional competencies and occupations.

3. NEW INFORMATION ON THE DRIVERS OF SKILLS CHANGE

3.1 Identifying drivers

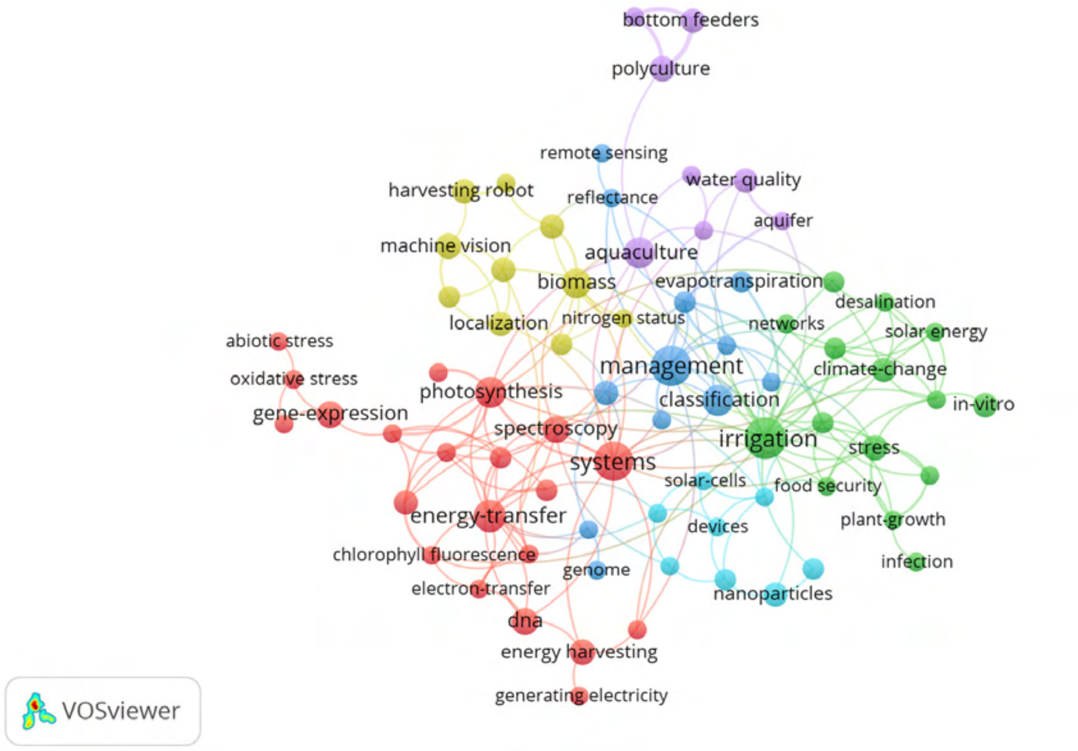
In the standard skills analysis model, skills needs are seen to emerge, more or less, in response to a range of external drivers of change. These are usually specified with respect to various forms of change, including:

- the product market strategies of companies (and, in aggregate, sectors and national economies);
- technological change (including digitalisation);
- greening of the economy;
- regulatory change;
- demographic change;
- political factors;
- economic factors;
- social factors.

In addition, the product market strategies of companies (and, in aggregate, sectors and national economies) set the overall demand for skills. If companies adopt a relatively high product market strategy then this is likely to be reflected in a relatively high demand for skills (Mason, 2004). The emphasis here is very much upon technological change and identifying the specific technologies that are likely to be increasingly commonplace over the short- to medium-term and to which education and training providers will need to respond if skills supply is to keep pace with demand. Technological change tends to often be something of a black box represented by, for example, levels of investment in new plant machinery and equipment with little regard to the specifics of the technologies being introduced. Using a text mining approach it is possible to obtain a more detailed specification of the types of change being introduced, notably that of a technological kind.

To illustrate, the agri-tech case study from Israel can be used as an exemplar. Drivers of change were identified through a combination of Big Data and empirical methods of research (literature review, surveys sent to innovative companies in the sector, interviews with most relevant stakeholders). In relation to the use of Big Data, we searched the entire Scopus and Web of Science databases to find scientific papers and conference proceedings related to the agri-tech sector in Israel. This was supplemented by web scraping data from specialist agri-tech websites. The documents we obtained were then text mined to extract the most relevant keywords that were then clustered using network analysis to indicate the main types of technological change taking place. Figure 1 provides a sample of the findings from the cluster. It is immediately apparent that clustering keywords provides a much more detailed specification of drivers than has typically been available hitherto in skills analysis. There are also interlinking groups of terms, e.g. between climate change and renewable energies, which is then linked to specific technologies such as solar cells. These trends can be monitored over time to indicate whether the frequency with which they are mentioned has been increasing or decreasing over time to obtain a sense of their importance. Text mining of patent data can then be used to identify specific technologies related to the key technological drivers of change.

Figure 1. Drivers of change identified from text-mined keywords



Source: ETF

The type of analysis that yields the detail provided in Figure 1 still needs to be interpreted in case it produces statistical artefacts. This is why it is important to frame the analysis of drivers within the literature and statistical review, which is a precursor to the text mining analysis. This also provides the opportunity to draw on various indicators that do not necessarily require text mining, such as regulatory or economic and demographic change. The former is readily available in legal texts and the latter can be gleaned from national statistics. In the remainder of this section we consider the findings that emerged from the national case studies.

The analysis has been grouped by broad sector: agriculture-related (Israel and Morocco); energy (Albania, Egypt and Tunisia); automotive (Türkiye); construction (Armenia), and healthcare (Ukraine).

3.2 Drivers of change in agriculture-related work

The precise focus of the case studies in Israel and Morocco differed slightly from each other (see ETF, 2020 and 2021). In Israel, the focus was upon agri-tech (i.e. technologically advanced agricultural production including the shift to precision agriculture, the use of hydroponics, etc.) whereas the focus in Morocco was on the agri-food sector (the interlinking agriculture and food sectors – 'from farm to fork'). There were commonalities in relation to the drivers of change. In both countries this is related to regulation, government support for the sector, globalisation, consumer awareness, climate change and aridity, contamination, plant diseases, and waste management. A comparison between the drivers that emerged for the two countries is shown in Table 2. From a technological perspective, there were commonalities in the technologies being adopted or likely to be adopted in the future (see Table 3), specifically the increase in robotics, automation and sensing technologies. In agri-tech, there was more emphasis on technologies/tools related to the biochemistry of producing a range of agricultural products, while in agri-food there was more emphasis on automation linked to food manufacturing.

Table 2. Drivers of change in agriculture

Drivers of change for Morocco	Drivers of change for Israel
• Globalisation of market and logistics • International regulations and standards • Government support and taxation • Technological innovation • Climate change • Aridity and efficient water management • Environmental sustainability and greening of the economy • Crop improvement and new plant varieties • Need to increase productivity • Quality and upgrade along the value chain • Changes in consumer tastes	• Regulations affecting the market for agricultural products • Government backing of specific areas/ investments • Consumer awareness of regulations for specific problems • Technological innovation • Climate change • Aridity/water scarcity • Contamination/pollution of soil and food • Plant diseases • Need for waste management • Favourable innovation ecosystem

Source ETF

Table 3. Key technologies driving change in agriculture

Selected key technologies in Morocco	Selected key technologies in Israel
• Data acquisition and analysis • Solar thermal devices • Chemical separation techniques • Telemetry for reducing energy consumption • Harvesting machines for precision farming • Image acquisition • Wireless technologies • Pumps for irrigation systems • Drive mechanisms • Hydraulics systems • Information systems development • Genetics, biochemistry, biotechnologies • Robotic arms/Automation • Automatic measurement for packing and transportation • Chemistry and green chemistry • Raw material extrusion • Sensors • Nanotechnologies	• Irrigation systems • Water treatment technologies • Image acquisition and analysis • Data analysis • Energy harvesting systems • Biomass production • Solar technologies • Robotics and drones • Harvesting, transport and storage devices • Dissemination and substance distribution devices • Soil processing devices • Control systems • Monitoring devices, sensors and detectors • Pesticides • Fertilisers • Microbiology, Biochemistry, Genetics • Bioinformatics • Greenhouse technologies • Animal entrapment or removal devices

Source ETF

While there may be commonalities in the technologies being introduced, which in many respects were oriented towards addressing common problems such as aridity, land productivity, and waste management, the changes were being introduced in differing economic environments. In Israel, there is a strong innovation culture supported by government which facilitated the development and take-up of new technologies which in turn opened business opportunities both domestically and internationally. There was a general view that in the future the increasing use of artificial intelligence and other new technologies in agriculture would lead to new (higher value) production which, if successful, would require those in the sector to develop new business models. Although this was fuelled by the need to deal with climate change and water scarcity, new technologies also provided market opportunities to be capitalised upon. To a large extent, the same was true for Morocco except that the innovation culture – or innovation eco-systems – was less well established than in Israel and it was recognised that smaller producers – a large segment of the sector – will need support if they are to take advantage of the market opportunities that technological change potentially provides and avoid the potential pitfalls of not keeping pace with change.

3.3 Drivers of change in the energy sector

The research in Albania, Egypt and Tunisia focused on their energy sectors (ETF 2022a, ETF2022b, and ETF forthcoming). The differences between these sectors are distinct; Albania is highly dependent on domestic hydroelectricity production, Egypt depends upon fossil fuels and hydroelectricity, as well as being involved in the international transportation of fossil fuels, while Tunisia's domestic energy is reliant on fossil fuels. However, there are common drivers, albeit from different starting positions, in that all three countries are looking to diversify their energy supply.

Albania has developed a large hydropower network but this has come under pressure from climate change as rainfall has become more unpredictable. The expected increase in tourism and intensification of the agricultural sector, as well as the impact of climate change, may put additional strain on Albania's water resources. New investments in hydro-electric are still taking place but the evidence suggests that the country will be water-stressed by 2040. The main direction of change is towards finding alternative sources of electricity supply.

Egypt is the largest non-OPEC oil producer in Africa and one of the leading dry natural gas producers in the region (after Algeria and Nigeria). The country is also an important transit route for oil and liquified natural gas through the Suez Canal and the Suez-Mediterranean Pipeline. In addition to this, Egypt is the home of several other networks where all forms of energy resources are transported from Egypt towards neighbouring countries, including the Arab Gas Pipeline, the subsea Eastern Mediterranean Gas (EMG) pipeline, and the Eight Countries Electric Interconnection Project that transfers electricity across Northern Africa, the Levant, and Türkiye. The country's ambition is to become a major player in the global energy market as highlighted in its recent investment plans for fossil fuel (natural gas and oil) extraction and renewables. Egypt is looking to diversify its energy supply by expanding provision in renewables, especially wind (it has high stable wind speeds, notably in the desert areas). In recent years, however, Egypt's take-up of renewables has been slow, in part because of the subsidies provided to fossil fuel suppliers (ETF, forthcoming).

Tunisia, too, relies heavily on fossil fuels as an energy source. As the country tackles the challenges of improving sustainability, increased electricity consumption, and climate change, there will also be a need to diversify energy supply. This includes reducing the country's dependency on gas imported from abroad as well as switching towards more sustainable sources. In a sense, Tunisia is facing the same problem as Albania in that it needs to shift its supply more to alternative, renewable sources and at the same time meet increasing energy needs. Table 4 below summarises and compares the drivers for all three countries.

In general, the technological drivers of change are the same across countries as they shift towards using more sustainable, renewable sources of energy. There is an increasing focus in all countries on bringing in wind turbines, solar energy (both photovoltaic and collectors), biofuel production and, in Egypt in particular, hydrogen production too. Technological input also makes fossil fuels usage more sustainable, from new technologies for oil and gas extraction to transportation and refinery. All such objectives will require skilled people to be achieved at scale.

There is a widespread need across numerous subsectors for digitalisation, automation, and decentralisation of energy production and management. The study further emphasised the importance of not only focusing on production but also on the infrastructure for transmission and distribution. This dual focus aims to enhance efficiency (or alternatively, minimise losses) and enable smart grid management maintaining a balance between electricity consumption and production.

In Albania, the background review and the interviews with stakeholders indicated that the existing electricity distribution sector needed to be made more efficient. The current distribution network is considered to waste too much of the existing supply. A distinct infrastructure-related need has emerged for Egypt too, although significant progress has been made in modernising the grid to enhance efficiency, the strategic objective of increasing energy exports to other countries necessitates significant upgrades to the grid's capacity.

Table 4. Drivers of change in the energy sector

Drivers of change	Albania	Egypt	Tunisia
• Differential availability of energy sources	✔	✔	✔
• Proximity to major energy distribution routes		✔	
• Economic growth and increased energy consumption	✔	✔	✔
• Adequacy of infrastructure (for internal distribution)	✔	✔	
• Adequacy of infrastructure (for export)		✔	
• Environmental sustainability	✔		✔
• Climate change	✔	✔	✔
• Aridity/water shortage		✔	✔
• State support/incentives within national policies	✔	✔	
• International policies, regulations, agreements in the energy sector		✔	✔
• Social awareness		✔	
• Availability of foreign investments	✔	✔	✔
• Technological innovation	✔	✔	✔
• New tools for management and control	✔		
• Energy efficiency improvement	✔	✔	
• Albania's EU accession agenda and transportation of acquis	✔		
• Geopolitical dynamics and events		✔	

In all the countries, there was a recognition that change does not take place in a vacuum. If new technologies, which potentially solve the problems each country faces, are to be introduced, then there needs to be a policy catalyst. In other words, a roadmap or strategy that outlines how the energy supply will diversify over time and how investments in these new sources will be secured. The problem of insufficient investment was also brought up by the participants in the workshop as the first factor that inhibits the development of the energy sector or certain parts of it (e.g. renewables in Egypt). Albania has been able to attract foreign investment for its energy supply, but there are concerns that there is insufficient knowledge transfer and know-how from the foreign companies involved in developing the energy infrastructure.

3.4 Drivers of change in the automotive sector

The automotive sector has one important driver of expansion in the Turkish economy. Between 2009 and 2019, the rate of output growth in the automotive sector, both in manufacturing and sales, outstripped that recorded in the economy as a whole. It is also a source of international trade in the country. In 2019, the automotive sector exported around 80 per cent of its total production (valued at USD 21 billion). Exports – especially of passenger cars – have been slowly decreasing over recent years. Türkiye is also a big importer of vehicles. As per capita income has increased over time in the country, it has driven up the demand from consumers for cars – increasingly for foreign-produced vehicles.

It is also a sector that has been subject to much change over recent years, something that is expected to continue over the medium term. Many of these changes mirror the global automotive sector. These are changes that Türkiye must keep pace with if it is to retain its position as a major regional producer of cars and vehicles. Looking to the future, there are a wide range of technologies coming on stream that are likely to transform the automotive sector, not least the increasing share of the market for electric vehicles. This is only part of the change with which the sector must keep pace. Table 5 summarises the various drivers of change that are likely to have some bearing on the sector's skills needs over the near future. This has been derived from the literature review, text mining of papers and patents and stakeholder interviews.

Table 5. Drivers of change in the automotive sector in Türkiye

Driver	Changes taking place
Technology	Electric cars, smart cars, etc, and production processes
New business models	From online trading removing middlemen and increased levels of customisation, to shifts towards renting or sharing vehicles rather than buying
Global Value Chains	Impact on know-how and best practices as production sites around the world integrate
International competition	Adoption of solutions to improve efficiency, reduce costs and maintain quality levels
Customers' expectations.	Leads companies to work on differentiating their products
Economic and political (in)stability	Affects foreign investments, domestic market revenues and conditions of access to (some) international markets
Public policies and incentives	For example, the development of a specialisation in electric cars. Also linked to corporate environmental responsibility
Standards/regulations (especially environmental)	
Safety requirements	Always a focus of the industry, this is now becoming relevant in relation to (semi)-autonomous vehicles

Source: ETF

Patents for the automotive sector in Türkiye have been increasing over time, with patents clustered around data processing, mechanical power transmission, wheel systems, sensor control systems, electrical propulsion systems to name but a few. Viewed in the round, the various new technologies coming on stream, especially the switch to electric vehicles and the increased use of sensors within vehicles, linked to AI, have the potential to completely disrupt and reshape the sector's production and business models according to stakeholders. New technologies and new market entrants such as Google or Apple are already seen to be reshaping the sector. The ability of companies to quickly adapt their business models and strategies to changing market demands is vital for survival.

3.5 Drivers of change in construction

There are various factors that have implications for skills demand in construction. These include:

- reducing the carbon footprint of the building process and the energy consumption of buildings;
- the use of new materials in construction (sometimes related to reducing construction's carbon footprint and improving the energy efficiency of buildings);
- changes in the production process throughout the value-chain, from the introduction of digital technologies into the design process (e.g. building information modelling (BIM) and digital twins), to increased automation in the construction process;
- the increased use of off-site prefabrication and the modularisation of construction that has implications for the skills needed on-site;
- regulations, in particular that related to energy efficiency, climate change, and health and safety.

These are changes that are evident worldwide. They reflect the impact of twin digital and green transitions. There are also specific factors Armenia needs to address:

- the need for earthquake resistant construction given the levels of seismic activity in the country;
- maintaining the current workforce given the tendency for skilled workers to take work abroad; and
- generating investment capital to invest in new housing (and thereby maintain levels of demand in that part of the construction sector).

Looking more specifically at the technologies being developed in Armenia, these are focused on:

- anti-seismic construction, and other seismic safety/protection measures (e.g. shelters);
- structural elements and building blocks, in particular to accelerate construction times;
- heat insulation, sound insulation;
- prefabricated buildings;
- road surfacing and reduction of the environmental impact of roads; and
- automated parking.

It is also likely over time that Armenia will be subject to global technological developments. Analysis of patent data suggests that the following technologies are increasingly coming on stream over the short- to medium-term. In other words, there are changes in progress that might eventually influence activities in the Armenian sector. Or, to put it another way, there are technological developments that the sector in Armenia will need too. These include:

- Building materials;
- Structural elements;
- Finishing elements;
- Green construction;
- Hydraulic engineering;
- Construction site processes;
- Road construction;
- Railway construction;
- Digital solutions;
- Bridge construction;
- Additive manufacturing;
- Robotics in construction.

Potentially these all have implications for the supply of, and demand for, skills in the construction sector. This is addressed in the next chapter.

3.6 Drivers of change in healthcare

PLEASE NOTE: This study was undertaken before Russia's invasion of Ukraine. Clearly this has an impact on the short- to medium-term skills needs in Ukraine's healthcare sector. Nevertheless the study demonstrates the skills needs that are likely to arise once the war ends and Ukraine's healthcare sector is once again fully functional. We believe the results may still be relevant to Ukraine.

Research in Ukraine focused on the health sector, which has struggled to provide effective services over the entire period since its independence after the demise of the Soviet Union. The Soviet-era Semashko system was already at breaking point at the end of the 1980s, suffering from inefficient processes and outdated equipment. Over the past 30 years the healthcare system has struggled to keep pace with change with the result that the provision of health care to the public is widely considered to be poor by international comparison. There have been many attempts at reform in order to rectify the situation. The National Healthcare System of Ukraine (NHSU) was created in April 2018 to act as a national procurer of medical services to kick start the first structural phase of the sector's transformation.

The NHSU has since signed contracts with healthcare providers for free patient services at the point of use. The private sector has been ever present in the Ukrainian health sector since independence, with private facilities being the only ones with the resources to obtain and use modern health technologies such as electronic record keeping, digital x-rays, various innovative dental technologies, and so on. Private IT companies have also entered the healthcare market to provide, amongst other things, digital platforms for video consultations. International stakeholders also play an important role in the health sector's reform. These reforms are a major driver of change and skills demand.

Looking to the future development of the healthcare sector, the main drivers relate to:

- demographic change related to both ageing and migration trends (before the invasion, the country had a high death rate and a low birth rate);
- financing healthcare, including the more efficient delivery of healthcare and medicines coupled with rooting out corruption;
- measures designed to prevent disease;
- digitalisation involving all the sectors both in service supply and medical device manufacturing. This is likely to include digitalisation of data management and the use of mathematical and computational systems for modelling in medical analyses;
- environmental change, bearing in mind that pollution is a major source of disease; and
- ongoing technological changes. The analysis of patent data records shows a substantial number of patents being registered for various medical advances in Ukraine.

There is also an interest in learning from international best practice (as facilitated by a range of international organisations providing advice to the country, e.g. the WHO).

Looking at the number of patents filed gives an indication of the innovative/technological change taking place. There appear to be three key fields: pharmaceuticals, diagnosis and prognosis, and surgery.

These three account for almost 80 per cent of Ukrainian patents in healthcare and outrun other areas of innovation and change by a substantial order of magnitude. The text mining analysis indicates that technological change, including digitalisation, signals rapid change has been taking place linked to tele-medicine, new surgical techniques, new types of diagnostics (linked to imaging, for example), etc. These are expected to drive change in the future.

3.7 Conclusion on drivers of change

The evidence provided above has focussed to a large extent on the technologies that are likely to shape the future demand for skills. Across the sectors there are commonalities. This is notable with respect to the demand for digital skills across a range of sectors (e.g. the use of AI/robotics, data collection and analysis to improve the efficiency with which goods and services are produced). This can be seen in the energy and construction sectors, for instance, where energy auditing is becoming more widespread, and in precision agriculture where sensors are used to collect information that can be analysed to improve yields. A similar cross-sector trend is the emphasis on sustainability and greening of production methods, which is prevalent in industries such as construction, agrifood, energy, and automotives. The health sector is less affected by this trend for obvious reasons.

Whether or not these technologies are adopted is dependent ultimately upon a range of other factors. These include:

- exposure to competition. Sectors such as the automotive sector operate within global supply chains and markets. The need to improve the efficiency with which vehicles (or the parts thereof) are made in line with that of international competitors can act as a spur to adopt new technologies. Something similar can be seen in the energy sector, especially where energy is being exported (as is the case of Egypt). There are other sectors, such as construction and healthcare, where competition tends to be domestic rather than international, something that potentially weakens the imperative to innovate relative to situations where there is international competition;
- climate change and the prevention of environmental degradation. In some instances, climate change exerts a strong influence over new technology take-up. For instance in the energy sector, concerns over water shortages have had an impact on energy diversification in Albania and Egypt – two countries with substantial hydropower sectors. It also has an impact on construction where the need to conserve energy (in the construction process and in the energy efficiency of buildings) is evidently to the fore;
- finding alternative sources of energy is also evident across countries as they move increasingly to renewable energies, typically in the form of wind and solar power. There are various factors driving this change, not least the price of energy on international markets but also the fact that some countries are relatively well placed to make use of wind or solar energy.

While the above provide imperatives to adopt the kinds of technologies that have the potential to drive skills demand in the future, there are uncertainties over the extent to which they will be adopted. This stems in large measure from:

- macroeconomic instability and the impact this has on government planning and both public and private investments. This was flagged as an issue in all of the countries and sectors covered by the study; and
- the availability of the skills that will be required either to construct the infrastructure required to move into, for instance, renewable energy, and then ensuring a sufficient supply of skilled personnel to tap the potential afforded by new technologies.

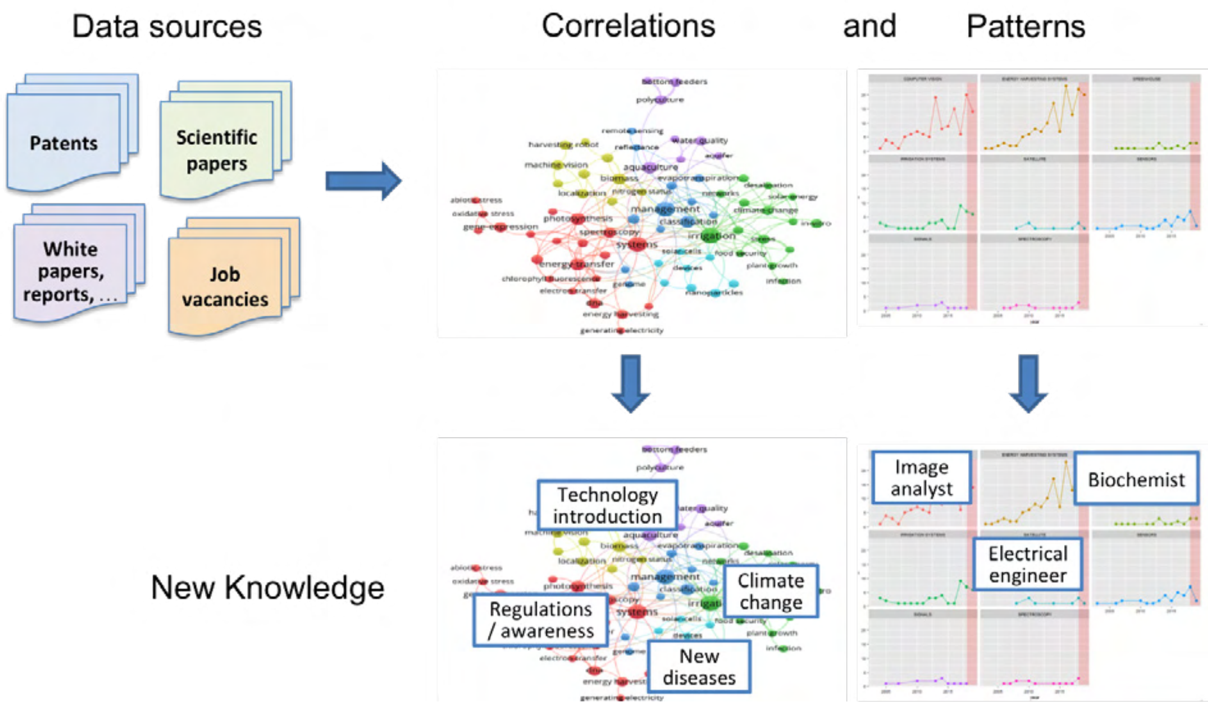
There are clearly a range of factors at play that are likely to affect the propensity of countries (and specific industries within them) to adopt the new technologies likely to shape the future of work across a range of sectors worldwide. The availability of skills is prominent among them. The characteristics of skills demand is addressed in the next section.

4. NEW DETAILED INSIGHTS INTO THE CHANGING PATTERN OF SKILLS DEMAND

4.1 Introduction

The previous section described the first phase of the text mining exercise in relation to the drivers of change. This was based on extracting data on (i) technical and societal drivers of change and (ii) technologies introduced into the sector and their spread over time. This is then used to identify the skills and occupations these changes and technologies are likely to give rise to (in this sense, the focus of this first part of the analysis is very much focused on emerging technological skills, while more general soft skills are analysed through more traditional empirical methods, including surveys and interviews). In the second phase of text mining, the information identified was compared and matched with the associated occupations and skills listed in skill databases such as ESCO by using semantic matching algorithms (i.e. algorithms able to find semantic connections between different concepts based on contextual information). Figure 2 summarises the two phases of the text mining process.

Figure 2. The text mining process: from drivers of change to emerging skills needs



Source: ETF

Each occupation in the ESCO database includes a description and a list of skills and knowledge considered relevant (either essential or optional) for that occupation. The semantic algorithm looks for matches of each technology with all the concepts associated with that occupation. When a match is found, the occupation is considered to be associated with the technology. The entire procedure is automated using ESCO's Application Programming Interface (API), which allows occupational data to be downloaded. If an occupation was affected by technology at any level, then the text mining found it. If no match was found in ESCO or O*NET due to emerging (future) jobs or new skills needs, we used other approaches – e.g. connecting the new skills through Wikipedia – to try to identify them. In this way, the analysis is not limited to identifying skills contained in databases that code historical (albeit recent) data.

In some cases, because ESCO's descriptions of skills may not take into account recent technological developments, certain associations may be missed. Links might be expected to be missing more frequently in the case of low-skilled occupations simply because technology has an impact on skill and low skilled jobs tend to comprise relatively few skills and, in part, because new technologies usher in a need to upgrade low-level skills to medium-skills ones. It may well be the case that lower-skilled jobs are simply not mentioned in relation to technological drivers of skills demand because such drivers do not directly affect the jobs of lower-skilled workers. To some extent, this needs to be explored through other methods (such as the interviews with stakeholders). The same is valid in relation to soft skill, as they are reported as being very important by most of the employers (yet not captured through the Big Data analysis described above). There is the possibility that these fail to emerge when the focus is specific technologies. To date, soft skills have been explored in the interviews with stakeholders but there is ongoing exploration to identify how the text mining algorithms can be developed to point to soft skill needs relating to both technological and non-technological drivers of change.

In order to identify the jobs most likely to be in demand in the future as a result of the new technologies identified in Chapter 3, we used the following to create a list:

- the technological transversality of the occupation, i.e. its importance grows if it has skills related to more than one technology or topics;
- whether the associated skills are essential or optional (as defined in the ESCO classification); and
- the weight of the technologies to which it has been matched, in terms of potential future use, as expressed by the normalised number of patents it appears in.

In essence, this provides a technology jobs ranking (TJR). This is an indication of the jobs that are likely to be relatively important in the future as a consequence of the types of technological change projected to take place in the future.

4.2 Skills needs in agriculture-related sectors

As an example of the insights derived from text mining, Figure 3 displays the top 25 professional backgrounds anticipated to be in high demand for both Israel and Morocco, based on their TJR value.

The two charts in Figure 3 are aggregated infographics that only represent a small portion of the overall list of occupations. However, one of the main findings of the study, applicable to all sectors and countries, is already apparent: technological advancements are affecting all skill levels, even roles such in business and sales, far removed from technical aspects. While many of the top positions are held by highly skilled professionals, medium-to-low skilled workers and operators are also present, as well as a few managers and salespeople. This is because the widespread adoption of innovations and the resulting changes in production and sales require the entire workforce to occur and then succeed.

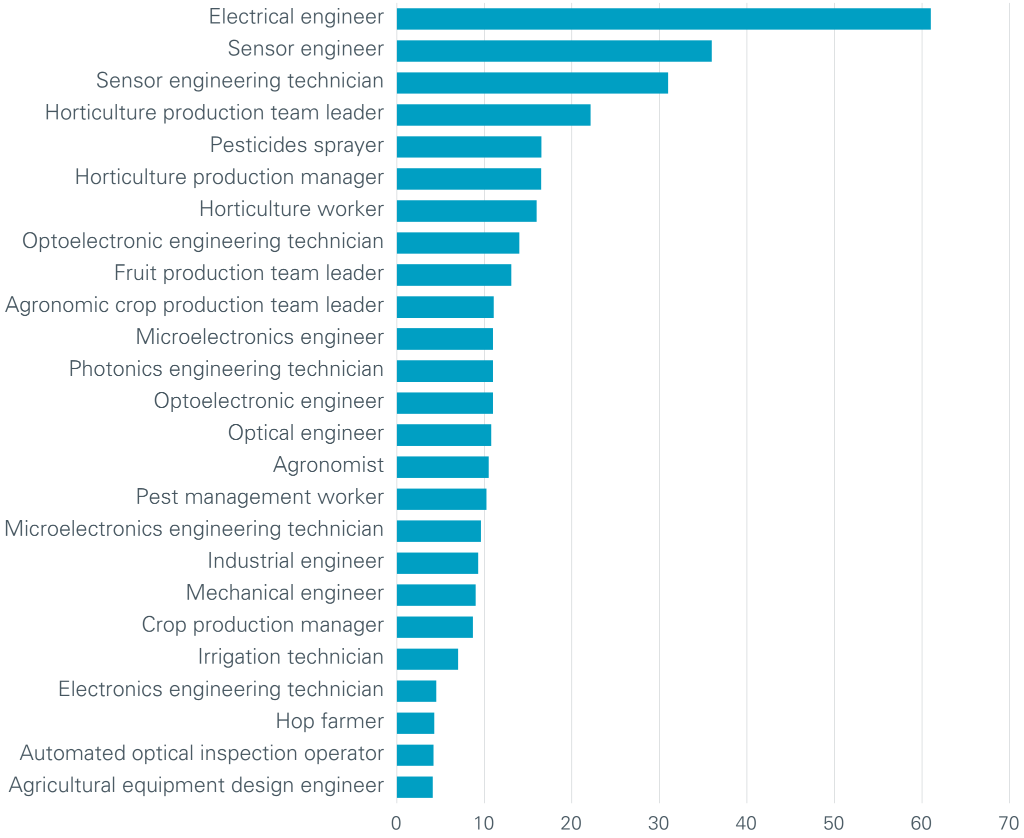
We produced the same ranked list based on TJR levels for three separate categories of workers: highly skilled professionals (ISCO groups 2.1, 2.5, 3.1, and 3.5), skilled workers, operators, and labourers (ISCO groups 6.3, 7, 8, and 9), and managers, business and sales professionals, and team leaders (ISCO 1.3, 2.4, 3.3, 5.2, 6.1, 6.2). The charts are not shown for the sake of conciseness, but the most relevant results are as follows.

The text mining analysis of emerging skills needs in agriculture-related sectors indicated that there will be a high demand for professional/associate professional occupations such as Electrical Engineers, Sensor Engineers, Water Plant Technicians, Biochemical Engineers, Sensor Technicians, and Agronomists. Occupations such as Agricultural Inspectors will still be needed in the future but perhaps less so given the pace of technological change.

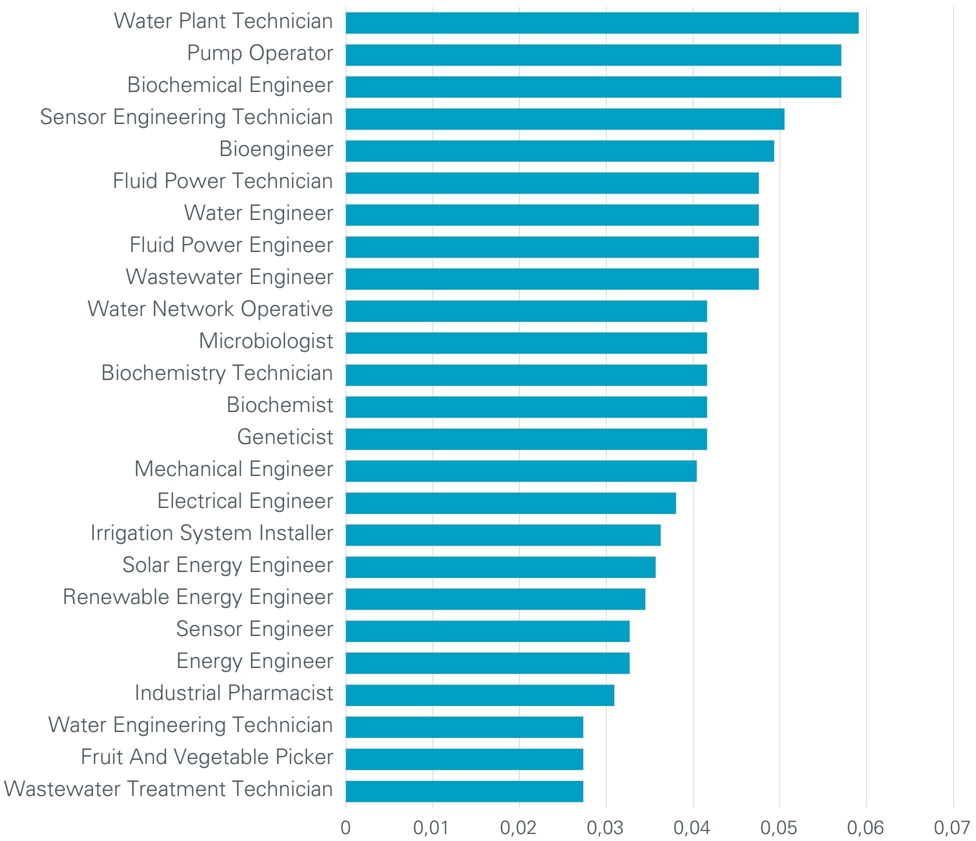
At the skilled trades/assembler level, in Israel there will continue to be a high demand for people to work in a variety of skilled jobs such as Horticulture Workers, Pesticide Sprayers, and Pest Management Workers. In Morocco there will be a range of jobs related to the control of fluids (e.g. Pump Operator, Fluid Power Technician, etc.).

Figure 3. Top 25 agriculture-related profiles – TJR for Israel and Morocco

Israel



Morocco



Source: ETF

As for business-related roles, the impact of new technologies will be primarily felt by managers and team leaders involved in production, as well as by salespeople who must adapt to e-commerce and similar digital technologies.

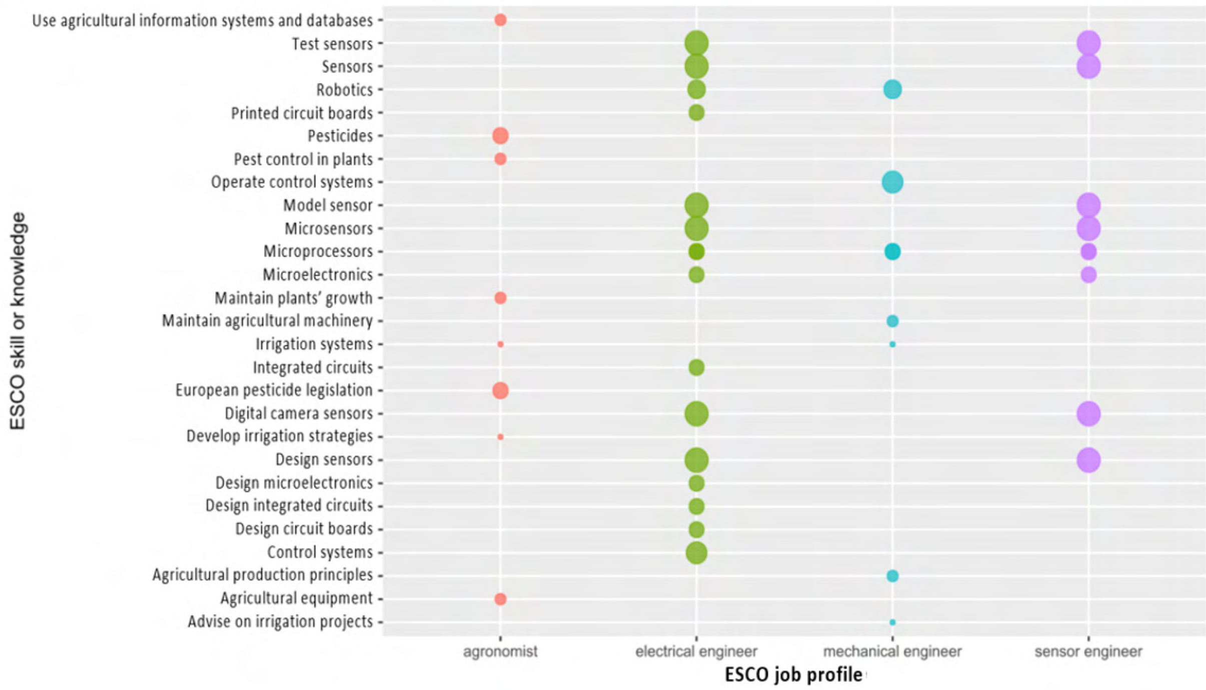
It is crucial to emphasise the significance of the aforementioned findings. Previous research has suggested that the impact of new technologies, such as those related to greening production, would be limited to high-end professions only, with the majority of jobs remaining unaffected. In contrast, our research demonstrates that the impact is much more pervasive, and thus the need for competency is greater at all levels, particularly for certain skills like digital ones.

This finding also has implications for the VET system. For instance, if, as discovered in the two studies on the agriculture sector, the farmer of the future will require digital skills, it is clear that they cannot solely acquire these skills at university. As a result, all educational levels must address this need.

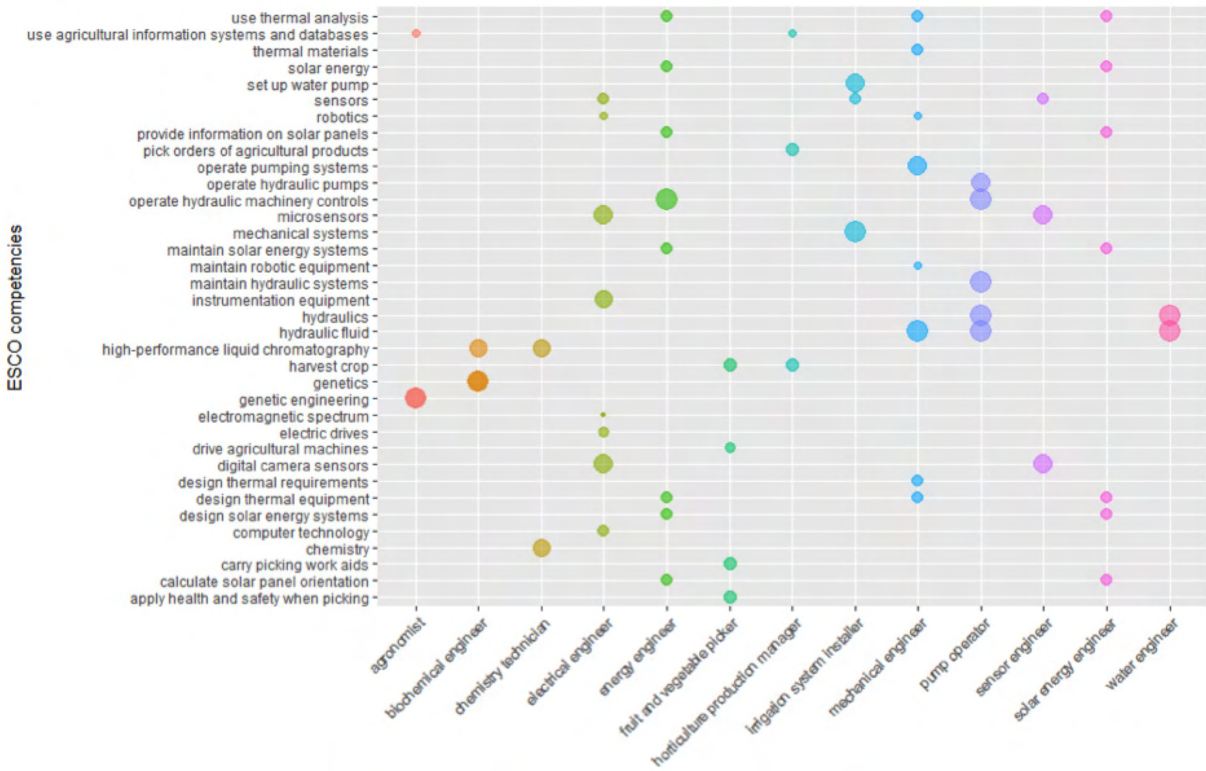
It is possible to look in more detail at the skills required in the jobs mentioned above in relation to both Israel and Morocco. In Figure 4, the horizontal axis lists four ESCO occupations that have been identified as being matched to the various technologies (and other changes) likely to affect the sector in the future. This is matched on the vertical axis with the skills ESCO assigns to each occupation. It reveals the transversal nature of some skills. For example, Electrical Engineers are required to have knowledge and skills related to a range of technologies from control systems to sensors to robotics. On the other hand, the traditional agronomist requires a much more unique set of skills. In fact, agronomists appear to require a limited set of skills, but with the increasing importance of precision agriculture, vertical farming and the like, it may well be that agronomist skills will become more expansive, requiring a wider and more complex set of tasks to be completed.

Figure 4. Skills demand in selected occupations in agriculture

Israel



Morocco



Source: ETF

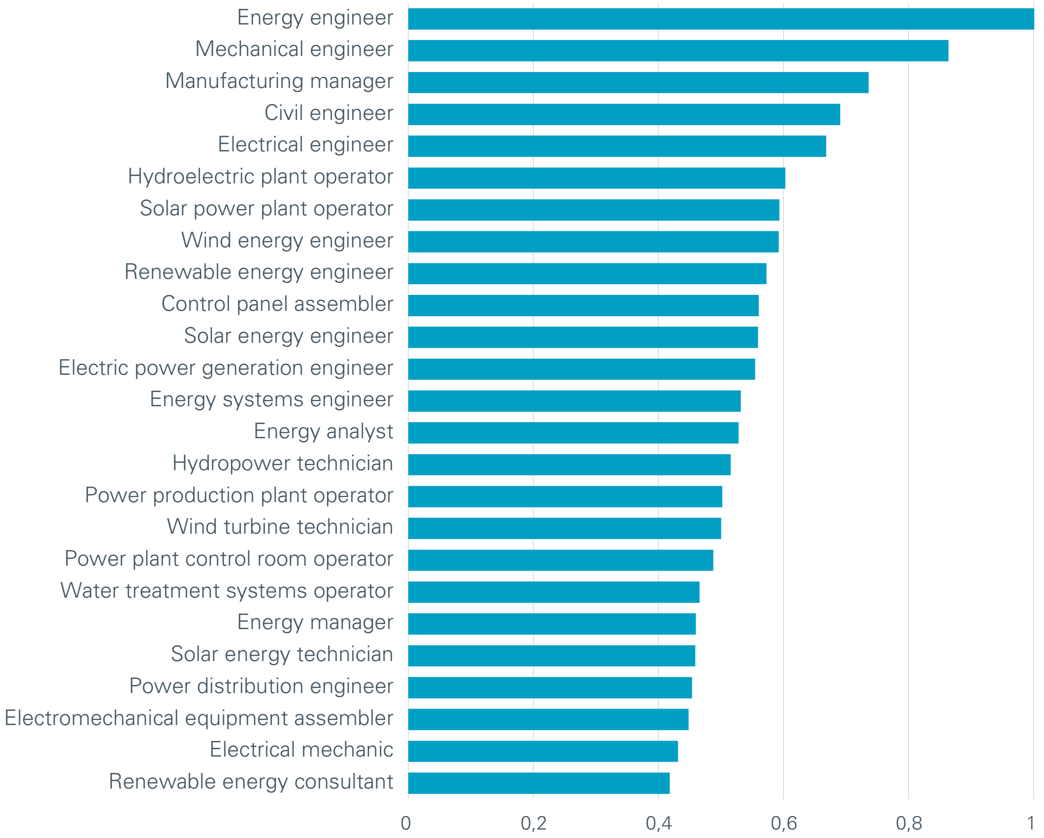
In the stakeholder discussions it was noted that some occupations in this sector show signs of obsolescence, such as manual or low-skilled occupations with a relatively high level of specialisation amenable to automation. Stakeholders representing employers tended to be of the view that overall employment levels should remain buoyant because productivity gains should provide the opportunity to develop into new areas of activity. Nevertheless, the overall aggregate situation ignores the fact that some tasks will be substituted by technology with the result that those working in jobs where these tasks comprise a large part of their job will need to be re-trained if they are to remain in agri-food or agri-tech.

4.3 Skills needs in the energy sector

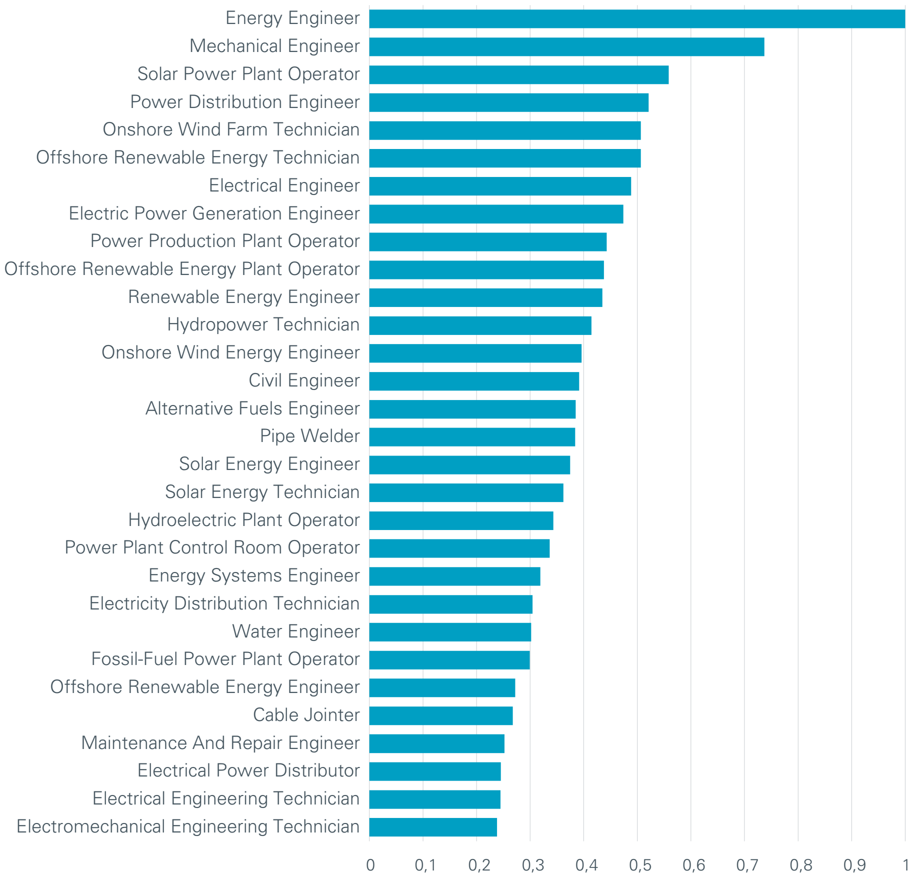
A summary of the future job demands resulting from technological change in Albania, Egypt and Tunisia can be obtained from the technology job ranking (TRJ) provided in Figure 5. Despite the energy sectors in Albania, Egypt and Tunisia being concerned with producing energy from different sources, the occupational skill needs are similar. In general, there is a demand for people to work in technology-related occupations and a range of business-service jobs. The technical jobs relate to Mechanical, Electrical, Civil and Energy Engineers at different levels. At professional/associate professional level there is a demand for people to work in jobs such as Energy Engineer, Renewable Energy Engineer, Mechanical Engineer, etc. In the case of Albania and Egypt, reflecting the fact that they are both dependent upon hydropower, there was a demand for Hydroelectric Plant Engineers. In Tunisia, there is a demand for Fossil Fuel Engineers, but this is less apparent in Egypt, which is also dependent upon energy from fossil fuels, but where skills demand is oriented towards engineers requiring wind energy know-how. At a skilled trades/assembler level, there is a demand for people to work in jobs such as Control Panel Assembler, Solar Energy Technician, Control Panel Tester, etc. Among business-oriented occupations, the demand is for managerial roles, sales staff specialised in the energy field, and external consultants linked to renewables.

Figure 5. Top 25 Energy-related jobs – TJR for Albania, Egypt and Tunisia

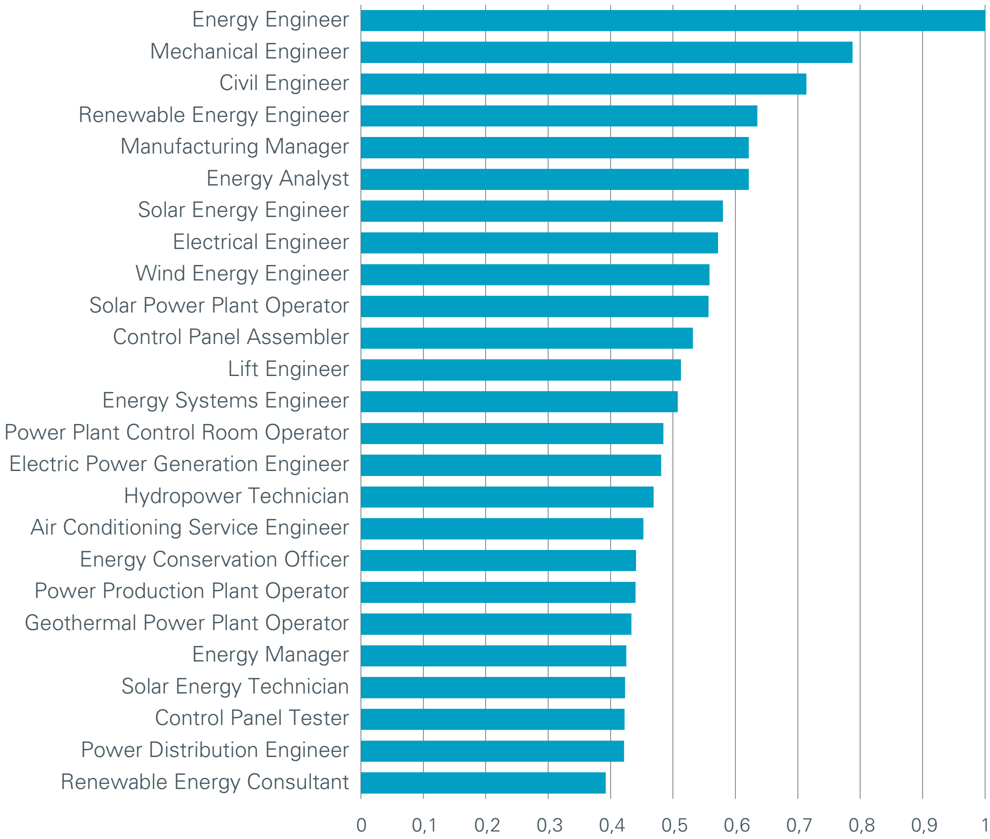
Albania



Egypt



Tunisia



Source: ETF

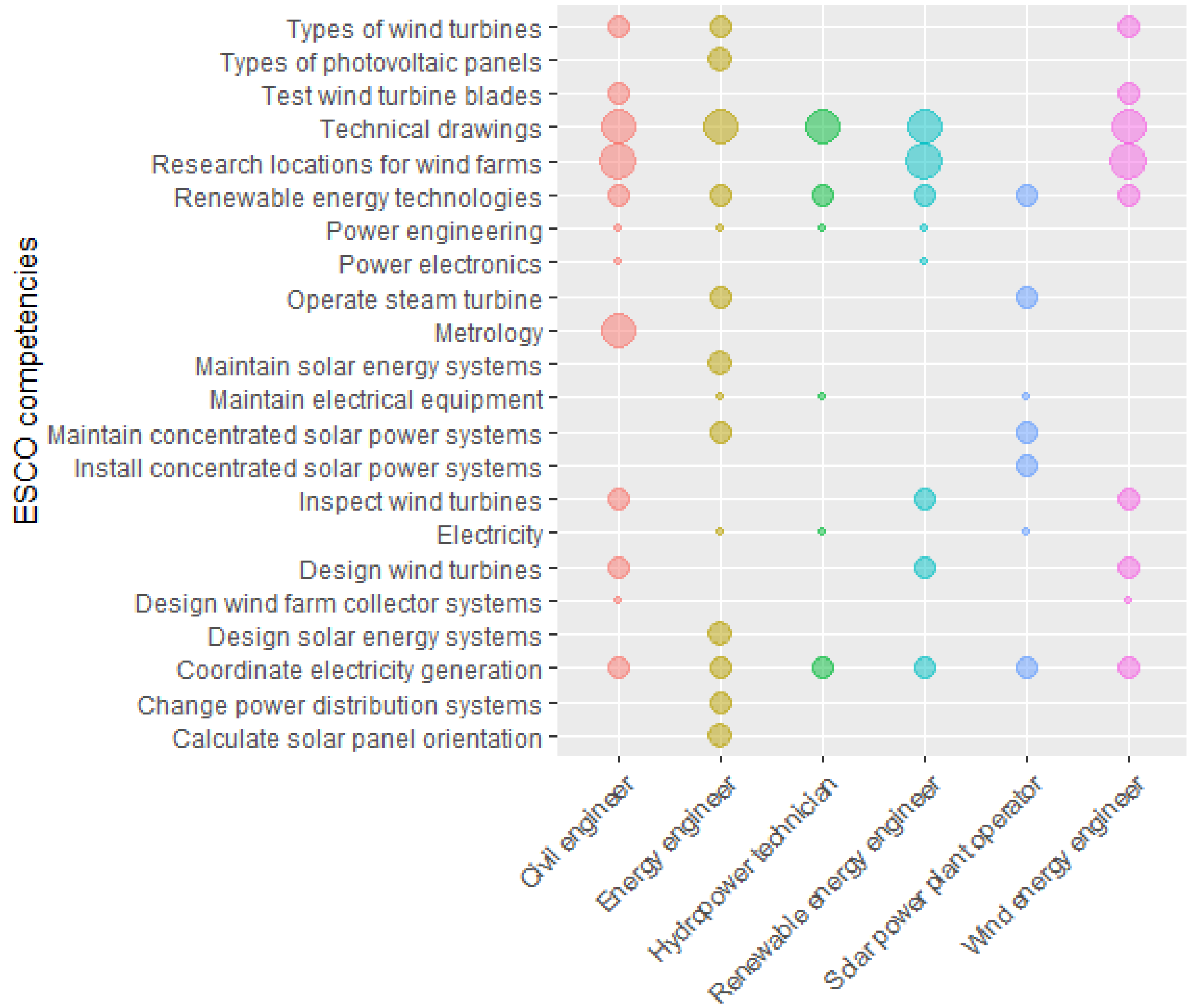
Please note that, the formula for TJR has changed over the three graphs in Figure 5 as the methodology evolved over the course of the study. In particular, the graph for Egypt (the latest study) uses a more sophisticated formula that takes into account the future projections of the relevance of the various subsectors (e.g. solar energy, fossil fuels, etc.) in national plans in order to weight the relative relevance of each profession.

The benefit of using text mining algorithms is that it is possible to go beyond just listing occupations that have been identified as being linked to specific technologies and look in more detail at the emerging skills needs. Figure 6 shows the specific skills attached to the types of jobs likely to be increasingly in demand. We can begin to see the specific skills needed for the jobs that are likely to be in increased demand. The figures also begin to identify some of the skills that are required across occupations, such as knowledge of renewable energy technologies or knowing how to coordinate electricity generation. And from a slightly different perspective, jobs that have a relatively high share of transverse skills, such as Energy Engineer or Renewable Energy Engineer. This may suggest that there is scope for people to transfer from other jobs into these ones. Other skills are more specific to certain jobs, such as installing concentrated solar power systems, which is specific to the solar power plant operator.

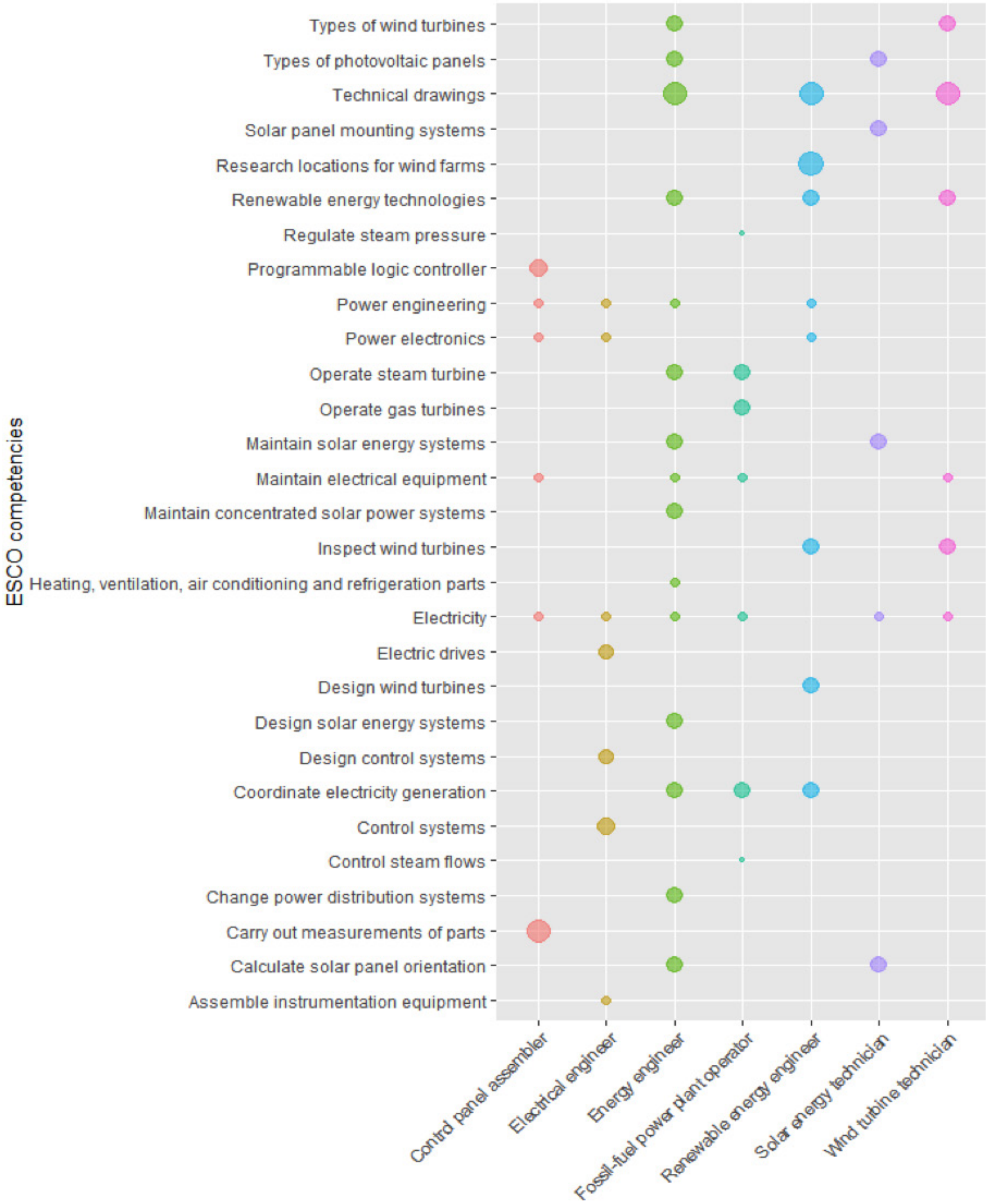
This type of chart has not been produced for Egypt since it would have given similar results to the previous cases. Instead, as part of the evolution of the methodology, we have described the transverse nature of certain professions (or conversely their vertical specialisation) using their correlation with specific subsectors of energy. Looking at Figure 7, one can observe that while Solar Energy Engineer represents a more specialised or niche profile, Mechanical Engineers have a role in nearly every subsector, as many energy production methods still involve mechanical components.

Figure 6. Skills demand in selected occupations in the energy sector

Albania



Tunisia



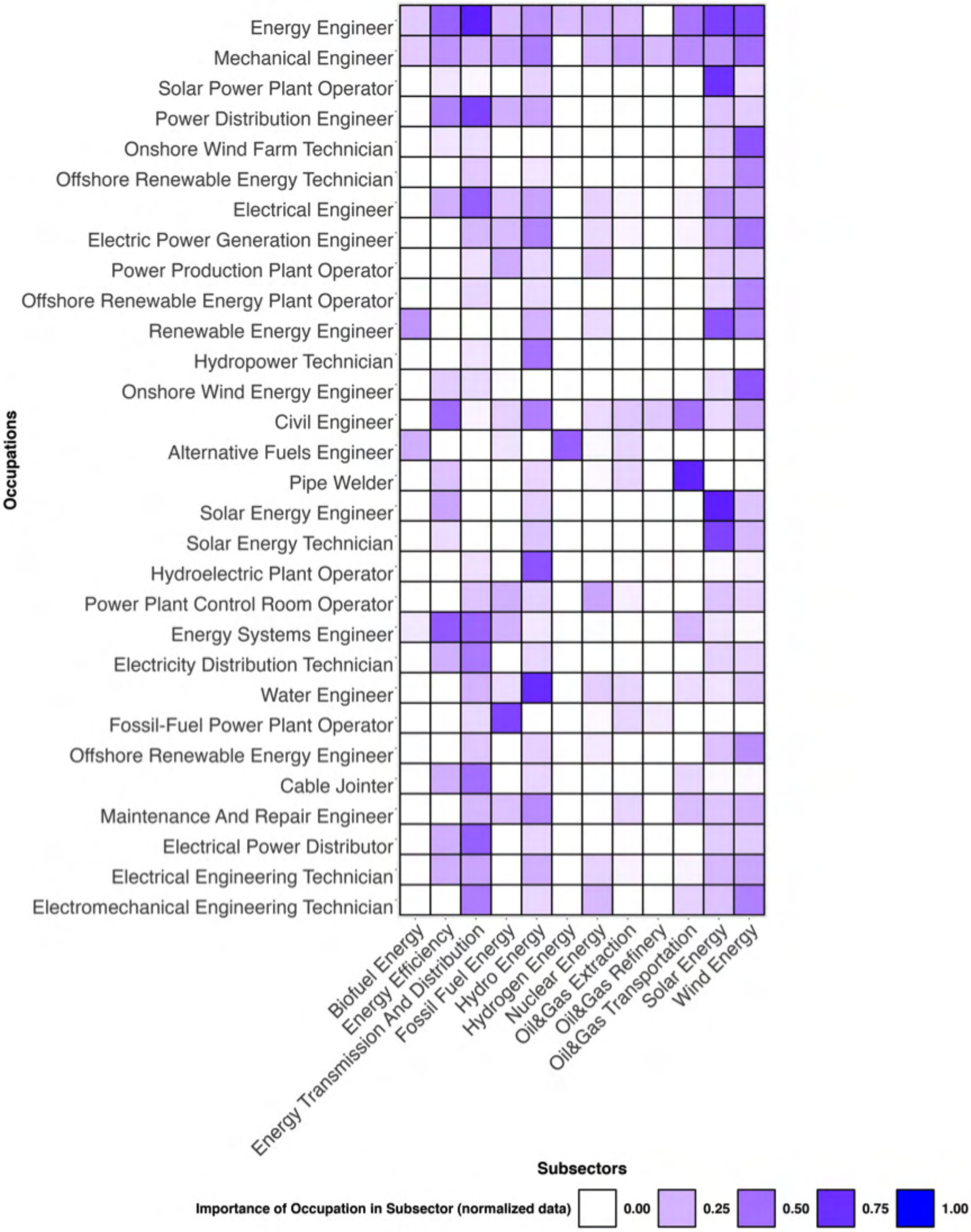
Source: ETF

Even specialised professions in the energy sector exhibit correlations with other technical areas due to the general or cross-sector applicability of various technologies and skills. Figure 7 reveals that future energy professions are unlikely to be isolated within specific subsectors, as they often share knowledge and skills. This suggests that training courses should accommodate the application of common skills across the different energy sources, enabling individuals to move between subsectors.

Additionally, Figure 7 highlights in-demand jobs for specific subsectors, revealing that beyond obvious specialists, there are other supporting roles, such as Civil Engineers in the wind energy sector, who supervise wind farm construction. These occupations may be overlooked in analyses that focus solely on energy-specific jobs and skills.

Figure 7. Degree of specialisation/transversality of different professions in the energy sector

Egypt



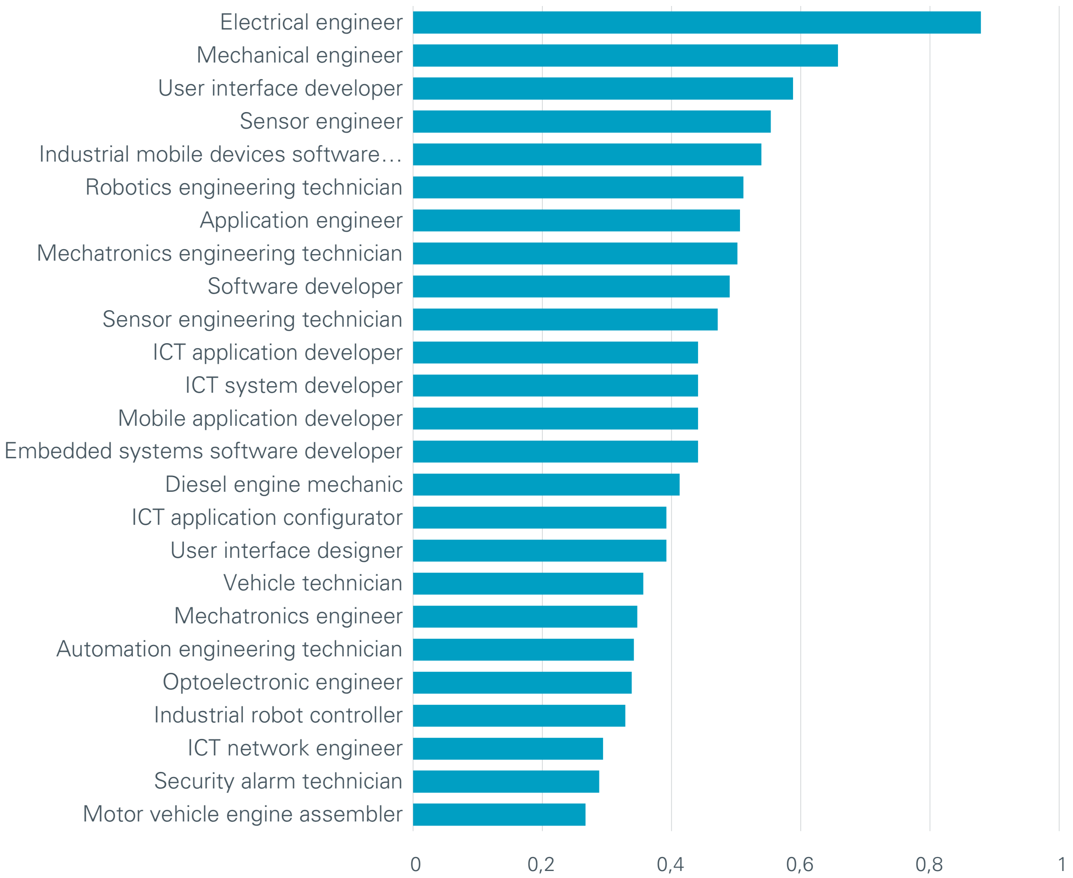
Source: ETF

One general trend, reported by stakeholders, is that workers in the energy sector will need a wider set of skills, with particular importance given to digital ones. This is for jobs at all levels from low to medium and high-skilled occupations. Stakeholders in Albania said that increased automation and digitalisation will reduce manual operations, but the overall level of employment will not decrease in the future given the technical requirements and administrative roles required by new regulations. Similarly, in Tunisia, participants told us that increased automation and digitisation would not bring about an overall reduction in the number of people employed, in part because current and expected growth in the renewable energies market will create employment opportunities. There was a general view from policy and education stakeholders in Egypt that the national government's energy plans will bring about moderate to substantial employment increases in the energy sector. Although the sector has a strong fossil fuel component, plus one oriented towards transporting fuel and energy, the future demand for skills will be skewed towards those expert in renewable energies (notably wind), nuclear energy, and energy management. Embedded within the roles of energy engineers and managers will be a range of digital skills including those linked to the use of AI and robotics.

4.4 Skills needs in the automotive sector

In Türkiye, the occupations linked to the various technologies at a professional/associate professional level include Electrical Engineers, Mechanical Engineers, User Interface Developers, Sensor Engineers, etc (see Figure 8). One can see a common theme here with the energy sectors and to a slightly lesser degree agriculture where similar types of engineering jobs are anticipated to be in higher demand in the future. In the skilled trades, there are a range of jobs that are much more automotive specific, including: Diesel Engine Mechanic, Vehicle Technician, Security Alarm Technician and such like. It is not just the job titles that are important but also the specific skills that individuals will require.

Figure 8. Automotive sector top 25 jobs – TJR for Türkiye

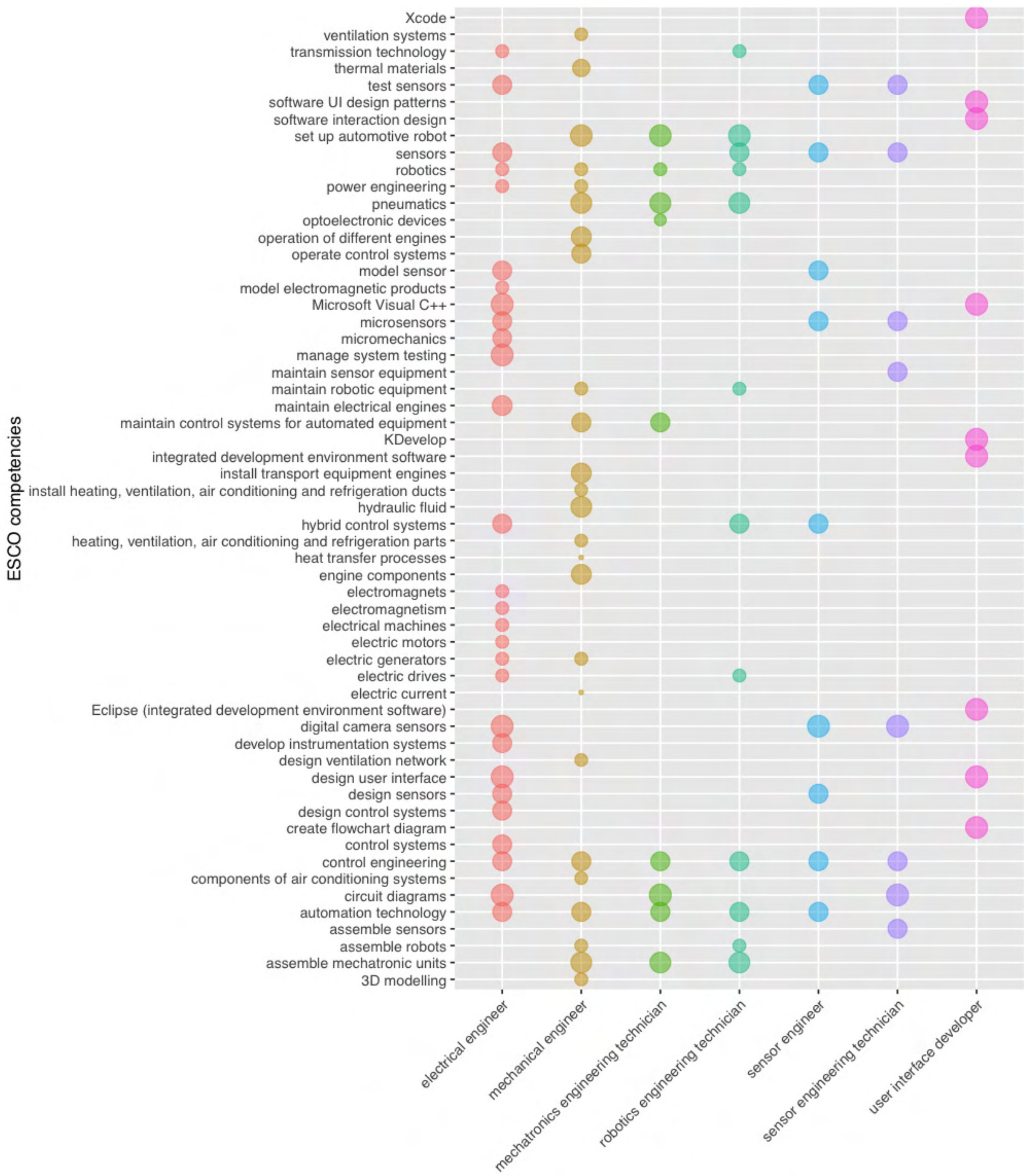


Source: ETF

Figure 9 below shows the skills that will be required in some of the jobs listed above. For example, it reveals that to work in the automotive sector, Electrical Engineers will need to have skills related to automation technology, circuit diagrams, electric drives, generators, motors, electromagnetism, know how to write code in C++, know how to design sensors, know how to manage system testing, etc. On the other hand, Mechanical engineers have skills that are mostly linked to the functioning of engines, control systems, robotics, ventilation systems, and 3-D modelling.

From the stakeholder discussions it became apparent that a new class of employee is emerging – grey-collar workers, so called because they are upskilled blue-collar workers with more technical expertise. As a result, the composition of the workforce will change: the number of low-skilled workers will fall in favour of an increase in medium- to high-skilled workers. New jobs are emerging that are not found in classifications such as ESCO. This is due to the rapid pace of technological change and the high level of specialisation this brings about. New job titles appear to be fluid, reflecting the trend towards multi-disciplinarity and the need for employees to have integrated knowledge of various technologies, including hybrid ones to work with technologies of different vintages.

Figure 9. Skills demand in selected occupations in the automotive sector in Türkiye



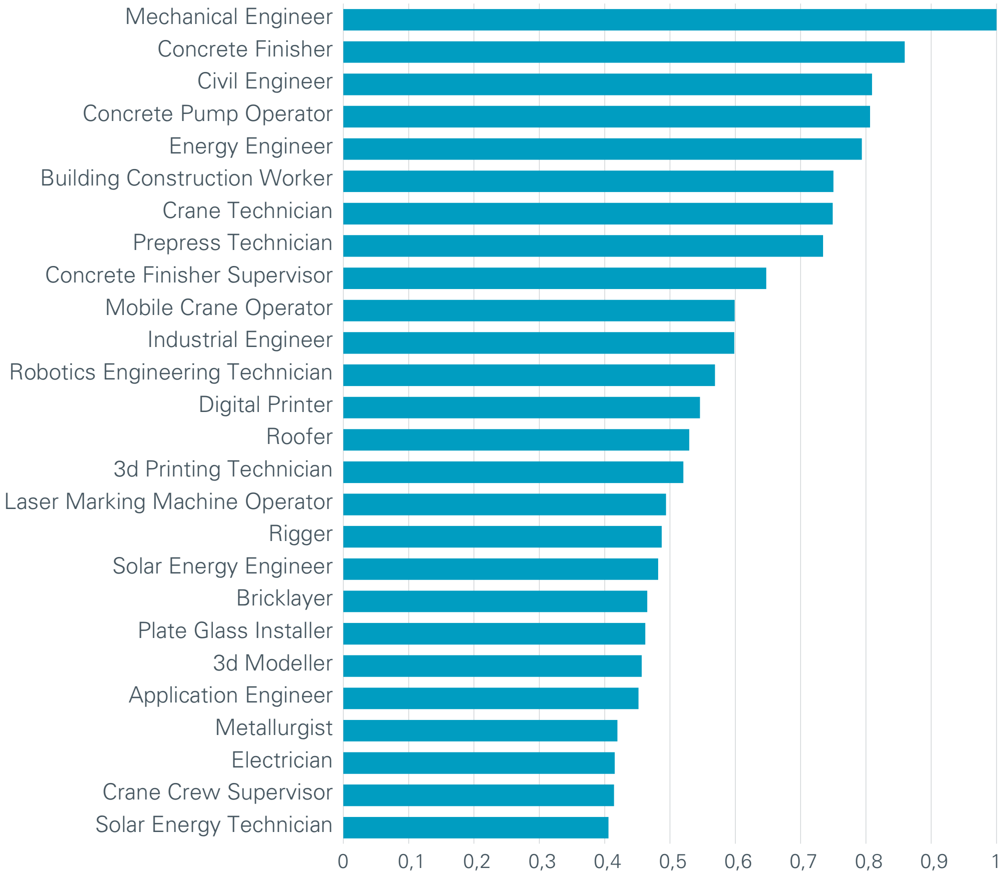
Source: ETF

4.5 Skills needs in the construction sector

Analysis of the occupations likely to be in highest demand over the short- to medium-term includes many traditional construction jobs – i.e. those linked to engineering (Mechanical Engineer, Civil Engineer, Industrial Engineer) and a range of skilled manual jobs (Concrete Finisher, Building Construction Worker, Crane Technician). There is also a degree of crossover to other sectors such as energy given the demand for Energy Engineers, Solar Energy Engineers, and Energy Managers (see Figure 10). This points to the role of construction in building the energy infrastructure for the shift into renewables. There are also some more job roles, such as 3D Printing Technician and 3D

Modeller, associated with manufacturing that likely reflect the increased take-up of prefabrication and modularisation in construction.

Figure 10. Construction sector skill needs – TJR for Armenia



Source: ETF

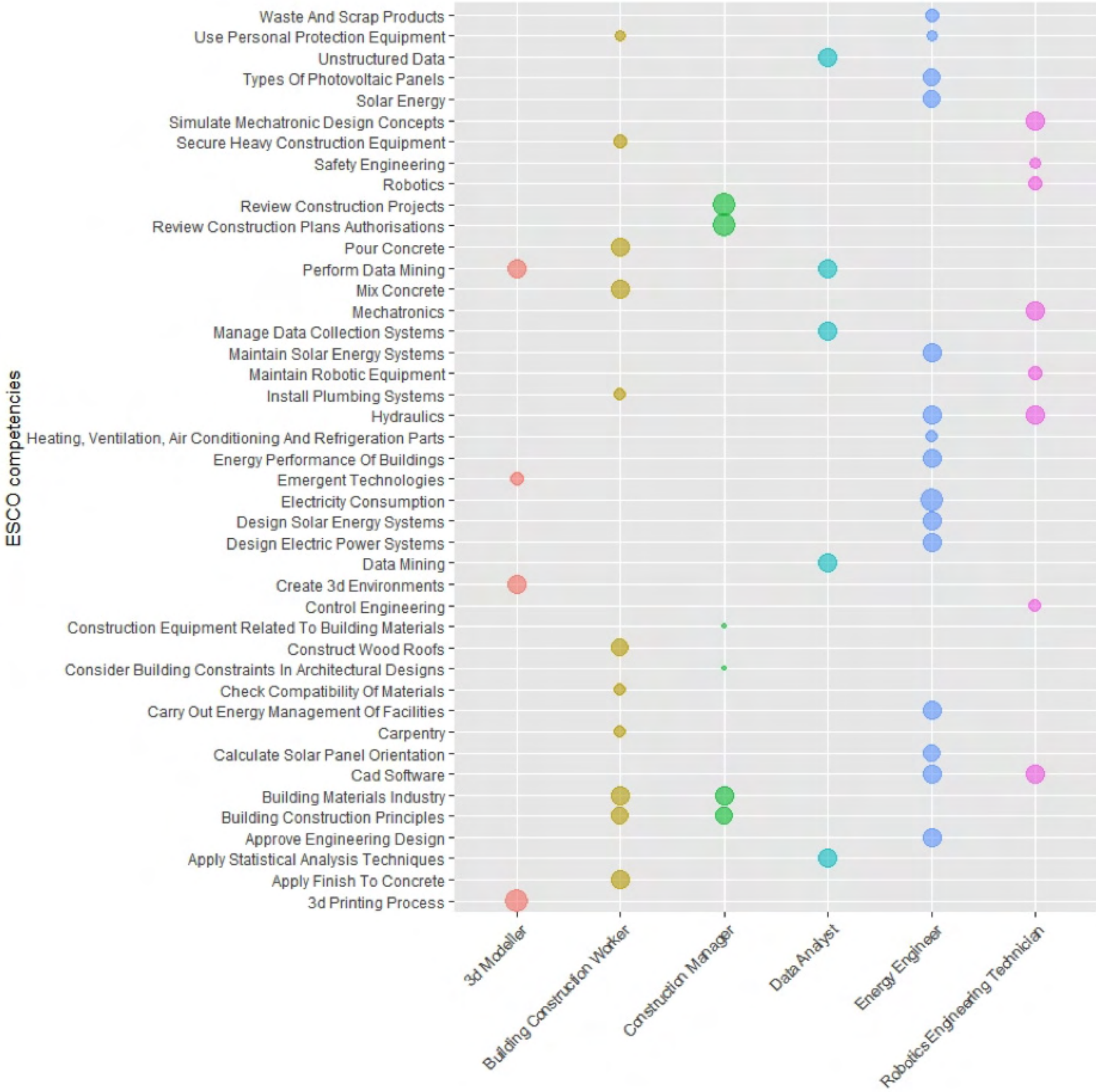
It is also possible to analyse how occupations differ from one another. Figure 11 shows the skills sets for selected construction occupations predicted to be in high demand in the future: 3D Modeller, Building Construction Worker, Construction Manager, Data Analyst, Energy Engineer ,and Robotics Engineering Technician. The chart demonstrates the way in which the skills for specific jobs are linked to the emergence of particular technologies (described in the previous chapter). This is especially the case with the job of Energy Manager where the skills required are tied to renewable energies.

Note: Each point in the plot is an association between a competence and an occupation, whereas its size is proportional to the importance of that technology (as previously stated, the importance of a technology depends on the amount of patents filed).

4.6 Skills needs in the healthcare sector

The healthcare sector contains a wide variety of activities with a concomitant wide variety of skills needs. To illustrate the specific skills needs that are likely to arise in the future, we selected a particular segment of healthcare provision: diagnosis and prognosis. The main professional and associate professional jobs associated with the technological drivers of change are linked to radiography. The job titles that emerged included: Diagnostic Radiographer, Therapeutic Radiographer; Nuclear Medicine Engineer, Chiropractors, Electrical and Mechanical Engineers, and Medical Device Engineers. Skilled trades/assembler jobs were mainly related to Surgical Instrument Makers, Dental Instrument Assemblers, and Scanning Operators (see Figure 12).

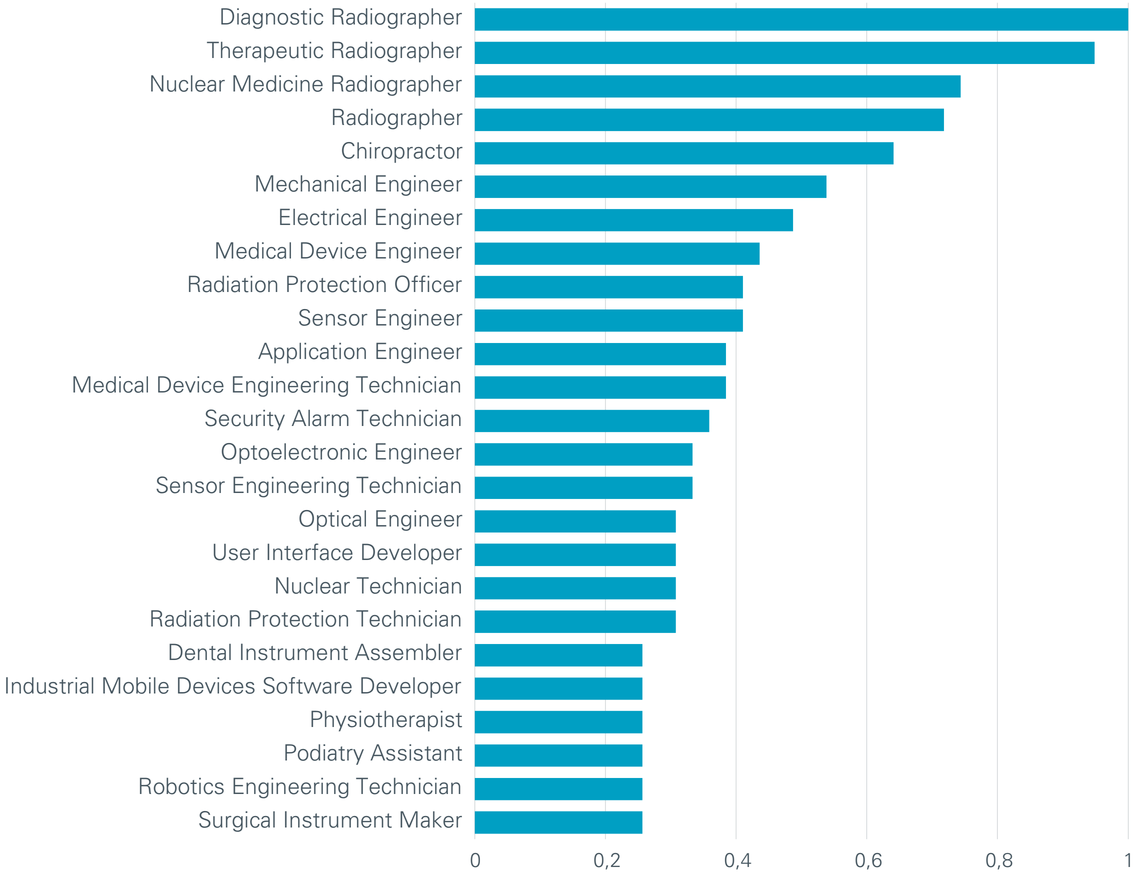
Figure 11. Key skills in selected construction occupations



Source: ETF

Figure 13 provides an insight into the various skills that will be required in some of the jobs that are the key to this part of the healthcare sector's future development. It indicates, to some extent, distinct sets of skills. Radiographers, for instance, require skills related to the use of radiation (such as knowledge of radiation physics, radiation protection, interpreting medical images, etc.). For the most, these skills were unique to the role of the radiographer (though chiropractors shared some of these skills). As the role of imaging and other diagnostic tools becomes more important in the future, these skills will be required from engineers to develop these technologies. Important here is that the Medical Device Engineer who designs, develops and monitors the whole manufacturing process from concept design to product implementation on medical equipment such as pacemakers, MRI scanners, and X-ray machines. While there are general engineering skills required, there are also elements that are specific to the healthcare sector given the nature of the products being produced.

Figure 12. Health care sector top 25 jobs for the diagnosis and prognosis segment of the healthcare sector – TJR for Ukraine

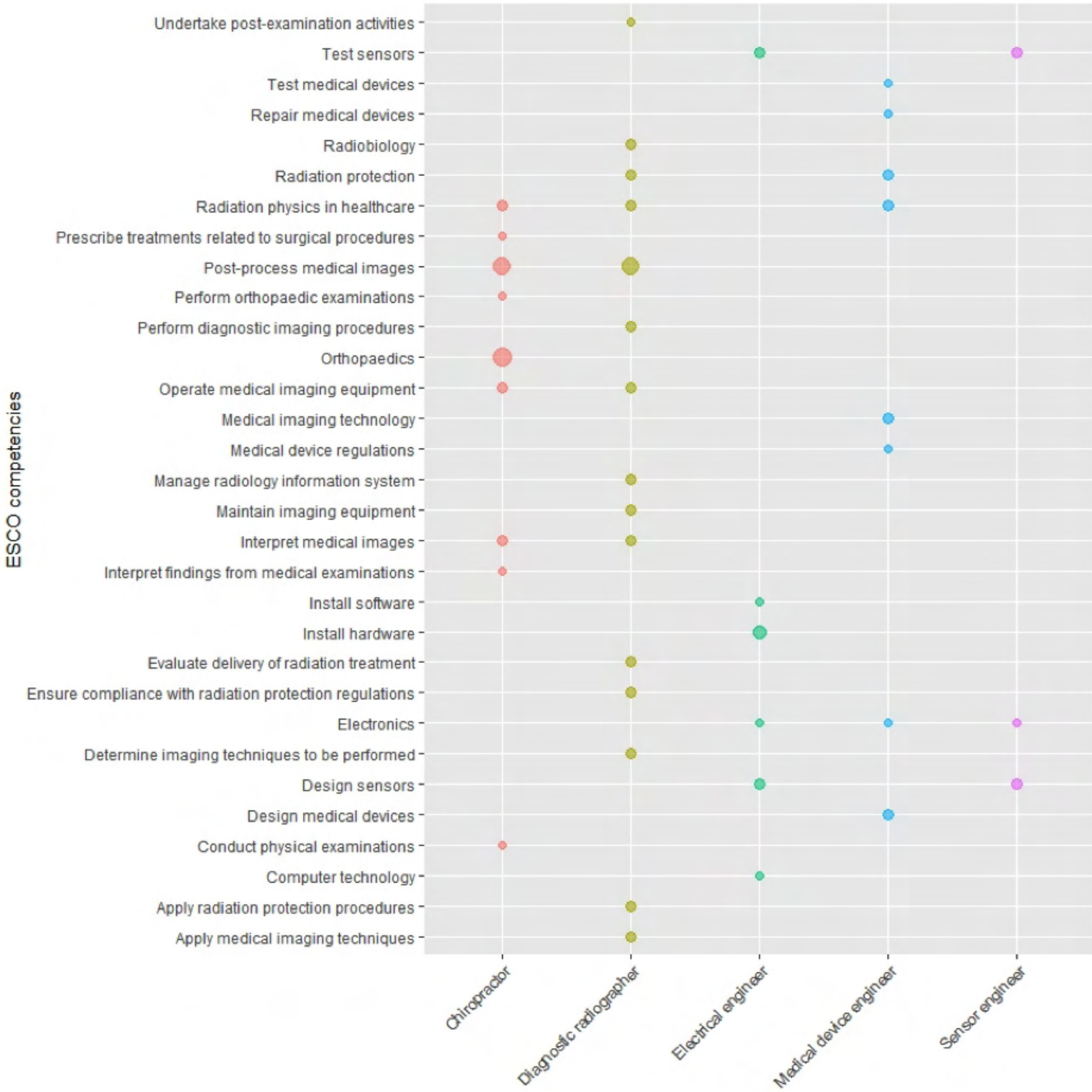


Source: ETF

4.7 Conclusion on evolving skills needs

The focus has been upon understanding the skills needs that result from new technologies that are likely to become increasingly commonplace across a range of sectors and countries. Accordingly, many of the skills needs relate to the roles of engineers and technicians. There are some sector specificities. This is particularly evident in relation to the healthcare sector where many of the diagnostic skills are related to imaging. These skills appear tied to the process of imaging and the advances being made in X-rays/CTs and MRI scanning. In other sectors, the commonalities relate to greening (reducing energy consumption and the production of waste) and digitalisation (almost instantaneous data collection analysis). In both instances the skills required are concerned with installation and use. These skills are seen to be in demand across the agriculture, automotive, construction, and energy sectors. There are country specific skills needs too. This reflects the particularities of the sector in a particular country. In the case of energy, some countries are more invested in hydropower than others (i.e. Albania and Egypt), some more in fossil fuels (i.e. Egypt and Tunisia). This is determined by, in the first instance, a country's geology and in the latter their access to, in this particular case, gas and oil, plus the strategic decisions government's might make. Similarly, the focus on earthquake resilient construction reflects the specific need of Armenia. That said, the degree of commonality is in skills needs resulting from the need to reduce energy, find alternative sustainable forms of energy, and fully utilise digitalisation of production processes across a range of sectors.

Figure 13. Skills demand in selected occupations in the diagnosis and prognosis segment of the healthcare sector in Ukraine



Source: ETF

5. DERIVING VALUE FROM THE ETF APPROACH TO SKILLS ANTICIPATION: FROM DATA TO POLICY

5.1 Expanding the scope of skills anticipation

This report provides an overview of the key findings from the analysis on sectoral training demands in a selection of ETF partner countries using a new methodology designed to make the most of the available data. In this sense, the methodology fills a knowledge gap – i.e. what specific technical skills are needed for the jobs of the future – not present in traditional skills anticipation tools. It reveals commonalities in skills demands across countries within the same sector, and those that extend across almost all sectors. The findings also demonstrate the importance of economic and social contexts. Due to their development trajectories, some countries possess greater capabilities to address the diverse changes they confront. Furthermore, some countries encounter more obstacles when implementing change than others. The multi-faceted methodology ETF has developed considers all these factors. This potentially provides information that can be used to inform skills policy within the sectors and nationally.

To understand the link to policy making, and the value that the ETF methodology adds, it is necessary to provide a brief recap of the policy discourse in relation to skills anticipation. To date, identification and anticipation of skills demand when looking at the specific skills required by people in the workplace has tended to focus on generic cognitive and non-cognitive skills. Studies that have adopted a skills requirements approach, such as the European Skills and Jobs Survey, have produced a rich stock of evidence about the level and usage of a various cognitive skills in the workplace, alongside that on the importance of various non-cognitive ones, but much less about the specific technical skills required to do a specific job. This is not to underestimate the importance of non-technical skills. It is clearly important for people to possess the wherewithal to, for example, interpret evidence, problem solve, and work effectively with their colleagues. These are important components of almost any job. So it is important to collect evidence on these types of activity. It is, however, technical skills that allow people to do the core activity of the job in which they are employed. They may do that job better if they possess the range of generic cognitive and non-cognitive skills that are seen to improve performance in the workplace, but it is the technical knowledge, know-how and skills related to the core activity that allows them to do that job in the first place.

Empirical, timely and comprehensive evidence about the specific technical skills required to do a particular job remains a weak spot in skills anticipation. It would be, for instance, difficult, expensive and time consuming to compile comprehensive information from an employer or employee survey about the specific skills required in particular jobs (a survey for every job or group of jobs). And even if it were possible, given concerns about the pace of technological change such surveys would need to be repeated on a regular basis (every two to three years). Data scraping from vacancy websites provides a partial solution but it tends to focus on current skills demands in a particular job rather than emerging skills needs. It allows education and training systems little or no time to anticipate and respond to skills demand. In the absence of anything else, anticipating the future skills needs of a particular job – such as an energy auditor working in the construction sector – is dependent upon obtaining the expert views of those who are knowledgeable about that job. Such views can be subject to bias. More importantly, expert views may represent the current state of play in a given sector or country rather than the global trend, thereby potentially underestimating the skills that might be required to improve relative performance.

Because the analysis is based on identifying technologies that are likely to come on stream in the short- to medium-term from patent data, and then identify the skills associated with those technologies, there is already a skills anticipation element in the ETF methodology. The results it provides offer a window of opportunity for measures to be put in place to adapt available training programmes to emerging skills needs.

The methodology is designed to be an add-on to existing systems in place for skills anticipation. It is not designed to be a process divorced from other approaches. There is a substantial participative component to the methodology where various stakeholders are engaged in validating the information provided from the background reports and text mining analysis to ensure that outputs meet the needs of various stakeholders and add value to what is already known.

How the results from studies that have used the ETF methodology can be fed into policy making is addressed in the following sections.

5.2 From skills anticipation to skills policy

What are the policy implications of the findings from the various sector studies? To provide a structure for the commentary, Figure 14 below schematically outlines the link between the research results and policy making. In essence, the ETF methodology provides a detailed assessment of the demand side both currently and over the short- to medium-term. It indicates the types of skills that will be required as a consequence of technological change and other external drivers that affect job tasks. It also provides an insight into the factors that might inhibit those skills needs being met in the future. This is something to which policy must respond.

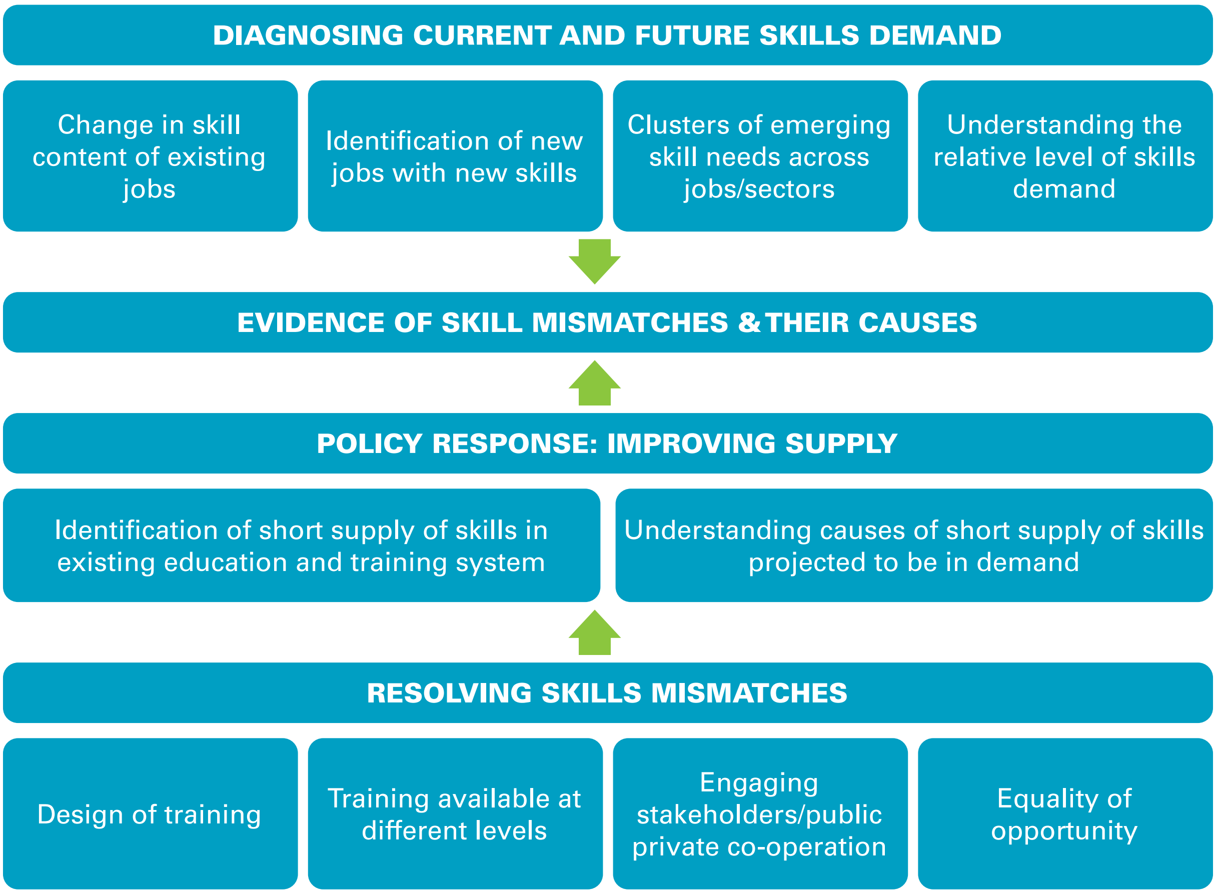
In the first instance, there is a need for a **diagnosis of skills requirements**. This is about identifying the key skills needs both currently and in the future. This provides policy makers with the information to inform training providers of the skills that will be required in the future and the extent to which there are common (transversal) skills needs across jobs. An international comparative element can be useful here to indicate the extent to which skills demands are above or below those in other (competitor) countries (see below). If the volume and level of skills demand is relatively low compared with, say, comparator countries, then there is a danger that latent skill mismatches might arise. These may well have long-term consequences for the development of a sector. If, for example, a sector develops along a given trajectory that results in a relatively low level of skill demand with respect to either volume or level of conceptual difficulty, then this may result in relatively few skill shortages being reported over the short-term. The sector may, however, be disadvantaged over the longer-term and be left vulnerable to, for instance, imports from more competitive, skill-intensive sectors in other countries. Avoiding this kind of relatively low-skill equilibrium is also a focus of skills policy.

Once skills needs have been diagnosed, attention can be turned to **skill mismatches**. There is a need to identify precisely where skills might be in short supply. If the demand side analysis indicates that skill A will be in greater demand in the future, there needs to be an assessment of whether there is already some supply of skill A, and whether that supply is sufficient. The ETF methodology deals with this aspect of the policy response by collecting information on skills in short supply, and why this is the case (through background analysis and engaging with stakeholders). Avoiding or minimising skills mismatches, especially the types of skills where shortage would impinge on societal and economic goals, is a key policy goal in many countries and one that the ETF methodology can address.

In looking in more detail at the implications of policy, we need to think about the **design and delivery of skills**, especially those in short supply. Important here are:

- developing programmes and courses that meet current and future skill needs in a way that makes them attractive to would-be learners and employers;
- identifying economies of scale in the provision of education and training where skill sets are in demand across a range or cluster of jobs or sectors;
- ensuring that training is available at various levels;
- having place stakeholder co-operation and public-private engagement to deliver skills to a sector;
- guaranteeing equal opportunity for all groups to programmes and courses.

Figure 14. Using the ETF methodology to inform skills policy



Source: ETF

Diagnosing demand

At its core, the methodology identifies the specific skill requirements resulting from various drivers of change. In doing so, the research has been able to identify clusters of skills required across a range of jobs and sectors. This is a key finding as it provides the foundation for a strategic response by policymakers. Many skills clusters relate to core engineering and technician skills. This is something which is explored further below in relation to course and programme design. There is also evidence of new jobs emerging, typically related to areas such as data analysis on the use of sensors and jobs which sit at the interface of automation and humans. The study of the automotive sector in Türkiye, for instance, identified the role of translators. These are professionals who understand the logic of machine/data/software processes and translate it into something meaningful for others in a business or organisation. They also translate business needs into something amenable to digital/automated solutions. Examples of specific translator jobs included Industrial Big Data Scientists, Robotics Specialists, and Digital Mentors. By being able to spot these types of emerging occupations, there is potentially time available to develop supply before shortages become acute. This is important because, in general, across the range of sectors in the scope of the overall study, skill shortages were reported in many of the core technical occupations.

The study also provides policy makers with a holistic view of skills demand. While part of the value-added is the information provided on technical skill sets, information was also collected about soft skills. In the case of the energy sector in Albania, stakeholders were keen to point out that leadership and managerial skills were important but had proved difficult to develop resulting in a shortage of these types of skill. Recognising the synergy between technical and soft skills proves to be essential for developing comprehensive strategies that effectively prepare individuals for the evolving demands of the workforce.

Skills demand can also be compared internationally. Information is provided on the level of skill development compared with the European Union, with an indication of the types of skills need emerging for technologies likely to be increasingly commonplace over the short- to medium-term. The latter has been achieved by analysing Europe-wide patent data and the skills needs to which these give rise. This provides an indication of the skill levels a country or sector will need if they are to match developments elsewhere and avoid latent skills mismatches.

Minimising the extent of skills mismatches

It is important to gauge the content, extent, and causes of skills mismatches if they are to be addressed. The evidence points to mismatches being a constraint on industry. In the case study of the automotive sector in Türkiye, companies were asked which factors limited the take-up of new technologies and the general development of the automotive businesses. Most of the companies gave the shortage of skilled workers as one of the main factors inhibiting investments.

Minimising the extent of skill mismatches in the first instance requires data that speaks to policy makers – i.e. those responsible for the design of skills policy, the content of programmes and courses, and the delivery of skills – about current and emerging skills needs. This is where the methodology adds value. Until relatively recently, there has been a focus on understanding changes in the demand for people to work in different types of job and, as far as possible, to identify how skills needs have shifted within those jobs. This provides valuable information to the supply side – training providers, vocational schools, etc. – to adapt their training to the skill changes within jobs. There is an important proviso to add here. If the focus is upon existing jobs (or groups of jobs in an occupation) there is an inherent bias insofar as there is a presumption that change can be detected by looking at changes in these jobs. New skills requirements may arise that are grouped together in such a way that new types of job emerge. Therefore, the research and policy focus has expanded to identify the **rise of new skills and new jobs**. This potentially provides a vast array of information that can then be structured to reveal clusters of emerging skills by sector, occupation, and level of conceptual difficulty (as captured by classifications such as ISCED). This is the type of information the ETF methodology produces.

Across sectors and countries, the reasons why skill shortages arise were said to stem from:

- a lack of co-ordination between business, education and training providers, and policy makers;
- a shortage of trainers skilled in the use of technologies;
- a failure by training providers to sufficiently develop practical skills and know-how relevant to the sector; and
- a lack of intermediate-level vocational training.

These all provide prompts to which the supply side can respond.

Improving supply and resolving skills mismatches

By the supply-side, we mean: the initial education and training system providing education to young people either prior to labour market entry or in labour market transition (e.g. via programmes such as apprenticeships); and continuing education and training provided by the education and training sector and by employers to adults. Detailed information about emerging skills needs, especially those that are reported to be in shortage, can be used to develop curricula across a range of courses and, potentially, lead to additional modules within existing courses and programmes or create new ones. **Where commonalities of emerging skills are found across sectors and occupations, this potentially provides scope for economies of scale**. A particular module can be delivered to learners across a variety of courses.

Effective teaching and issues related to whether or to what extent training should be workplace-based (cf. apprenticeships) or in the classroom are outside the scope of the current study. That said, stakeholders across all countries mentioned the importance of workplace-based training, sometimes in the form of apprenticeships or traineeships, as a relatively effective means of conferring skills on employees that had value within the organisation. The study of the agri-food sector in Morocco revealed that new graduates needed more experience of the sector (the nature of the market and production processes). It was felt that this could only be learned in the field. A period of apprenticeship-style training was seen as essential if new recruits were to possess the skills required and learn from those already working in it.

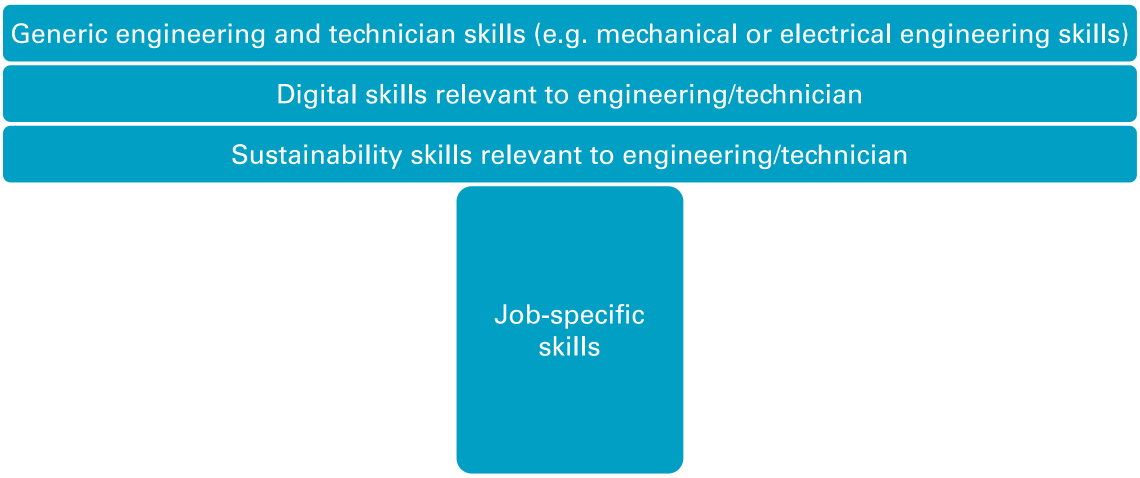
A recurring theme across the country sector studies is the need to make training attractive to both learners and employers. Mention was made that some training was regarded as unattractive because it did not align with learners' aspirations. This sometimes manifests itself in the form of, for example, young people preferring courses that grant access to higher education and the types of job they aspire to fill (whether or not those jobs are available in any sizable number). To some extent, this can be countered by emphasising the technical and scientific aspects of a job. But this is unlikely to be sufficient. In the case of Israel's agri-tech sector, respondents spoke of the need to increase supply in more traditional skill sets as well as those related to the latest technological and scientific breakthroughs. Universities and colleges, they said, were more interested in the latest cutting-edge areas of research such as molecular biology and less interested in more traditional areas such as breeding and plant physiology. As a result, those leaving the education sector sometimes lacked the practical know-how employers sought.

Related to the above point was the lack of training at certain levels in the education system, especially intermediate-level vocational training that had the potential to deliver many of the technician-level skills required by employers. Stakeholders from the energy sector in Albania, for instance, mentioned that there was relatively little vocational training, especially outside the major cities, which resulted in shortages of people with the range of practical skills required in the energy sector. In Morocco, respondents said there was a relatively plentiful supply of higher-level skills from the higher education sector, but relatively little for intermediate, technician-level skills. Training was increasing but demand, for the time being, continued to outstrip supply. Even where vocational education was available, it was said that difficulties existed in keeping its trainers' skills up to date.

A further factor in skills shortages was essentially that of co-ordination failures. Employers were sometimes not aware of their skills and human resource development needs, and there was relatively little concerted action between employers, education and training providers, and policy makers. This was mentioned in relation to the energy sector in Tunisia where respondents said that there was no systematic approach for developing skills based on the needs of companies and little in the way of an integrated sector-wide approach to meeting its skill needs. This was common, albeit to differing degrees, across most countries engaged in the study.

A lack of an integrated approach potentially stands in the way of meeting skills needs. At various points in the report, comment is made on the commonalities between sectors' skills needs. In many respects, we are looking at **core engineering and technician skills that are transferable** across a range of sectors. There is also an **interest in sustainability with respect to reducing energy consumption and waste levels**. This is a **core skill requirement in the energy sector** where the shift to harnessing renewable energy sources was underway across all countries, **but it was also evident in agriculture, automotive and construction**. Additionally, there were more specialist skills that related to the specificities of a particular job. From the perspective of education and training curriculum design, this has focused attention on **developing T-shaped type courses and programmes**. There is a general component (the horizontal bar) and specialist spokes (the vertical bar or bars) that provide learners with specialist, job-specific skills (see Figure 15). There are **relatively general engineering or technician skills** (such as electrical engineering), then there are the **specific sustainability and digitalisation skills** that relate to engineering/technician roles, and finally there are the **job-specific skills**. From an education and training perspective, there are general technical skills that learners can pick up across a range of occupations, as well as job-specific skills of interest only to individuals working in or planning to enter a particular job. , potential commonalities across specific jobs can be identified and catered to prevent an excessive number of courses. In summary, this paves the way for **training to encompass a range of related jobs or occupations**.

Figure 15. T-shaped programme structure



Source: ETF

Contributing to equality of opportunity

The European Union's European Skills Agenda for Sustainable Competitiveness, Social Fairness and Resilience makes reference in its title to social fairness. It is evident across many of the country studies that sectors face difficulty in finding people with the skills required to do the jobs they have on offer. One must always be circumspect with reference to the extent to which reports of skills shortages reflect shortages of people with the skills required or unattractive features of the job unrelated to skills (such as the salary or the location of the employer). But if one accepts that there are sometimes widespread skills shortages in some sectors and countries, the fact these exist alongside sometimes high unemployment or inactivity rates cannot be ignored. In some countries, the inactivity rates of working-age women are far higher than those of men. And some countries report relatively high youth unemployment rates. This potentially represents a large pool of untapped potential that could be drawn upon to meet countries' skills needs, as well as a lack of opportunity for the individuals concerned. In this sense, the findings contribute to developing systems that equip people with skills that can help them succeed in the fast evolving labour market.

5.3 Embedding the methodology in policy making processes

As well as providing an input into the content of education and training courses, consideration needs to be given to how the results can be communicated to potential users, including: those responsible for the curriculum design and employers who need to be made aware of emerging skills needs. This requires the type of information generated by the ETF methodology to be embedded within the core of a country's skills anticipation systems in return for which information will be tailored to the needs of specific user or target groups. In the table below, examples are provided of potential user and target groups, with an indication of how data might need to be supplied if it is to meet their needs and be acted upon. The table also includes international bodies, as they may also use information generated by the methodology to develop and finance their support programmes. The examples of user and target groups are not exhaustive and designed to indicate the assortment of bespoke outputs that might be needed.

Table 6. Indicative information needs of potential users and target groups

Target groups	Type of information needed
Ministries of Labour/Employment	An indication of the overall levels of skills demand, associated mismatches, and the impact of those mismatches on businesses, workers, and the economy as a whole
Education authorities	For example, an indication of the types of skill required and the level at which it is needed in order to fulfil a particular task within an occupation or sector-oriented vocational course. Also, some indication of the extent to which the skill is common across occupations and sectors
Education and training planners	Information that indicates the scale of provision required (e.g. how many learners, at what level, type of course, programme or scheme)
Career Services/learners	The relevance of a particular skill set to the current or future labour market in finding and retaining employment. This will require sector-specific information that can guide lifelong careers
Employers	The relevance of certain skills to their current and likely future production processes and strategies given their commonality across the sector(s). Sharing of good or innovative practice. Information on how to engage with the education and training system so that it can improve the skills supply potentially available to them
Sector bodies	Information on sector-specific skills needs and the extent of mismatches (skill shortages and surpluses)
EU bodies, multilateral organisations and development banks	The specific investment needed to include human capital development measures in investments and support programmes

Source: ETF

Embedding the ETF methodology within a country's skills policymaking processes relies on demonstrating:

- the scientific rigour underpinning the results;
- the added value of the methodology to the existing approach for collecting skills anticipation data;
- the comparative efficiency and effectiveness of the results produced vis-à-vis alternative approaches;
- the capacity to provide information useful to a range of potential user and target groups;
- the ability to combine methodologies and consolidate their outcomes effectively.

The process of producing the results described in this report is a transparent one and described in detail in the methodological reports produced for the ETF to demonstrate the **scientific rigour** of the approach. As noted in the section above, it involves using natural language programming to extract information about the drivers of skills demand and emerging skills needs from patent data and bibliographical databases. Statistical techniques are then used to identify the associations between drivers of change (mainly, though not exclusively, technological) and specific skills. The **added value of the methodology** is its use of data sets that provide information about changes that are currently taking place in the sector and that are likely to have implications for skills needs over the short- to medium-term. Patent data tends to reflect innovations that inventors wish to protect because they are likely to come on stream over the next few years. As such, it provides a future-oriented perspective. This also reveals **the relative efficiency and effectiveness of the approach** taken. At present, the only other means of identifying skills needs is to scrape data from vacancy websites. This should be regarded as a complement to the method described here rather than an alternative. The text mining algorithms used to extract data from patent and bibliographical databases have very much in common with those used in web scraping vacancy websites. The advantage of the approach described here is that it has a future-oriented perspective whereas vacancy websites provide data, albeit detailed, on current demand. Notwithstanding this, scaping data from vacancy websites can be readily incorporated within the ETF methodology (and has been done so on test basis).

If the above provide a justification in relation to three of the conditions that need to be satisfied for the methodology to be embedded within a country's existing skills anticipation system, the final condition relates to providing information in a way that means it is of **use to a range of potential users and target groups** – policy makers, educationalists, employers, learners, sectoral groups, careers advisers, etc. To date, the emphasis has been very much upon demonstrating the proof of the concept in a range of sectors and countries. The focus has been upon demonstrating the depth of information that can be extracted and classified about emerging skills needs using data sources that have only recently come within the reach of skills analysis. The approach and the value of the information it has provided has been validated with a range of key stakeholders in each country where the methodology was tested. The next step is to transform that information into something that is readily interpretable by a range of users. This would provide important knowledge to stakeholders and allow them to make informed decisions.

5.4 Next steps for developing the methodology and its relevance to policy making

The ETF methodology has developed, through its trial in various sectors and countries, to encompass a broader range of factors driving skills demand than technology related ones. It now captures a comprehensive range of skills including technical, cognitive, and non-cognitive. The next steps are about turning the information generated into something that a plurality of potential users and target groups can readily use in their day-to-day activities, be they, say, policy makers or young people thinking about what course to choose. Ultimately how countries decide to do this is down to them. Presented here are the issues that need to be addressed in further developing the ETF methodology so that it can serve a range of policy purposes.

There are, plausibly, several global issues that need to be addressed, including:

- the specification with which information on skills is presented;
- the identification of transversal technical skills (and the sectors and occupations they cross);
- the relative importance of different skill sets (and how they interlink);
- an assessment of the scale of demand for differing skill sets (quantitative assessment) and a mapping of the skills supply in the sector;
- the characteristics of potential future skills obsolescence; and
- the development of indicators germane to various groups.

In most instances, these are already dealt with to some extent in the existing methodology. Here, the focus is on how further improvements might be implemented. At the moment, the study captures detailed information on skills needs and then uses ESCO to provide a detailed **definition of the skills identified**. ESCO is constantly updated to provide a comprehensive list and description of skills needs. Consideration needs to be given to skills that might fall outside of the ESCO classification system and/or are very much context specific (e.g. where there is particular sector-based dimension to a common skill need). In fact, the methodology has already proven its ability to identify numerous additional technological skills that, although not classified in ESCO, may be highly valuable for the VET system to recognise (for instance, as is the case with many hydrogen-related skills in the energy sector, which are not yet present in ESCO). This then provides scope to raise information that might in turn be of use to ESCO.

It is apparent from the analysis presented in the sections above that some technical skill sets are common across a range of activities. The more one builds upon a research database in applying the methodology across sectors and countries, the more it will become apparent that there are skill sets that are common across countries and sectors. There is potential to develop the text mining element of the study to systematically identify **transversal skills and the sectors and occupations they cross**. There is also an interest in identifying **the way different skill sets are interlinked**. This will give an indication of the way in which skills are clustered, which is likely to be of importance to those planning skills supply. This is important given the policy interest in, for example, T-shaped skills. There is a need to think about the way in which skills are interlinked and the relative importance of different skill sets within that mix.

At the moment, **the importance of a skill** is identified principally with respect to the frequency with which it is mentioned in the text mining exercise (and then heard in the key stakeholder consultations). This remains a robust indicator of importance. There is however a need to reflect on the possibility that the text mining might yield statistical artefacts. Even among skill sets that have more or less the same frequency of mentions, one might be more important than the other in practice. This draws attention to how the importance of a skill might be better defined in the future (e.g. with respect to its centrality to the production process, the frequency with which a person uses it, etc.).

As well developing a precise understanding of the skills required and their relative importance, information on **the scale of demand** is also required. In other words, an indication of the potential number of people who might require their skills to be developed in a certain way. This needs to factor in likely future demand and the extent to which existing employees will need to be re-skilled or upskilled. Linked to this is understanding **the degree of skills obsolescence**. Ideally, we need information about the skills likely to become obsolescent and how many people might be affected. Lastly, it is essential to recognise that technologies are constantly evolving, and so is the demand for competency in that technology. As a result, it is crucial to update the aforementioned analysis on a regular basis.

The above are difficult issues to address. To some extent, the multi-faceted approach of the ETF methodology does already address it to some degree. It is more a question of thinking about how much the above can be addressed with the current methodology and the data it draws upon, or whether there needs to be further data collection. The methodology was never envisaged to stand alone. It was always something that could be combined with other data collection and analyses that yield complementary information on skills demand. For instance, if there is a clear picture of emerging skills needs, it is possible that a survey of employers or learners (or possibly expert panels] could be used to gauge the importance or scale of particular skills needs. The ETF methodology was designed to bridge a data gap: the provision of detailed information on emerging skills needs in particular sectors with the focus on skills rather than jobs. It was never envisaged as being an all-encompassing holistic approach to skills anticipation. It provides specific input into the skills anticipation process. In developing the methodology further, and addressing some of the issues above, it is all about **the art of the possible**, bearing in mind the purpose of the methodology.

For the purpose of action and better policy making in countries, the findings could feed national forecasts, which would identify what priority actions are needed to progress the national growth agenda. It may be possible to conduct an analysis of trends, weak signals and emerging issues against different conditions or scenarios (developed for this purpose or otherwise) in order to test their relevance, by sector and across sectors, with specific reference to the associated required skills to achieve a given objective (for instance, to enable a particular country or region to grow, or to become more competitive, to increase the country's overall quality of life or to transition towards lifelong learning systems, etc.). In this further step, it would be important to collect the assumptions of different stakeholders for collective critical analysis. This would challenge existing assumptions while bringing up new ones and identify and address strategic questions while co-developing fit-for-purpose transition pathways towards a desired future. It would also build in adaptability and embrace uncertainty.

Taking all the issues outlined above into account, one further area for consideration relates to **the format and specification of outputs**. To some extent, this depends upon the complementary skills anticipation work carried out in a country since the data these collect can play a part in establishing the indicators. Ultimately, the design of indicators for use by policy makers, labour market intermediaries, employers, and so on is dependent upon knowing more about the specific information sets that the various user and target groups require. This needs to be tied directly to the aim of the methodology so that indicators are direct outputs from the analysis it produces. This will require liaison with the various user and target groups in order to design the various indicators and gauge the extent to which they can be satisfied by adapting the existing methodology or will require supplementary data collection.

6. CONCLUSION

In summary, the value-added contribution to skills research delivered by the ETF's methodology lies in offering detailed information on how sector-based drivers of change influence the demand for specific technical skills. This enables those working in particular economic areas to identify skills that are increasingly likely to be in demand. The research also shows the intrinsic key role of human capital development for sectors to prosper, for social well-being and for innovation. The methodology and its implementation deliver even more insights, including:

- an analysis of the specific drivers of change – especially technological ones – that are likely to influence the demand for skills in the sector, identifying specific technologies rather than treating technological change as an unknowable mechanism;
- a sector-by-sector analysis of technical skills that reveals similarities in skills demand across countries, highlighting examples of converging technical skills need in various industries due to developments like renewable energy in precision farming. Examining the energy sector in Albania, Egypt and Tunisia reveals common skills needs, frequently in relation to renewable energy technologies, especially solar power. While there are country specific nuances, such as Albania and Egypt's reliance on hydroelectricity and Tunisia's dependence on fossil fuel-based energy, a future convergence in their technical skills needs is evident due to the focus on renewable energy development. Likewise, the agri-tech and agri-food sectors in Israel and Morocco exhibit similar findings as they transition towards precision farming and improved water management strategies.
- identifying technical skills that are common to nearly all sectors, stemming from digitalisation and the opportunities it provides for data analysis to improve the efficiency of production systems.

It is important not to under-estimate the differences between countries. The capacity of one country to respond to the drivers of change and meet the resulting skills needs may significantly differ from another. While sectors in countries share common forms of technological change that drives the demand for skills, country specific factors also contribute to different responses. Drivers of change, such as those related to the climate, macroeconomic stability and demographics have the capacity to affect the speed and breadth of change and, critically, the resources for investing in new technologies, impacting skills demand. Each country reveals a degree of path dependence, with respective sectors shaped by policy decisions at various stages, determining their current capability to respond to changes.

With the above caveats in mind, there are several key messages that emerge from the study pertaining to skills policies:

- The evolving landscape of new skills demands across various economic sectors and countries presents a multifaceted scenario of both risks and opportunities. Countries and individuals that adapt swiftly to the evolving skill sets needed can seize new economic prospects. The research reveals that this is particularly true in the case of countries that are in a development or transition stage.
- High quality, flexible and relevant initial education and training remain key to equipping people with the foundation and technical skills needed on the labour market. Young people will need strong key skills to be prepared for possible changes in their personal and professional lives.
- At the same time, the growing emphasis on upskilling and reskilling underscores the need for this to be accorded equal importance alongside initial education to accompany the quick and constant transformations. Adult learning becomes crucial, as far more people will need to have affordable access to lifelong learning opportunities to update and upgrade their skills and learn new skills at different stages in their lives. It is therefore essential that a democratic upskilling and reskilling system is in place to ensure that all workers can adapt to quickly changing environments.
- As new skills demands emerge, there is an urgent need to modernise education at all levels, with a particularly critical focus on vocational education and training. The transformative impact of technology on industries demands a workforce that is not only prepared for new jobs but also equipped with the agility to perform an array of tasks associated with technological

advancements. Modernising VET courses is essential to bridge the gap between traditional skill sets and the digital know-how required in today's workplaces.

- A comprehensive approach that combines theoretical learning with practical exposure and industry-specific insights can help address the lack of practical know-how and sector-specific knowledge. This translates into a preference for work-based-learning including apprenticeships and traineeships to ensure that workers possess the practical skills employers require and are more quickly operational.
- In rapidly evolving contexts, teacher training is key to ensuring that students are equipped with the skills they need in light of the new emerging technologies in the different sectors.
- It is essential to address coordination failures and foster an integrated approach involving employers, schools, training providers, and skills policy makers in identifying and resolving sector-based skill-related challenges. Establishing robust partnerships with the private sector is critical for skills systems to effectively adapt to and embrace the rapid changes in the labour market.
- Last but not least, it is essential to implement a systematic monitoring framework for identifying emerging skills needs in a sector. By establishing a robust and ongoing mechanism for gathering, analysing, and disseminating data on changing skills requirements, universities and colleges can stay attuned to the real-time demands of various industries.

Ultimately, the study underlines the importance to act at individual level. Shaping the future is about people and investing in people is more important than ever. Human capital is a central driver for sustainable economic growth and social well-being. Improving people's skills through life is key for adaptability and innovation.

With the improved availability of information on emerging skills needs and likely areas of shortage, there is the basis for addressing all of the above in a way that efficiently and effectively improves skills supply.

REFERENCES

Attewell, P. (1990). 'What is Skill?' *Work and Occupations*, 17(4), 422–448.

Cedefop (2022). *Challenging digital myths: first findings from Cedefop's second European skills and jobs survey*. Luxembourg Publications Office.

Cedefop (2021). *Understanding technological change and skill needs: big data and artificial methods: Cedefop practical guide 2*. Luxembourg: Publications Office. http://data.europa.eu/doi/10.2801/144881

Cedefop (2020). *Strengthening skills anticipation and matching in Estonia: capitalising on OSKA's potential to realise national ambitions*. Luxembourg Publications Office.

Cedefop (2015). *Skills, qualifications and jobs in the EU: the making of a perfect match? Evidence from Cedefop's European skills and jobs survey*. Luxembourg Publications Office. Cedefop reference series; No 103. http://dx.doi.org/10.2801/606129

European Commission (2020). *European Skills Agenda for Sustainable Competitiveness, Social Fairness and Resilience*. Brussels, European Commission.

ETF (2020). *Future skill needs in the agri-tech sector in Israel*. Turin, European Training Foundation, https://www.etf.europa.eu/sites/default/files/2020-11/future_of_skills_agri-tech_sector_in_israel.pdf

ETF (2021a). *Future skill needs in the agri-food sector in Morocco*. Turin, European Training Foundation, www.etf.europa.eu/en/publications-and-resources/publications/future-skills-case-study-agri-food-sector-morocco

ETF (2021b). *Future skill needs in the automotive sector in Türkiye*. Turin, European Training Foundation, www.etf.europa.eu/en/publications-and-resources/publications/future-skills-case-study-automotive-sector-Türkiye

ETF (2021c). *Case studies on the future of skills: Methodological note for conducting case studies,* Skills for the future case studies, methodology | Open Space (europa.eu)

ETF (2021d), *Changing skills for a changing world: Understanding skills demand in EU neighbouring countries – A collection of articles*, www.etf.europa.eu/en/publications-and-resources/publications/changing-skills-changing-world-understanding-skills-demand

ETF (2021e), *New forms of employment in the Eastern Partnership countries: Platform work*, https://www.etf.europa.eu/en/publications-and-resources/publications/future-work-new-forms-employment-eastern-partnership

ETF (2022a). *Future skill needs in the energy sector in Tunisia*. Turin, European Training Foundation, https://www.etf.europa.eu/en/document-attachments/future-skills-energy-sector-tunisia

ETF (2022b). *Future skill needs in the energy sector in Albania*. Turin, European Training Foundation, Future of skills: Energy sector in Albania | ETF (europa.eu)

ETF (2022c), *Recognising emerging skills needs in the craft sector in the EU Neighbourhood and Central Asia*, The future is in our hands | ETF (europa.eu)

ETF (2023a). *Future skill needs in the construction sector In Armenia*. Turin, European Training Foundation, https://www.etf.europa.eu/en/document-attachments/future-skill-needs-construction-sector-armenia-country-report

ETF (2023b). *Future skill needs in the energy sector in Egypt*. Turin, European Training Foundation.

ETF (2023c), *Embracing the digital age: New forms of employment and platform work in the Western Balkans*, Embracing the digital age | ETF (europa.eu)

ETF (unpublished). *The Future of Skills: A case study of the healthcare sector in Ukraine*. Turin, European Training Foundation.

Green, F. (2013) *Skills and Skilled Work: An Economic and Social Analysis*. Oxford: OUP.

Mason, G. (2004). *Enterprise Product Strategies and Employer Demand for Skills in Britain: Evidence from the Employers Skills Survey*. SKOPE Research Paper. ESRC Centre on Skills, Knowledge and Organisational Performance (SKOPE), University of Oxford.

Mezzanzanica, M. and Mercorio, F. (2019) *Big Data for Labour Market Intelligence: An introductory guide*. Turin, European Training Foundation.

Nedelkoska, L. and Quintini, G. (2018). *Automation, skills use and training*. OECD social, employment and migration working papers, No 202.

Pouliakas, K. (2018). 'Risks posed by automation to the European labour market'. In: Hogarth, T. (ed). *Economy, employment and skills: European, regional and global perspectives in an age of uncertainty*, pp. 45-75.

Working together
Learning for life

European Training Foundation

www.etf.europa.eu
www.twitter.com/etfeuropa
www.youtube.com/user/etfeuropa
www.facebook.com/etfeuropa
www.instagram.com/etfeuropa
openspace.etf.europa.eu