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FROM SKILLS ANTICIPATION TO SKILLS ACTION

Collection of articles to understand skills demand in EU neighbouring countries

THE EU AGENCY SUPPORTING COUNTRIES TO DEVELOP THROUGH LEARNING

This report was prepared for the European Training Foundation (ETF) by Fondazione Giacomo Brodolini. It comprises articles authored by contributors from selected research projects conducted under the auspices of the ETF Skills Lab Network of Experts. The articles were edited by Ummuhan Bardak, Terence Hogarth, Chiara Fratalia, and Ed Thorpe.

The manuscript completed in 2025.

ISBN 978-92-9157-750-7 DOI: 10.2816/3566823 TA-01-25-004-EN-N

PREFACE

The world is undergoing a period of profound change, driven by rapid technological change and digitalisation, climate change, globalisation and demographic shifts. These forces are reshaping economies and labour markets globally, albeit at different speeds. This transformation brings uncertainty, but also significant opportunities and risks that countries must manage to build more inclusive, greener, and more prosperous societies. To build more inclusive, greener, and more prosperous societies, countries must be able to manage this change effectively.

In this context, understanding how labour markets and skills demand are evolving is more important than ever. Evidence on these changes is essential for designing skills development systems that can respond to future needs and improve the match between the demand for and the support of skills.

To support this goal, the European Training Foundation (ETF) established the ***Skills Lab Network of Experts*** in 2021. The network is a voluntary knowledge community that promotes a culture of skills anticipation and matching[1] in ETF partner countries[2]. It brings together researchers, experts, and practitioners from transition and developing countries, EU Member States, and other international contexts. Any interested expert can join the network by completing a simple registration form[3].

In December 2022, as part of its mission to promote collaboration and mutual learning, the Skills Lab Network launched ***a call for joint research proposals***. The call encouraged proposals involving teams from multiple countries working on comparative research in the field of skills anticipation and skills demand. Seven proposals were selected in June 2023, although one was later withdrawn due to time constraints[4].

The selected teams received a variety of support throughout the 2023-24 implementation period. This included access to data and information sources, methodological guidance, peer review, editorial support, and English language editing. The ETF supervised the whole process.

This report is the result of that collaborative effort. It brings together six independent articles written by research teams from various countries, alongside and editorial introduction that provides context and links the individual contributions. All the articles focus on countries neighbouring the EU, although the collection is by no means exhaustive of all the research taking place in the ETF partner countries.

The report begins with an editorial article by *Terence Hogarth, Chiara Fratalia, and Ummuhan Bardak*, which introduces a common analytical model for understanding how the green and digital transitions affect employment and skills demand. It also presents contextual information on the countries featured in the report and highlights the key findings of the six articles that follow.

Each of the six articles offers new insights into skills needs, mismatches, and labour market developments in various sectors and occupations across ETF partner countries. The contributions are:

- Bridging sustainability and digital gaps in the agri-food sector: Insights from a study on the related skill needs of small farms in Serbia (*Branka Andjelkovic, Tanja Jakobi, Miki Mitrovich*);

[1] See Skills demands analysis | ETF as well as The Skills Lab Network of Experts | Open Space
[2] The partner countries are grouped into the four macro-regions: South-East Europe (Albania, Bosnia and Herzegovina, Kosovo*, Montenegro, North Macedonia, Serbia, Turkey and Israel); South and East Mediterranean (Algeria, Egypt, Palestine, Morocco, Lebanon, Jordan, Tunisia and African Union); Eastern Partnership (Armenia, Azerbaijan, Georgia, Moldova and Ukraine); and Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan & Uzbekistan).
[3] The Network also has a LinkedIn group for continuous exchange, ETF Skills Lab Network of Experts | Groups | LinkedIn
[4] For more information, see the Catalogue of joint research projects 2022–24, Catalogue of joint research projects 2022–24 | ETF

- Green jobs, skills needs and skills gaps in the green economy: Evidence from Lebanon and Tunisia (*Rihab Bellakhal-lead, Sonia Ben Kheder, Houda Haffoudhi, Feriel Omrani, Lynda Achkouty, Riad Makdissi, Sarah Makhoul, Sélim Mekdessi-lead*);
- Addressing skills gaps and mismatches in the emerging energy sector transition: Skills needs identified in Albania, Egypt and Tunisia (*Ahmed Hamza H. Ali and Liga Baltina*);
- The transition to work and graduate qualification and skill mismatch: Case studies of Morocco and Serbia (*Ivana Prica, Imane El Ouizgani, Will Bartlett*);
- Identifying sectoral skills needs: Lessons from Poland and Wales for the Turkish steel industry (*Magdalena Jelonek, Marcin Kocór, Barbara Worek, Dean Stroud, Tamer Atabarut, Ruhi Kaykayoğlu*);
- Youth digital-social entrepreneurship in Albania, Kosovo[5] and North Macedonia: Tackling the skills gap and identifying opportunities for growth (*Geena Whiteman and Arta Istrefi*).

The ETF would like to thank the 24 researchers and experts who authored these articles for their valuable contributions and their spirit of collaboration across countries and institutions. Short Finally, special thanks go biographies of the authors are provided at the end of the report.

Special thanks are also due to the regional facilitators of the network - *Slavica Dimovska*, *Najib Hamouti*, *Bakyt Omurzakov*, and *Rodion Kolyshko* - for peer reviewing the articles and offering valuable comments and suggestions. The ETF also warmly thanks the editors of the report - *Ummuhan Bardak*, *Chiara Fratalia*, *Terence Hogarth* and *Ed Thorpe* – as well as those who oversaw and supported the process, including *Francesca Rosso* and *Cristiana Burzio (ETF)*, and *Gabriel Currie-Clark* and *Giancarlo Dente* (Fondazione Giacomo Brodolini).

The ETF hopes that this collection of research will inspire further dialogue and investigation into the future of skills demand and skills development. Equipped with stronger evidence, education and training systems can be better adapted to serve the evolving needs of individuals, economies and societies.

[5] This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

CONTENTS

CHAPTER 1: Introduction to changing skills demand and supply trends in the EU neighbouring countries

Terence Hogarth, Chiara Fratalia and Ummuhan Bardak

1.1 Introduction

The nature of work is changing. Technological advances, digitalisation, climate change, globalisation, and demographic shifts are reshaping jobs and the skills they require. Across the world, countries are experiencing these changes differently, but no labour market is untouched.

A growing body of literature explores how these global trends are redefining skills demand. Many of these studies have benefited from the rise of sophisticated skills anticipation methods, helping policy makers and practitioners identify where skills gaps lie. A recent European Training Foundation (ETF) report distilled the broad impacts into six key labour market shifts (Bardak et al., 2021):

- Job destruction due to automation and offshoring in global value chains.
- Changing tasks in existing occupations, from physical to intellectual and social skills.
- Creation of new jobs, especially linked to new technologies and digitalisation.
- Job polarisation, with shrinking medium-skilled jobs and growth in higher and lower-skilled jobs.
- Increasing standardisation and fragmentation of knowledge work (digital Taylorism).
- The rise of non-standard employment and a weakening of traditional employment protections.

In late 2022, the launch of ChatGPT – an artificial intelligence (AI) large language model accessible to anyone with an internet connection – sparked new fears about automation. Unlike earlier waves of technology, AI appeared to reach into the cognitive territory once thought safe from machines. This has once again raised fears that the latest digital technologies might lead to wholesale job loss. Except that, successive technological revolutions – the world is currently experiencing its fourth or fifth one depending upon how you define revolution – suggest that new technologies are both employment and skill-enhancing (Autor et al., 1998). History reveals that technological change increases employment in relatively high-skilled, high-paid jobs. For the time being at least, this remains the case.

Results from the second European Skills and Jobs Survey (ESJS) in the EU demonstrate that where new digital technologies were introduced into the workplace it tended to require workers to undertake new tasks rather than simply reducing their existing ones (Cedefop, 2022). This raises the prospect of new digital technologies - including those which will drive forward the green transition - enhancing the skills of workers and, just possibly, their job quality.

Even if AI's impact on employment and skills is piecemeal and incremental, this might result in major changes taking place over the space of, say, a decade. Besides, AI is not the only change affecting the demand for labour and skills. Geopolitical tensions, shifts in geographical patterns of trade and the need to address climate change all have implications for skills demand. The fact that the global economy is forced to address these simultaneously adds to uncertainties about the future of work and the skills people will need to navigate the labour market (Bardak et al., 2021). Thanks to substantial investments in skills anticipation over the recent past, there is an improved understanding of both the skills individuals will need in the future and the adaptations required in education and training systems to deliver those skills. Despite this, skill mismatches persist (ETF, 2024), continuing to afflict labour

markets across the world often in the form of overqualification or over-skilling. Where workers' qualifications and skills are in advance of those required in their jobs, they tend to obtain lower wage returns than those whose skills are matched (McGuiness et al., 2024; McGuinness et al., 2018). And where skill shortages are evident, this can inhibit economic development (ETF, 2024).

Evidence to support the commentary above is mainly drawn from the EU and North America. It provides what might be considered the standard model or view of how the twin digital and green transitions affect the demand for skills. But there is always a degree of uncertainty about the extent to which the experiences of large trading blocs - which include countries with some of the highest levels of GDP per capita on Earth - reflect experiences in other, often less affluent, parts of the world (Bardak et al., 2021). The degree of impact seems to vary by country based on existing country-specific factors, such as political and legal systems, and economic and institutional structures. In some countries, existing systems and structures facilitate an inclusive transition to the future, whereas in others they work in the opposite direction. Business climate, labour relations and availability of skilled labour all affect the economic and social gains which the digital and green transitions have the potential to deliver.

In the chapters that follow, evidence is presented on emerging skill needs in the ETF's partner countries. More specifically, a series of chapters are presented which address emerging skill needs related to the twin digital and green transitions in the Western Balkans, North Africa, Turkey and the Middle East. The chapters draw attention to, amongst other things, how national and regional factors affect the demand for, and supply of, skills and the resulting levels of skill mismatch. Many factors, it would seem, stand in the way of skills supply more readily responding to demand. Many of the chapters address this very point. The answer in several instances seems to be the better use of the information that skills anticipation provides to guide investments in skills made by the state, employers, education and training providers, and individuals. The title of this chapter, From Skills Anticipation to Skills Action, was selected to draw attention to the pressing need for more action, especially in relation to skills supply, to be determined by the skills anticipation data which are increasingly available to labour market actors.

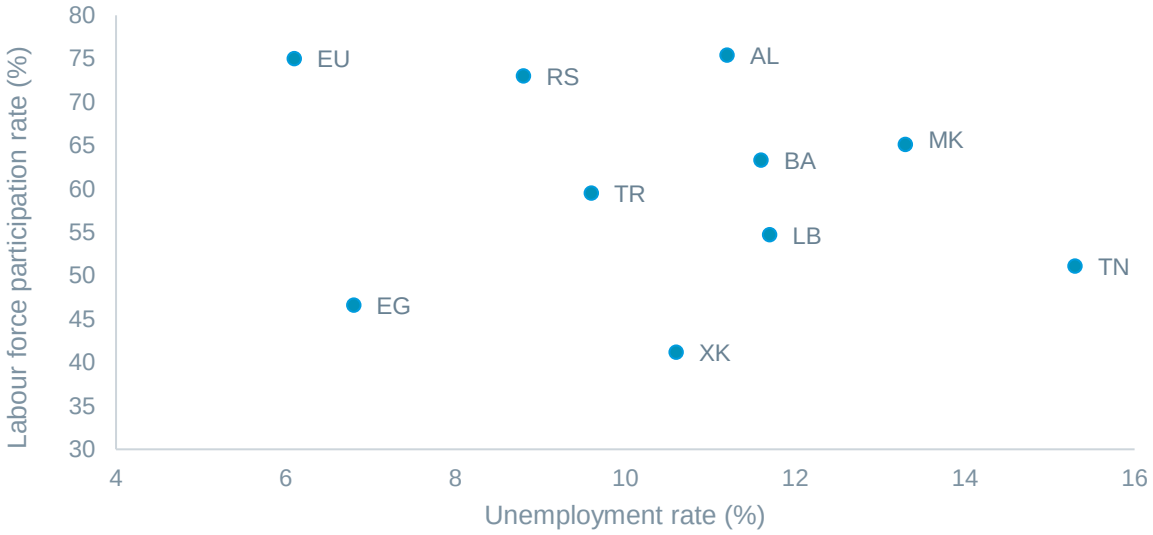
1.2 The labour market context

Before exploring the way in which the digital, green and demographic transitions affect the demand for, and supply of, skills in various ETF partner countries, it is useful by way of context, to demonstrate how labour market conditions vary. The chapters in this report address skill-related matters in nine countries: Albania (AL), Egypt (EG), Kosovo (XK)[6], Lebanon (LB), Morocco (MA), North Macedonia (MK), Serbia (RS), Tunisia (TN), Turkey (TR). In addition, the data presented contain information for Bosnia and Herzegovina (BA) and the European Union (EU-27) (as from 2020).

All these above countries differ from one another on a variety of economic and labour market indicators. The interest of this report is on meeting countries' skill needs and, in doing so, improving the employment prospects of the population. Figure 1: Unemployment and labour force participation rates: 15-64-year-olds (%) captures some of the main characteristics of the supply of, and demand for, labour. There are countries which have labour force participation rates which are not too far removed from those in the EU, but their unemployment rates are much higher (i.e. Serbia and Albania). In contrast, countries such as Tunisia, Morocco and Lebanon exhibit high unemployment and low participation rates.

[6] This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

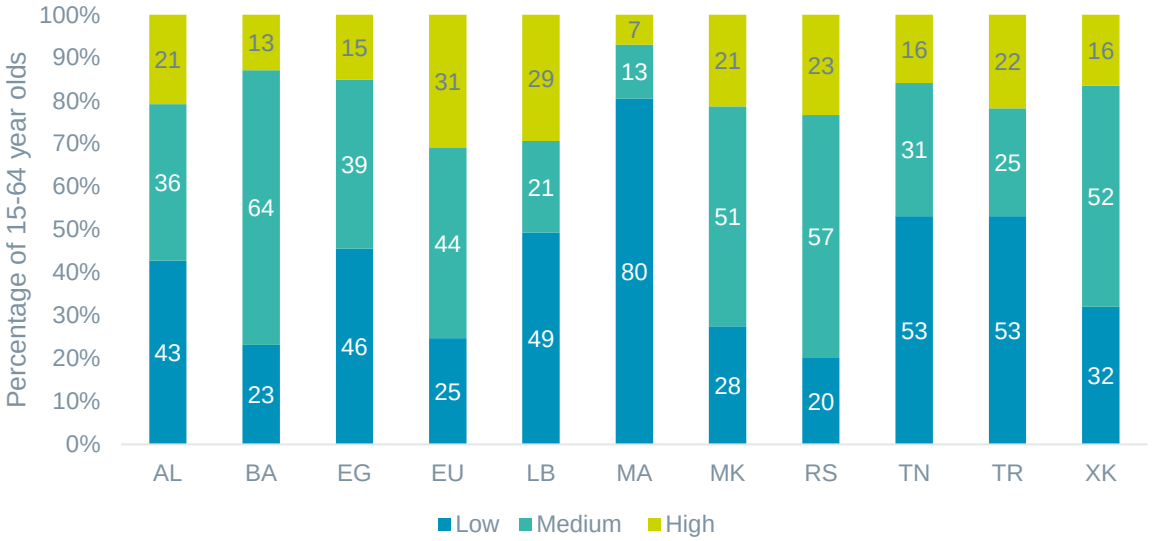
Figure 1: Unemployment and labour force participation rates: 15-64-year-olds (%)



Sources: ILOSTAT [UNE-DEAP-AGE-RT- A and UNE-DWAP-AGE-RT-A] and Eurostat EU Labour Force Survey
Note: Data for 2023 except for Lebanon (2019) and Morocco (2022). Participation rate for Morocco is for 15+ and unemployment rate for EU is for 15-74.

Figure 2: Highest level of educational attainment provides a comparison of educational attainment levels. Again, there are countries which reveal levels of education similar to those in the EU, with reference to the share of the working population with advanced level qualifications (ISCED levels 5 to 8), including Lebanon, Serbia and Turkey. However, Turkey also has a relatively high share of its working-age population with low levels of educational attainment compared with the EU, along with countries in North Africa.

Figure 2: Highest level of educational attainment of 15-64-year-olds (%)



Sources: ILOSTAT [POP-XWAP_SEX_AGE_EDU_A] and Eurostat EU Labour Force Survey
Note: Data for 2023 except for Lebanon (2019) and Morocco (2022).

The above figures demonstrate that there is a substantial amount of variation with respect to labour demand and skills supply across the countries which form the focus of the chapters that follow. Even if

sectors across the world experience similar types of technological change, national specificities are likely to affect the pace of that change and the way in which labour market actors respond.

1.3 A standard view of how the green and digital transitions affect skill demand

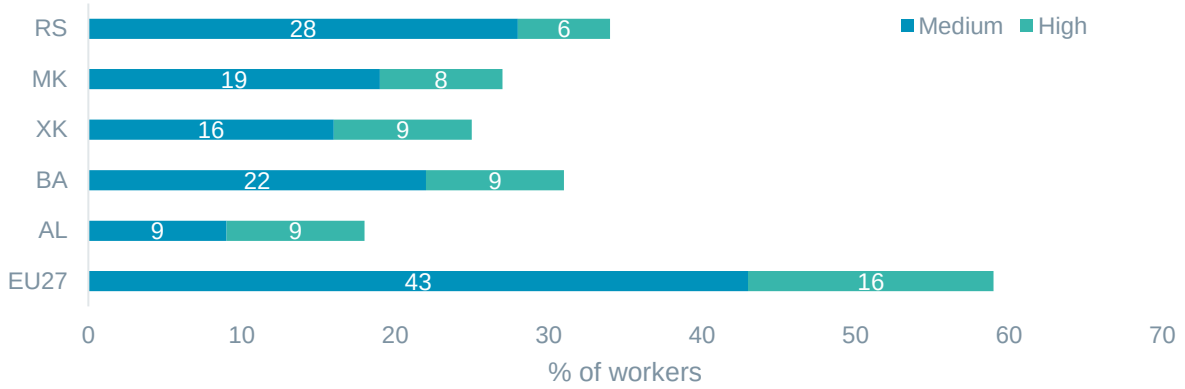
1.3.1 AI, digitalisation and skills

The standard theory or model is that technological change disproportionately affects jobs in the middle of the occupational distribution (Autor et al., 2003). This is the theory of routine-biased technological change. The use of the word routine is perhaps unfortunate. Some of the tasks which can be automated may well be complex, but they are routine in the sense that tasks follow a discernible set of rules. These are patterns which can, potentially, be replicated by machines. It just so happens that the jobs which are routine in this sense are ones typically found in, for example, skilled trades jobs, entry to which is typically governed by completion of a post-secondary vocational education, located in the middle of the skills hierarchy. This produces a hollowing out of the labour market because new technologies are less able to replicate tasks, such as the non-cognitive ones which are central to both relatively high-skilled jobs (e.g. professional and managerial occupations) and low-skilled ones (e.g. elementary occupations). Accordingly, employment change exhibits evidence of occupational polarisation, or at least it does so in the USA and the UK (Autor, 2022; Goos et al., 2007; Goos et al., 2009). Evidence from the EU has always been more ambiguous, with occupational employment change tending to favour relatively high-wage, high-skill employment and less evidence of any polarisation (Eurofound, 2015; Pouliakas, 2018).

AI potentially disrupts the existing understanding of how technology affects the demand for labour and skills. Within its grasp are those jobs previously thought to be out of technology's reach. Increases in computing power allow more complex task patterns within jobs to be recognised and thereby replicable by machines. Consequently, those working in high-skill jobs are now potentially substitutable by machines as are those working in relatively low-skilled, service-based jobs. This has led to projections which suggest dire outcomes for employment. Frey et al. (2017), for example, estimated that the latest waves of technological change could provide a substitute for nearly 50 per cent of all jobs and the people employed in them.

In practice, the extent of digitalisation appears to be modest, at least in some of the ETF's partner countries compared with the situation in the EU. The Digital Skills Intensity Index captures information on the volume and complexity of digital tasks performed by individuals. The scores from Western Balkan countries, by way of example, are substantially below those of the EU (see Figure 3).

Figure 3: Digital Skills Intensity Index scores in the Western Balkans and the EU



Source: ETF (2025) Figure 15.1, p.21 based on ETF Second ESJS (2023) and Cedefop ESJS (2021)
Notes: ESJS means European Skills and Jobs Survey, a survey of adult workers aged 25-64 in the EU-27 and selected ETF partner countries.

Analyses of technological change's impact on the tasks undertaken by workers in their jobs make a distinction between:

- automation – where machines take over some or all of the tasks undertaken in a job;
- augmentation – where the same machines complement the tasks undertaken by workers such that their productivity increases; and
- task reinstatement – where new tasks or new jobs emerge from the introduction of new technologies (Acemoglu et al., 2018).

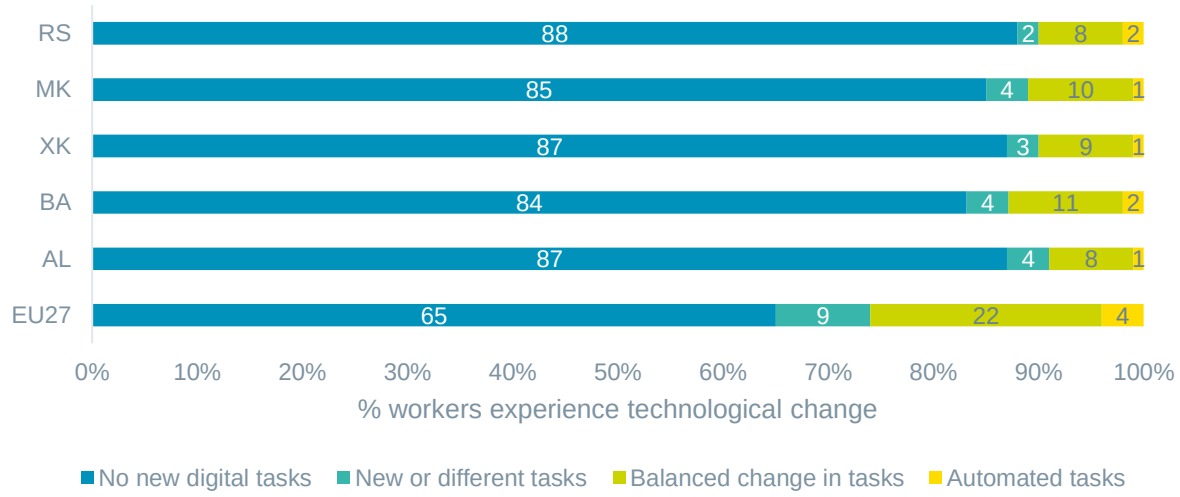
To date, the evidence tends to favour the view that the latest wave of digital technologies augments the tasks of workers rather than fully replacing them. The second European Skills and Jobs Survey (ESJS) indicates that a minority of workplaces had experienced digitalisation over the past 12 months. Also, where it had taken place, it tended to result in either no change in task requirements or balanced change. (ETF, 2025; Cedefop, 2022). Balanced change refers to where some skills are lost but others are gained with the implication that digitalisation augments rather than substitutes for workers' skills. The information provided in Figure 4 below, which compares results from the ESJS in the EU with that undertaken in the Western Balkans (WB), reinforces the point made above, that developments in the EU or USA are not necessarily good indicators of change elsewhere.[7]

The ESJS reveals that the introduction of new technologies into WB workplaces is less commonplace than in the EU. In the EU, 43 per cent of workplaces had introduced new technologies over the past 12 months, compared with 35 per cent in Albania, 27 per cent in Bosnia and Herzegovina, 28 per cent in Kosovo, 23 per cent in North Macedonia, and 21 per cent in Serbia (ETF, 2025). And where change is introduced, it is much more likely to have no impact on workers' tasks than in the EU. There is also a much lower incidence of balanced change in the WB (see Figure 4).

Where the evidence is less clear, in relation to almost any country, is the extent to which there is a task reinstatement effect and whether this is concentrated in relatively high or low-skilled employment.

[7] The example of the WB is used because comparable data are readily available from the second ESJS undertaken in the region in 2023. This is not to suggest that all ETF partner countries will reveal the same pattern. The WB example is used simply to demonstrate that things are sometimes different outside the major economies of the world.

Figure 4: Introduction of digitalisation and change in task requirements in the EU and the Western Balkans



Source: ETF (2025) Figure 10, p.10 based on ETF Second ESJS (2023) and Cedefop ESJS (2021).

1.3.2 Climate change and the demand for green jobs and green skills

Alongside the digital transition is the green one. In the EU, €600 billion has been allocated to support the European Green Deal (EGD) between 2021 and 2027 to support the introduction of measures to achieve net zero emissions of greenhouse gases by 2050. The EGD contains a myriad of measures concerned with the production and consumption of energy (e.g. the shift to renewables and an increased focus on energy efficiency); food security and green agriculture; industrial production processes that reduce overall levels of pollution and waste; and the built environment, including retrofitting buildings to make them energy efficient and the shift towards smarter, greener urban environments.

Skills are an important component of the EGD. Without the right skills being in place to introduce green technologies and green production processes, the net zero ambition is at risk. Being able to introduce green technologies and equipping people with green skills requires coordination of many stakeholders (ETF, 2023). Identifying the green jobs and skills which will bring about the ambitions set out in the EGD, and other strategies such as the 'Farm to Fork' one, is far from easy (Hogarth et al., 2024). Often the focus is on transversal skills such as those listed in the EU's GreenComp classification (Bianchi et al., 2022). The types of competence GreenComp identifies are rather general such as those required for 'valuing sustainability', 'systems thinking' and 'political agency', to name but a few. These may be important, but there are also many technical skills which are also required to bring about the green transition.

In the areas which surround the EU, the green transition is an often pressing one given the impact of climate change on energy generation (e.g. the generation of hydro-electric power during periods of drought) and farming (e.g. the need for water management and managing the risk of crop failure). The ETF's Future of Skills studies revealed how, in the Western Balkans, the Middle East and North Africa, certain skill sets will need to be cultivated if these regions are to match the progress towards a greener future similar to that found in, for instance, the EU (ETF, 2024). This includes:

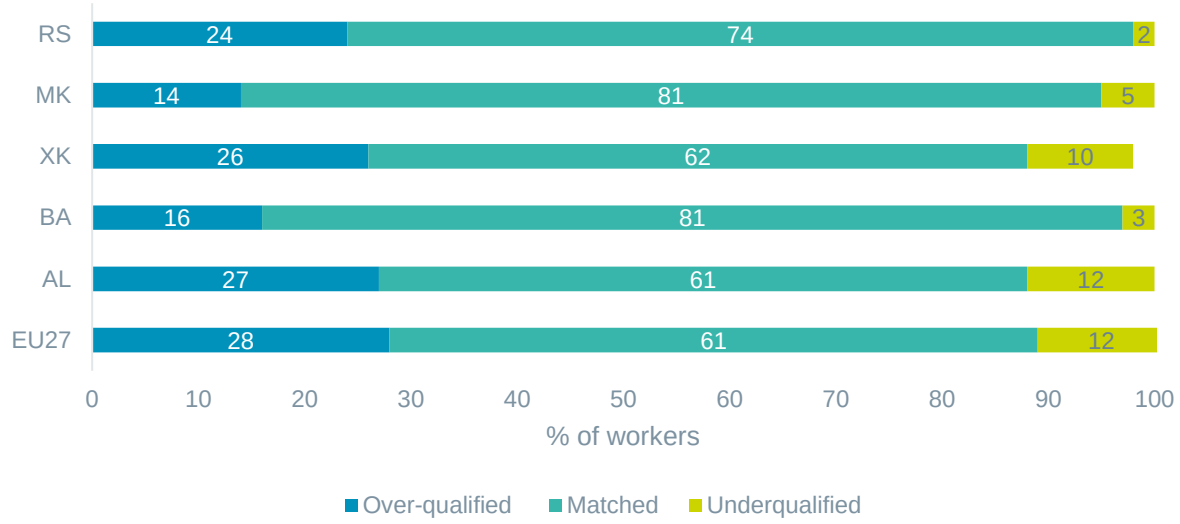
- technical skills related to sustainability practices, such as water, waste, energy and soil management, and those related to new production methods such as hydroponics in agriculture, the generation and transmission of renewable energy or producing electric or hybrid cars;[8]
- digital skills related to the use of robots, data analysis and drones, and the analysis of the data these technologies are able to collect; and
- transversal skills related to business management (entrepreneurship, communication, marketing, risk management and human resource management).

Some of these generic skills are in demand across many sectors. What makes them distinct from a green perspective is the way in which they are combined with more traditional skills in the energy, construction and agri-food sectors, respectively. The hybrid nature of these skills makes them sector- or job-specific (Lazear, 2009). Despite there being a degree of consensus on the types of skills required to progress towards the net zero ambition, education and training systems either in the EU or the ETF's partner countries struggle to produce the skills required (ETF, 2024).

1.3.3 Adapting skills supply to skill demand

From the foregoing, it is evident that much is already known about the skill needs which are likely to arise from the digital and green transitions. Yet skill mismatches are still much in evidence both in the EU and the ETF's partner countries. While the EU has a larger volume of skill mismatches than, for example, the Western Balkans, even in the latter they account for a substantial share of employment (see Figure 5).

Figure 5: Extent of skill mismatches in the Western Balkans and the EU



Source: ETF (2025) Figure 20, p.30 based on ETF Second ESJS (2023) and Cedefop ESJS (2021).

There is a hint from the evidence of the second ESJS, and from other studies conducted in the region, that a low-skill equilibrium is evident (ETF, 2025). The incidence of new technology take up is relatively low which, in turn, drives down the demand for training and, by implication, that for skills. The shortage of skills, albeit latent, required to guide investments in new technologies acts as a barrier to investment, such that the introduction of new production processes and products fails to take place on a sufficient scale, leading to limited demand for skills. Education and training providers cannot be

[8] ETF (2021) study of future skills needs in the Turkish automotive sector showed a large impact of sustainability on car production and related skills needs for hybrid and electric cars.

reasonably expected to design and deliver programmes for learning for which there is little demand. To suggest that breaking out of this kind of vicious circle proves difficult, whether in the EU or in an ETF partner country, would be an understatement that fails to fully capture the persistent nature of the problem, especially in those regions where much-needed skilled personnel emigrate to areas where their skills might be more productively employed (ETF, 2022).

1.4 New evidence on demand, supply and mismatches

The foregoing has provided an outline of the standard model in relation to the skill needs arising from the digital and green transitions, respectively. It has also indicated how it might vary depending upon the part of the world one is looking at. The series of papers developed for this volume provide a range of insights, some of which challenge the standard model, some of which reinforce it, and some which suggest pathways out of a potential low-skills equilibrium.

Andjelkovic et al., in ***Chapter 2***, address the low take-up of digital technologies among farmers in Serbia. Her study reveals the multiple, interrelated barriers that impede the effective integration of digital technologies into small-scale farming. In part, this stems from the relatively high cost of digital technologies such as GPS-guided drones, and /or farmers' lack of knowledge of these technologies and the returns they might deliver to their businesses. Even if the digital literacy of farmers could be improved, they would still face problems finding workers with the skills to operate these new technologies. Filling the digital gap between the agriculture sector in Serbia with that in other parts of the world requires a holistic response that provides financial incentives to farmers to make use of technologies that are becoming increasingly standard in many countries, along with business support services that can assist with technology transfer. Linked to this is the need for farmers (or their representative organisations) to work with education and training providers, plus the other state authorities responsible for skills, to develop the courses and programmes, encompassing both IVET and CVET, that will ensure that skills supply is better matched to demand. This all needs to happen simultaneously. The paper makes clear that improving the skills supply is only part of the solution. Other measures are required to support employers invest in new technologies, moving into new higher value-added markets, and identifying their emerging skill needs.

In ***Chapter 3***, ***Bellakhal et al.*** tackle a similar set of issues but with more of a focus on the green transition. Their paper investigates the challenges and opportunities of the green transition in Lebanon and Tunisia. It identifies the types of green jobs for which demand will increase and the gap between current skills provision and the skills needed to progress the green transition. Through a detailed analysis of green jobs and associated training supply, as well as a survey of workers in green sectors, the research highlights the main skills challenges faced by each country to provide the green economy with the skills it needs. The authors reveal that there are differences between the preparedness of each country in meeting the skill needs of a growing green economy, but there are similarities too. In both countries there has been an increase in demand for those with high-level skills in sectors such as agriculture, waste management, energy and environmental protection. Courses have been developed to feed the increasing demand, but skill shortages and gaps persist especially in relation to technicians, engineers and managers. The survey of workers reveals that a substantial share of workers in green sectors report that they are under-skilled to carry out their current job. In part this results from a lack of vocational education and training provision and course curricula not being sufficiently adapted to changing patterns of skill demand. Attention is also drawn to the lack of managers with the skills and knowledge to lead the green transition across many sectors. There is a link here with the study from Serbia which identified farmers' lack of knowledge of the new technologies which might improve the productivity of their farms.

The energy sector is of central importance in achieving countries' ambitions to reduce their carbon footprint. Studies of the energy sector capture the challenges of introducing technological change to produce cleaner energy, amongst other things, thereby combining the digital and green transitions into one. In ***Chapter 4, Ali and Baltina*** explore changes which have taken place in the energy sectors of Albania, Egypt and Tunisia. In all three countries, energy consumption has more than doubled over the past 20 years. The energy sector is central to each country's ambition to increase economic growth. The paper highlights the various factors limiting development, including the need to increase the supply of relatively high-skilled people with digital and managerial competencies, plus those with skills linked to renewable energy, efficiency and sustainability. Just as is the case in many other countries, more investment in skills development needs to be guided by employers and education and training authorities working in tandem to develop skills courses and programmes. The paper also reflects on the types of action which will facilitate change in the energy sector. This includes the development of regional renewable energy training centres (because renewable energy sites are located away from population centres), energy technology innovation hubs, cross-border internships, shared digital learning platforms and regional energy efficiency projects. All of these are said to have potential to simultaneously boost the demand for, and supply of, skills to support the sector's technological and green transformation.

A recurrent finding in many studies, including those reported in this collection, is the increased demand for people with relatively high-level skills, typically those commensurate with completing tertiary education. ***Bartlett et al.*** in ***Chapter 5*** demonstrate that simply increasing the supply of tertiary-educated students is not a panacea. The paper presents the findings from a pilot project on the extent and consequences of qualification and skill mismatch in Morocco and Serbia based on a survey of graduate employees. These two countries are dissimilar with respect to the higher education sectors and labour market performance. The overall findings show a relatively high degree of overqualification and a general trend of under-skilling of graduates in both countries. There is some improvement in skill matching for Moroccan master's degree graduates compared with bachelor level, while in Serbia master's courses appear to offer no improvement in terms of skills. While skill matching improves over a graduate's career, in Serbia the gender gap in skill mismatch worsens over the course of the graduates' careers, a phenomenon that is not observed in Morocco. The skill-mismatch position of Serbian female graduates is much worse than that of men and the gender disparity is worse for Serbian female graduates than for Moroccan female graduates. The study also demonstrates a large economic cost expressed as a wage penalty associated with all types of qualification mismatch well above the wage penalty found in comparable international studies.

As well as diagnosing skill needs, there is an interest in understanding how skills supply matched to demand can be improved, especially through policy transfer. In Poland and Wales, robust frameworks have been developed to improve skills supply to the steel industry. ***Jelonek et al.*** in ***Chapter 6*** explore how the initiatives undertaken in each country can be adapted and transferred to Turkey's steel sector. The Sectoral Human Capital Studies (SHCS) in Poland and the European Steel Skills Agenda (ESSA) in Wales have been shown to be effective methodologies for identifying and responding to critical skills gaps. Adapting SHCS and ESSA methodologies to Turkey's steel sector holds considerable promise. In particular, sector-specific skills alliances are identified as having the potential to enhance collaboration among industry stakeholders, educational institutions and policymakers in Turkey. This should increase the probability that training programmes are responsive to market demands and technological advances at the sectoral and regional levels. Based on the experiences of Poland and Wales, the authors recommend that the steel industry in Turkey undertake sector-specific studies to identify critical skills gaps and future requirements[9]. This needs to be linked

[9] An ETF study already provides information on emerging skill needs in Turkey's automotive sector and the challenges faced in ensuring that these skill needs are met (ETF, 2022).

to stakeholder collaboration through skills alliances to facilitate collaboration between industry stakeholders, educational institutions and policymakers. Sector alliances need to focus on skills related to green technologies and digitalisation considered important for maintaining competitiveness in the global market. Continuous monitoring and adaptation are also required to update skills profiles and training needs. Finally, inclusive employment practices need to be put in place to promote diversity and inclusivity in workforce development initiatives, ensuring equal opportunities for all individuals. This will increase the talent pool and foster innovation.

Looking further into the actions which might address skill mismatches of one kind or another, in ***Chapter 7, Whiteman and Istrefi*** look at the potential benefits digital entrepreneurship might confer on young people making the transition from school to work in Albania, Kosovo and North Macedonia. The focus is on digital-social entrepreneurship (DSE): the pursuit of entrepreneurial initiatives with social purposes developed by incorporating digital technologies into their business model. Digital social entrepreneurs focus on creating ventures that address social challenges. By doing so, they contribute to the wellbeing of their communities and help in creating more equitable and inclusive societies. The evidence demonstrates that DSE among young people is an emerging phenomenon but there is not much support in place to develop it in the Western Balkans. In all three countries, the DSE ecosystem is currently disconnected, though there are ongoing attempts to facilitate stronger connections between the key actors within the ecosystem. This is reflected in government policy, the growth in working groups relating to digital and social entrepreneurship, and the growth in DSE-oriented training programmes. Despite this, curricula are underdeveloped. While there is a focus on digital entrepreneurship and digital skills, there is limited progress in tying this to social entrepreneurship and developing programmes aligned to the values of DSE. Incubators and non-governmental organisations (NGOs) are seen to be important institutions in supporting DSE. There are already incubators in place which provide short-duration training. While this is considered insufficient to support the growth of DSE, it provides a base of sorts on which to build should funding become available to further develop DSE.

1.5 Conclusions

Although new forms of digitalisation which make greater use of AI than hitherto might disrupt the relationship between technological change and skills demand, the evidence to date suggests that its impact is rather benign, at least according to the findings from the second ESJS. Where new digital technologies are introduced, it tends to result in task and skill augmentation. The problem, from an economic and employment perspective, may be that there is too little rather than too much digitalisation being introduced into the workplace. A recurrent theme running through the chapters that follow is that change is often failing to take place on a sufficient scale in ETF partner countries such that there is a risk that they will fall behind some of the major economies. There appears to be a latent skills gap related to knowledge about new technologies and how they might transform product ranges and production processes in almost any sector. They are latent in that employers fail to recognise this kind of skill or knowledge requirement. And even if there is knowledge about the technologies that are part of the digital and green transitions, their cost is such that employers are concerned about the return they will generate, especially with the attendant concerns about recruiting people with the skills required to implement and operate them.

The methods and methodologies are largely in place to anticipate skill needs (see ETF, 2024; and Bardak et al., 2021). This is increasingly undertaken at a high level of disaggregation which identifies specific job tasks and the competences required to fulfil them. Similarly, there is no shortage of evidence on how to solve skill shortages and gaps. Problems, however, arise where skill needs are small-scale or nascent such that training providers see little return from delivering certain skill sets,

and /or where there are more powerful forces laying claim to available supply. While there may be a preference for people who have acquired skills via vocational education and training (another recurrent theme in the papers which make up this volume) the attraction of general education, often at the tertiary level given the returns it potentially confers on its graduates, exerts a strong influence on skills supply. This is an education and skills problem if the signals would-be learners receive are in some way misleading. This is resolvable by improving the supply of labour market information. This type of information is readily available to career services. It is not an education and training problem, or solely its problem, if the returns from general education, other things being equal, are higher than those from VET. In which case the solution is more about improving the employment opportunities available to VET graduates. The wider point being made here is that not all skill gaps and skill shortages are resolvable through the measures those working in the education and training sector have at their disposal. But some are.

Examples are provided in the chapters that follow about how the supply of skills might better match certain demands, such as through interlinked technology and knowledge transfer, peer learning, the role of sector alliances, incubators and skills hubs. But unless it is possible to kick-start change in the first instance to create a sufficient critical mass of skills demand to make it worth the while for education and training providers to develop and deliver courses and programmes, some of the skills gaps and skill shortages reported on in subsequent chapters are likely to persist. The chapter by Andjelkovic *et al* below suggests that a holistic response is required where skills policies are integrated with those which encourage capital investments in new technologies and assist with technology and knowledge transfer. This is probably a good place to start.

The importance of being able to simultaneously stimulate investments in new technologies and ensuring that the skills are in place to support their introduction has been touched upon by ETF in its analysis of migration (ETF 2022). Where countries fail to make investments in human capital to meet the needs of the labour market, there is a danger of creating a vicious circle where highly skilled individuals exit a country and consequently drive it towards an even lower skill equilibrium. Investments in skills anticipation mean that policymakers are better placed than ever to identify the skills needed to accompany the introduction of new digital and green technologies. Labour market skills intelligence is now available to direct the kind of actions which should avert the risk of investments in new plant, equipment and software being undermined by skill shortages. But actions on the skills front need to be part and parcel of actions to support investments in new digital and green technologies. One without the other will not do.

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CHAPTER 2: Bridging sustainability and digital gaps in the agri-food sector: Insights from a study on the related skill needs of small farms in Serbia

Branka Andjelkovic, Tanja Jakobi, and Miki Mitrovich

2.1 Introduction

Agriculture[10] plays an important role in Serbia, contributing 5.2% of GDP in 2023 and employing 14% of the country's labour force (Statistical Office of Serbia, 2023). Despite its significance, the sector's average growth rate over the last 10 years has been around 1.5%, well below its potential (World Bank, 2024).

Structural limitations, low levels of investment and limited technological adoption have hindered productivity and sustainability of the agricultural sector (Dimitrijevic, 2023). In Serbia, approximately 99.6% of agricultural producers are family-owned farms, with an average farm size of 6.4 hectares compared to the EU average of 16.1 hectares (Agriculture Census, Statistical Office of Serbia, 2023; Eurostat, 2022). In addition, agriculture in Serbia has historically been characterised by traditional farming methods, with limited integration of modern technologies (Vapa Tankosić et al., Tagarakis et al., 2018). The demographic profile of farm owners – primarily men aged over 60 years whose educational attainment is at primary or lower secondary education levels – also poses constraints to improving digital literacy and effectively implementing new technologies (Vukadinović et al., 2022). These factors, coupled with low government investments in the sector, create significant obstacles to taking full advantage of digitalisation and modernisation of agriculture in Serbia (Dimitrijevic, 2023).

Recognising these challenges, Serbia has introduced a Smart Specialisation Strategy 2020-2027, identifying agriculture as a priority area for innovation and productivity enhancement. The strategy emphasises integrating digital tools (such as precision farming, drones, sensor-based monitoring and big data analytics) and sustainable practices in agricultural production, to enhance efficiency and competitiveness in global markets (Government of Serbia, 2020). Despite the potential benefits, the adoption of these technologies in Serbia has been limited. A 2020 study found that 14% of surveyed Serbian farmers had adopted state-of-the-art digital technologies in their farming practices, with adoption primarily concentrated among larger farms (FAO and ITU, 2020). According to recent research, farm owners face significant barriers to adopting digital solutions, preventing their widespread use (Kljajic et al., 2024).

In further recognition of the need for digital transformation, the Serbian government launched the eAgrar digital platform in 2023 to provide farmers with access to official records and enable them to apply for government support programmes online. Approximately 330,000 farmers have registered on the platform so far (Agricultural Survey, Statistical Office of Serbia, 2023). However, the high level of assistance required for registration revealed that many farmers were unable to connect to the platform without assistance from the national Agricultural and Advisory Services of Serbia (Agronews, 2024). These findings emphasise the need for comprehensive digital skills development among farmers.

In parallel, Serbia made efforts to align its agricultural sector with the EU and associated strategies such as the Green Agenda for the Western Balkans (2020) and the Digital Agenda for the Western Balkans (2018) (UNDP, 2022; EIT Food, 2024). Nevertheless, evidence of the practical impact of these measures on transforming traditional farming practices remains scarce. This suggests that

[10] NACE (Nomenclature des Activités Économiques dans la Communauté Européenne) is the statistical classification system used by the European Union to categorise economic activities. NACE Section A (Agriculture, Forestry, and Fishing): Often simply referred to as "NACE 1" or "NACE Section A," this section encompasses activities related to the cultivation of crops, animal production, forestry, fishing, and aquaculture.

greater integration of systemic reforms and enhanced stakeholder engagement are needed to achieve meaningful progress.

Serbia's agricultural sector, despite its vital economic role, faces significant structural and technological challenges that impede its growth and sustainability. The prevalence of small farms, outdated farming methods and low digital literacy among farmers have resulted in slow productivity gains and an increasing gap between Serbia and the EU. While digital technologies have the potential to transform farming practices and increase efficiency and sustainability, adoption remains low, particularly among smallholder farmers (smallholders) who often lack the necessary knowledge, resources and institutional support.

The research objectives of this paper are directly aligned with addressing these challenges. The paper identifies which digital products and services are most often used and are practically beneficial for smallholders, ensuring that digitalisation is tailored to the realities of Serbia's agricultural landscape rather than being a one-size-fits-all solution. It also examines the specific digital skills deficiencies preventing farmers from effectively utilising digital solutions, providing insights into how training programmes should be designed to bridge this gap. Additionally, it investigates potential incentive structures that could encourage the adoption of innovative technologies and practices among smallholders. The paper also explores socio-cultural factors that may inhibit willingness to engage with digital agriculture, ensuring that solutions address both technological and human factors. Lastly, examples are provided to illustrate how digital tools and services can empower smallholders.

By addressing these key research objectives, the paper aims to generate insights that will inform policymakers, agricultural institutions and farming communities on how to bridge the digital divide and ensure that smallholders can fully participate in the digital transformation of agriculture. The research findings will contribute to the development of targeted policy interventions aimed at strengthening digital literacy, enhancing farmers' engagement with agricultural technologies, and fostering a more competitive and sustainable agricultural sector in Serbia.

2.2 Beyond large-scale farming: digitalisation challenges facing small farms

Integrating digital technologies into agriculture provides numerous opportunities for advancing the sector. Digital agriculture combines essential resources – such as computers, mobile devices and reliable internet access – with advanced technologies such as the Internet of Things (IoT), Geographic Information Systems (GIS), AI-driven analytics, and robotics. Together these innovations optimise farming practices, enhance productivity, and improve food quality and safety (Vukadinovic et al., 2022; Kovács et al., 2018). Moreover, the deployment of these technologies helps reduce environmental impacts while increasing agricultural yields (Rolandi et al., 2021; de Souza et al., 2023). Advanced solutions like cloud computing and blockchain can further enhance transparency and accountability across agricultural supply chains, enabling more secure and traceable food production systems (Rolandi et al., 2021).

However, despite these transformative potentials, small-scale farms continue to face distinct challenges in fully benefiting from digitalisation. This disparity arises primarily due to structural limitations, including fragmented land ownership and smaller farm sizes, which often prevent economies of scale and hinder investments in advanced digital solutions. Small farms frequently lack the financial resources needed to acquire modern equipment such as automated irrigation systems, which typically involve significant upfront costs and ongoing maintenance expenses (Klerkx et al., 2019; Rotz et al., 2019).

Moreover, limited digital literacy and insufficient technical training present additional barriers, as many small-scale farmers lack the necessary skills to operate digital tools effectively (Egorov et al., 2023; Wu, 2024). The absence of accessible, tailored educational programmes exacerbates this issue, restricting farmers' ability to leverage data-driven decision-making processes. Data management and analysis skills, essential for fully exploiting digital technologies, are particularly underdeveloped. For

instance, these competencies enable farmers to monitor soil conditions, track weather patterns, automate irrigation systems, and optimise input use (fertilisers, water, pesticides) through real-time data analysis.

Digital infrastructure is another important enabler in the digital transformation of small farms, particularly in rural or remote areas. Studies highlight that without sufficient infrastructure, even the most digitally skilled farmers may struggle to utilise advanced agricultural technologies effectively (Klerkx et al., 2019; Rotz et al., 2019). Connectivity challenges in rural communities may inhibit farmers' ability to use IoT and precision farming tools, which require stable internet connections for real-time data transmission (Rotz et al., 2019).

Research to date has principally focused on digitalisation in relatively large-scale commercial farming within developed countries, particularly in the EU and USA, with relatively little attention paid to the case of small farms. For instance, a bibliometric study of agricultural digitalisation confirms that most studies concentrate on applications of digital technologies within commercial farming contexts, where economies of scale and established infrastructures support advanced digital tools (Beigi Firoozi et al., 2023; Thakur et al., 2024). Thus, addressing this research gap by focusing more closely on small-scale agriculture is crucial for creating effective, inclusive strategies for digital transformation.

Building upon the existing body of literature, the study sought to investigate the determinants of digital tools' adoption among smallholder farmers in Serbia.

2.3 Methodology

The evidence provided below explores key areas influencing the digital transformation of agriculture in Serbia. Specifically, it seeks to: (1) determine the digital products and services used by smallholder farmers, supporting them to transition to more sustainable agricultural methods; (2) identify the digital skills gaps among farmers, especially those operating small farms, focusing on their capacity to adopt sustainable practices and advanced technologies; and (3) evaluate potential incentive structures that could encourage the adoption of innovative technologies and practices among small farms.

For this paper, the team conducted desk research and focus group discussions to understand the digital skills gaps, products, services and incentives essential for farmers and small producers in Serbia to transition towards more sustainable and efficient production practices. The study aimed to examine the barriers and enablers that affect the adoption of digital solutions among smallholders.

The desk research involved an extensive review of secondary data sources including reports and academic papers. This phase enabled the identification of challenges facing small farms in Serbia, particularly related to digital skills, technology access, and potential pathways for sustainability improvements. By analysing these sources, the desk research highlighted gaps in current digital adoption practices and identified critical skills needed among smallholders.

In addition to this desk research, two focus groups were conducted in September 2024 to gather qualitative insights from key stakeholders. The first focus group included eight participants from the Smart Agriculture Council of the Serbian Chamber of Commerce, who provided expert perspectives on the state of digital agriculture in Serbia, potential advances, and the role of policy in facilitating digital transformation among smallholder farmers. The second focus group, consisting of seven representatives from the Serbian Agricultural Advisory and Professional Services (AAPS), explored the practical challenges faced by smallholder farmers, their digital literacy levels, and the specific barriers to adopting new technologies.

Structured around open-ended questions, these focus group discussions were recorded, transcribed, and subjected to thematic analysis, allowing the researchers to gain preliminary insights into the underlying factors influencing the adoption of sustainable practices among smallholders. It is anticipated that the information reported on here will be used to develop an exploratory questionnaire survey (planned for 2025) targeting smallholders in Serbia. The survey will provide important insights

into the specific digital tools and practices currently used by farmers, the skill gaps they experience, and the factors that could encourage or hinder their adoption of sustainable and digital solutions.

2.4 Research findings

2.4.1 Technology usage patterns

Research on digital access among Serbian farmers indicates that a significant majority, more than 80%, have access to computers and use the internet daily (Ciric et al., 2017; Ilić-Kosanović et al., 2019; Dasic et al., 2022). Nevertheless, as Ciric et al. (2017) highlight, 39% actively use the internet to gather information for improving agricultural practices. These findings are corroborated by recent studies, which suggest limited digital engagement for agricultural improvement (Ilić-Kosanović et al., 2019; Dasic et al., 2022; Agronews, 2024).

Among the digital tools most frequently adopted by small farms in Serbia, mobile applications for weather forecasting and social media platforms stand out as particularly popular choices. Mobile applications not only improve operational efficiency but also contribute to sustainable farming practices by enabling farmers to respond effectively to climate variability. These applications are particularly popular due to their affordability and ease of use (Cikic et al., 2022; Nikolic et al., 2023; Vukadinovic et al., 2022).

Social media platforms, such as Facebook and Viber, are also favoured on small farms for direct marketing and product promotion to local consumers. These platforms offer a cost-effective means for farmers to broaden their customer base and manage client relationships independently, without relying on intermediaries (Dasic et al., 2022). By using social media, small-scale farmers can promote sustainable local food systems while fostering stronger community ties, but research indicates that farmers still underutilise the full potential of these platforms for business purposes (Dasic et al., 2022).

While digital tools for farm management and decision-making hold significant potential for pursuing sustainable practices, a large proportion of Serbian smallholder farmers remain unfamiliar with such technologies (Dimitrijevic, 2023). Only a limited number of farmers have adopted farm management software to monitor resource inputs, track production metrics and minimise environmental impacts through informed decision-making. Scepticism towards digital technology adoption also persists, as some farmers question whether the benefits of ICT outweigh the associated costs. Farmers engaged in organic farming display a slightly more positive attitude, perceiving ICT as valuable for monitoring organic standards, managing soil health, and reaching specialised markets (Ilic-Kosanovic et al., 2019).

Advanced digital technologies, such as precision agriculture (PA), are particularly overlooked among Serbian smallholder farmers. Evaluations reveal that adoption rates for PA remain low, despite its transformative potential for sustainable farming (Vapa Tankosić et al., 2024; Dimitrijevic, 2023; Tagarakis et al., 2018). While PA technologies have gained traction in countries like the Netherlands, Germany, and the Czech Republic (Mori et al., 2021), Serbia has been slower to adopt such practices, with most farmers continuing to rely on traditional farming methods.

Digital infrastructure disparities further impede the broader application of digital tools across Serbia. The Survey on the Usage of Information Communication Technology (ICT) in Serbia (Statistical Office of Serbia, 2024) highlights substantial gaps in internet coverage, with 87% coverage in urban areas compared to only 70% in rural regions. These disparities, as noted by researchers, restrict farmers' adoption of digital tools and more resource-efficient, environmentally friendly farming methods (Cikic et al., 2022).

Building on this, the focus group discussions provided first-hand insights into how the adoption of technology affects daily farming operations. They revealed that small-scale Serbian farmers generally use a limited range of digital tools, opting for low-cost, user-friendly applications like SMS weather alerts, basic farm management apps, and social media. One focus group participant observed,

"Farmers are more likely to adopt tools that are simple and accessible, such as SMS alerts, because they don't require advanced digital skills."

Distinct patterns in digital tool usage emerged across sub-sectors, with beekeepers and vineyard owners demonstrating a higher degree of digital engagement compared to crop and livestock farmers. In the words of one participant, *"Beekeepers benefit from SMS-enabled hive monitoring, allowing them to track productivity without constant physical presence,"* which highlights the value of practical, low-cost technology. In contrast, another focus group contributor noted that *"for traditional field cropping or livestock, farmers see less relevance in digital tools and are often hesitant to adopt them."* This difference in technology adoption was attributed to varying economic structures and product-specific demands across agricultural sub-sectors.

A commonly used tool among more digitally engaged farmers is the AgroSens platform, which provides real-time data on weather, soil conditions, and crop growth. By offering real-time data, the AgroSens platform enables farmers to adopt sustainable practices such as precise irrigation, targeted pest control, and informed crop rotation, which collectively reduce environmental impacts. All these services are offered free of charge to farmers. As one focus group participant remarked: *"AgroSens is incredibly helpful for monitoring crop health, especially for larger-scale fruit growers who rely on this information for decision-making."* Another participant remarked: *"Such tools are more popular among farmers with larger farms who are more comfortable with digital technology."*

Social media also plays a vital role, with platforms like Viber and Facebook groups providing farmers with essential channels for marketing and community-building. The discussion highlighted the importance of groups such as *Small Food Producers in Serbia,* which serves as both a marketplace and a forum for advice and information sharing. According to one of the contributors: *"Farmers use these groups to learn from each other and share knowledge about farming practices."* This community-focused use of social media illustrates the growing reliance on informal digital networks for knowledge exchange among small farmers.

Several participants emphasised the need for digital tools to be both user-friendly and accessible to support food security efforts. As one participant pointed out: *"If these technologies are simple to use and affordable, more farmers will adopt them, which could help us improve food security."* Gender differences in digital adoption also surfaced in the discussions, with women in the farming community showing a higher tendency to adopt smartphone applications and other accessible digital tools. The focus group findings emphasise the importance of incorporating a gender-sensitive approach in digital skills training, as women may play a crucial role in applying technology for sustainable farming.

The role of policy in supporting digital transformation among smallholders was also highlighted. In the words of one participant: *"Policy support is crucial; without financial incentives and guidance, digital adoption among small farms will remain limited."* Another perspective highlighted the need for a strategic policy focus: "*Strategic policies that integrate sustainability goals into digital transformation efforts are critical. It's not just about giving farmers technology, but about creating an ecosystem that supports digital tools and knowledge transfer."* These participants emphasised the importance of both technological and policy support to make digital transformation accessible for small-scale farmers.

Together, the desk review and focus group findings suggest that the application of digital technology among smallholders in Serbia is at a low level, compared to highly developed countries. Although some variations appear regarding interest in digital adoption, many farmers in Serbia underutilise the potential of these tools for advancing sustainable agricultural practices. Additionally, a prevailing perception that ICT that is not essential for small-scale operations further impedes progress. Consequently, understanding the link between technological adoption and the realisation of smart, resilient farming practices remains largely beyond the vision of most small farmers. Insufficient governmental support for the broad implementation of digital technology in agriculture, it was said, is aggravating these challenges.

2.4.2 Skills gaps and knowledge transfer

Limited digital skills among the majority of farmers, compounded by the scarce availability of tailored educational programmes, represents a significant barrier to digital innovation in agriculture (Čikić et al., 2022; Agronews, 2024).

As highlighted in the earlier sections, a growing body of research highlights the necessity for farmers to develop basic digital skills, including the use of smartphones, computers, and internet-based platforms to effectively access critical information, engage with market systems, and utilise available institutional support. These skills are seen as crucial for farmers to make data-driven decisions that enhance sustainability and economic efficiency (Vukadinovic et al., 2022; Vapa Tankosić et al., 2024). Older farmers, however, who dominate in Serbia, are often unfamiliar with computers and mobile applications. This in turn, reduces their willingness and ability to adopt new technologies effectively (Ilić-Kosanović et al., 2019; Čikić et al., 2022).

At the same time, social media and digital marketing skills are increasingly recognised as essential among farmers engaged in direct-to-consumer sales, highlighting another crucial area where digital competencies can enhance economic opportunities and green agricultural practices. Studies from Serbia document how small farms successfully utilise platforms such as Facebook and Instagram to promote and sell products, particularly in regions with short food supply chains (Sljukic et al., 2021; Dasic et al., 2022). This is corroborated by other researchers (Abdulai et al., 2023) who identify that factors such as familiarity with mobile platforms and online agricultural resources are crucial for participation in digital services. The authors also point out that even the acquisition of these digital skills remains challenging for many farmers.

The desk review further highlighted a significant digital skills gap on small farms, particularly around the use of advanced digital tools for farm management and resource optimisation. These skills serve small farmers to monitor their productivity and make informed decisions (Ilic-Kosanovic, 2019).

Recent survey research in Serbia indicates that under 50% of respondents currently use digital technologies, and many are unfamiliar with new technology applications in agriculture (Kovljenic et al., 2023; Cikic et al., 2022). Additionally, over 50% of respondents had not received any training related to digital technology in agriculture, emphasising the critical need for accessible training programmes (Kovljenic et al., 2023; Čikić et al., 2022). The same survey reported that the main limiting factors for the use of digital technology in agriculture are lack of education and training (Kovljenic et al., 2023). Another study found similar results, with 63% of surveyed farmers reporting no formal education or training in digital technology adoption (Čikić et al., 2022).

Research further indicates that farmers often face significant time constraints that hinder their ability to fully engage in acquiring new skills or learning about new farming practices (Nikolic et al., 2022). As a result, they miss opportunities to improve economic efficiency and achieve better agricultural outputs.

Support and guidance are, in this regard, critical gaps. Farmers who wish to adopt digital skills frequently lack access to specialised advice and support needed for successful skills adoption (Čikić et al., 2022). Agricultural advisory services or technical support personnel are often scarce and lack sufficient training in digital technologies, limiting their effectiveness in assisting farmers with digital skills enhancement (Agronews, 2024; Dasić et al., 2022).

As a follow-up to the skills gaps identified in the desk research, one of the recurrent themes among focus group participants was the pressing need for practical, hands-on training programmes tailored specifically to smallholder farmers. Participants pointed out that existing training programmes are often too theoretical, focusing on broader agricultural principles rather than specific digital skills or tools. As one of them highlighted: *"Farmers do not need to learn about big agricultural trends; they need someone who can sit down with them and show them how to make the most of what's available"*. This was further emphasised by the comment: *"Tailored training should also integrate sustainability principles, for example, techniques that reduce chemical inputs, optimise irrigation, promote soil conservation, etc.".*

The focus groups' participants expressed the importance of peer learning and community-driven knowledge sharing, seeing it as an effective way to transfer knowledge and reduce the skills gap in digital technology use. According to their views, peer learning can also spread knowledge about sustainable practices like organic farming, renewable energy use, or environmentally friendly pest control. One focus group participant observed: *"When a farmer sees another farmer using a new tool successfully, he is more open to trying it himself. Farmers trust each other's experiences more than what is heard in formal training."* Another echoed this sentiment, noting that peer exchanges provide a sense of reassurance: *"If a farmer can ask someone from his own network who's using the same technology, it feels more achievable."* This sense of community trust and shared experience suggests that peer-led workshops or mentorship programmes could be instrumental in promoting digital tool adoption on small farms, particularly in regions where formal training may be less accessible.

Focus group participants further emphasised the need for localised, customised training that takes into account the unique contexts of different farming operations and regions. As one participant explained: *"Training needs shall be adapted to what farmers actually grow and the challenges they face. They need training that is tailored to their specific needs."* In the words of another participant: *"Small-scale grain farmers have different training needs than beekeepers or vineyard owners. Tailored programmes would make the training more applicable."* It was also highlighted that small farms have very different needs compared to large-scale commercial operations, particularly regarding crop types, land size and resource availability. This feedback highlights the potential benefits of specific training initiatives that not only address digital skills, but also tailor lessons to the unique agricultural practices and economic conditions of farm type and size.

Digital literacy was widely recognised as a critical issue, particularly for older farmers. Many participants agreed that training programmes should focus on the basics, such as mobile-friendly solutions, since smartphones are more accessible than computers for those working on small farms. *"Many farmers don't have a computer but have a phone. If they could just be shown how to use it for more than calls, that would be helpful,"* said one participant. Others echoed this view, stressing the need for introductory training that focuses on the basics, such as navigating mobile apps, finding weather information, and accessing market prices. As suggested by one participant: *"Even if farmers are just shown how to check prices online or manage a calendar, it would already be a big step."* These testimonies highlight the importance of designing training programmes that are not only accessible, but also aligned with the technologies farmers already have.

A recurring theme was the critical role that agricultural advisors and support staff could play in bridging the knowledge gap, if adequately trained. Many participants pointed to the need to accelerate the advisers' training in the knowledge transfer of digital skills. Equipping agricultural advisors with more robust digital skills training would create a support network for farmers, enabling consistent and reliable guidance. *"If we the advisors had more training in digital tools, we could be their first point of contact, and that would make a big difference,"* one participant highlighted.

Additionally, focus group participants recognised the value of cooperatives, and vocational schools as training hubs. These institutions, they argued, could provide both essential digital literacy and sector-specific guidance. This approach aligns with the concept of rural digital ecosystems, where localised training infrastructure plays a crucial role in promoting technology adoption in remote areas.

Finally, participants spoke about the potential of younger generations to drive the adoption of digital skills and technologies on family farms. Several participants acknowledged that their children or younger relatives were more comfortable with technology and could act as key facilitators of knowledge transfer. *"Younger farmers know more about computers and phones, so they help others understand how to use the technology"*. This generational approach to knowledge transfer shows the importance of engaging young people in agriculture as digital ambassadors, both to reduce the skills gap and to ensure the sustainable adoption of new technologies in family farms.

Together, the desk review and focus group findings suggest that addressing the digital skills gap requires not just general digital training, but also targeted support focused on using agricultural technologies. Participants consistently emphasised the need for accessible, hands-on training programmes that offer practical, immediately applicable guidance rather than general agricultural

theory. Peer learning and mentorship were also identified as instrumental in bridging the skills gap. The primary required skills – such as smartphone use and internet navigation – are crucial for small farms to make informed decisions that improve sustainability and productivity. Focus group participants strongly advocated for community-based and segmented training approaches, calling for user-centred solutions that meet the specific needs of different farm types and demographics.

In conclusion, the combined insights from the desk research and focus groups reveal that bridging the digital divide in Serbian agriculture will require a holistic strategy that incorporates accessible, customised training, community-based knowledge sharing, and the engagement of younger generations.

2.4.3 Drivers of digital adoption among smallholder farmers

The adoption of digital tools in agriculture is significantly influenced by various economic, social and structural factors. Research highlights several critical drivers and inhibitors shaping farmers' decisions to invest in training and adopt digital solutions. Studies conducted in Serbia align closely with international trends, revealing shared themes in technology adoption among small-scale farmers. The most significant motivator is the clear economic benefit that these technologies bring, such as increased yields or reduced input costs. Farmers are more likely to adopt new solutions if they can see tangible, immediate improvements in productivity and profitability (Mori et al., 2021; Ilic-Kosanovic et al., 2019). As Mori et al. (2021) reveal, farmers are particularly influenced by solutions that deliver "quick wins" and provide clear evidence of financial returns. Conversely, costs of digital tools pose a substantial barrier, particularly for advanced technologies. For smallholders, the cost of equipment such as drones, sensors, or GPS-guided machinery is often prohibitive, if the return on investment is not immediately apparent (Tagarakis et al., 2018; Vukadinovic et al., 2022). In contrast, simplified tools that require minimal training and demonstrate quick financial returns serve as significant turning points for adoption (Mori et al., 2021; Nikolic et al., 2024). Farmers are more inclined to embrace new technologies when they perceive them as user-friendly and directly applicable to their needs (Čikić et al., 2022).

In addition to economic factors, farming tradition and cultural attitudes also influence skills acquisition for technology adoption. Traditional agricultural practices are deeply ingrained in many rural communities, leading to a strong resistance to change and weak appeal of digitalisation (Čikić et al., 2022).

Among the key motivators for digital adoption in agriculture is the support provided by government programmes, which play a critical role in curtailing financial and technical barriers through subsidies, training initiatives, and infrastructure development. Government-backed policies and subsidies further enhance adoption rates by reducing the perceived risks of unfamiliar technologies (Mori et al., 2021; Nikolic et al., 2024). Comparative studies show that some EU countries and the USA have successfully accelerated digital transitions through government support, research investment, and tailored training programmes (Dimitrijevic, 2023). While government subsidies, such as those to be provided through Serbia's eAgrar platform, are a step in the right direction, the literature suggests that these financial supports need to be more widely accessible and better communicated to farmers. Serbia requires more robust policies and financial support to bridge the gap and realise the full potential of technological advancements in agriculture (Dimitrijevic, 2023).

Expanding on these findings, the focus group discussions offered insights into factors influencing technology adoption among smallholder farmers. The complexity of technology, associated with the time required for its mastering, were frequently identified as primary barriers to the adoption of digital tools in agriculture. One participant noted: *"For many farmers, especially the older generation, these tools are too complicated and time-consuming to learn."*

The cost of digital tools emerged as another significant concern among focus group participants. They emphasised that the high expenses associated with advanced digital tools and systems remain a prohibitive barrier to adoption. Participants further noted that the perceived benefits of new technologies are often seen as abstract or indirect. As highlighted in the discussion: *"Farmers want to see immediate results – like higher yields or lower costs – not just a promise of future gains."* Digital

tools that demonstrated these practical benefits were more favourably considered, suggesting that any digital intervention must have a practical orientation to allow farmers to observe the benefits firsthand. Sustainability and environmentally sound practices, while recognised as important, have not been perceived as standalone motivators for the adoption of digital tools in agriculture. One focus group participant noted: *"Regenerative agriculture is not the main reason farmers adopt digital tools. For most, it's about saving costs and increasing productivity first".* Participants also highlighted the need for government financial incentives as crucial steps to lowering the entry barriers to digital tools. One participant remarked: *"If the government could support training and offer subsidies, more farmers would be willing to try these technologies."*

Finally, focus group discussions touched on the social and cultural barriers that may inhibit technology uptake, such as community resistance to change or intergenerational knowledge gaps. One participant remarked: *"There's still a lot to learn about how these social dynamics play out in the adoption of digital tools."*

Together, the desk review and focus group findings suggest that the adoption of digital tools in agriculture is shaped by a complex interplay of economic, social and structural factors. While economic benefits such as increased productivity and cost savings serve as the primary motivators for adoption, significant barriers persist, including high costs, technological complexity, and resistance to change rooted in traditional practices. Government support, through subsidies and tailored training programmes, emerges as a critical enabler, yet such efforts in Serbia remain insufficiently accessible and under-communicated. The findings underscore the importance of practical, user-friendly tools and financial incentives in driving adoption, while also highlighting the need to address cultural resistance and intergenerational knowledge gaps to facilitate a broader digital transformation in agriculture.

2.5 Discussion and conclusion

The adoption of digital technology among smallholder farmers in Serbia remains significantly lower compared with highly developed countries. Despite the transformative potential of digital technologies to enhance agricultural sustainability and productivity, their application is underutilised. While digital tools hold the potential to improve agricultural efficiency, enhance sustainability, and provide a competitive edge in the market, these advantages remain largely inaccessible to many small-scale farmers in Serbia.

The findings reveal the presence of multiple, inter-related barriers that impede effective integration of digital technologies into small-scale farming.

One of the most pervasive barriers to digital adoption is the perceived high cost of acquiring and maintaining both basic and advanced digital tools. Technologies such as GPS-guided machinery, drones and sensors require substantial financial investments, which are often prohibitive for small-scale farmers. Even when farmers recognise the potential benefits of digitalisation, the immediate financial risk often outweighs the long-term advantages, especially in a sector vulnerable to market fluctuations and environmental unpredictability. These economic constraints are compounded by the perception of digital tools as high-risk investments with uncertain returns, particularly among older farmers who are less inclined to adopt unfamiliar technologies. These findings are consistent with international research, which highlights affordability as a critical determinant of technology adoption. Without tangible financial support mechanisms such as subsidies, tax credits or low-interest loans, smallholders face significant challenges in transitioning to digital agriculture.

The lack of digital literacy among small farmers presents another significant barrier to technology adoption. While access to smartphones and internet connectivity is gradually improving, many farmers lack the skills required to navigate these tools effectively. Moreover, social media and digital marketing skills emerged as a significant focus area, particularly for farmers engaged in direct-to-consumer sales. Yet, the research indicates that the interest in utilising digital marketing is overshadowed by a lack of the skills necessary to maximise the social media platforms' potential.

This skills gap is consistent with findings from other regions where digital illiteracy disproportionately affects smallholders. Findings emphasised the need for practical, hands-on training programmes that teach specific applications, such as using mobile apps for weather forecasting, market analysis and farm management. Customised, community-based training initiatives were also highlighted as important for aligning content with the specific needs of various farming operations. For example, grain farmers may benefit from training on precision planting technologies, while beekeepers may focus on hive monitoring systems. Furthermore, training programmes should prioritise mobile-friendly solutions, as smartphones are more prevalent than computers among smallholders, particularly among older ones. Engaging younger generations as digital ambassadors could further facilitate knowledge transfer, leveraging their familiarity with technology to bridge the skills gap. Encouraging the adoption of digital tools by women farmers can also drive sustainability initiatives, as they are often key decision-makers in implementing environmentally friendly practices at the household and community levels.

The important role of the national agricultural advisory services in providing knowledge transfer to small farmers was particularly emphasised. Focus group participants advocated for equipping agricultural advisors with robust digital skills, enabling them to act as first points of contact for farmers seeking assistance and knowledge. This approach would not only build farmers' confidence in using digital tools, but also ensure consistent support throughout the adoption process.

Social and cultural dynamics also play a critical role in shaping farmers' attitudes towards technology adoption. Traditional agricultural practices remain deeply ingrained in many Serbian farming communities, leading to resistance to change. Older farmers often perceive digital tools as complex and unnecessary, which is further exacerbated by intergenerational knowledge gaps. Peer learning and mentorship have emerged as effective mechanisms to overcome these social and cultural barriers. Farmers are more likely to trust and adopt technologies when they see their peers using them successfully. In this regard, community-based knowledge-sharing initiatives, farmer cooperatives, or the like, can create a supportive environment for peer learning for technology adoption. These initiatives should emphasise the observable, practical benefits of digital tools, such as increased yields or reduced input costs, to build confidence and reduce scepticism. In addition to offering targeted skills development, localised training initiatives could strengthen community ties that facilitates ongoing knowledge exchange. Additionally, incorporating gender-sensitive approaches can enhance engagement, as women in rural farming communities have shown greater openness to adopting accessible digital tools.

Limited digital infrastructure in rural areas further exacerbates the challenges associated with technology adoption. While urban areas in Serbia enjoy relatively high internet penetration, rural regions remain underserved, creating a digital divide that restricts smallholders' access to technology-driven solutions. Addressing these disparities requires government investment in rural broadband and other digital infrastructure to ensure equitable access.

A notable gap identified in the findings is the underutilisation of digital tools to advance sustainable agricultural practices. While digital technologies have the potential to optimise resource use, reduce waste, and enhance environmental stewardship, these benefits remain underexplored among Serbian farmers. These tools are rarely adopted because of their perceived complexity and cost. Training programmes should explicitly highlight the sustainability benefits of digital tools, framing them as solutions to environmental challenges. Demonstrating how digital tools can reduce water waste, minimise chemical inputs, and improve soil health could motivate farmers to integrate sustainability into their decision-making processes.

The combined insights from desk research and focus group discussions emphasise the need for an integrated, multifaceted government approach to bridging the digital divide in Serbian agriculture. Financial incentives, including subsidies and tax credits, play an important role in motivating farmers to adopt digital tools. Programmes such as Serbia's eAgrar platform represent initial efforts to provide financial assistance, but these initiatives must be scaled and better communicated to ensure broad accessibility. Lastly, investments in rural broadband and other digital infrastructure are critical to ensuring equitable access of small farmers to digital technologies.

By addressing these interconnected barriers, Serbia can enable smallholders to become digitally literate, and technologically equipped, not only improving productivity and economic resilience, but also fostering environmental sustainability. This integrated approach has the potential to align Serbia's agricultural practices with global sustainability and development goals, ensuring the sector's long-term viability and competitiveness.

The research reported on here serves as a pilot, laying a foundation for the next phase that will engage a broader spectrum of agricultural producers and consider a wider range of variables. It is anticipated that subsequent steps will not only provide more robust understanding of the digital literacy needs among agricultural producers, but will also drive meaningful advances in green and digital agriculture, supporting sustainable development across the sector.

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CHAPTER 3: Green jobs, skills needs and skills gaps in the green economy: Evidence from Lebanon and Tunisia

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3.1 Introduction

In the last decade, the notion of green economy has aroused major interest among politicians, economists, environmentalists and the wider public. From a broad point of view, the green economy is perceived as a means to reach the UN Sustainable Development Goals (SDGs). In the specific case of Lebanon and Tunisia, two developing countries, the transition to a green economy should help address the economic, social and environmental challenges that both countries face. This paper aims to analyse the skills gap related to green jobs in Lebanon and Tunisia.

Lebanon's economy is service-oriented, with major sectors including banking, tourism and trade. Agriculture and industry also contribute but to a lesser extent than services. Lebanon grapples with issues like water scarcity, waste management and pollution. Additionally, political instability and economic crises have complicated environmental management. The Lebanese government has initiated various programmes aimed at renewable energy (solar and wind), water conservation and waste management. However, political instability often hampers consistent policy implementation.

Tunisia's economy is diverse, with significant contributions from agriculture, manufacturing, mining and tourism. Like Lebanon, Tunisia faces environmental challenges such as water scarcity, desertification, and pollution, which have driven the need for green jobs and sustainable practices. The Tunisian government has been proactive in promoting renewable energy, particularly solar power, and implementing policies to support sustainable development and green job creation.

However, one of the most important challenges to greening the economy in the two countries involves meeting skills needs. Because of the urgency of transforming energy consumption patterns and production practices, the transition to a greener economy urgently requires the acquisition of new skills, either to progress in current jobs that need to be adjusted, or to access emerging jobs. Training in these new skills will be one of the main keys to the success of the ecological transition. Without a properly trained workforce, the transition cannot succeed. While some research has addressed the topic of potential jobs in the green economy in Lebanon and Tunisia, the question of the potential skills gap related to these jobs is still under-researched. Such an analysis is crucial for both countries, and will be helpful for job seekers to identify potential jobs in the green economy and for policymakers to develop their labour market policies or training strategies related to the green economy.

There is still a lack of clear definitions and consensus across countries on the terms 'green economy', 'green jobs' and 'green skills', leading to various interpretations and applications. Nevertheless, for the purposes of our study, we adopt the following comprehensive definitions for these terms:

Green economy is the shift from conventional economic paradigms towards building sustainability, environmental consciousness and social inclusivity (Schulz and Bailey, 2014). It focuses on aligning economic growth with environmental welfare, recognising the interdependence of human wealth and ecological prosperity (Fiorino, 2018).

Green job is broadly defined by UNEP (2008) as any decent job, whether in agriculture, industry, services or administration, that helps preserve or restore the quality of the environment. Two categories of jobs play crucial roles in supporting the green economy: ***green jobs*** and ***greening jobs*** which we both consider in our study. *Green jobs* refer to entirely new roles created by the green economy, directly contributing to environmental sustainability through activities such as renewable

energy production, energy efficiency and waste management. These jobs emerge as economic sectors innovate and adapt to environmental needs. In contrast, *greening jobs* involve traditional occupations that have been modified to incorporate green tasks, ensuring they align with sustainability goals. Together, these job categories reflect the dynamic nature of the workforce as it evolves to meet the demands of the green transition.

Finally, ***green skills*** are defined as the knowledge, abilities and competencies individuals acquire to perform activities aimed at ensuring environmental sustainability and supporting the goals of a green economy (Pavlova, 2018). The five key categories of green skills essential for supporting the transition to a sustainable economy are: Technical Proficiency in Sustainable Practices, which involves knowledge of clean technologies and eco-friendly methods; Interdisciplinary Knowledge, which emphasises the integration of environmental, economic and social dimensions; Adaptability and Innovation, highlighting the capacity to respond creatively to evolving sustainability challenges; Resource Management and Conservation, focusing on the efficient use of resources and the application of circular economy principles; and Communication and Stakeholder Engagement, which underscores the ability to advocate for and collaborate on sustainability initiatives.

This paper is structured as follows. Section II gives an overview of drivers of green jobs and skills in Lebanon and Tunisia, Section III presents the methodology of the study, and Section IV analyses the demand in terms of green jobs and the supply in terms of green skills in both countries. In Section V, we study the emerging skills gaps, and finally, Section VI concludes the text and gives some policy recommendations.

3.2 Drivers of green jobs and skills in Lebanon and Tunisia

Lebanon and Tunisia are both actively engaged in green transitions, sharing a common vision of sustainable development while facing challenges shaped by their unique structural and economic characteristics. Both countries recognise the importance of green jobs in driving sustainable growth, with key sectors such as renewable energy, water management, waste management, construction, agriculture and manufacturing offering significant potential for job creation. Renewable energy, particularly solar, is a priority for both nations due to their abundant sunshine, and both emphasise water management and conservation in response to water scarcity. Waste management and recycling are also critical in both Lebanon and Tunisia to address pollution and urban waste issues, making these sectors vital for green job creation.

However, significant differences exist in the scale and emphasis of these efforts. Tunisia's agricultural sector is far more substantial than Lebanon's, playing a central role in its economy with a strong focus on sustainable farming practices and soil conservation. Agriculture contributes 9% to Tunisia's GDP and employs 15% of the workforce, while in Lebanon, agriculture holds less prominence. Tunisia has positioned itself as a leader in organic agricultural exports, particularly olive oil and dates, with organic farming considered a strategic sector for job creation. Lebanon's agricultural focus is narrower, targeting sustainable farming and regenerative practices to restore soil fertility and biodiversity. Both countries share concerns about water usage in agriculture, with Tunisia emphasising integrated water management systems to reduce wastage and Lebanon addressing similar inefficiencies.

In the renewable energy sector, both countries have adopted ambitious plans to increase the share of renewables in their energy mix, aligning with international frameworks such as the Paris Climate Change Agreement (2016) and the UN 2030 Agenda for Sustainable Development. Lebanon's Lebanese Solar Energy Plan (LESP) aims to achieve 30% renewable energy by 2030, while Tunisia's Tunisian Solar Plan (TSP) targets the same renewable energy share in electricity production by 2030. These plans highlight the shared importance of solar and wind resources in green job creation. However, Tunisia's industrial base provides greater opportunities for local production of renewable energy systems, which could create up to 30,000 jobs, whereas Lebanon remains more reliant on imported systems due to financial and institutional constraints. Both countries face challenges in financing and implementing renewable energy projects, with delays caused by political instability in Lebanon, and technical and communication-related challenges in Tunisia.

Water management and waste recycling are shared priorities, with both countries recognising the importance of integrated systems to address water scarcity and urban waste. Recycling and waste-to-energy initiatives are essential in tackling increasing waste complexity, aligning with SDG 12 (Responsible Consumption and Production) and SDG 6 (Clean Water and Sanitation). Tunisia's waste management sector has incorporated broader circular economy practices, while Lebanon's efforts focus more narrowly on urban waste management and innovative recycling technologies. In both countries, the waste sector presents opportunities for job creation through advanced recycling and sustainable waste management practices.

Despite these similarities, distinct economic and policy challenges shape the trajectories of green job development in each country. Lebanon has implemented national initiatives, such as the National Energy Efficiency Action Plan (NEEAP) and the CEDRO Projects, which aim to promote energy efficiency and renewable energy adoption. However, Lebanon's policy implementation has been hindered by political instability and limited institutional capacity, leaving gaps in achieving its renewable energy targets. Tunisia has implemented national strategies such as the National Strategy for the Green Economy (2016–2036), which outlines sectoral objectives and identifies potential for green job creation across various industries. The implementation of this strategy is expected to generate over 260,000 jobs, 200,000 of them permanent. Agriculture accounts for 38% of these potential jobs (Ministry of Local Affairs and the Environment Report 2016).

Both countries face challenges in closing the green skills gap, which is critical for meeting the demands of the growing green economy. In Tunisia, the ETF (2022) study on future skills in the energy sector highlights the need for expertise in renewable energy technologies, grid integration and energy efficiency optimisation. Similarly, Lebanon's renewable energy sector has created demand for skilled professionals such as solar engineers, wind energy specialists, and technicians for installation and maintenance. Vocational training and educational programmes are essential in both countries to equip the workforce with the skills needed for green jobs, particularly in renewable energy and sustainable construction.

Small and medium-sized enterprises (SMEs) play a critical role in the economies of both countries, yet they face significant barriers to participating in the green transition. In Lebanon, financial and institutional challenges limit the ability of SMEs to adopt green practices and contribute to green job creation. A similar situation exists in Tunisia where SMEs, which make up over 90% of firms, often lack access to incentives such as subsidies, credit lines and specific funds. Proactive policies are needed in both countries to support these enterprises, particularly in areas such as waste management, energy efficiency and organic farming.

While similarities in green job priorities and challenges reflect shared commitments to international sustainability frameworks, differences in sectoral strengths, economic structures and institutional capacities define the unique trajectories of Lebanon and Tunisia. It is recommended that both countries address their specific challenges while leveraging their respective strengths to advance their green transitions and contribute to global sustainability goals.

3.3 Methodology

In this paper we applied the following four steps to analyse the skills gap related to green jobs in both countries:

- Identification of green jobs demand: based on a documentary analysis of national documents and the usage of Occupational Information Network (O*NET) taxonomy of green jobs.
- Identification of green skills supply: analysis of existing public training programmes and courses in higher education and TVET, which corresponds to the green jobs identified above.
- Comparison and matching of demand with supply: a qualitative analysis of green skills gaps based on the main green areas in demand and supply.

- Performing an online survey of individuals working in green sectors: a sample of 100 employees (including recruiters) in each country who are considered to be in the green sectors and jobs, based on their LinkedIn profiles.

Below is an explanation of each step.

3.3.1 Identification of green jobs demand

For the identification of green jobs, a documentary analysis has been used to clarify requirements for what constitutes a green job. A number of local documents, classification frameworks and international taxonomies of green jobs have been used for each country. Ensuring that the country's classification aligns with international standards was crucial for consistency and recognition.

Two taxonomies are often used for jobs classification: the Occupational Information Network (O*NET) taxonomy of green occupations[11]; and the European Standard Classification of Occupations (ESCO) developed in 2022. The latter has the advantage of providing detailed descriptions of the tasks as well as the skills required by jobs. Nevertheless, it does not deal exclusively with the green sector, making its handling within the framework of our study less easy than that of the O*NET database. ***Therefore, this paper uses the O*NET taxonomy to identify potential green and greening jobs in Lebanon and Tunisia.***

The O*NET approach provides a comprehensive system for classifying and analysing occupations, including green and greening jobs. It uses a detailed taxonomy to identify the skills, tasks and knowledge required for various professions. To ensure relevance and accuracy, O*NET is regularly updated by integrating data from labour market trends, expert input and surveys, allowing it to keep pace with evolving job roles in emerging sectors. The system is dynamic, continuously reflecting changes in workforce needs, technological advancements, and legislative requirements that influence job definitions.

O*NET categorises green jobs into three types: (i) ***Emerging green jobs***, created in response to the greening of the economy, focus on environmental preservation; (ii) ***Green enhanced skills jobs***, while not new, have significantly changed as green technologies and materials have reshaped tasks, skills, and knowledge requirements, such as the evolving role of architects in energy-efficient building design; and (iii) ***Green increased demand jobs*** have not undergone significant transformation but are more sought after due to the economy's greening, such as power line installers whose roles are vital for infrastructure upgrades. In the present study, we focus only on the two first types which we call respectively ***green*** and ***greening*** jobs.

In addition to the O*NET taxonomy, local documentations have been used in each country:

In Lebanon:

Guidelines from global bodies such as the International Labour Organization (ILO) and the United Nations Environment Programme (UNEP) are used for defining and promoting green jobs as other international standards. In terms of local guidelines, we worked with the Ministry of the Environment and other relevant governmental bodies in Lebanon[12] to adapt these international standards to local contexts.

In Tunisia:

The Tunisian Directory of Professions and Skills (RTMC, 2018 version) developed by the National Agency for Employment and Self-Employment (ANETI). This document includes 14 major domains of the Tunisian economy, bringing together 109 professional domains and 512 job descriptions (in all fields).

[11] https://www.onetcenter.org/reports/GreenTask.html
[12]The Ministry of Energy and Water, The Central Administration of Statistics, The National Employment Office, Lebanese Environment Forum, Greenpeace MENA, Society for the Protection of Nature in Lebanon.

The Directory-guide of the potential of green jobs in Tunisia (RGPEVT) elaborated by the Ministry of Local Affairs and Environment in 2017[13], including potential green jobs by governorate and by economic region for the sectors of agroforestry, ecotourism, renewable energy, energy efficiency, waste management and recovery.

The National Strategy for Disaster Risk Reduction by 2030[14] published by the Ministry of the Tunisian Environment and The National Low-Carbon Development Strategy (SNBC), Horizon 2050[15].

Following this approach, we have developed a comprehensive classification of green and greening jobs in both countries.

3.3.2 Identification of green skills supply

For the identification of green skills supply, we focused in particular on training programmes and courses related to the green field. The analysis was limited to the existing programmes and courses in higher education and vocational training. Data on existing training programmes in both countries are gathered from the Ministry of Higher Education and the Ministry of Education and Vocational Training, using official information (documents, websites, ...).

Several training programmes and diplomas are identified that provide courses or skills related to green fields or sectors, and allow students to practice green jobs. Each training or diploma is described according to the domain of activity (sector), the corresponding educational level, and the courses offered within the training or diploma, in order to be able to match them with the corresponding job identified in the demand part.

3.3.3 Comparison and matching of demand with supply

In this step, we match the green jobs demand with the green skills supply in order to check whether the provision of existing training in Lebanon and Tunisia could meet needs in terms of green jobs and skills, and if the workforce in both countries is adequately prepared for the green transition process. First, this required mapping the jobs identified in the first step (green jobs demand) to the required types of training and diplomas. Then, jobs were matched with the corresponding diploma(s) from the list of training and degrees offered by higher education and vocational training related to green skills (green skills supply). Our objective here was to check if the required training programme for the identified occupation exists. Note that our study analyses qualitatively the green skills gap, and does not intend to quantify the gap in terms of number of graduates for potential green jobs. This would require more sophisticated projections and simulations, which is beyond the scope of this study.

3.3.4 Online survey with individuals working in green sectors

In order to further investigate the skills gap related to green jobs, an online LinkedIn survey was carried out in both countries during May-June 2024. The survey targeted people working in green or greening jobs in Lebanon and Tunisia. Sectors and jobs identified in the jobs demand analysis were the main criteria of sampling for each country. Indeed, they were used as inputs for the survey to improve the quality and representativeness of the data to be collected.

The sampling method was designed to get a representative sample of green sectors and jobs identified in the demand part as much as possible. For this, we used the information provided on members' profiles, such as job titles, sectors, or fields of study. In total, a sample of 100 employees from different sectors and jobs, including managers and owners of companies as the recruiters was selected for each country. The questionnaire included questions about the educational level of the worker, their qualifications, as well as any difficulties they faced in performing the tasks required by

[13] https://scid.tn/images/2020/document/cinquime_guide_potentialits_Edition_2017_1.pdf
[14] http://admin.environnement.gov.tn/fileadmin/Bibliotheque/Environnement_en_Tunisie/strategie_nationale_de_reduction_Finalise.pdf
[15] https://cc-tunisie.com/strategie-bas-carbone/ FICHE-SECTORIELLE-AFAT-SNDNC-RCC2050.pdf

their job. From the manager's side, questions focused on the difficulties in finding the requested profile for the offered position.

3.4 Results of the green jobs demand and skills supply analysis

3.4.1 Analysis of green jobs demand in Lebanon and Tunisia

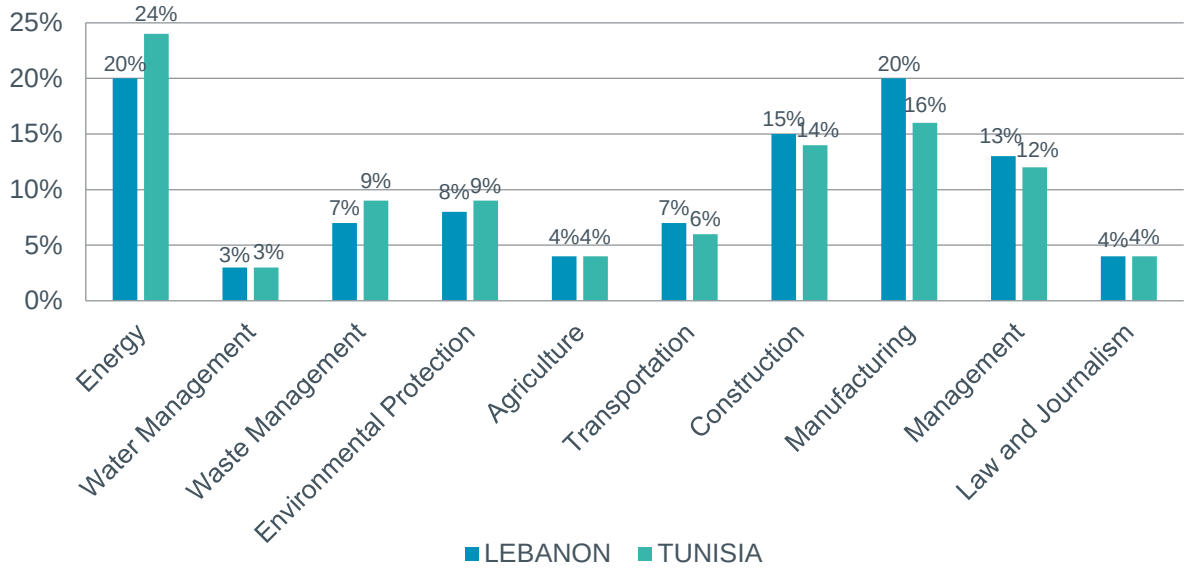
This section presents the results of the identification of green jobs demand (following the methodology described in 3.3.1) for both countries.

Table A in the appendix presents, for Lebanon and Tunisia, the identified jobs and their details (the activity sector, specific job title, type (green/greening), and key tasks associated with the job). This table serves as a comprehensive reference for green and greening jobs in both countries, detailing the necessary qualifications and aligning them with relevant sectors. Most of the jobs are in line with local guidelines and the O*NET database's taxonomy of green occupations, while a few others are exclusively taken from the O*NET database because they match with the Lebanon and Tunisian environmental strategies. We choose the job appellations proposed by O*NET because they are subject to a certain consensus at the international level, and are close to or even the same as those used in the local documents. Finally, a total of 92 potential green and greening jobs in Lebanon and 101 in Tunisia have been identified, highlighting that compared to Lebanon, the greening of the Tunisian economy has had a stronger impact on the demand for green and greening jobs.

Figure 1 summarises the output of Table A. ***In both countries,*** 8 main sectors have been identified for potential green jobs, including energy, water management, waste management, environmental protection, agriculture, transportation, construction and manufacturing. In addition, two transversal areas of occupations have been identified that are common to several green and greening areas, and support green activities: management; and law and journalism.

In both countries, 3 sectors present a great potential for green jobs: the energy sector with 20% of existing or potential green jobs in Lebanon and 24% in Tunisia; the manufacturing sector (with respectively 20% and 16% of green jobs in Lebanon and Tunisia); and the construction sector (with 15% and 14% of total green jobs respectively). Likewise, transversal jobs (in management, and law and journalism) that cut across all economic fields are affected by this green transition, corresponding to 17% of this demand in Lebanon and 16% in Tunisia. Comparing the two countries, we can notice that ***Tunisia*** presents a higher demand for green jobs than Lebanon in sectors directly linked to the environment, particularly in energy which presents the greatest potential in terms of green jobs in the country. Meanwhile, ***Lebanon*** has a higher demand outside these traditional sectors, particularly in manufacturing, construction and transportation.

Figure 1: Green demand by activity sector



Looking at the distribution of green and greening jobs by activity sector (Figure 2), we can notice that the energy sector is the one with the highest share of green jobs in both countries, representing 29% and 31% of total green jobs respectively in Lebanon and Tunisia. This is essentially due to the 2030 strategy adopted by the two countries to reduce their carbon footprint and ensure a transition to cleaner energy. Construction accounts for 32% of greening jobs in both countries. Indeed, the content and requirements of jobs in this sector are changing with the emergence of new eco-friendly materials, new regulatory requirements in terms of energy management, and the preservation and development of green spaces. Manufacturing also offers a large potential demand for greening jobs, mainly ***in Lebanon***, where the share of employment in total greening jobs (22%) is twice that of Tunisia (11%).

Figure 2: Distribution of green jobs and greening jobs by activity sector

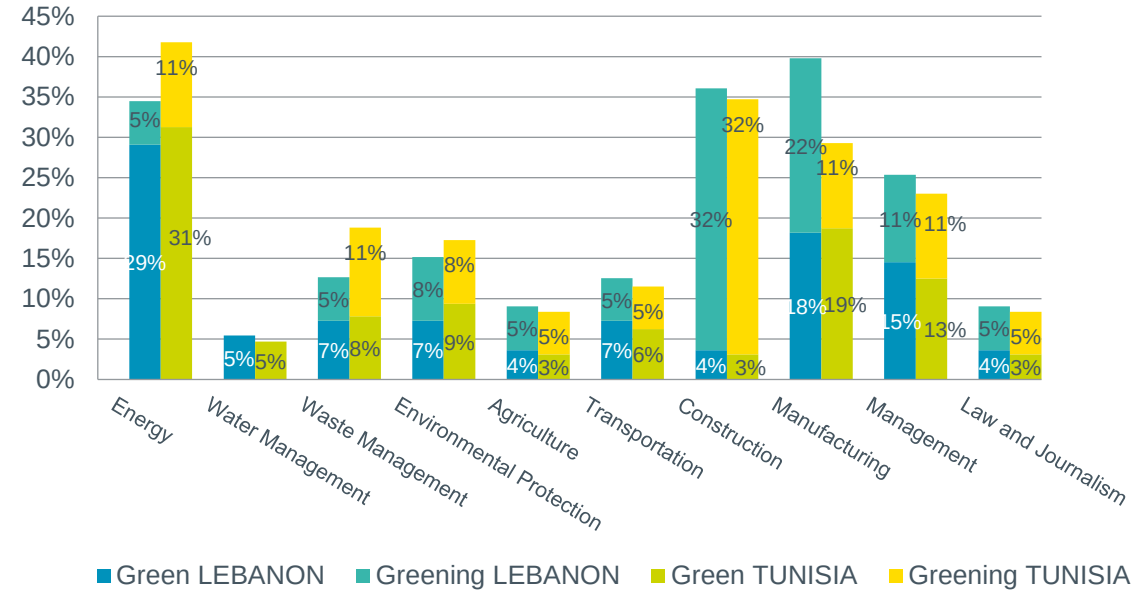
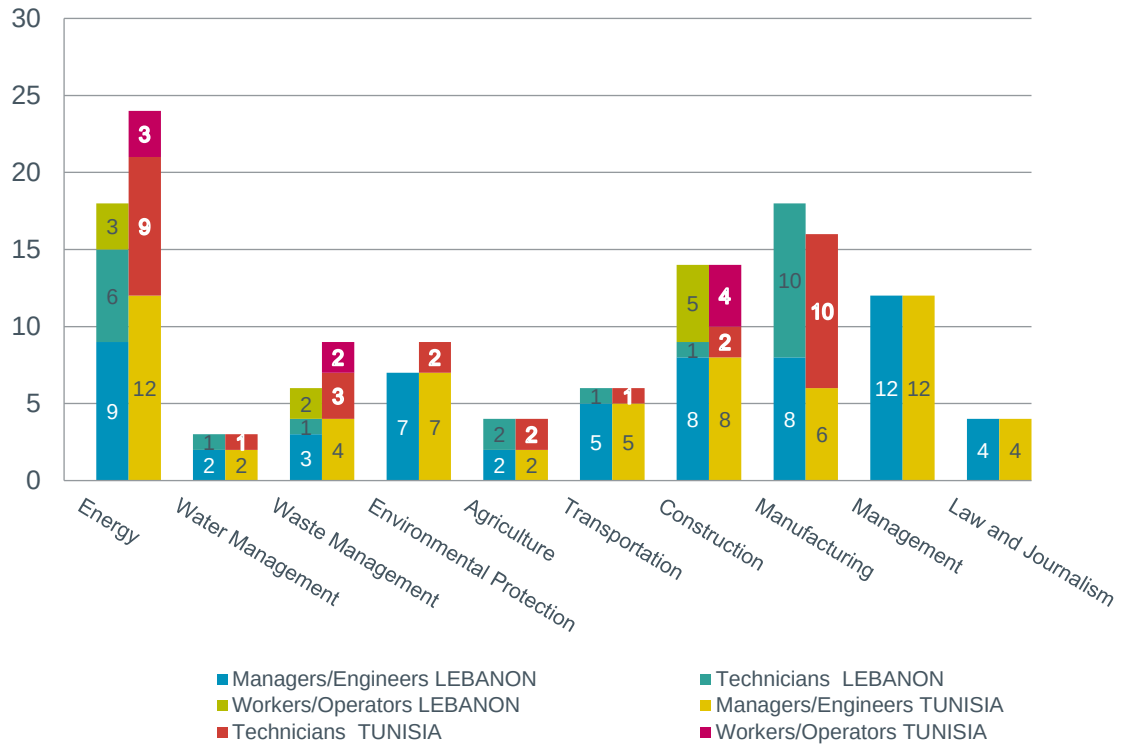


Figure 3 gives the distribution of the identified jobs by sector and the level of qualifications required by the job. The identified green jobs have been classified into three categories – “Managers/Engineers”, “Technicians” and “Workers/Operators”, depending on the level of qualifications required by the job.

According to the European Qualifications Framework (EQF)[16] classification, the first category corresponds to level 7 or 8, the second one to level 6, and the last one to level 5. The two countries show similarities; jobs that require the highest level of qualifications (managers and engineers) represent the highest level of jobs demand for green and greening jobs in both countries, particularly in the energy, construction and management sectors. A small number of jobs are in the categories of technicians and workers or operators, with no demand for these categories in sectors like management, and law and journalism. This may indicate that the success of the green transition in Lebanon and Tunisia needs to equip the labour market with highly educated profiles.

Figure 3: Distribution of jobs by qualifications and sectors



3.4.2 Analysis of green skills supply in Lebanon and Tunisia

This section gives an overview of the existing educational and training offers for green jobs provided in higher education and vocational training systems in Lebanon and Tunisia.

Higher education

In both countries, the courses offered in higher education lead to four main types of diploma for graduates holding a High School Degree. These are the Bachelor's degree (3 years), the National Engineering Degree (5 years), the Master's degree (research or professional, 5 years) and the PhD (3 years after the research Master's degree). Besides, in Tunisia, the Higher Institute of Environmental Technologies, Urban Planning and Building (Institut Supérieur des Technologies de l'Environnement, de l'Urbanisme et du Bâtiment) awards the National Diploma in Urban Development and Country Planning after three years of higher education.

Generally, Bachelor's degrees provide students with fundamental skills related to the teaching area. Professional Master's degrees include complex project management skills, depending on the field of specialisation. National Engineering Degrees equip students with the scientific and technical skills needed to propose practical solutions to business problems. Research Master's and PhDs provide students with skills in critical analysis and advanced research.

[16] https://europass.europa.eu/en/description-eight-eqf-levels

In ***Lebanon***, the green wave sweeps through diverse programmes and degrees designed to equip the students with competencies required by this vastly developing sector. Private institutions under the supervision of the Ministry of Higher Education provide most of the programmes. These programmes belong mainly to the areas of energy, construction, agriculture and waste management. Below, we give an overview of some of the options available in these sectors:

Renewable Energy

- American University of Beirut (AUB): Masters of Science in Environmental Sciences and Management with a focus on Renewable Energy Engineering. This programme details solar, wind, and other renewable technologies, making students ready for careers in project development, system design and policy analysis.
- Lebanese University (LU): Masters of Science in Renewable Energy Systems. This programme focuses on the technological aspect of renewable energy sources such as solar, wind, biomass and geothermal. Lab work and field projects help students get practical experience.
- Université Saint-Joseph (USJ): Clean Energy and Sustainable Design, Master of Science. This programme is general since it talks about renewable energy technologies, energy efficiency, and sustainable building design. Students learn how to develop creative solutions towards a sustainable world.

Green Buildings and Construction

- Beirut Arab University (BAU): Master of Engineering in Sustainable Design and Construction. This programme provides the students with knowledge and skills to formulate energy-efficient buildings and incorporate water conservation strategies in addition to sustainable materials used as a result of building green.
- Holy Spirit University of Kaslik (USEK): Sustainable Architecture and Landscape Master of Science. The programme's main purpose is to incorporate sustainable concepts in architecture and landscape development, intertwining nature with human-made environments while using resources sustainably.
- Université Saint-Esprit (USE): The concentration for the Bachelor of Science in Environmental Engineering is Sustainable Buildings. This undergraduate course offers a solid foundation in engineering principles, with an emphasis on using them to develop cleaner and more energy-efficient structures.

Sustainable Agriculture and Waste Management

- AUB: Sustainable Agriculture and Food Systems Concentration in Master of Science Environmental Science & Management. This programme addresses the obstacles and prospects for sustainable agriculture, including organic farming, food security and agroecology.
- LU: Master of Science in Sustainable Agriculture and Rural Development. The focus of this programme is on promoting environmentally friendly agricultural practices that advance livelihoods in rural communities.
- Université Antonine (UA): This is a Bachelor of Science in Environmental Management specialising in Waste Management. This programme provides students with the necessary knowledge and skills to handle waste properly through reduction, recycling, reuse or composting.

In ***Tunisia***, the Tunisian Directory of Training Courses in Higher Education (Annuaire Tunisien des Offres de Formations Universitaires, ATOFU) lists all the training courses offered by public and private higher education establishments. Looking at the training courses offered in relation to green skills, an average of 352 degree courses related to green skills have been offered annually by public institutions in Tunisia over the last five years.

Almost half of the degree courses conferring green skills belong to the areas of Agricultural Sciences, Biotechnology and the Environment. The training provision offers a comprehensive range of degree

programmes, including those related to agronomy and the agri-food industries, as well as degrees in sustainable water and natural resource management, biodiversity, and sustainable regional development, to cite but a few. For example, the bachelor's degree in environmental biotechnology and waste recycling offered by the Higher Institute of Biotechnology of Monastir provides students with analytical skills to follow waste treatment and recycling processes. These skills include an understanding of ecosystems and biodiversity, and the modelling and optimisation of waste treatment and management processes.

The second major training area is Exact Sciences and Technology[17]. It provides various training programmes in nearly all fields of environment and energy. We can cite the National Engineering Degrees in Energy and in Renewable Energy, a PhD in hydraulic engineering and power engineering, Master's degrees in environmental engineering, and bachelor's degrees in energetics. For example, the National Engineering Degrees in Energy Efficiency give students the skills they need to advise on and audit energy efficiency. The National Engineering Degrees in Renewable Energy provide students with in-depth knowledge of energy production processes and the technical, environmental and regulatory constraints associated with renewable energy projects, which enable them to design and lead renewable energy projects. The bachelor's degrees in energetics train technical managers in energy management – in the fields of energy and renewable energy production and operation.

Private higher education institutions have a significant role to play in the development of green skills. Private institutions are more flexible than their public sector counterparts and are even more keen to quickly adapt their curricula to the demands of the market. We identify around 30 degree courses, divided almost equally between Agricultural Sciences, Biotechnology and the Environment, Exact Sciences and Technology, and Business and Management.

Education initiatives and vocational training

In Lebanon, while the Lebanese Ministry of Education's curriculum is undergoing updates to integrate green concepts more comprehensively, specific courses tailored solely to green jobs are still limited. However, there are encouraging initiatives and promising avenues for vocational training in these fields (ILO, 2022).

Green seeds in the curriculum

- *Environmental Education Project:* Launched in 2005, this project incorporates environmental education into various stages of schooling, including primary, secondary and vocational levels. Through dedicated modules and activities, students gain awareness of environmental issues, sustainable practices, and the importance of responsible resource management.
- *UNESCO Project on Education for Sustainable Development (ESD):* In collaboration with UNESCO, the Ministry of Education is developing and implementing ESD frameworks within the national curriculum. This aims to equip students with the knowledge, skills and values necessary to make informed decisions and contribute to a sustainable future.

Vocational training blossoms

- *Technical and Vocational Education and Training (TVET):* The Ministry of Education, in partnership with various technical and vocational institutes, offers training programmes relevant to green jobs. These include:
  - Renewable Energy Technician: This programme equips students with the skills to install, maintain and repair solar panels, wind turbines, and other renewable energy systems.
  - Energy Auditor: This programme trains individuals to assess the energy efficiency of buildings and recommend solutions for improvement.
  - Organic Agriculture Technician: This programme teaches students about organic farming practices, soil management, and sustainable agriculture techniques.

[17] This major training area is sometimes called Sciences and Technology in the Directory.

- Waste Management Technician: This programme provides training in waste collection, sorting, recycling, and composting methods.

- *Private and NGO Initiatives:* Several private institutions and NGOs also offer vocational training programmes in green fields, such as:
  - Beit el Baraka: This organisation provides training in composting, organic farming and environmental awareness.
  - Arcenciel: This NGO offers training in waste management, recycling and environmental education.
  - Fantasmeem: This organisation offers training for green designers and capacity building.

Vocational training ***in Tunisia*** is under the supervision of the Ministry of Labour and Vocational Training, and it is subdivided into two categories, initial training and continuing training. The main players in vocational training are the Tunisian Agency for Vocational Training (Agence Tunisienne de la Formation Professionnelle, ATFP) and the National Centre for Continuing Training and Professional Development (Centre National de Formation Continue et de Promotion Professionnelle). While efforts have been made to introduce a module on Environmental Culture and Energy management in all levels of vocational training, training programmes specific to green jobs are still limited. Below are the main programmes offered:

Initial training

- Advanced technician in environment, energy and fluids, heating and sanitation option: the Sectorial Centre for Training in Building and Ancillaries Ibn Sina equips students with the skills to plan installation and maintenance activities and optimise sanitary and heating installations.

Continuing training

- Installation, operation and maintenance of grid-connected and off-grid photovoltaic systems: several vocational training centres offer programmes that equip people with the skills to install, operate and maintain grid-connected and off-grid connected photovoltaic systems, as well as solar pumping systems.

In ***Tunisia,*** in addition to these training courses provided in Higher Education or under the auspices of the Ministry of Labour and Vocational Training, we can note several initiatives aimed at promoting green jobs and meeting the needs of Tunisia's ecological transition. For instance, the Tunis International Centre for Environmental Technologies (CITET) regularly organises green job courses to broaden the skills of young graduates, help them enter the world of work, and create new green job opportunities. The courses cover a range of subjects relating to environmental protection, waste management, energy management and the development of renewable energies. Regarding ***Lebanon,*** Lebanese universities keep adding ongoing projects to develop new programmes to their list of green programmes and degrees.

3.5 Results on the emerging skills gaps

In this part, we analyse the gap related to green skills in both countries. As described in the methodology, this gap was identified following two ways: by comparing and matching the green jobs demand with the green skills supply, and by carrying out an online survey of a sample of individuals working in green jobs.

3.5.1 Analysis of comparison/ matching green jobs demand with green skills supply

In this step, we match green occupations with training programmes (courses) and degrees associated with each occupation category across various sectors. As mentioned in the methodology, our objective

here is to check if the required training programme exists for the identified occupation. The findings are summarised in Table 1, below, highlighting trends and gaps for both countries.

Table 1: Comparison and matching of green jobs demand with skills supply

Green jobs demand		Green skills supply					
		Lebanon			Tunisia		
Sector	Job category*	PhD/Master/Engineering	Bachelor	Vocational Training	PhD/Master/Engineering	Bachelor	Vocational Training
Energy	Managers/Engineers	■			■		
	Technicians		■			■	
	Workers/Operators			■			■
Water Management	Managers/Engineers	■			■		
	Technicians		■			■	
	Workers/Operators			✕			✕
Waste Management	Managers/Engineers	■			■		
	Technicians		■			■	
	Workers/Operators			■			■
Environmental Protection	Managers/Engineers	■			■		
	Technicians		✕			■	
	Workers/Operators			✕			✕
Agriculture	Managers/Engineers	■			■		
	Technicians		■			■	
	Workers/Operators			✕			✕
Transportation	Managers/Engineers/ Scientists	■			■		
	Technicians		■			■	
	Workers/Operators			✕			✕
Construction	Managers/Engineers Architects	■			■		
	Technicians		■			■	

Green jobs demand		Green skills supply					
		Lebanon			Tunisia		
Sector	Job category*	PhD/Master/Engineering	Bachelor	Vocational Training	PhD/Master/Engineering	Bachelor	Vocational Training
	Workers/Operators						
Manufacturing	Managers/Engineers						
	Technicians						
	Workers/Operators						
Management	Managers/Engineers						
	Technicians						
	Workers/Operators						
Law and Journalism	Managers/Engineers						
	Technicians						
	Workers/Operators						

Source: Authors, based on the information in Table A, information from the Ministry of Higher Education and the Ministry of Education in Lebanon, the Tunisian Directory of Training Courses in Higher Education (ATOFU), and the Ministry of Labour and Vocational Training for Tunisia.
Notes: *The educational level required to the job categories is: Managers/Engineers/Scientist/Architect: 5 years after the baccalaureate, Technicians: 3 years after the baccalaureate, workers and Operators: baccalaureate and less.

#The corresponding years of education for each degree are: PhD: 3 years after master degree, Master/engineering: 5 years after the baccalaureate, Bachelor: 3 years after the baccalaureate, Vocational training: baccalaureate and less.

Skills gap: The supply matches the demand; The supply does not match the demand; No corresponding training for the job category; No demand for the job category

Globally, in both countries, the supply of workers with green skills matches the current demand in several sectors where we found sufficient programmes and courses offered to satisfy the demand for green jobs. In Lebanon, supply and demand for green skills are globally aligned in sectors like energy, water management and waste management, with environmental protection and agriculture presenting the most balanced picture. This may suggest the existence of government initiatives and sectoral reforms in these areas. In **Tunisia**, training supply matches the green jobs identified in most sectors, suggesting an adequate training supply for green jobs. Note that for Tunisia, training supply in the agriculture sector is much higher than jobs demand, which can be explained by the economy not yet generating enough positions for employment in this sector, although there is a workforce equipped with the necessary skills for these roles. This could be due to difficulties in adapting traditional jobs in agriculture to green and sustainable practices. The sector therefore remains on the margins of its potential for greening.

Four challenging sectors are identified for **Lebanon**, where training supply does not satisfy the demand for green skills. These are transportation, manufacturing, management, and law and journalism. This gap reflects the fact that the transition to sustainable practices in these fields has been slow and underscores the need for retraining programmes to equip workers with the necessary

skills for environmentally sustainable processes in these sectors. **Tunisia** is performing well in most sectors. The gap in terms of skills is mainly observed for transportation, where for several jobs, the corresponding diploma or degree is missing. Jobs like “Freight Forwarders”, “Shipping, Receiving, and Traffic Clerks”, lack the necessary training or diploma. Note that for greening sectors and jobs, required skills are often acquired through continuing training rather than initial training. Our analysis only lists degrees and diplomas from initial training.

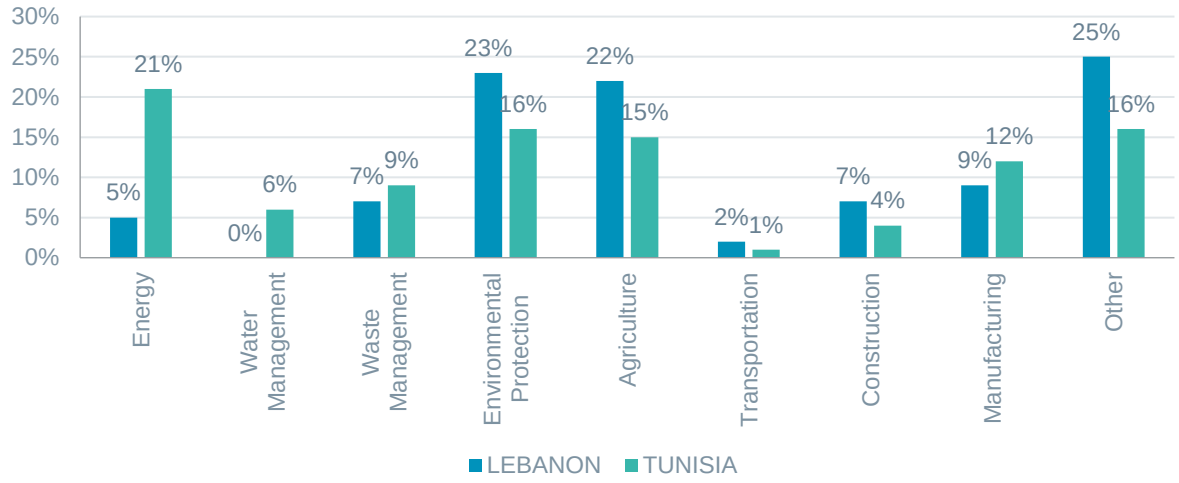
Focusing on the gap by degree level, in general, compared to Lebanon, Tunisia shows a more positive picture, where qualifications match the level of skills required for jobs in several sectors. ***In Lebanon***, the gap in terms of provided skills is observed for two categories of jobs which are technicians (needing a bachelor’s degree) in the energy, water management, waste management, transportation, construction and manufacturing sectors; and managers/engineers (needing a higher degree) in the transportation, manufacturing, management, and law and journalism sectors. Conversely, vocational training was particularly strong in sectors like energy and waste management, and provides the category of workers and operators with adequate green skills. ***In Tunisia***, the category of managers/engineers has the highest number of adequate training and diplomas (corresponding to PhD, Master’s and engineering). The mismatch in terms of skill adequacy rather occurs for the category of workers and operators. In many sectors, green skills supply lacks vocational training degrees that may contribute to equipping this job category with the necessary skills. This is particularly the case in the waste management sector where a corresponding training (vocational) for the job category “Workers/Operators” does not exist. The few existing vocational training degrees are mainly offered in the energy sector, but are not enough to satisfy the increasing demand for green jobs in this sector. The Tunisian government should make efforts to increase the contribution of vocational training to support the green transition.

3.5.2 Analysis of the online survey of individuals working in green sectors

In this section, we present the main findings of the online survey in Lebanon and Tunisia. In each country, the sample size of the survey included 100 employees. *In Lebanon*, women constitute 55% of respondents, with age demographics showing 45% of respondents are in the 30-39 age group, 42% are in the 20-29 age group, and 13% are 40 years or older. *In Tunisia,* 53% of respondents are women, 37% are in the 30-39 age group, 36% are in 20-29 group, and 27% are 40 years or older.

As illustrated in Figure 4, the primary sectors of activity *in Lebanon* include 23% in environmental protection and 22% in agriculture. Water management and transportation are the least represented sectors in the sample. *In Tunisia,* respondents in the sample belong to three main activity sectors: 21% work in the energy sector; 16% in environmental protection; and 15% in agriculture. This is in line with the previous finding of a strong potential for green jobs in the three sectors. Construction and transportation are the least represented, with respectively 4% and 1% of respondents in these sectors.

Figure 4: Distribution by activity sector



Looking at the jobs of respondents, Figure 5 reveals that the highest number of job categories in **Lebanon** are managers (67%), while only 1% of respondents are technicians. Among the 67% of managers, 34% are entrepreneurs. This result reflects the strong Lebanese entrepreneurial ecosystem with mostly highly skilled employees in the green business. Two categories are the most dominant ***in Tunisia***: engineers with 39%, and managers with 37% of the sample. Both had been identified before as the main categories of green jobs in **Tunisia**. Only 10% of the sample are technicians.

Figure 5: Distribution of respondents by job category

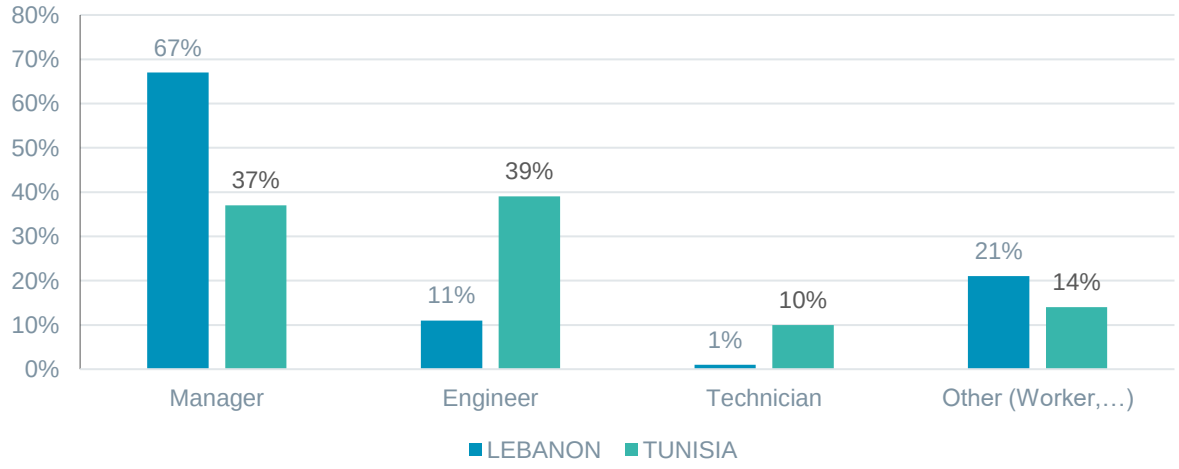
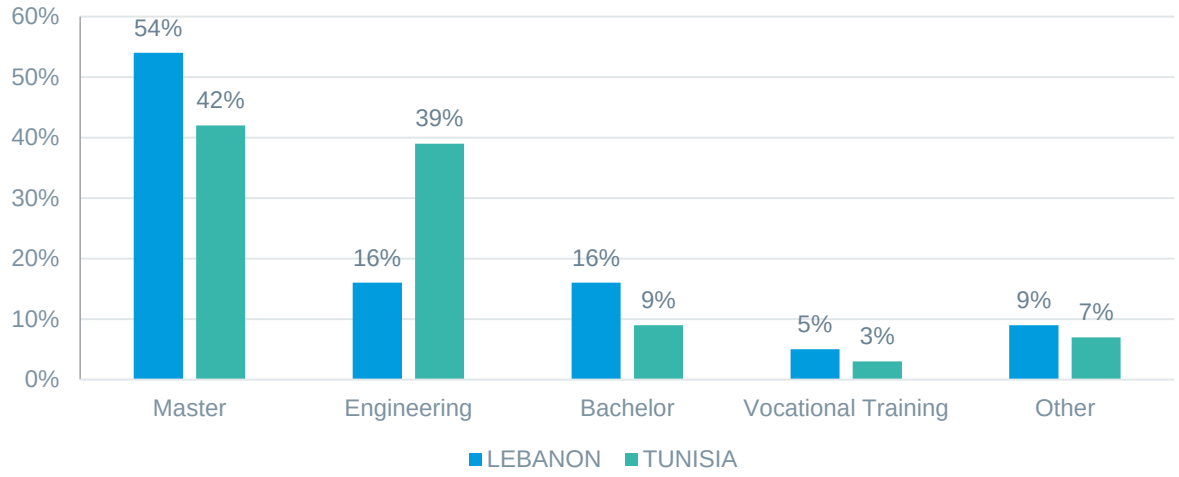


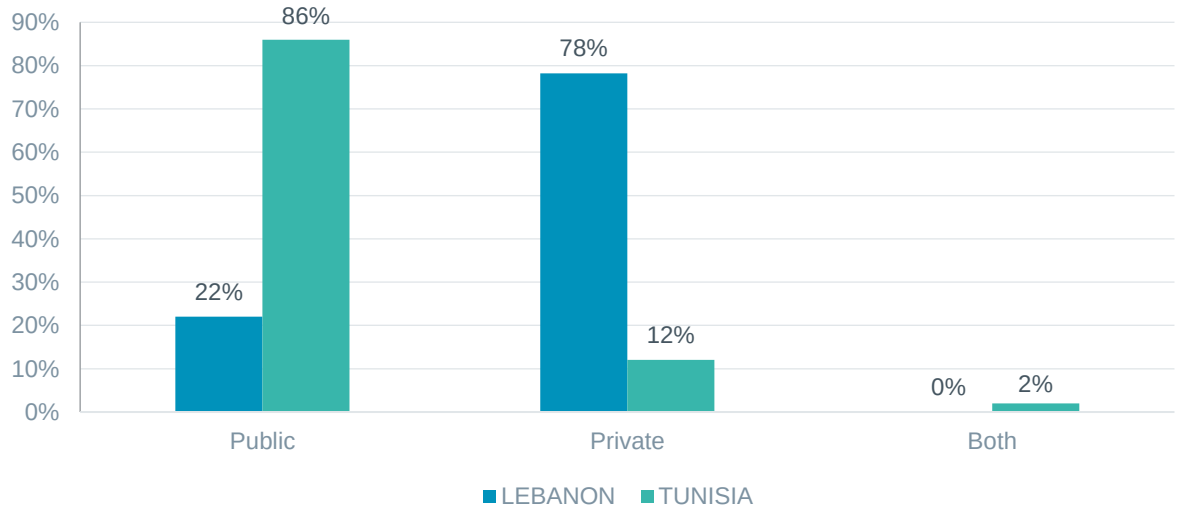
Figure 6 shows that in **Lebanon**, more than half of the respondents (54%) hold Master's degrees, which is aligned with skills distribution for green jobs ***in Lebanon***, indicating that these roles are not limited to engineers. Compared to Lebanon, most of the respondents ***in Tunisia*** have engineering (39%) and Master's level degrees (42%). This is in line with the skills offer related to green jobs in Tunisia, where most of the training programmes in the green field are provided at the level of engineering or Master's level. Unfortunately, for both countries, vocational training does not play an important role in this context, with only 5% holding a vocational training diploma in Lebanon and 3% of green job workers in Tunisia having vocational training certificates from public institutions, despite the importance of the practical skills they bring. It should be mentioned that while this result is consistent with our previous results, the use of LinkedIn might have limited the representativeness of some jobs and profiles, as LinkedIn is used mainly by managers and high-skilled employees, and in lesser way by technicians and vocational training graduates.

Figure 6: Distribution of respondents by their diploma type



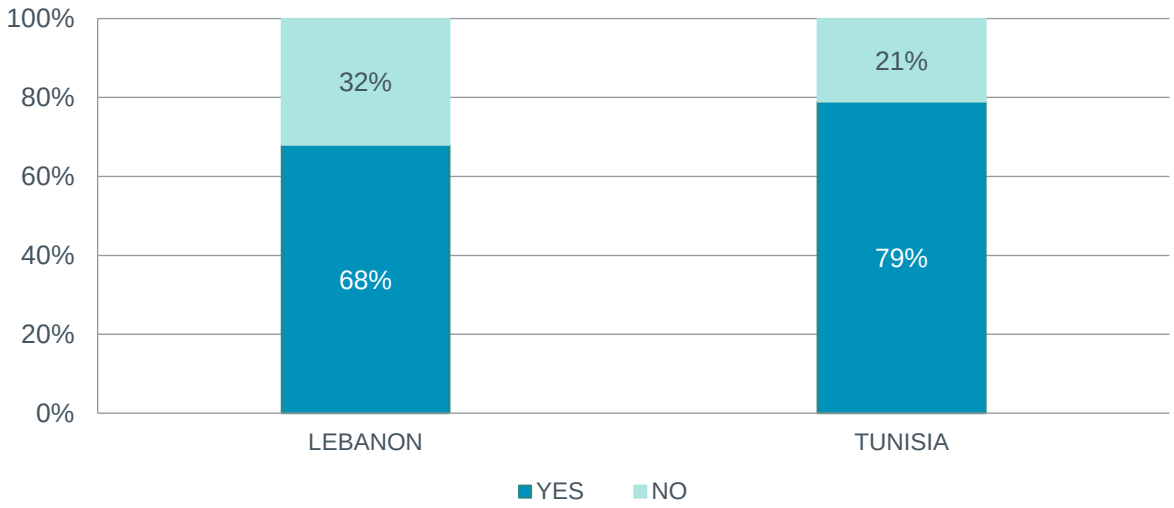
The private sector in **Lebanon** overwhelmingly supplies green skills, contributing 78%, compared to 22% from public institutions under the Ministries of Higher Education and Professional Training (Figure 7). This is in line with the characteristics of the Lebanese education system, which is by and large in private hands at all levels. Conversely, in **Tunisia,** green skills training is provided publicly, mainly by institutions belonging to the Ministries of Higher Education and Professional Training. This is well reflected in the sample, where 86% of the respondents obtained their diploma from a public institution and only 12% from a private one.

Figure 7: Distribution by the type of institution



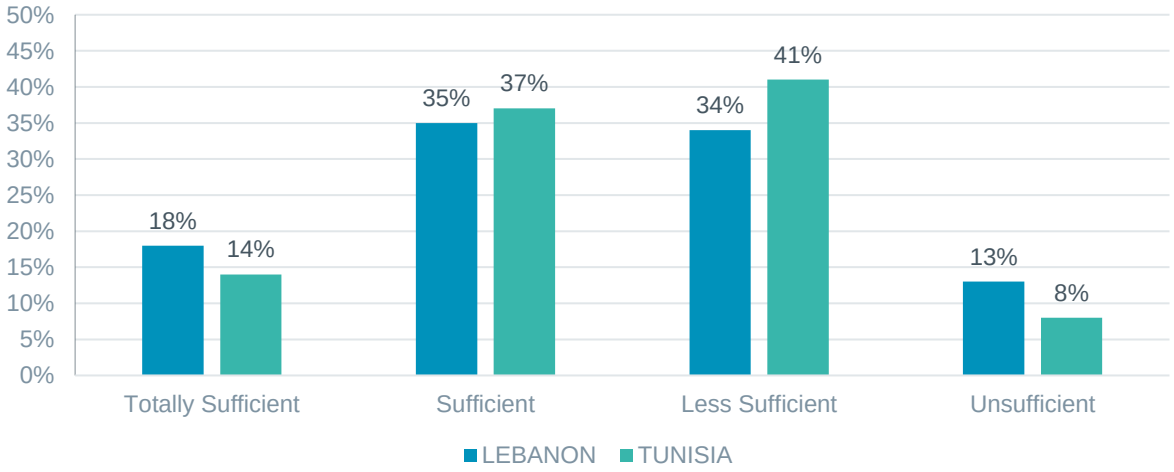
Additionally, in **Lebanon** 68% of respondents state their diploma speciality aligns with their current job, while in **Tunisia**, 79% of respondents indicate that the speciality of their diploma is in line (in the same discipline) with their current job (see Figure 8).

Figure 8: Adequacy between diploma and job



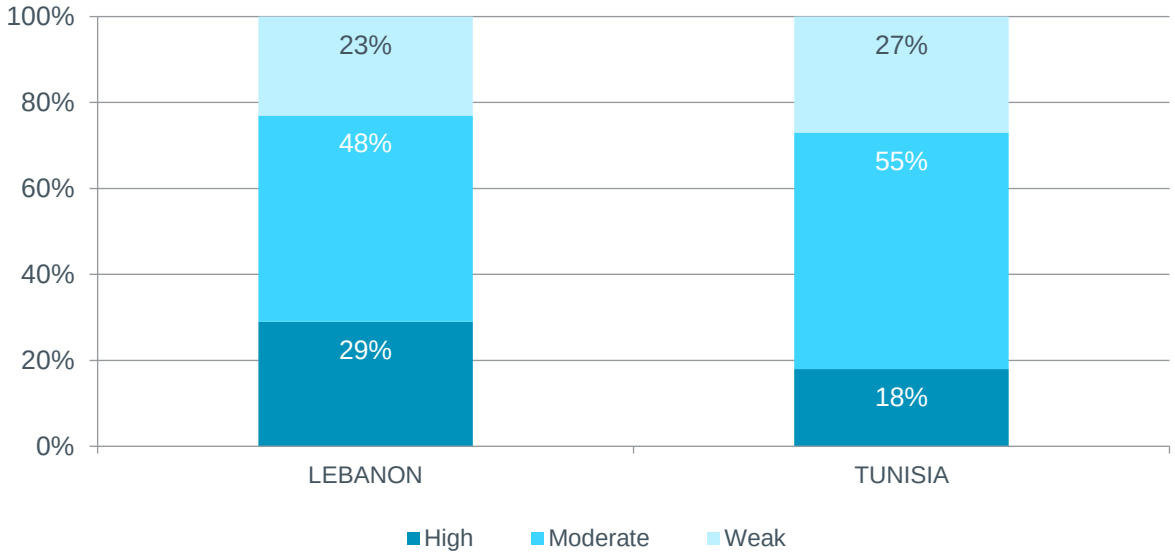
Furthermore, Figure 9 shows that 18% and 35% of the respondents ***in Lebanon*** respectively considered that their diploma (initial training) was totally sufficient or sufficient to practice their current job, while almost 47% were not that satisfied. Only 13% believed that it was insufficient. In **Tunisia**, while 37% of respondents consider their diploma sufficient for their current job, 49% of them indicate that their diploma (initial training) is less sufficient or insufficient.

Figure 9: Initial training sufficiency



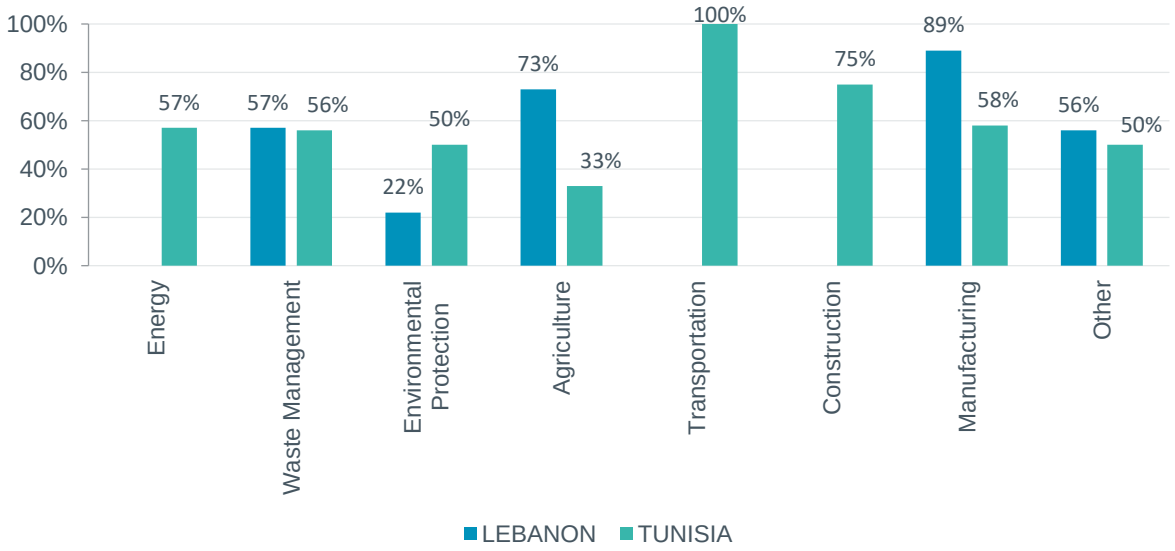
Among the individuals who assessed the gap between green jobs and green skills, in **Lebanon** 48% indicated that the training gap between green skills acquired and those required for the green job practiced is moderate. This proportion is higher for ***Tunisia***, representing 55% of individuals. Only 23% ***in Lebanon*** and 27% ***in Tunisia*** mentioned that the gap is weak (Figure 10).

Figure 10: Gap between green skills and green jobs



Looking at the shares of respondents indicating the low sufficiency or insufficiency of their diploma for their current job by sector (Figure 11), the manufacturing and agriculture sectors are the least effective at equipping professionals with the necessary skills in **Lebanon**. In contrast, the sector of environmental protection is seen as performing well, scoring only 22% in skill insufficiency. In **Tunisia,** the agricultural sector seems to provide the most complete and needed skills for jobs carried out in this sector, among others. Transportation and construction are the least sufficient in terms of training and skills provided.

Figure 11: Percentage of training insufficiency by sector

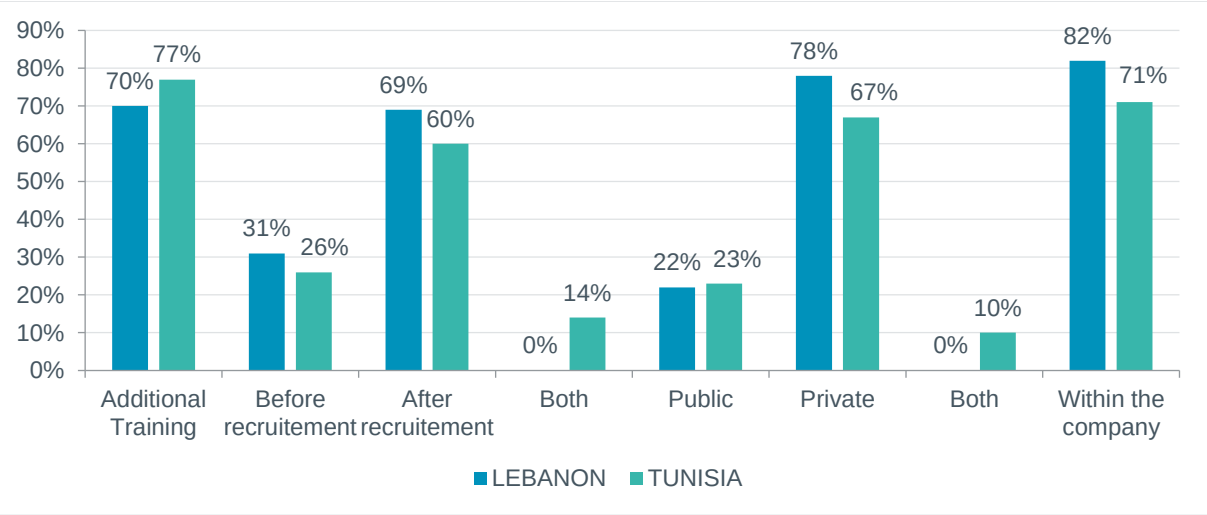


Several questions were put to the individuals in the sample concerning potential additional training in relation to green skills and the role of their company in this regard. ***In Lebanon***, 70% of respondents indicate that they completed extra training specifically to develop green skills (Figure 12). This training is often provided after hiring, with 78% by private institutions, highlighting a contrast with the initial educational qualifications obtained prior to employment. The need for additional post-hiring training highlights a disconnection between formal education and the evolving requirements of the workforce, especially in green sectors. Corporate involvement in this process is substantial, with 82% of employees in the sample receiving additional training related to their roles or green jobs within their

companies. Indeed, this gap in initial education forces companies to provide supplementary training to fully prepare individuals for specific green jobs.

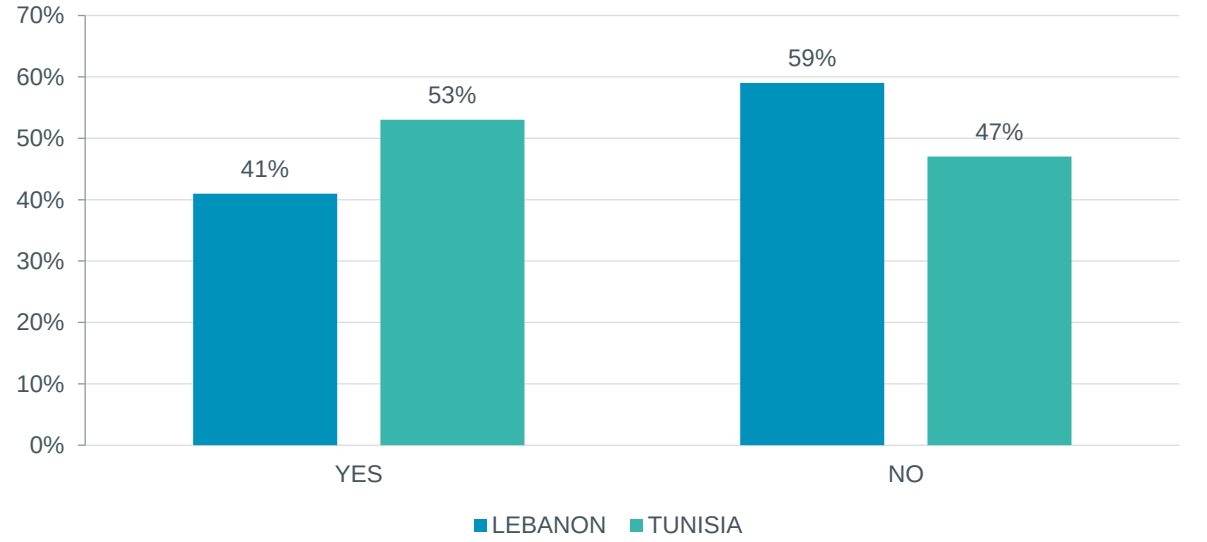
Regarding ***Tunisia***, 77% of respondents had completed additional training to acquire green skills, often acquired after recruitment and, unlike the initial diploma or training, mainly through private institutions (67% of respondents). The involvement of companies in their employees' acquisition of green skills was also important. 71% of employees indicated that they had benefited from additional training in relation to their job or to green jobs in general within their company, which reflects the willingness of private companies in Tunisia to support a skilled workforce for green transition.

Figure 12: Additional training in relation to green skills



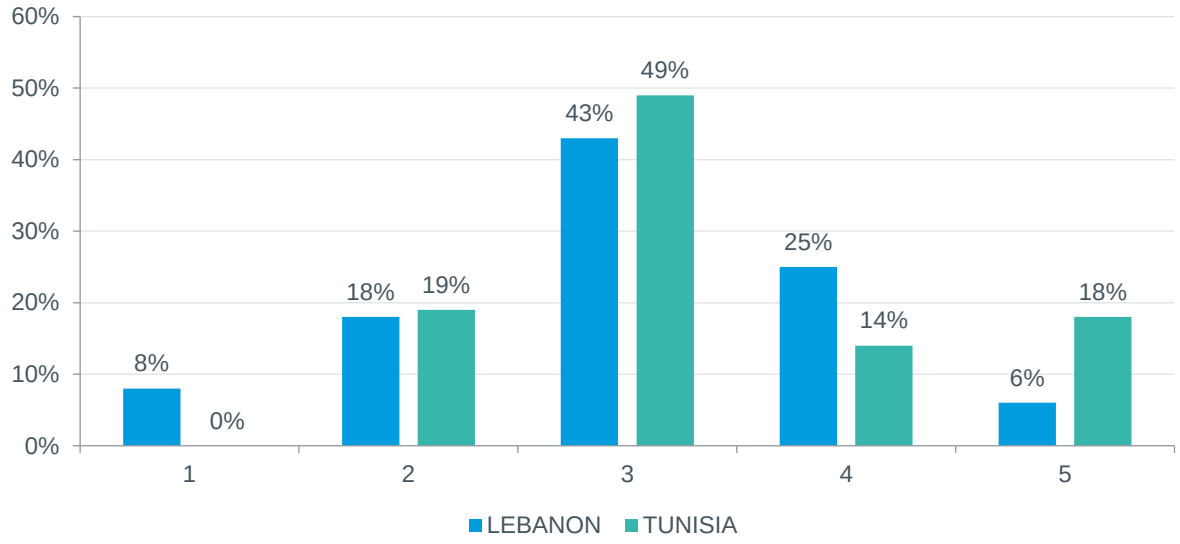
In both countries, specific questions were asked to get insights into the skills gap from the point of view of recruiters. Figure 13 indicates that 41% of recruiters ***in Lebanon*** struggle to find candidates with adequate green skills, compared to 53% ***in Tunisia***, which presents a significant challenge for their activities.

Figure 13: Difficulties in finding necessary skills (recruiters)



Furthermore, as Figure 14 shows, 43% of recruiters in **Lebanon** are only moderately satisfied with their employees' training levels in green jobs, with 6% reporting high satisfaction. These proportions are higher for **Tunisia,** with 49% of individuals moderately satisfied and 18% indicating a higher degree of satisfaction.

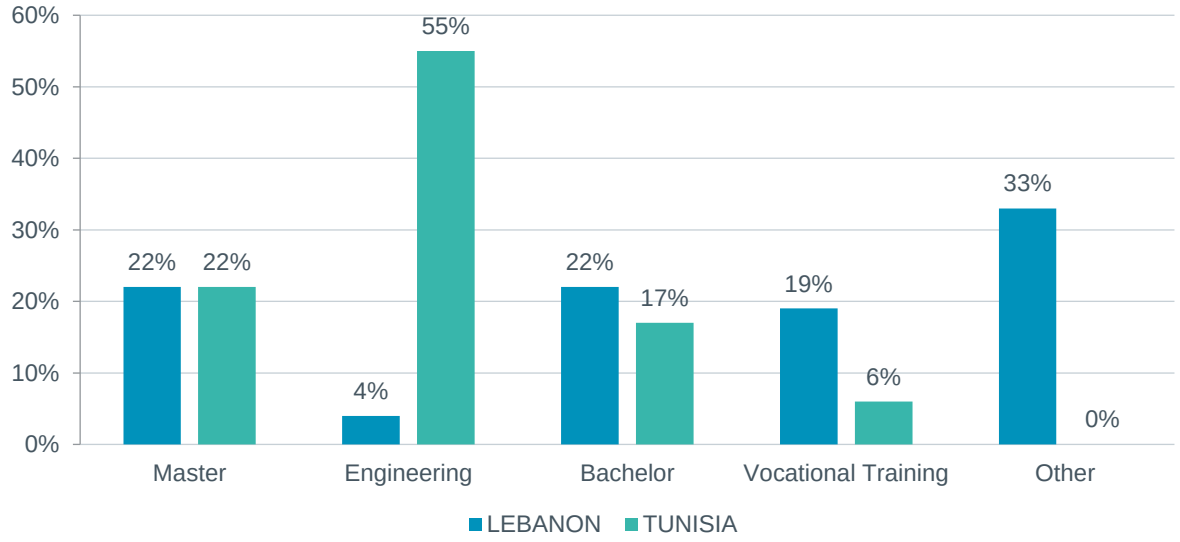
Figure 14: Degree of satisfaction with green skills (recruiters)



Note: *1 to 5: from least satisfactory to most satisfactory.

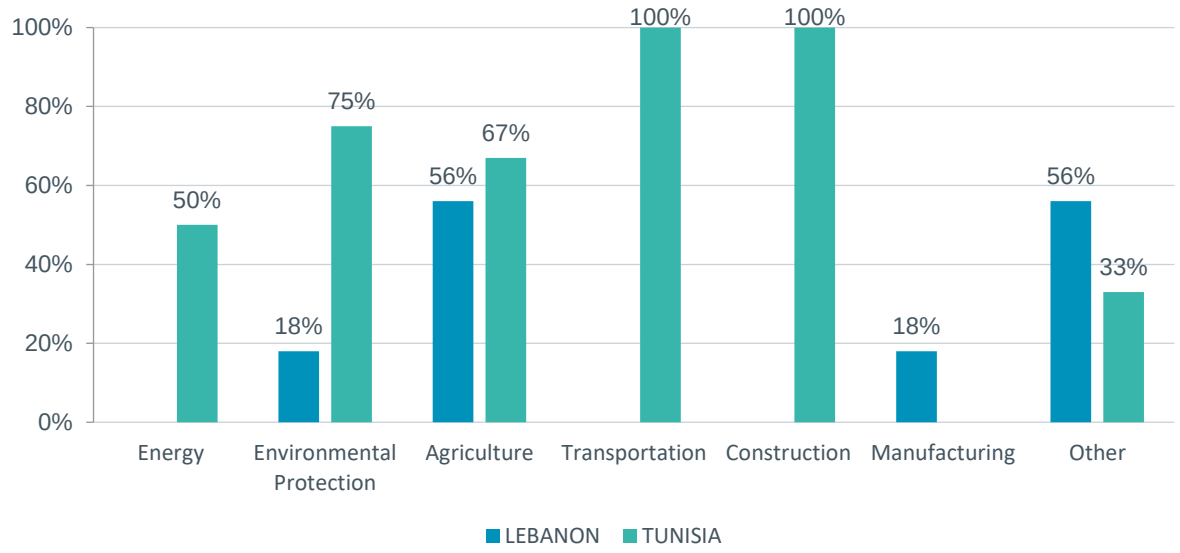
As for the most satisfactory diploma in terms of matching their expectations in relation to the (green) jobs offered by their company (Figure 15), 33% of managers in **Lebanon** find professional training from private institutions to be the most versatile and complete, followed by Master's and bachelor's degrees, at 22% each. The results are different ***for Tunisia***, where the majority of recruiters (55%) considered the engineering diploma to be the most versatile and complete, standing out in terms of effectiveness, followed by the Master's degree (22%). On the other hand, vocational training is the least satisfactory (less than 6%) in terms of providing necessary green skills for green jobs offered. It does not meet their expectations in terms of green qualifications.

Figure 15: Most satisfactory diploma in relation to green jobs (recruiters)



Finally, as indicated in Figure 16, the sector where recruiters have the most difficulties in finding the necessary skills (profiles) for the green jobs offered within their company in **Lebanon** is agriculture, with 56% of managers in this sector reporting recruitment challenges. For **Tunisia**, most difficulties have been found for transportation and construction, sectors where all the recruiters in the sample reported facing difficulties in finding the required profile for the job. Lesser difficulties are observed for the energy and agriculture sectors.

Figure 16: Difficulties in finding necessary skills by sector (recruiters)



3.6 Conclusions and policy recommendations

This study analyses the potential of green jobs in Lebanon and Tunisia, paying particular attention to green skills gaps. The analysis was performed following several steps, allowing the identification of, first, potential green sectors and jobs in each country, and second, the gap in terms of skills related to these jobs. The gap was analysed qualitatively by matching green jobs demand with training supply, based on countries' official documents provided by relevant Ministries, and through a survey of a sample of individuals working in green jobs.

Several conclusions emerge from this analysis. Both countries have great potential in terms of green jobs, and share common goals and challenges in developing them. However, their specific economic structures, environmental challenges and focus areas lead to different focuses on their green job strategies. Compared to Lebanon, Tunisia has higher potential in terms of green and greening jobs. This is mainly due to the fact that the Tunisian economy is more diverse, thanks to significant contributions from several sectors of the economy. Common strategic sectors for green jobs in Lebanon and Tunisia are manufacturing, construction and energy, the latter taking up the greatest part of existing or potential green jobs in Tunisia.

Furthermore, in both countries, the green transition is accompanied by a greater demand for high rather than low skills. Diplomas like engineering and Master's degrees are the most needed for green jobs. In addition, in both countries, green skills are provided mainly in higher education with a small contribution from vocational training institutions, particularly in Tunisia. Public institutions are the main providers of green skills in Tunisia, while in Lebanon, several offers come from private institutions.

Globally, both countries have made efforts to provide the green workforce with the necessary qualifications by offering several programmes and training related to the green economy. However, some jobs and sectors still lack the necessary and adequate profiles for the required jobs, which poses several challenges.

The analysis of the green skills gap shows that while some sectors in Lebanon, such as energy, water management, waste management, environmental protection and agriculture have successfully matched green jobs with workforce skills, others (such as transportation, construction and manufacturing) face considerable challenges in either generating sufficient demand or equipping workers with the right expertise. Furthermore, the lack of supply of green skills for the categories of technicians and managers/engineers suggests that the green transition in Lebanon lacks several profiles, which could slow it down. To address these gaps, Lebanon needs to invest in training, policy

reform, and sectoral development to ensure sustainable growth in green employment across the economy. In particular, special efforts need to be made to train green managers to accelerate and improve the green transition, while vocational and educational training although strong in some sectors, should be extended to other strategic sectors.

Compared to Lebanon, Tunisia is performing well in many sectors, where the supply of skills matches the demand for almost all sectors and, unlike in Lebanon, supply matches demand in the Managers/Engineers job category. However, this is not the case for technicians and operators, who are in short supply, highlighting the role that vocational training could play in providing workers with the appropriate green skills.

The survey analysis largely confirms previous findings, and particularly highlights strategic sectors for both countries, the supply of high-skilled workers, and the shortage of technicians, operators and vocational training graduates in general. The survey also shows that in both countries, the majority of workers in green or greening occupations consider that their qualifications are not sufficient to do their job, with higher gaps mentioned for Lebanon, and many indicate that they completed additional training to acquire green skills. In this context, much effort should be made in developing and adapting training programmes to the green jobs demand. Academic actors should collaborate more with demand actors in order to enhance the adequacy of green skills and jobs.

Based on these findings, several policy recommendations come with this study:

- - Vocational training needs to be further developed and adapted to the green transition process in both countries. This would help to match skills supply and demand, and provide sufficient technicians and operators with green skills, particularly in Tunisia.
- - Institutional actions are also necessary. The involved Ministries should have broad prerogatives to revise curricula and study plans, adapted to the green economy and draw up a national plan for the development of green jobs and skills, starting with basic, secondary education and VET to higher education. This can be done by:
    - Adding more practical activities linked with the environment into primary and secondary education and VET programmes. These may include, for example: recycling workshops where students learn to sort waste and create objects such as sculptures or decorations from recycled materials; raising awareness by asking students to create posters or presentations on environmental themes, such as climate change; conferences and debates with “green” experts and entrepreneurs on subjects such as renewable energies or sustainable development; green business visits; and asking students to design projects to reduce their school's carbon footprint, such as installing solar panels or improving energy efficiency. These activities allow students to develop a green mindset.
    - Integrating specific modules on sustainability, environment, natural-resource management into existing university and VET courses. For example, training in recognised certifications for green skills such as ISO 14001 or LEED (Leadership in Energy and Environmental Design) or Green Business Certification Inc. (GBCI) could increase students' green skills and prepare them for the green jobs market. The introduction of co-constructed bachelor's degrees, particularly in Lebanon, can also meet this need and contribute to the alignment of university training with market needs in terms of specific occupations for some sectors.
- - Compulsory in-service training or certification modules for teaching staff (of universities and VET schools) are also needed to ensure their ability to teach innovative technical subjects. For example, in Tunisia, these training and certification modules can be carried out via the Virtual University platform.
- - Strengthen the involvement of the private sector in the green transition via:
    - More cooperation between firms and training institutions to strengthen practical training (projects, apprenticeships, internships);

- More support for green entrepreneurs from their peers and the authorities of the two countries during the different phases of the entrepreneurial journey. In Tunisia, initiatives from ANETI, UTICA and student entrepreneur centres are multiplying in this direction;
- The creation of partnerships between firms and training establishments to co-build programmes adapted to the market's needs for green jobs. Such partnerships would cover the development and implementation of professional training courses. They would exploit existing talents on all sides to develop targeted skills. In Tunisia, the co-construction of training is strongly encouraged through a series of laws such as Law No. 2008-19 and Decree No. 2008-3123, and via initiatives such as quality support projects developed by the Ministry of Higher Education.

Such initiatives can support the growth of a skilled workforce, promote green entrepreneurship, and ultimately contribute to satisfying the skill demand identified in this study for both countries. However, this cannot be done without developing the skills of teaching staff and professional trainers themselves, or without government support through the implementation of an integrated strategy, and legal and fiscal incentive measures.

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Appendix

Table A: Current and potential green jobs in Lebanon and Tunisia

Sector	Job	Type	Main green tasks	Lebanon	Tunisia
Energy	Renewable Production Managers	Green	Apply the basic principles of energy efficiency and sustainable use of resources. Supervise employees in renewable energy power plants or well fields.	✓	✓
	Renewable Technology and Product Development Managers	Green	Provide technical or scientific guidance to technical staff in the conduct of renewable energy research or development.	✓	✓
	Biofuels Production Managers/	Green	Approve proposals for the acquisition, replacement, or repair of biofuels processing equipment or the implementation of new production processes. Supervise employees in geothermal power plants or well fields.		✓
	Biomass Production Managers	Green	Monitor and operate communications systems, such as mobile radios.	✓	✓
	Hydroelectric Production Managers	Green	Check hydroelectric operations for compliance with prescribed operating limits, such as loads, voltages, temperatures, lines, or equipment.	✓	✓
	Wind Energy production Managers	Green	Develop relationships and communicate with customers, site managers, developers, landowners, authorities, utility representatives, or residents. Provide verbal or written project status reports.	✓	✓
	Solar Energy Installation Managers	Green	Assess potential solar installation sites to determine feasibility and design requirements.	✓	✓
	Fuel Cell Engineers	Green	Test the power output, environmental impact of new hydrogen or non-hydrogen fuel cell system designs.		✓
	Photonics Engineers	Green	Design solar energy photonics or other materials or devices to generate energy.		✓
	Wind Energy Engineers	Green	Test wind turbine components, using mechanical or electronic testing equipment.	✓	✓
	Solar Energy Systems Engineers	Green	Conduct engineering site audits to collect structural, electrical, and related site information for use in	✓	✓

Sector	Job	Type	Main green tasks	Lebanon	Tunisia
			the design of residential or commercial solar power systems.		
	Energy Engineers	Green	Research renewable or alternative energy systems or technologies, such as solar thermal or photovoltaic energy.	✓	✓
	Geographic Information Systems Technicians	Green	Analyse Geographic Information Systems (GIS) data to determine the best locations for renewable energy sites, including solar or wind energy installations.	✓	✓
	Photonics Technicians	Green	Adjust equipment for energy measurement devices.		✓
	Geophysical Data Technicians	Greening	Measure, sample, collect data about the ground at a potential site. Maintain, update and distribute information for library or record systems.	✓	✓
	Wind Turbine Service Technicians	Green	Assist in assembly of individual wind generators or construction of wind farms.	✓	✓
	Biofuels Processing Technicians	Green	Assess the quality of biofuels additives for reprocessing.		✓
	Biomass Plant Technicians	Green	Assess quality of biomass feedstock. Maintain and repair energy production installation	✓	✓
	Hydroelectric Plant Technicians	Green	Change oil, hydraulic fluid, or other lubricants to maintain condition of hydroelectric plant equipment.	✓	✓
	Solar Photovoltaic Installers	Green	Install and test photovoltaic (PV) systems to verify system functionality and conformity to performance expectations.	✓	✓
	Solar Sales Representatives and Assessors	Green	Select solar energy products, systems, or services for customers based on electrical energy requirements, site conditions, price, or other factors.	✓	✓
	Service Unit Operators, Oil, Gas, and Mining	Greening	Apply green technologies or techniques such as the use of coiled tubing, slim-hole drilling, horizontal drilling, hydraulic fracturing, or gas lift systems.	✓	✓
	Continuous Mining Machine Operators	Greening	Apply new technologies developed to minimise the environmental impact of coal mining.		✓
	Power Plant Operators	Greening	Adjust controls to generate specified electrical power or to		✓

Sector	Job	Type	Main green tasks	Lebanon	Tunisia
			regulate the flow of power between generating stations and substations in order to prevent wastes.		
Water Management	Water Resource Specialists	Green	Write proposals, project reports, informational brochures, or other documents on wastewater purification, water supply and demand, or other water resource subjects.	✓	✓
	Water/Wastewater Engineers	Green	Analyse and recommend chemical, biological, or other wastewater treatment methods to prepare water for industrial or domestic use.	✓	✓
	Environmental technicians	Green	Research and note violations of water and groundwater management regulations.	✓	✓
Waste Management	Environmental advisors	Green	Work for a public or private organisation. Implement the waste management policy (sorting/storage/recycling) and awareness of environmental protection	✓	✓
	Waste treatment Engineers	Green	Organise the treatment of waste and its storage to avoid the risk of pollution. Perform toxicity analyses and plan treatment cycles.	✓	✓
	Biochemical Engineers	Green	Develop bioremediation processes to reduce pollution, protect the environment, or treat waste products.		✓
	Confirmation and remediation Inspectors	Greening	Inspect or test cleantech or green technology parts, products, or installations, such as fuel cells, solar panels, or air quality devices, for conformance to specifications or standards.	✓	✓
	Recycling Coordinators	Green	Coordinate recycling collection schedules to optimise service and efficiency.	✓	✓
	Hazardous Materials Removal Workers	Greening	Apply bioremediation techniques to hazardous wastes to allow naturally occurring bacteria to break down toxic substances.		✓
	Recycling and Reclamation Workers	Green	Clean materials, such as metals, according to recycling requirements.	✓	✓
	Refuse and Recyclable	Greening	Collect refuse and recyclable materials in order to sell it to recycling manufactories.	✓	✓

Sector	Job	Type	Main green tasks	Lebanon	Tunisia
	Material Collectors				
	Environmental Managers	Green	Apply for permits required for the implementation of environmental remediation projects. Advise internal management or business partners on the implementation or operation of compliance programmes.	✓	✓
Environmental Protection	Environmental Engineers	Greening	Conduct diagnosis and studies on the impact of construction or manufacturing projects. Write reports related to environmental engineering issues.	✓	✓
	Environmental Economists	Green	Assess the costs and benefits of various activities, policies, or regulations that affect the environment or natural resource stocks.	✓	✓
	Quality / Validation Engineers	Green	Validate or characterise sustainable or environmentally friendly products, using electronic testing platforms.	✓	✓
	Air, atmospheric and space analyst engineers	Greening	Monitor, analyse and interpret air samples. Formulate predictions by interpreting environmental data, such as meteorological, atmospheric, oceanic, paleoclimate, climate, or related information.	✓	✓
	Climate Change Analysts	Green	Analyse and distil climate-related research findings to inform legislators, regulatory agencies, or other stakeholders.	✓	✓
	Geoscientists	Greening	Analyse and interpret geological, geochemical, or geophysical information from sources such as survey data, well logs, bore holes, or aerial photos.	✓	✓
	Remote Sensing Scientists and Technologists	Green	Recommend new remote sensing hardware or software acquisitions.		✓
	Remote Sensing Technicians	Green	Collaborate with agricultural workers to apply remote sensing information to efforts to reduce negative environmental impacts of farming practices.		✓
	Agricultural Managers	Greening	Replace chemical insecticides with environmentally friendly practices.	✓	✓

Sector	Job	Type	Main green tasks	Lebanon	Tunisia
Agriculture	Sustainable agriculture advisors	Green	Diagnose the functioning of agricultural businesses. Guide farmers in waste management and reduction of pollution	✓	✓
	Agricultural Technicians	Greening	Conduct studies of alternative agricultural application methods, quantities, or timing to ensure minimisation of environmental impact	✓	✓
	Precision Agriculture Technicians	Green	Programme farm equipment, such as variable-rate planting equipment or pesticide sprayers, based on input from crop scouting and analysis of field condition variability.	✓	✓
	Transportation Managers	Greening	Plan or implement energy-saving changes to transportation services, such as reducing routes, optimising capacities, employing alternate modes of transportation, or minimising idling.	✓	✓
Transportation	Transportation Planners	Green	Collaborate with other professionals to develop sustainable transportation strategies at the local, regional, or national levels.	✓	✓
	Freight Forwarders	Green	Arrange for transport, using a variety of modes, such as rail, short sea shipping, air, or roadways, to minimise carbon emissions or other environmental impacts.	✓	✓
	Shipping, Receiving, and Traffic Clerks	Greening	Compare shipping routes or methods to determine which have the least environmental impact.	✓	✓
	Logistics Engineers	Green	Conduct logistics studies or analyses, such as time studies, zero-base analyses, rate analyses, network analyses, flow-path analyses, or supply chain analyses.	✓	✓
	Geographic Information Systems Technicians	Green	Apply Geographic Information Systems (GIS) data in transportation routing settings to determine the best routing to reduce pollution or energy consumption.	✓	✓
	Construction Managers	Greening	Ensure responsible design and building activities or to achieve favourable LEED ratings for building projects.	✓	✓

Sector	Job	Type	Main green tasks	Lebanon	Tunisia
Construction	Energy Auditors	Green	Prepare job specification sheets for buildings and plants energy improvements	✓	✓
	Civil Engineers	Greening	Develop or implement engineering solutions to clean up industrial accidents or other contaminated sites.	✓	✓
	Transportation Engineers	Green	Develop plans to manage transportation structures within environmental standards for sustainable development.	✓	✓
	Electrical Engineers	Greening	Inspect completed installations and observe operations to ensure conformance to design and equipment specifications and compliance with operational, safety, or environmental standards.	✓	✓
	Construction and Building Inspectors	Greening	Review plans, blueprints, site layouts, specifications, or construction methods to ensure compliance to environmental regulations.	✓	✓
	Architects, Except Landscape	Greening	Plan or design structures in accordance with environmental, safety, or other regulations.	✓	✓
	Landscape Architects	Greening	Create landscapes that minimise water consumption such as by incorporating drought-resistant grasses or indigenous plants.	✓	✓
	Electrical Engineering Technicians / technologists	Greening	Assemble or test solar photovoltaic products, such as inverters or energy management systems. Review installation or quality assurance documentation	✓	✓
	Heating and Air Conditioning Mechanics and Installers	Greening	Repair or service heating, ventilating, and air conditioning (HVAC) systems to improve efficiency, such as by changing filters, cleaning ducts, or refilling non-toxic refrigerants.	✓	✓
	Construction Laborers	Greening	Perform site activities required of green certified construction practices	✓	✓
	Plumbers	Greening	Install, maintain, improve water- or energy-efficient appliances or systems in order to minimise waste.	✓	✓
	Roofers	Greening	Apply reflective roof coatings, such as special paints or single-ply roofing sheets, to existing roofs to reduce solar heat absorption.	✓	✓

Sector	Job	Type	Main green tasks	Lebanon	Tunisia
	Sheet Metal Workers	Greening	Install green architectural sheet metal components, such as cool roofs or hot or cold walls.	✓	✓
	Electronics Engineers	Greening	Develop solar photovoltaic products more energy savers.	✓	✓
Manufacturing	Mechanical Engineers	Greening	Direct the installation, operation, maintenance, or repair of renewable energy equipment.	✓	✓
	Automotive Engineers	Green	Research or implement green automotive technologies involving alternative fuels, electric or hybrid cars, or lighter or more fuel-efficient vehicles.	✓	✓
	Manufacturing Engineers	Green	Develop sustainable manufacturing technologies to reduce gas emissions, minimise raw material use, replace toxic materials with non-toxic materials, replace non-renewable materials with renewable materials, or reduce waste.	✓	✓
	Mechatronics Engineers	Green	Design or develop automated control systems for environmental applications, such as waste processing, air quality, or water quality systems.	✓	✓
	Robotics Engineers	Green	Design robotics applications for manufacturers of green products, such as wind turbines or solar panels to increase production time, eliminate waste, or reduce costs.	✓	✓
	Fashion Design manager	Green	Design products with minimal environmental impact	✓	
	Automotive Engineering Technicians	Green	Analyse test data for green automotive systems, subsystems, or component parts. Convert vehicle fuel systems.	✓	✓
	Manufacturing Engineering Technologists	Green	Develop processes to recover, recycle, or reuse waste or scrap materials from manufacturing operations.	✓	✓
	Mechanical Engineering Technologists	Green	Conduct statistical studies to analyse or compare production costs for sustainable and non-sustainable designs.	✓	✓
	Manufacturing Production Technicians	Green	Adhere to all applicable regulations, policies, and procedures for health, safety, and environmental compliance.	✓	✓

Sector	Job	Type	Main green tasks	Lebanon	Tunisia
	Fuel Cell Technicians	Green	Conduct tests or provide technical support for tests of prototype fuel cell engines or thermal management systems.	✓	✓
	Machinists	Greening	Separate scrap waste and related materials for reuse, recycling, or disposal.	✓	✓
	Electro-Mechanical Technicians	Greening	Operate, test, or maintain robotic equipment used for green production applications, such as waste-to-energy conversion systems, minimisation of material waste, or replacement of human operators in dangerous work environments.	✓	✓
	Robotics Technicians	Greening	Operate robots to perform customised tasks, such as environmental clean-up or explosive detection operations.	✓	✓
	Electromechanical Engineering Technologists	Greening	Modify, maintain, or repair electrical, electronic, or mechanical components, equipment, or systems to ensure proper functioning.	✓	✓
	Electronics Engineering Technologists	Greening	Participate in the development or testing of new green electronics technologies, such as lighting, optical data storage devices, or energy efficient televisions.	✓	✓
	Fashion Design technicians	Greening	Ensure manufacturing processes comply with environmental regulations	✓	

Table B: Current and potential green transversal jobs in Lebanon and Tunisia

Transversal jobs				Lebanon	Tunisia
Management	Sustainability Managers	Green	Create and maintain sustainability programme documents. Assess or propose sustainability initiatives. Manage the movement of goods into and out of production facilities to ensure efficiency, effectiveness, or sustainability of operations.	✓	✓
	Brownfield Redevelopment Specialists and Site Managers	Green	Conduct quantitative risk assessments for human health, environmental, or other risks.	✓	✓
	Supply Chain Managers	Green	Investigate or review the carbon footprints and environmental performance records of current or potential storage and distribution service providers.	✓	✓
	Logistics Managers	Green	Process orders. Ensure that goods are delivered at the right time and place while minimising costs and maximising efficiency. In addition to current tasks, analyse the environmental impact of proposed logistics decisions, such as routing, shipping modes, or product volumes.	✓	✓
	Storage and Distribution Managers	Greening	Identify and implement carbon minimisation activities to offset carbon emissions	✓	✓
	Training and Development Specialists	Greening	Develop or implement training programmes related to efficiency, recycling, or other issues with environmental impacts.	✓	✓
	Green Marketers	Green	Develop branding or sales initiatives for green products or products using renewable or recycled materials.	✓	✓
	Marketing Managers	Greening	Integrate environmental information into product or company marketing strategies, policies, or activities.	✓	✓
	Public Relations Specialists	Greening	Arrange public appearances, lectures or exhibits regarding green products or projects or to increase product or service awareness or to promote goodwill.	✓	✓
	Energy Brokers	Green	Answer customer questions related to energy sales procedures, energy markets, alternative energy sources.	✓	✓
	Green Financial Analysts	Green	Conduct financial analyses related to investments in green construction or projects. Develop tools to be used in the assessment of green technologies or green financial products.	✓	✓

	Green Risk Management Specialists	Green	Determine potential environmental impacts of new products or processes on long-term growth and profitability.	✓	✓
Law and Journalism	Legal Advisors in environmental law	Green	Follow changes in environmental law. Advise organisations on compliance with environmental regulations.	✓	✓
	Environmental Regulatory Affairs Specialists	Green	Determine regulations or procedures related to the management, collection, reuse, recovery, or recycling of packaging waste.	✓	✓
	Arbitrators, Mediators, and Conciliators	Greening	Specialise in the negotiation and resolution of environmental conflicts involving issues such as natural resource allocation or regional development planning.	✓	✓
	Reporters and Correspondents	Greening	Report on green technology or environmental issues, such as pollution, energy efficiency, recycling, or renewable energy.	✓	✓

Source: Authors, based on the O*NET database's taxonomy of green occupations and its comparison with the local guidelines in both countries.

CHAPTER 4: Addressing skills gaps and mismatches in the emerging energy sector transition: Skills needs identified in Albania, Egypt and Tunisia

Ahmed Hamza H. Ali and Liga Baltina

4.1 Introduction

The energy sector comprises all activities related to the production and supply of energy, including non-renewable (petroleum products, gas, nuclear, etc.) and renewable (hydropower, biofuels, solar and wind power, etc.) sources. It encompasses all phases, from exploration and extraction to transportation, refining and distribution of oil or gas reserves, oil and gas drilling, pipeline and refining, mining (coal, nuclear), and renewable energy. It includes the electrical power industry, electricity generation, electric power distribution networks, and sales.

From the classification of economic activities such as NACE, the following categories are most likely included in the definition of the energy sector (in the case of the EU): *B- Mining and quarrying, D- Electricity, gas, steam, and E- Water supply, sewerage, waste management*. Employment in these sectors only approximates the level of employment in the energy sector, and the numbers should be taken as indicative.

The energy sector is strategically important as countries aim for self-sufficiency to meet rising demand. Economic growth drives energy consumption, necessitating efficient use of resources. While fossil fuels dominate globally, renewable sources, such as solar, wind, hydropower, bio-waste, and low-carbon nuclear energy, are growing due to climate change awareness and technological advances. The energy sector encompasses monitoring and maintaining energy generation plants, transmission networks, and investments in efficiency, such as insulation, smart networks and grids. Activities range from extraction and refining to renewable energy generation, distribution and sales. Albania, Egypt and Tunisia have more than doubled energy consumption over the past 20 years, emphasising the sector's economic importance. Strategies and investments in renewables reflect these countries' commitment to the sector's development, though achieving these goals requires financial resources and enhanced workforce skills.

This research explores skills gaps in Albania, Egypt and Tunisia by analysing current and future skill requirements for advancing resilience, carbon neutrality and efficiency. These countries face unique challenges and opportunities in their energy transitions. For instance, Albania heavily relies on hydro-electric resources and is vulnerable to climate change, while Tunisia depends on imported natural gas, raising energy security concerns. Egypt, meanwhile, is advancing solar energy and energy efficiency through its National Energy Efficiency and Renewable Energy Action Programme.

Building on European Training Foundation (ETF) research 2021-2023 (ETF, 2022a, 2022b, 2023a), this study deepens the understanding of the skills required for the sector's transformation. It provides policy recommendations to bridge existing and future skills gaps, emphasising the importance of sustainable transitions. The study suggests ways for these countries to address challenges while aligning with global energy trends. By identifying commonalities and differences in occupational skill needs, the research provides targeted actions for skills development and labour market alignment, informing policy strategies to position Albania, Egypt and Tunisia in the evolving energy landscape. Comparisons are provided with the development of the EU's renewable energy sector and the measures introduced to ensure that the supply of skills facilitates a reduced dependence on fossil fuels.

4.2 Developments in the energy sector in the EU, Albania, Egypt and Tunisia

Countries such as Albania, Egypt and Tunisia, which play a role in energy outsourcing for EU industries, are directly influenced by the EU's energy policies. The European Green Deal and 'REPowerEU" plan: Affordable, secure, and sustainable energy for Europe' are helping the EU to save energy, diversify energy supplies and produce clean energy. REPowerEU engages these countries by encouraging investments in renewable energy projects, energy efficiency and sustainability practices. This partnership creates a need for aligned skills development frameworks to support the local workforce in meeting the new demands of the energy transition. Tunisia targets a 35% renewable energy share by 2030, requiring 4,850 megawatts (MW) of renewable energy capacity in 2030 and 8,350 MW by 2035. The financial implications of this goal are significant, with an estimated investment required of around 55 billion Tunisian Dinars (about 16.66 billion Euros), with challenges of attracting foreign investment, developing local expertise and modernising grids (ETF, 2022b).

Albania's energy supply is hydropower-dominated, accounting for 88.5% of its electricity production in 2019 (Eurostat, 2021). Albania's total primary energy production was 1.7 million tonnes of oil equivalent (toe) in 2019, a 39% increase from 2009. Petroleum products contributed the largest share at 57.9%, followed by renewable energy sources at 35.8%. These latter have seen a significant increase of 17.7% since 2009 (ETF, 2022a), thanks to specific efforts to diversify energy sources. However, hydropower output varies with climate conditions, emphasising the need for energy security strategies (Energy Community Secretariat, 2020).

Egypt boasts significant oil and gas reserves. In 2019, Egypt's natural gas reserves accounted for about 1.63% of the world's total, making it a notable player in the global energy market (BP, 2020). Hydroelectricity is another important component of Egypt's energy mix, contributing approximately 16.2% of total electricity generation. Recent renewable energy projects are gradually reshaping Egypt's energy landscape. By 2019, the country had already achieved a renewable energy generation capacity of 0.25% of the global total (ETF, 2023a). With a rapidly growing population, Egypt's energy demand is expected to increase significantly, posing challenges to its energy infrastructure and continuous supply. The post-2021 period witnessed an increasing shift towards renewable energy, indicating Egypt's commitment to diversify energy sources and enhance sustainability.

The energy sectors in the EU, Tunisia, Albania and Egypt share several areas of strategic interest, reflecting their common goals of enhancing energy security, improving sustainability and transitioning towards a low-carbon economy (see Table 1). However, the focus and progress in each area vary depending on the country's resources, infrastructure and policy priorities. Solar energy is central to meeting energy needs, with Tunisia and Egypt leveraging abundant solar resources. With its high solar insolation levels, Tunisia has set ambitious targets to increase solar energy's share in its energy mix. Egypt's solar potential is also enormous, with projects like the Benban Solar Park making it one of the largest solar installations globally. Wind energy development is another shared interest, particularly in the EU, which has extensive onshore and offshore wind farms. Tunisia and Egypt are expanding their wind energy capabilities, leveraging favourable wind conditions, particularly in coastal areas and deserts. Hydrogen is also emerging as a focus, with Egypt exploring green hydrogen for export (Learnbook on Hydrogen Imports to the EU Market, 2024).

Table 1: Key areas of the energy development sector for Tunisia, Albania, and Egypt

Area of interest	Albania	Egypt	Tunisia
Solar Energy	Yes	Yes	Yes
Wind Energy	Yes	Yes	Yes
Hydro Energy	Yes	Yes	Yes
Hydrogen Energy	Emerging	Yes	Emerging
Energy Efficiency	Yes	Yes	Yes
Thermal Energy	Yes	Limited	Yes
Fossil Fuel Energy	Yes	Yes	Limited
Oil and Gas Extraction/ Refinery/Transport	Yes	Yes	Yes
Nuclear Energy	No	Yes	Emerging
Biofuel Energy	Limited	Emerging	Emerging
Energy Transmission and Distribution	Yes	Yes	Yes

Source: Table created from the findings of the ETF studies in 2022a, 2022b, 2023a.

Albania and Tunisia are in the early stages of hydrogen development but are interested in developing this further (Energy Community Secretariat, 2020). Thermal energy, particularly geothermal and other forms of heat energy, is more developed in Tunisia and Albania. Egypt, however, has limited development in this area but could consider its potential in the future. Energy efficiency is critical across three countries, with increasing efforts to reduce energy consumption and emissions and to focus on modernising infrastructure and implementing energy-saving technologies (ETF, 2022a, 2022b, 2023a).

Fossil fuel energy remains a significant part of the energy mix, particularly in Egypt and Albania, while the EU is gradually phasing out fossil fuels (BP, 2020). The modernisation of energy transmission and distribution networks is critical across all regions to integrate renewable energy sources, improve efficiency and ensure reliability. Tunisia, Albania and Egypt have prioritised grid upgrades to support the integration of renewable energy and improve energy access (ETF, 2022a, 2022b, 2023a). These developments align Tunisia, Albania and Egypt with the EU's energy goals.

4.3 Drivers of change in the energy sector in Albania, Egypt and Tunisia

This section outlines key factors transforming the energy sectors in Albania, Egypt and Tunisia, focusing on emerging technologies and strategies shaping future labour and skill demands. Shared trends include prioritising energy sustainability, attracting investment, introducing new regulatory frameworks and integrating technological innovations. All three countries emphasise transitioning to more sustainable energy. Tunisia and Egypt aim to reduce fossil fuel dependence by expanding solar and wind energy. Albania relies on hydropower but seeks diversification to enhance energy security and sustainability. Tunisia and Egypt have set ambitious renewable energy targets aligned with global decarbonisation trends. All three countries are committed to attracting significant investments to develop new renewable energy facilities. Tunisia and Egypt focus on creating a predictable regulatory environment to attract large-scale renewable energy projects. Albania is leveraging its EU accession process to align its energy policies with EU standards to attract investment for energy security but also for economic growth and job creation (ETF, 2022a, 2022b, 2023a).

It is important to mention the emerging technological advances transforming the energy sector everywhere: smart energy systems enable the integration of renewable energy, enhance grid flexibility, and facilitate the energy transition. Technologies such as AI, big data analytics, and the Internet of Things are transforming energy production, distribution and consumption. Energy storage systems, such as those supported by the EU's Horizon Europe initiatives, play a critical role in addressing intermittency in renewables like solar and wind. Integrating these new technologies is also a shared priority for the three countries. As smart grid technologies, energy storage solutions and digitalisation are areas where significant advances are expected, they will require a workforce equipped with new skills, particularly in areas such as data management, advanced manufacturing and systems integration.

The European Commission's research on energy technology innovation highlights the importance of aligning skill development with technological change to ensure a smooth energy transition. Improving infrastructure is key to reducing inefficiencies in the energy production-transmission-distribution chain. Albania is enhancing its infrastructure for hydropower management, while Tunisia and Egypt are focusing on modernising grids to integrate renewables and meet growing energy demand. While Tunisia is advancing through its Solar Plan, Albania is beginning to explore storage for hydropower and solar integration. Egypt is incorporating storage in large-scale projects like the Benban Solar Park (ETF, 2022a, 2022b, 2023a). All three countries align with the EU's principles, leveraging support to adopt solar, wind and hydropower technologies while modernising grid infrastructure through smart grids and flexibility markets. Table 2 provides a list of country-specific factors.

Table 2: Factors transforming the energy sector in Tunisia, Albania, and Egypt

Country	Transforming factors
Albania	▪ Exploiting renewable energy potential, improving infrastructure efficiency ▪ Enhancing environmental sustainability, particularly in hydropower ▪ Aligning national energy policies with the EU's to attract investment ▪ Deploying technological innovations that shape the energy labour market and future skill needs
Egypt	▪ Exploiting renewable energy potential (e.g. solar, wind, hydropower) alongside fossil fuel ▪ Deploying technological innovations that shape the energy labour market and future skill needs ▪ Coping with climate change challenges and their impact on renewable energy sources ▪ Creating a clear regulatory framework and a predictable investment environment ▪ Meeting growing energy demand due to population growth, urbanisation, and rising living standards ▪ Attracting investment in renewable energy facilities
Tunisia	▪ Enhancing sustainability and reducing fossil fuel reliance ▪ Attracting renewable energy investments and creating a predictable regulatory framework ▪ Strengthening transmission and distribution facilities ▪ Deploying technological innovations that shape the energy labour market and future skill needs

Source: Table created from the findings of the ETF studies in 2022a, 2022b, 2023a.

Albania's energy sector is heavily influenced by its EU accession process, which requires alignment with the EU's strict energy and environmental standards. This alignment is expected to drive significant reforms in the energy sector, including adopting renewable energy targets and implementing energy efficiency measures. The Energy Community, which supports Southeast European countries in aligning their energy policies with the EU, has been instrumental in guiding Albania's energy reforms (Energy Community Secretariat, 2020).

4.4 Employment and skills overview in the energy sectors of Albania, Egypt, Tunisia and the EU

Despite the changing definition of the energy sector from one country to another, which has implications of non-comparability of employment statistics, under no circumstances is the energy sector characterised as employment intensive (JRC, 2020). Based on the classic definition of the energy sector (e.g. NACE categories D, B, E), the share of employment in the energy sector is around 2% of total employment in most countries across the world. According to the International Energy Agency (IEA), in its World Energy Employment 2024, over 67.5 million people were employed in the energy and related sectors in 2023, up from 65 million in 2019 (IEA, 2024). In IEA's definition, the energy sector includes fuel supply (coal, oil, gas and bioenergy), the power sector (generation, transmission and distribution) and energy end uses (vehicle manufacturing, and energy efficiency for buildings and industry).

Based on the figures provided by IEA (2022), China has the largest number of energy workers (nearly 20 million), representing around 2.5% of total employment. North America has an even larger proportion, with 3.4% of total employment amounting to 7.9 million workers in the energy sector. In the Middle East and Eurasia, the energy workforce makes up a relatively high share of economy-wide employment, averaging 3.6%. Finally, Europe has 7.5 million workers in energy sector, or 2.4% of total employment (IEA, 2022). Despite accounting for a small share of overall employment, the energy sector is strategically important given its role in maintaining modern life and providing the means to power the economy. It also plays a leading role in reducing carbon emissions and bringing about a greener society.

Out of 67.5 million energy-related jobs, 51.5% are in clean energy (34.8 million jobs) as of 2023 (IEA, 2024). Amid the many positive trends emerging for clean energy employment, skilled labour shortages are already plaguing the sector and require attention. The energy sector needs more skilled workers than most other industries — 36% of energy jobs are within high-skilled occupations by ILO definitions, especially in the construction, manufacturing and utility sectors (IEA, 2023). A survey of over 160 energy companies conducted by the IEA indicates that installation and repair work positions were the number one occupation segment for which respondents had the greatest difficulty hiring, mostly due to a lack of industry-specific knowledge (IEA, 2023).

This section offers insight into the current employment trends and skills requirements in the energy sectors of the EU, Tunisia, Albania and Egypt. It explores the shifts in labour demand, the growing importance of specialised skills in renewable energy, and the evolving workforce dynamics as these regions strive to meet their energy transition and sustainability goals.

4.4.1 Employment and skills in the energy sectors of Albania, Egypt and Tunisia

In Albania, the share of employment in the energy sector is around 2% of total employment, including the workforce in three NACE sectors: B, D, and E. Therefore, around 9,000 people are employed in D-Electricity, around 7,500 in B-Mining, and around 10,700 in E-Water. Employment shares have not changed much over the past decade (ETF, 2022a)[18]. Most of the workers in the electricity sector are employed in the public Electric Power Distribution Operator (OSHEE), with approximately 6,000 people. Private companies are primarily involved in system operation and maintenance and employ around 500 workers. The energy efficiency segment of the sector also contributes to employment, with around 140 energy auditors and managers active in the field. The most in-demand jobs are electricians, reflecting the sector's current focus on operational roles rather than more advanced technical or engineering positions (ETF, 2022a).

According to a report of the World Bank on the employment benefits of green transition in Egypt, the clean-energy sector is expected to provide 2 million job-years over 30 years until 2050. This is equivalent to 67,000 job opportunities per year (about 0.2% of the total labour market based on 2020

[18] This makes up a total of 27 300 people employed in the three sectors in 2019 (D-Electricity, E-Water, B-Mining), 2% of total employed population (1 260 000) (ETF, 2022a).

figures) (World Bank, 2022). The Egyptian renewable energy sector offers growth potential, though overall energy-related employment decreased by 5.2% from approximately 357,000 workers in 2010 to 338,000 in 2020, contrasting with the country's overall 10% employment growth. The decrease in energy sector employment is primarily attributed to reductions in the extraction of crude petroleum and natural gas (21%) and the electricity, gas and air-conditioning supply sectors (13.7%) (ETF, 2023a). Employment in mining support services grew by 29%, and the petroleum manufacturing sector saw a 24.5% increase in jobs, reflecting shifts in the country's energy focus and labour market demands.

The decline in traditional energy sector employment may be partly due to the economic challenges following the Arab Spring and the global energy market's volatility. However, expanding the renewable energy sector is expected to create new employment opportunities. Despite Egypt's growing interest in renewables, the decline in employment in the electricity sector suggests a potential mismatch between the current skills available in the labour market and those required for the emerging renewable energy industry. As Egypt continues to invest in renewables, addressing this skills gap will be key for maximising the sector's employment potential.

Tunisia's renewable energy sector is poised for significant expansion. The Tunisian Solar Plan aims to create approximately 12,000 jobs by 2030, driven primarily by solar energy projects. The broader 2035 Energy Strategy aims to generate 70,000 new jobs across various green technologies, including solar, wind, and hydrogen energy. This ambitious target represents a substantial increase from nearly 3,000 jobs created by a similar programme in 2015. This is critical given the country's high unemployment rate, which stood at 16.8% in 2021, and its even higher youth unemployment rate (40% of young workers and 30% of young graduates) (ETF, 2022b).

For example, the Tataouine Wind Farm (120 MW) generated 500 direct jobs during construction and continues to support 30 permanent positions in operation and maintenance. Similarly, Kairouan's 10 MW photovoltaic plant created 200 temporary jobs and 10 permanent roles. However, it is important to note that while the construction phase of renewable energy projects can create a substantial number of jobs, the operational phase requires relatively few personnel. This means that the long-term impact on unemployment may be modest. Therefore, while renewable energy projects can provide a temporary boost in employment during construction, their sustained impact on reducing unemployment will depend on continuous investment in new projects and the development of related industries.

The EU, with its advanced renewable energy sector, shows a clear shift towards more diversified and technology-driven employment opportunities. In contrast, Tunisia and Egypt are in the early stages of a green transition that promises significant job creation, particularly in regions with high unemployment. Albania's energy sector, while smaller in scale, remains strategically important, with a need for greater investment in skills development to support its energy infrastructure and efficiency goals. Across all regions, the transition to renewable energy and the integration of new technologies will be key drivers of future employment trends, requiring targeted efforts to align workforce skills with the demands of a rapidly evolving energy sector.

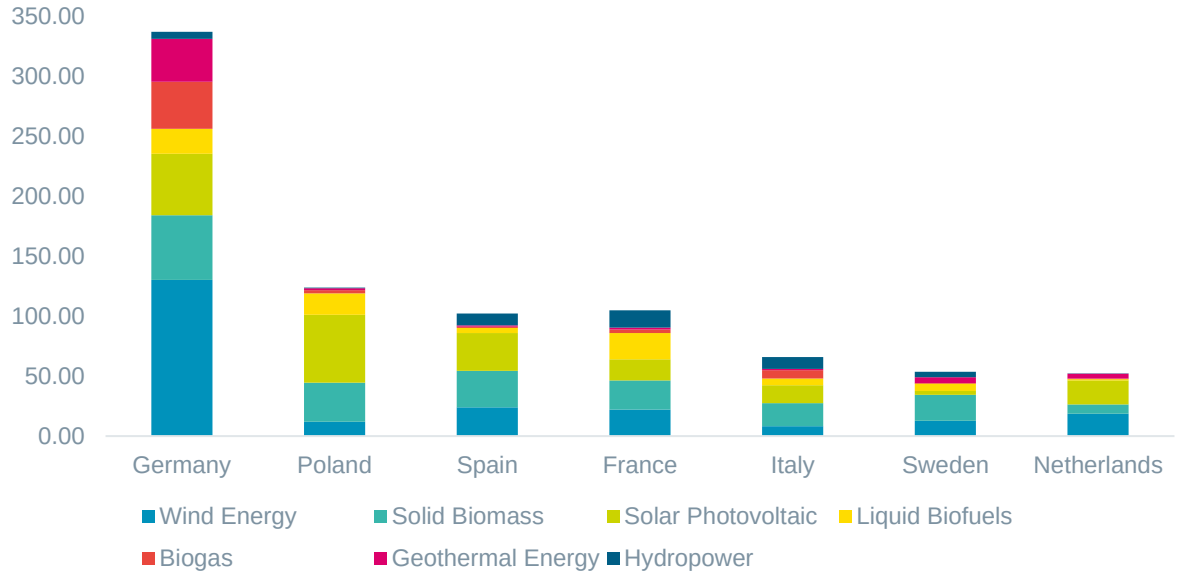
4.4.2 Employment and skills in the EU energy sector

Evolutions in the EU's renewable energy sector may provide an indication of the direction in which labour and skills demand is likely to change in Albania, Egypt and Tunisia. As mentioned before, Europe has 7.5 million workers in the energy sector, constituting 2.4% of total Employment (IEA, 2022). In 2023, renewable energy represented 24.5% of energy consumed in the EU, up from 23% in 2022 (European Commission, 2024). The EU Directive 2023/2413 on the promotion of the use of energy from renewable sources has revised upwards the EU's 2030 renewable energy target from 32% to 42.5%. Sweden ranked first among EU countries, with two thirds (66.4%) of its gross final energy consumption coming from renewable sources in 2023. Sweden primarily relies on solid biofuels, as well as hydro and wind. Finland followed with 50.8%, relying on the same sources, while Denmark came in third with 44.9%, with most of its renewable energy sourced from solid biofuels and wind (European Commission, 2024).

On the other hand, renewable energy sources made up 45.3% of the EU's gross electricity consumption in 2023 (European Commission, 2024). Wind and hydropower accounted for more than two-thirds of the total electricity generated from renewable sources (38.5% and 28.2%, respectively). The remaining third of the electricity generated was from solar power (20.5%), solid biofuels (6.2%) and other renewable sources (6.6%). Among EU countries, more than 75% of electricity consumed in 2023 was generated from renewable sources in Austria (87.8%), Sweden (87.5%) and Denmark (79.4%) (European Commission, 2024).

The EU's renewable energy sector employed over 1.6 million people across its 27 Member States in 2022. This accounts for 12% of the global renewable energy workforce, which is 13.7 million jobs. Employment is concentrated in key technologies, with solar photovoltaic leading at 33.7%, followed by solid biomass (23.0%), wind energy (20.8%), liquid biofuels (9.6%), heat pumps (6.0%) and hydropower (5.4%) (IRENA, 2023). As shown in Figure 1, employment distribution is uneven across the EU, with Germany hosting 22% of EU renewable energy jobs, followed by Poland (13%), Spain (10%), France (9%) and Italy (7%) (IRENA, 2023). This reflects national differences in energy policy, investment levels and industrial capacity.

Figure 1: Employment in the renewable energy sector by type of technology in EU member states with at least 50,000 jobs in 2021



Source: IRENA, 2023.

The employment landscape within the electricity sector is diverse, with varying trends across different occupations between 2015 and 2021. For instance, the number of electrical equipment installers and repairers increased by 13.7%. In contrast, the number of physical and engineering science technicians decreased by 12.8%, including all sources of electricity (renewables and non-renewables). The sector has seen a notable rise in general office clerks, with employment growing by 140.2%, reflecting a shift towards administrative and management roles. Conversely, some technical roles, such as process-control technicians and electrotechnology engineers, have experienced a decline, indicating potential shifts in the skills required as the sector evolves (see Table 3).

Table 3: Employment in the electricity sector in EU-27 by occupations

ISCO code	Occupation	Employed 2015	Employed 2021	Difference (absolute) 2021-2015	Difference (percentage) 2021-2015
7.74.741	Electrical Equipment Installers and Repairers	157	178	21	13.7%
3.31.311	Physical and Engineering Science Technicians	127	111	-16	-12.8%
4.41.411	General Office Clerks	37	90	52	140.2%
2.21.214	Engineering Professionals (excluding Electro technology)	62	89	27	43.6%
3.31.313	Process Control Technicians	100	78	-21	-21.4%
2.21.215	Electro technology Engineers	72	63	-8	-11.4%
3.33.334	Administrative and Specialized Secretaries	39	41	2	4.8%
4.43.432	Material Recording and Transport Clerks	56	39	-17	-31.2%
2.24.241	Finance Professionals	21	38	17	79.6%
3.33.332	Sales and Purchasing Agents and Brokers	33	38	4	12.4%
2.24.243	Sales, Marketing and Public Relations Professionals	31	37	7	21.9%
2.24.242	Administration Professionals	26	35	9	33.4%
7.71.712	Building Finishers and Related Trades Workers	39	35	-4	-11.1%
4.41.412	Secretaries (general)	27	31	4	16.2%
4.42.422	Client Information Workers	24	30	7	28.6%
2.25.251	Software and Applications Developers and Analysts	16	30	14	86.7%
7.72.723	Machinery Mechanics and Repairers	28	29	1	2.6%

Source: IRENA, 2023

The EU's energy sector contrasts with those of Albania, Egypt and Tunisia in scale, technology and workforce sophistication. The EU's workforce is diverse, with growing roles in digitalisation, smart grids, and renewable technologies. In contrast, Tunisia and Albania focus on operational and technical roles, while Egypt faces a skills mismatch in its renewables sector. The EU advancements in solar, wind and biomass highlight a matured renewable energy transition supported by strong technical and administrative roles. While prioritising renewables, Tunisia, Albania and Egypt are at earlier stages, emphasising workforce expansion over specialisation. Germany, Spain and France dominate EU employment in the sector, showcasing the benefits of targeted national strategies.

Compared to the EU member states, Albania, Egypt and Tunisia are at earlier stages of their energy transitions (ETF, 2023b). Nevertheless, they stand to benefit from adopting lessons from the EU's approach, particularly in terms of aligning education and training systems with emerging energy technologies. As these countries look to expand their renewable energy sectors, targeted investments in skills development – especially in technical, digital and managerial capacities – will be important to ensure a sustainable energy transition, similar to the shifts seen in the EU (ETF, 2023b).

4.5 Mapping skills demand in the energy sectors of Albania, Egypt and Tunisia

This section explores the specific skills demand in the energy sector of the three countries, emphasising the urgent need for technical and managerial expertise. In this context, we have analysed the work conducted by the ETF on the future skill needs in the energy sectors of Tunisia, Albania and Egypt. The findings presented here are supported by ETF's in-depth research (ETF, 2022a, 2022b, 2023a), which involved extensive data collection, big data analysis, and consultations with key stakeholders and companies in each country.

Skills demand identified in the Albanian energy sector: Albania's energy sector is also undergoing a profound transformation, driven by the country's efforts to modernise its energy infrastructure and increase the use of renewable energy sources.

- **Technical skills demand:** There is a high demand for professionals who can manage the transition to new energy systems. This includes a range of engineering profiles, such as mechanical, civil and energy engineers, who are essential for developing renewable energy projects, including hydropower, solar, wind, and thermal energy. Specific profiles such as wind energy engineers, solar power plant operators and water treatment system operators are increasingly in demand, reflecting the diverse energy sources being developed in the country.
- **Cross-sector skills:** Mechanical engineers with expertise in turbines, gears and shafts are particularly valuable, as their skills can be applied across various energy sub-sectors. Similarly, energy analysts and manufacturing managers are important in ensuring energy projects' efficient operation and strategic development.
- **Educational and training gaps:** Despite the demand for these specialised skills, Albania's ability to supply these professionals is lacking. This gap highlights the need for targeted educational programmes and training initiatives that focus on the specific needs of the energy sector. The development of specialised courses and hands-on training in renewable energy technologies is important to equip the workforce with the necessary skills.

Skills demand identified in the Egyptian energy sector: Egypt's energy sector, particularly renewables, is a key area for future employment growth. However, this potential needs to be addressed in order to realise it fully.

- **Technical skills demand:** There is high demand for energy efficiency engineers, sustainability experts, energy auditors and engineers with experience in solar and wind power design and infrastructure. Electrical engineers and technicians skilled in installing, operating and maintaining power plants are also in high demand. Additionally, there is an emerging need for specialists in wind-blade maintenance, reflecting the sector's expansion into wind energy.
- **Managerial and IT skills:** As the energy sector modernises, there is an increasing need for managerial roles such as energy management system operators and energy managers. These positions require technical expertise and strong IT and software competencies to manage complex energy systems effectively. Integrating digital technologies into energy management underscores the importance of IT skills in the sector.
- **Training and education needs:** The current educational offerings in Egypt are insufficient to meet the evolving demands of the energy sector. There is a critical need to update curricula in

engineering and technical schools to include knowledge of renewable energy technologies. This includes developing new courses focused on emerging technologies such as photovoltaic cooling, hydrogen energy and waste-to-energy. Practical, on-site training for engineers and technicians, particularly those installing and maintaining renewable energy systems, is also essential. Collaborative efforts between industry and educational institutions are needed to develop comprehensive training programmes that address these gaps.

The main skills demanded across the three countries are summarised in Table 4 below, which are classified under technical, managerial and cross-sectoral skills. All these skills are crucial in supporting the ongoing energy transitions. The most pressing need is technical expertise in renewable energy technologies, digital skills to manage modern energy systems, and managerial competencies to lead the transition.

Skills demand identified in the Tunisian energy sector: Tunisia's energy sector is transitioning towards renewable energy and efficiency, creating demand for a mix of traditional and emerging skills.

- **Technical skills**: There is a high demand for specialist welders (e.g. laser welders), pipefitters and solar power technicians, particularly as the solar and wind sectors expand. However, Tunisia lacks wind energy professionals, such as wind turbine technicians, due to the limited number of wind power projects and training programmes.
- **IT and digital skills**: Expertise in maintaining digital tools such as sensors, programmable logic controllers (PLCs) and servers is essential for modern energy infrastructure.
- **Managerial and environmental skills:** Roles such as energy and environmental managers are important for optimising energy consumption, identifying inefficiencies and implementing sustainable practices. Environmental management, including waste management and sustainable energy production, is becoming increasingly important. However, Tunisia currently has limited trained environmental managers, indicating a significant skills gap.
- **Training and education initiatives:** Tunisia has a strong engineering education system, with many institutions offering programmes in mechanical, electrical and energy engineering, which needs alignment with the evolving industry demands. Organisations like the International Center for Technologies and Environment of Tunis (CITET), the Tunisian German Chamber of Industry and Commerce (AHK), and the National Agency for Energy Management (ANME) are actively involved in providing specialised training in renewable energy and energy efficiency. These initiatives aim to bridge the skills gap by offering programmes catering to the energy sector's specific needs.

The main skills demanded across the three countries are summarised in Table 4, which are classified under technical, managerial and cross-sectoral skills. All these skills are crucial in supporting the ongoing energy transitions. The most pressing need is technical expertise in renewable energy technologies, digital skills to manage modern energy systems, and managerial competencies to lead the transition.

Table 4: Key skills in demand across the energy sectors of Tunisia, Albania, and Egypt

Skill category	Albania	Egypt	Tunisia
Technical skills	Mechanical engineers (turbines, gears)	Energy efficiency engineers	Specialist welders (e.g. laser welders)
	Civil engineers	Sustainability experts	Pipefitters
	Energy engineers	Energy auditors	Solar power technicians
	Wind energy engineers	Solar energy design engineers	Wind turbine experts
	Solar power plant operators	Construction engineers (renewables)	IT specialists for the energy sector
	Water treatment system operators Thermal and heating engineers	Electrical engineers (power plant ops.)	Instrument maintenance technicians
		Wind blade maintenance technicians	
Managerial skills	Energy analysts	Energy management system operators	Energy managers
	Manufacturing managers	Energy managers	Environmental managers
	Renewable energy engineers	Software competencies for energy roles	Energy assessors
	Decarbonisation managers*	Decarbonisation managers*	Decarbonisation managers*
Cross-Sectoral skills	Mechanical engineers (cross-subsector)	IT skills for digital energy management	Engineers with IT and digital expertise
	Cross-functional energy skills	Hybrid technical-commercial skills	Engineers with environmental management skills?
	Training in renewable energy technologies	Training in solar, wind, and hydrogen	Training in renewable energy and efficiency
Educational needs	Specialised renewable energy courses	Updated engineering and technical curricula	Enhanced engineering curricula
	Hands-on training in renewable energy	In-company technical training for engineers	Practical training in solar and wind energy

Source: Table created from the findings of the ETF studies in 2022a, 2022b, 2023a.

Although not included in the ETF reports in driving the energy transitions in Tunisia, Albania and Egypt, other roles such as Quality Audit Managers – whether internal or external – are becoming increasingly important in this context. These professionals play a crucial role in aligning organisations with environmental standards and supporting them in achieving certifications, such as ISO 14001 for environmental management systems. The evolving regulatory landscape in the energy sector, particularly around sustainability and environmental compliance, suggests that there will likely be a growing demand for skilled Quality Audit Managers and potentially similar profiles soon. This presents an opportunity for further research and development of training programmes to ensure that companies can meet both national and international environmental standards.

Another profile not mentioned in the ETF's country reports but is becoming increasingly important is that of decarbonisation managers due to the emphasis on decarbonising the energy sector,

particularly in the context of climate change and energy efficiency improvements. Decarbonisation is highlighted as a crucial step in reorganising energy production and improving energy-efficient consumption. As Albania, Tunisia and Egypt push forward with their energy transitions, the need for Decarbonisation Managers to lead carbon reduction strategies will become more critical. These managers will be important for aligning energy operations with sustainability goals and implementing decarbonisation initiatives.

4.6 Examples of EU initiatives for employment and skills in the energy sector

The foregoing analysis has indicated the extent to which the development of the renewable energy sectors in Albania, Egypt and Tunisia lag behind the EU in the development of the skills required to reduce carbon emissions. By looking at some of the measures introduced in the EU to ensure better matching of skills demands with supply, insights are provided into the kind of measures each of the three countries might contemplate in an effort to offset the danger that skill shortages will hamper the transition to a carbon-neutral economy.

4.6.1 Industrial alliances and collaborative platforms

The EU has established alliances like the European Solar Photovoltaic Industry Alliance, the European Clean Hydrogen Alliance, the Renewable and Low-Carbon Fuels Value Chain Industrial Alliance, and the European Battery Alliance to drive innovation and workforce readiness. These alliances collaborate with training providers to develop programmes targeting industry-specific skills. For instance, the Solar Photovoltaic Industry Alliance focuses on training for solar panel installation, maintenance and project management. Similarly, the Clean Hydrogen Alliance develops expertise in fuel cell technology, safety protocols and infrastructure development.

The **Pact for Skills**, which is a large-scale renewable energy skills partnership, supports these efforts by:

- developing and adopting policy recommendations that support skills development tailored to the needs of the renewable energy sector;
- increasing the involvement of education and training institutions, including Vocational Education and Training (VET) providers, in delivering relevant skills; and
- implementing strategies to attract more women into the sector, addressing gender disparities and promoting diversity within the workforce (European Commission, 2023b).

4.6.2 Centres of Vocational Excellence

Centres of Vocational Excellence (CoVEs) aim to address the gap between industry needs and educational offerings aligned with green transition requirements. CoVEs work towards ensuring that training programmes are up to date with the latest technological advancements and aligned with the European Qualifications Framework (EQF) levels 4-8. An exemplary case is the GREENOVET project, which focuses on enhancing vocational excellence in green innovation across Europe. The project has created networks of CoVEs that work closely with local and regional stakeholders to identify skills gaps related to the green transition. This collaboration has led to the development of specialised curricula in areas such as renewable energy technologies, sustainable manufacturing and eco-innovation, which are now being rolled out across participating regions (GREENOVET, 2023).

Another initiative is SECOVE[19] (Sustainable Energy Centres for Vocational Excellence), which establishes a cooperation platform for CoVEs across Europe in the renewable and sustainable energy sector. SECOVE promotes lifelong learning opportunities, facilitates work-based learning, and enhances collaboration between education providers, industry and incubators. It also supports the

[19] https://secove-project.eu/about/

internationalisation of VET providers and seeks to attract more women into technical qualifications, addressing existing gender disparities in STEM-related fields. By aligning with national and regional policies, SECOVE fosters excellence in skills development for sustainable energy systems, smart grids and energy efficiency. Extending these initiatives to other areas requires a tailored approach involving key stakeholders at the local or regional levels and conducting comprehensive assessments of skills gaps. The role of CoVEs in the green and digital transitions often emphasises implications for specific sectors such as energy (see ETF 2023c and 2023d). There is a special ETF network of CoVEs for greening vocational education and training (see ETF, 2023e).

4.6.3 The EDDIE Project: A blueprint for digitalisation in the energy sector

The EDDIE project (Education for Digitalisation of Energy) is a strategic initiative to create a Skills Alliance in the European energy sector. The project aims to enhance digitalisation, match current and future skills demand, and improve the quality of VET programmes across Europe. One of the key outcomes of the EDDIE project is the development of a **Blueprint Strategy** for digitalising the energy value chain. The focus areas include: reinforcing fundamental technical skills, such as understanding energy economics, mastering specific technical operations, and integrating modern technologies into energy production and distribution; incorporating green skills into educational curricula, which emphasise ethical behaviour, resource conservation and ecological integrity; and addressing the growing need for digital competencies, such as big data analytics, the Internet of Things (IoT) and cybersecurity. These skills are critical for managing the complexities of modern energy systems and ensuring their security and efficiency.

4.6.4 Other initiatives

In addition to the initiatives mentioned above, several other initiatives provide lessons and good practices in addressing skills gaps in the energy sector:

- The **Energy Skills Partnership** in **Scotland (UK)**: This initiative brings together colleges, universities and industry to deliver training programmes tailored to the renewable energy sector. It has been successful in aligning training with industry needs, particularly in areas such as offshore wind, energy efficiency and sustainable construction.
- The **Skills for Energy** **initiative in the UK**: A programme led by the Energy & Utility Skills Group focuses on developing a future-proof workforce by identifying emerging skills needs and creating targeted training programmes. This initiative emphasises the importance of lifelong learning and continuous professional development in maintaining a skilled workforce in the energy sector.
- The **German Dual Education System**: Germany's dual education system is known for its strong emphasis on vocational training, combining classroom-based education with hands-on industry experience. This model has been particularly effective in producing a workforce equipped with the technical and practical skills needed in the energy sector, including emerging areas such as renewable energy and energy efficiency (German Federal Ministry of Education and Research, 2023).

These initiatives demonstrate the importance of strategic collaboration in addressing the skill needs of the energy sector. Expanding these good practices to other regions and sectors requires proactive identification of emerging skills gaps, the development of relevant training programmes, and the promotion of an inclusive and diverse workforce.

4.7 Conclusions and recommendations

This research has explored the evolving skill needs in the energy sector in Albania, Egypt and Tunisia focusing on emerging technologies and interdisciplinary roles important for the sector's transformation. Key findings are the following:

- **Evolving skill requirements:** The energy sector's transition necessitates a shift towards high-skilled jobs, with a growing emphasis on digital, managerial, and specialised skills related to renewable energy, energy efficiency and sustainability. This transition shows the need for enhanced training in these areas to support the sector's evolution (IAEA, 2023).
- **Educational and training gaps:** There is a deficiency in dedicated higher education and technical training programmes tailored to the emerging needs of the energy sector. Existing curricula are often outdated or insufficiently aligned with the latest technological advancements and industry requirements. The ETF country reports highlight that many graduates from engineering programmes enter the labour market with insufficient practical skills to meet the demands of renewable energy projects.
- **Limited stakeholder collaboration:** Collaboration between educational institutions, VET providers and industry stakeholders is limited. This results in a disconnect between the skills taught and the skills required by employers, contributing to a skills mismatch in the labour market (OECD, 2022).
- **Specialised workforce shortages:** The sector faces a shortage of skilled workers across various specialties, including renewable energy technologies, energy efficiency and digital management. This gap highlights the need for targeted training programmes to develop a workforce capable of meeting the sector's demands (World Economic Forum, 2023).

The following table includes the key areas of focus, country-specific recommendations and the rationale for each recommendation (see Table 5).

Table 5: Country-specific recommendations for energy sector skills development

Country	Area of focus	Specific recommendations	Rationale
Albania	Emerging technologies	1. Create training programmes for niche areas such as wind turbine technology and solar power operations. 2. Develop advanced courses for energy analysts and engineers.	Build expertise in emerging technologies and strategic roles critical for sector transformation.
	Public-private partnerships	1. Promote partnerships between public institutions and private companies to align TVET programmes with industry needs. 2. Engage local companies in curriculum development.	Ensure training programmes are relevant and responsive to real-world industry requirements.
	Skill development	1. Focus on training for civil, mechanical, and renewable energy engineers. 2. Enhance skills for roles specific to hydropower, solar, wind and thermal energy.	Equip the workforce with specialised skills for Albania's diverse energy resources and future projects.
Egypt	Renewable energy skills	1. Develop training programmes for solar PV, wind energy and energy efficiency. 2. Revise engineering curricula to include renewable technologies and digital skills.	Address skills gaps in renewable energy and modernise education to keep pace with technological advancements.
	Digital skills and technology	1. Enhance training in digital skills related to data analytics, cybersecurity and IoT. 2. Incorporate digital technologies into energy sector training programmes.	Support the integration of digital tools and technologies into energy systems for better efficiency and innovation.
	Professional development	1. Promote continuous professional development for existing workers in emerging technologies.	Ensure current professionals stay updated on new technologies and practices to remain competitive in the evolving market.

Country	Area of focus	Specific recommendations	Rationale
		2. Develop CPD programmes focused on energy management and efficiency.	
Tunisia	Renewable energy training	1. Develop specialised training programmes for solar and wind energy technologies. 2. Expand energy manager and assessor training programmes.	Address current shortages in skilled professionals and meet increasing demand in renewable energy sectors.
	International collaboration	1. Strengthen partnerships with international organisations (e.g. CITET, AHK) for best practices and training. 2. Enhance support for international certifications.	Leverage global expertise and resources to improve local training programmes and standards.
	Education system improvement	1. Integrate renewable energy and efficiency topics into engineering and technology curricula. 2. Increase funding for research in renewable technologies.	Modernise educational programmes to match industry needs and support technological advancements.

To address the skills gaps in the energy sectors of Albania, Egypt and Tunisia, there is potential to develop collaborative projects and incentives, building on shared challenges and opportunities. These initiatives could be taken as a collaboration not only between the three countries analysed here but also between the EU area and other neighbourhood regions. Here are some proposed joint initiatives:

1. **Regional renewable energy training centres**: Establish a network of training centres across Albania, Egypt and Tunisia, focusing on renewable energy technologies such as solar, wind, and energy efficiency. These centres could provide specialised courses, certification programmes and hands-on training tailored to the needs of each country while ensuring a standardised approach to skill development. The goal is to address the skill shortages in these technologies and ensure that training aligns with regional and international standards. Potential partners for this initiative include government agencies, industry associations, international organisations such as the International Renewable Energy Agency, and local universities.
2. **Energy technology innovation hub**: Create a collaborative hub that brings together researchers, industry professionals and educational institutions from the three countries to work on cutting-edge energy technologies. This hub could focus on areas such as energy storage solutions, smart grids and digital energy technologies. By fostering innovation and research, the hub aims to advance the development of new technologies and build a pipeline of skilled professionals. Key partners could include universities, research institutions, technology companies and stakeholders in the energy sector.
3. **Joint policy advocacy and cross-border internship and exchange programmes**: Develop internship and exchange programmes that enable students and professionals to gain experience in the energy sectors of Albania, Egypt and Tunisia. These programmes could provide participants with opportunities to work on real-world projects, collaborate with international peers and gain exposure to diverse energy practices. The objective is to enhance practical skills, cross-cultural understanding and professional networks among emerging energy professionals. Educational institutions, companies and industry associations in the three countries could be partners in this initiative.
4. **Standards development**: Form a regional coalition to advocate for policy changes and develop common standards for energy sector skills and training programmes. This coalition can work to align educational curricula with industry needs and promote best practices across the countries. The aim is to harmonise standards and policies, improve the alignment between education and industry requirements, and promote regional best practices. Key partners would include

government bodies, educational institutions, and industry representatives from Albania, Egypt and Tunisia.

5. **Shared digital learning platform**: Develop a digital learning platform that offers access to online courses, webinars and resources related to energy technologies and skills. However, this platform could facilitate knowledge sharing and continuous education across all participatory countries, focusing on emerging technologies and digital skills by increasing accessibility to high-quality training resources. The platform can support continuous professional development in the energy sector. E-learning providers, universities, industry experts and governmental education departments could be partners.
6. **Regional energy efficiency projects**: Develop collaborative projects aimed at improving energy efficiency in public buildings, industrial processes, and urban environments. These projects would include training for local professionals on best practices and technologies for energy efficiency. The objective is to demonstrate and implement energy efficiency measures, while building local expertise and capacity. Potential partners for these projects could include municipalities, energy companies, technology providers and international development organisations.

The suggestions provided above are designed to stimulate skills supply to the energy sector in the three countries in a way that anticipates emerging skills demand, with the aim that skill shortages do not act as a drag on the development of renewable energy generation. The danger of not making the kind of investments suggested is that the development of the renewable energy sector stalls or, worse, the dependence upon carbon-based sources of energy increases. Europe as a whole provides a wealth of examples that can be drawn upon to ensure that the demand for and supply of skills is optimised to support renewable energy generation and distribution.

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CHAPTER 5: The transition to work and graduate qualification and skill mismatch: Case studies of Morocco and Serbia

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5.1 Introduction

This paper investigates the extent, nature and consequences of qualification and skill mismatch in two EU neighbouring regions of North Africa and the Western Balkans, that face similar developmental challenges. In our primary research, each region is represented by only one of their countries: Morocco and Serbia, respectively. Both countries have strong relationships with the EU; for example, Morocco exports 64%[20] and Serbia exports 66%[21] of their goods exports to the EU. We argue that comparing these two countries can reveal how different socioeconomic and cultural contexts in the EU neighbourhood shape education and labour market outcomes. For instance, Serbia's tertiary education attainment at 34% (for 25–34-year-olds) (ETF, 2022) contrasts with Morocco's workforce dominated by basic education (81%) (DTDA, 2024). The stark gender gaps in Morocco's employment rates (respectively 18% for women vs. 63% for men in 2022) (ETF, 2023a) highlight the persistent cultural and structural barriers to women's workforce participation, while Serbia shows a relatively higher inclusion (43% female employment rate in 2022) (ETF, 2023b). Additionally, the two countries are service-driven, with services accounting for 55% of employment in Serbia and 47% in Morocco, although Morocco focuses more on agriculture (29%) while Serbia prioritises industry (30%). This underscores their differing developmental stages and economic priorities (ETF, 2023ab). This comparison offers valuable insights into the relationship between education, skills, gender, and labour dynamics, with potential lessons for policy and reform in both contexts.

The project on which this paper is based has investigated the extent to which the skills that students have learnt at their universities in Morocco and Serbia have prepared them for their roles in the workplace. We calculate a measure of labour market mismatch to identify the extent to which universities are successful in preparing students for their future careers and how this differs between the two cases. The analysis pursues three lines of enquiry: (i) measuring the levels of education and skills' proficiencies attained, (ii) measuring the type and extent of education and skill mismatch and some correlates of mismatch and (iii) identifying the consequences of educational and skill mismatch for the wage levels of university graduates.

Skill mismatch refers to a situation in which an employee's qualifications or skills are above or below those that are needed for the job (McGuinness et al., 2018). The former situation is often called "overeducation" or "overqualification" and the latter situation is often called "undereducation" or "underqualification", both being components of vertical mismatch (as opposed to horizontal mismatch which refers to mismatch by field of study). Three approaches to measuring vertical mismatch have been adopted in the literature. These are the "statistical method", the "normative method" and the "subjective method" (Leuven et al., 2011). The statistical method compares the average educational requirement of an occupation with a worker's actual level of education (McGuinness et al., 2018). It can be calculated from existing labour force surveys which gather information on educational attainment and occupation. Its disadvantage is that it does not provide any information on the skill levels actually required to do the job but simply reflects the average credentials of all workers within a given occupation (McGuinness et al., 2018). The normative method compares the normal educational requirements for each occupational group as judged by expert analysis of the level of education of each person in employment. The limitation of this approach is that as jobs and educational

[20] https://www.eeas.europa.eu/morocco/european-union-and-morocco_en?s=204
[21] https://neighbourhood-enlargement.ec.europa.eu/sites/default/files/2022-12/Serbia_12.22.jpg

requirements increase in complexity due to rapid technological change, the classifications quickly become outdated (ILO, 2018). The normative method also suffers from its reliance on the assumption that all jobs within a given occupational group require the same level of education (Quintini, 2011). The "subjective" method provides a more sensitive and individualised method of assessing educational or skill mismatch. It uses survey evidence to compare the highest level of qualification or skill attained by an employee with the (self-assessed) qualifications or skill required by the job (McGuinness et al., 2018). This can be identified through surveys that ask employees whether they have the right level of educational qualifications or skills to do their jobs. This is the approach that we adopt in this paper, as individual-level data provide more scope for individual-level analyses of the causes and consequences of qualification and skill mismatch.

Numerous empirical studies have been carried out to measure the extent of labour market mismatch in many countries. An average level of overeducation of 25.9% was found from over 100 studies that used the statistical method, while an overeducation level of 25.5% was found in a smaller number of studies that used the normative method (McGuinness et al., 2018).[22] This compares to an average level of overeducation of 21.5% from almost 150 studies that used the subjective method. The 2019 European Company Survey, using the subjective method, found that 26% of employees in the EU had a higher level of skills than was needed in their job, ranging from 35% in Germany to 16% in Slovakia[23]. Thus, whichever method is used, overeducation and over-skilling seem to be major phenomena across many countries, although it should be noted that the studies vary in the details of the methodology used and in the groups of workers covered (e.g. all workers or just those with a tertiary degree). It has also been found that individuals can be "trapped" in overeducation. A study in Spain found that young workers who were overeducated in their first job were 40 percentage points (p.p.) more likely to be overeducated in a subsequent job compared to well-matched young workers. (Acosta-Ballesteros et al., 2018). Similar evidence of persistence of overeducation during an individual's career was observed in Poland by Kiersztyn (2013). Overeducation also has a gender dimension which disadvantages female workers (Robst, 2007; Baran, 2024). Relatively few studies have investigated undereducation. Those that do so typically find a relatively low incidence of undereducation ranging from 26.3% using the statistical method, 15.8% using the normative method, and just 10.7% using the subjective method (McGuinness et al., 2018).

In the next section we set out the methodology of the research and some descriptive statistics from the graduate surveys carried out in Morocco and Serbia in the second quarter of 2024. Section 3 presents our findings on the transition to work of university graduates. Section 4 sets out the findings on qualification and skill mismatch, and section 5 sets out findings on the wage penalty of mismatch. Section 6 summarises the main findings and sets out our conclusions.

5.2 Methodology of the research

The survey was carried out among graduates from two universities: the Ibn Zohr University in Morocco and the University of Belgrade in Serbia, both considered major universities in their respective countries[24]. We used a specially designed questionnaire to identify the characteristics of the graduate respondents, their educational experience, their transition to work, their labour market status, their qualifications, job skills' requirements, wage levels and other issues. The survey provided information enabling us to examine the extent, nature and consequences of educational and skill mismatch among the surveyed graduates. The questionnaire was distributed online from March to July 2024 by local alumni associations using Google Forms. The Moroccan survey received 184 responses, while the Serbian sample received 97 responses.

[22] Studies carried out by the ETF have found similarly high rates of overeducation in Serbia among highly skilled workers ranging from 24% in 2016 using the normative method (ETF 2019) and 26% in 2019 using the normative method (ETF, 2022b) and 28% using the empirical method (ETF, 2022b).
[23] https://www.eurofound.europa.eu/surveys/data-visualisation/european-company-survey-data-visualisation
[24] The university of Belgrade is the first university in Serbia (https://www.bg.ac.rs/university-of-belgrade-ranks/). As for Ibn Zohr University, it covers 50% of the Moroccan territory (https://www.uiz.ac.ma/presentation)

Table 1: Qualifications and gender

	Bachelor	Master	PhD	Total	Male	Female	Total
Morocco	29.9%	59.8%	10.3%	100%	49.5%	50.5%	100%
Serbia	47.4%	47.4%	5.2%	100%	25.0%	75.0%	100%

Source: Primary data

As shown in Table 1: Qualifications and gender, the Moroccan sample has a majority of graduates with a master's degree, while the Serbian sample is more equally balanced between bachelor's and master's degree holders. The Moroccan sample is well balanced by gender, while in the Serbian sample three quarters of graduates are women. In the Serbian sample, the majority are ex-Faculty of Economics and Business, University of Belgrade students. In the Moroccan sample, 60% of respondents are ex-Faculty of Legal, Social and Economic Sciences (FSJES Agadir), 11% are ex-Faculty of Technical Sciences (FST Agadir) and 9% are Business School graduates (ENCG Agadir). This makes the Serbian and Moroccan samples specific to the graduates who chose to study economics and business. This applies to their socio-demographic characteristics, their skill set and their job preferences.

Table 2: Age distribution

	Under 25	26-30	31-35	36-40	41-45	46-50	Over 50
Morocco	32.0%	31.3%	11.5%	11.5%	8.8%	2.2%	1.6%
Serbia	2.1%	18.9%	23.2%	17.9%	10.5%	11.6%	15.8%

Source: Primary data

The age composition of the two samples is different (Table 2). In the Morocco sample, one third of graduates are under 25 and only 1.6% are over 50. In the Serbian sample, 2% of graduates are under 25 and 16% are over 50. While the Serbian sample has a relatively even distribution across age groups, the Moroccan sample distribution peaks at the beginning of the age scale. Two thirds of the Moroccan sample comprise recent graduates (under 30) while only one fifth of the Serbian graduates are under 30. The socio-economic characteristics of the sample also differ. In Morocco, one quarter (26%) of graduates' fathers and 14% of their mothers had university level education, while in Serbia almost half of fathers (46%) had a university education as did 43% of mothers.

Job security is relatively high in Serbia where most graduates (88%) have a full-time job compared to just over half the Moroccan graduates (56%). More than four fifths of graduates in Serbia hold permanent or open-ended employment contracts, compared to only just over two thirds in Morocco, where one tenth have fixed-term employment contracts, one tenth is self-employed and 7% are probationers. Three fifths of graduates (60%) in Serbia are employed as professionals or associate professionals, compared to two fifths (43%) in Morocco. One third of graduates in Serbia have managerial positions compared to one fifth in Morocco. In stark contrast to Serbia, one third of graduates in Morocco are employed as clerical support workers whereas hardly any in Serbia hold this position.

Over one fifth of the Moroccan sample (22%) are not in work, compared to only 3% in Serbia. This reflects the higher unemployment rate in Morocco than in Serbia and the older age profile of the Serbian sample who, having pursued their careers for longer, are more likely to be employed. Since 22% of graduates in the Moroccan sample are unemployed compared to only 3% in Serbia, the effective sample for the skill mismatch analysis is 144 in Morocco and 94 in Serbia.

Table 3: Sector, ownership and size

Sector of industry of current main job (only sectors with >3% share are listed here)	Morocco	Serbia	Current main employer	Morocco	Serbia
	% sample	% sample		% sample	% sample
Agriculture and forestry; Mining	9%	0%	Public or majority state-owned	34%	29%
			Privately owned	55%	65%
Manufacturing	6%	5%	Not-for-profit sector	3%	2%
Wholesale and retail trade	0%	11%	Other	8%	4%
Communication activities	1%	4%	*Total no. of employees*	*% tot.*	*% tot.*
Financial and insurance activities	8%	20%	1	5%	3%
Professional, scientific and technical activities	11%	20%	2-10	14%	8%
Public administration and defence	9%	5%	11-50	23%	15%
Education	23%	12%	51-250	20%	20%
Other	16%	9%	more than 250	38%	54%

Source: Primary data

Regarding the sector of activity, most graduates concentrate in the education sector (especially in Serbia) and in professional, scientific and technical activities and in financial and insurance activities (see Table 3). More than half of graduates in both countries work in the public sector, and more than half of Serbian graduates work in large organisations with more than 250 workers, whereas only two fifths do so in Morocco.

5.3 The transition to work in Morocco and Serbia

When leaving university, graduates who wish to work and earn their own living have to search for a job or set up their own business. An unsuccessful job search can lead to unemployment or involuntary inactivity. To assist in graduates' job search, several formal and informal institutions can be accessed, including a university careers office, the public employment services, and networks of friends and family. The latter are often the most important institutions supporting graduate job search activity. Once employed, graduates may follow a career path that leads to job changes that better fulfil their personal preferences and the degree of matching may improve. In this section, we examine the graduates' transition to work in Morocco and Serbia. In each country, university graduates face a difficult transition to work, especially in Morocco where 25.8% of those with advanced education were unemployed in 2022 compared to just 5.7% in Serbia[25]. More evidence on the transition to work is provided from our survey. For each degree level we first ask how much graduates agree with statements regarding the contribution of their course of study to their employability (Table 4).

[25] World Bank World Development Indicators online database variable code SL.UEM.ADVN.ZS

Table 4: Sector, ownership

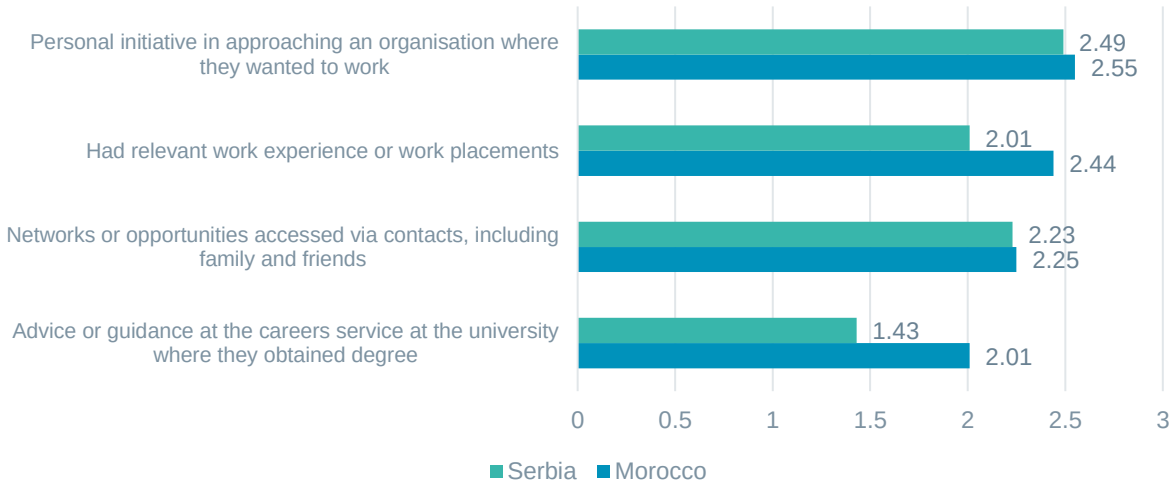
	Morocco			Serbia		
	Bachelor's studies	Master's studies	PhD studies	Bachelor's studies	Master's studies	PhD studies
My field of study was an advantage in looking for a job	3.36	4.27	4.89	4.33	3.37	3.40
The skills I developed at university improved employability	3.83	4.66	5.35	4.39	3.86	4.20
The university I attended was an advantage in looking for a job	3.44	4.10	4.76	5.45	5.12	4.20

Source: Primary data. Note: Average for scores on scale 1-7, 1 = strongly disagree, and 7 = strongly agree

In Morocco, bachelor's studies contribute less to employability than master and PhD studies, suggesting an improving experience as students move up through their degree levels. This is probably because most of the Moroccan graduates studied in a faculty where more than 10,000 students enrol each year in bachelor's studies and study in large groups.[26] In contrast, access to master's and doctoral programs is more selective and competitive, and the courses are taught in much smaller groups. In Serbia, the opposite picture emerges, with bachelor's studies contributing strongly to employability, while postgraduate studies are not a strong contributing factor to employability. In Serbia, the university that the graduates attended (University of Belgrade) was an advantage when looking for a job, which suggests that this university is well-ranked by employers. In Morocco, the skills that graduates developed at university are the highest rated option.

A range of factors support graduate job search on leaving university (see Figure 1). Personal initiative is the most important in both countries, along with help from social networks and contacts including family and friends. In this respect, personal connections can play an important role in successful job search by graduates who are better connected than others on a personal basis, supporting the findings of previous research on this topic in the Western Balkans (Bartlett and Uvalić, 2018; Uvalić and Bartlett, 2020). Having relevant work experience is more important in Morocco than in Serbia. Advice from university guidance services has low importance in both countries, but is considered relatively more supportive in Morocco than in Serbia.

Figure 1: Job search support (scale 1=not important to 3=very important)



Source: Primary data.

[26] https://fsjes-agadir.uiz.ac.ma/

The length of graduate job search is similar in both countries. Between two fifths and a half of graduates were not unemployed at all since graduation and about a third of graduates found a job within six months of graduation. In Morocco, 17% of graduates take more than six months to find a job, and in Serbia 25% take more than six months to find a job. About one tenth of graduates in both countries take more than one year to find a job.

5.4 Qualification mismatch in Morocco and Serbia

As discussed above, qualification mismatch refers to the extent to which the qualification level of a graduate is appropriate to the qualification required by a job. Survey respondents were asked to answer the question "Do the qualifications required in your current job match the level of qualification you obtained in your university education?"[27]

Table 5: Qualification mismatch levels: share and frequency (Share, %)

	Morocco	Serbia
Underqualified	13%	2%
Matched qualifications	49%	66%
Overqualified	38%	32%
Total	100%	100%

Source: Primary data

More than one third of the graduates in Morocco report that they are overqualified and just under one third in Serbia (see Table 5). This could reflect various factors, including a relatively large proportion of graduates produced by the university systems in relation to labour market needs, or adjustment problems in the labour market with graduates unable to find a job that matches their level of education due to weaknesses in job-search institutions.

Table 6: Qualification mismatch vs HE level and gender (% graduates)

	Morocco				Serbia			
	Over-qualified	Matched	Under-qualified	Total	Over-qualified	Matched	Under-qualified*	Total
Highest degree								
PhD	33%	56%	11%	100%	40%	60%	0%	100%
Master's	39%	52%	9%	100%	40%	58%	2%	100%
Bachelor's	38%	38%	23%	100%	23%	75%	2%	100%
Gender								
Female	45%	48%	8%	100%	34%	63%	3%	100%
Male	34%	49%	17%	100%	25%	75%	0%	100%

Source: Primary data

In Morocco, only two fifths of bachelor's degree graduates work in jobs where they are well-matched compared to over half of postgraduates (see Table 6). In Serbia, three quarters of bachelor's degree

[27] Possible answers are "My qualification level is [(i) lower than (ii) matches (iii) higher than] the qualification level required by my job.

holders work in jobs where they are well matched. In particular, higher proportions of Serbian postgraduates are well matched than in Morocco. Noticeably, a high proportion of Moroccan graduates, especially bachelor's degree holders are underqualified for the job they hold, a phenomenon that is absent in Serbia. This phenomenon of underqualification in Morocco has been noted in a set of qualitative research interviews by Draissi et al. (2023)[28]. By gender, equal proportions of men and women are well matched in Morocco, while in Serbia a greater proportion of men are well matched than women. This may reflect gender discrimination in the labour market in Serbia even among the best educated women in the country.

Table 7: Public and private sector qualification mismatch (% across match status)

	Morocco			Serbia		
	Overqualified	Matched	Underqualified	Overqualified	Matched	Underqualified
Public sector, %	43%	45%	13%	41%	59%	0%
Private sector, %	38%	48%	14%	27%	70%	3%

Source: Primary data

There are also wide differences across public and private sectors (see Table 7Table 7). In Morocco, similar proportions of graduates who work in both public and private sectors are well matched, while in Serbia far more are well matched in the private than the public sector. In both countries, the share of overqualified graduates in the public sector is higher than in the private sector. Thus, the public sector seems to be attracting "too many" overqualified graduates compared to the private sector.

Table 8: Public and private sector qualification mismatch by degree level (% across match status)

	Morocco			Serbia		
	Overqualified	Matched	Underqualified	Overqualified	Matched	Underqualified
Public sector						
PhD	25%	67%	8%	40%	60%	0%
Master's	54%	33%	13%	50%	50%	0%
Bachelor's	36%	45%	18%	25%	75%	0%
Private sector						
PhD	50%	25%	25%	0%	0%	0%
Master's	33%	58%	9%	33%	63%	4%
Bachelor's	50%	19%	31%	22%	75%	3%

Source: Primary data

Considered by degree level, in Morocco only 45% of bachelor-level graduates are well matched in the public sector and as few as 19% are well- matched in the private sector. In Serbia bachelor-level graduates are relatively well matched in both public and private sectors, with as many as three quarters being well matched in both sectors. In Morocco, a third of bachelor-level graduates are overqualified in the public sector, while as many as half of those in the private sector are overqualified;

[28] This study concluded that there is an "urgent need to produce quality graduates who are competent and retainable for a challenging and sustainable workplace" (Draissi et al., 2023: 14).

suggesting a surplus of university graduates on the labour market. In Serbia, far fewer bachelor-level graduates are overqualified - about a quarter in both sectors.

Turning to post-graduates, in the Moroccan public sector over half of master's degree holders are overqualified, compared to just one third in the private sector again suggesting an oversupply, this time in the public sector. In contrast, PhD holders tend to be relatively well matched in the public sector (67% are well matched). In Serbia, half of master's degree holders and two fifths of PhDs are overqualified.

Overall, while overqualification is a more serious problem in the public sector than in the private sector in both countries, overqualification appears as a major problem also in the Moroccan private sector among both bachelor's degree holders and PhD graduates (see Table 8).

Table 9: Public and private sector qualification mismatch by gender (% across match status)

	Morocco			Serbia		
	Overqualified	Matched	Underqualified	Overqualified	Matched	Underqualified
Public sector						
Female	44%	50%	6%	42%	58%	0%
Male	43%	39%	18%	33%	67%	0%
Private sector						
Female	47%	42%	11%	30%	65%	5%
Male	29%	53%	18%	20%	80%	0%

Source: Primary data

Considering the gender dimension, a relatively high share of female graduates in the Moroccan private sector are overqualified, while there is an equal balance of overqualification across genders in the public sector. In Serbia, there is a more consistent pattern of overqualification among female graduates in both the public and private sectors. In Morocco, men tend to be better matched to their job in the private sector and worse matched in the public sector compared to women, while in Serbia a relatively high proportion of men are well matched to their job than women in both sectors. Overall, women seem to be worse matched than men except in the Moroccan public sector, and more at risk of being overqualified than men in both sectors and in both countries (see Table 9).

Table 10: Average age of graduates across matching status and public/private sector

	Morocco				Serbia			
	Total	Overqualified	Matched	Underqualified	Total	Overqualified	Matched	Underqualified
Public sector	35.7	35.8	36.0	34.2	37.9	37.0	38.4	0.0
Private sector	29.6	30.8	29.0	28.4	37.6	36.3	38.0	40.0

Source: Primary data

There is also an age-related pattern that could explain some of these effects (see Table 10). In Morocco, graduates are slightly older in the public sector, on average in their mid-thirties, while graduates in the private sector are on average younger, in their late twenties. These age differences may partly explain the relatively low level of matching achieved by bachelor's degree holders in the Moroccan private sector, and the relatively high level of underqualification in the Moroccan private sector and to some extent also in the public sector. This is to be expected since younger workers have

had less time to sort themselves into jobs appropriate to their level of qualification than have older workers (It may also contribute to the relatively lower wages of graduates in the Moroccan private sector that we analyse below).

In conclusion, there is a problem of overqualification of graduates in the public sector in both countries, an issue which especially affects master's degree holders in the public sector. Women suffer more from overqualification in both countries and in both sectors, while in Morocco, women also face a (relative) problem of underqualification. The age of graduates seems to play a role in explaining the high skill mismatch of bachelor's degree holders in the Moroccan private sector.

5.5 Skill mismatch in Morocco and Serbia

This section looks at mismatch regarding particular skills and capabilities. As mentioned previously, skill mismatch is defined as a difference between the actual skill proficiency of an employee and the skill requirement of the job. If there is no difference, then there is a match between the employee's skill levels and the employer-required skill level. Otherwise, there is a skill mismatch. If the employee's skill levels are higher (lower) than those required by the job, the employee is described as "over-skilled" ("under-skilled"). Either situation has an efficiency cost in terms of productivity for the employer.

5.5.1 Skill proficiencies

In our survey, graduates were asked to rate their level of proficiency in a set of 15 skills, rated on a scale of 1 to 7, where 1 stands for 'none', and 7 stands for 'top level' skill proficiency. The ratings provided in answer to these four questions are the skill proficiency ratings. They are collected for each graduate's formal education – in bachelor's and master's degree studies, for each skill. These are the "Bachelor's" and the "Master's" "skill proficiency ratings". The graduates also rate their current level of proficiency in those 15 skills. These are the "Current skill proficiency ratings". Finally, the graduates rate the level of proficiency that is required of them in their current main job. These are the "Job skill proficiency ratings". A skill proficiency rating is an interval variable that can take discrete values on the interval [1,7] with a central value of 4. For each of 15 skills, the mean of the skill proficiency ratings is calculated across the graduates, to obtain an overall proficiency score.

Table 11: Skill proficiency scores (scale 1-7, 1 = none and 7 = top level)

	Bachelor's skill proficiency		Master's skill proficiency		Current skill proficiency		Job skill proficiency	
	Morocco	Serbia	Morocco	Serbia	Morocco	Serbia	Morocco	Serbia
1. Written communication	4.01	4.73	4.77	5.10	5.35	6.38	5.24	6.29
2. Spoken communication	3.92	4.97	5.03	5.08	5.35	6.32	5.49	6.19
3. Numerical analysis skills	3.96	4.64	4.49	4.28	5.08	4.97	4.84	4.38
4. Foreign language skills	3.78	3.74	4.16	3.45	5.04	5.59	4.84	5.72
5. Research skills	4.06	4.22	5.17	5.00	5.42	5.72	4.69	5.17
6. Problem-solving skills	4.08	4.63	4.93	4.90	5.41	6.11	5.43	6.24
7. Entrepreneurial skills	3.61	3.16	4.03	3.13	4.75	4.96	4.11	4.13
8. Ability to manage time effectively	4.28	4.52	4.89	4.31	5.40	5.83	5.47	6.19
9. Ability to work in teams	4.28	4.54	5.39	4.15	5.65	6.11	5.51	6.26

	Bachelor's skill proficiency		Master's skill proficiency		Current skill proficiency		Job skill proficiency	
	Morocco	Serbia	Morocco	Serbia	Morocco	Serbia	Morocco	Serbia
10. Ability to work individually	4.83	5.47	5.16	5.71	5.74	6.55	5.34	6.31
11. Digital skills	3.89	3.55	4.59	3.88	5.13	5.57	5.08	5.77
12. Leadership skills	3.73	3.74	4.72	3.60	5.28	5.69	4.91	5.42
13. Conflict management skills	3.71	3.35	4.79	3.00	5.41	5.66	5.35	5.66
14. Bachelor's subject-specific skills	4.45	5.02			4.98	5.24	4.28	4.39
15. Master's degree subject-specific skills			5.16	4.86	5.37	5.11	4.84	3.81
Overall proficiency level:	**4.04**	**4.31**	**4.81**	**4.32**	**5.29**	**5.72**	**5.03**	**5.46**

Table 11 shows the proficiency scores across the 15 skills measured by the survey. Comparisons of skill levels within each country are free of self-reporting and cultural bias, while comparisons across countries contain cultural bias. At both education levels and for both country samples, above-average skill proficiencies are found in: ability to work individually, course-specific subject skills, spoken communication and problem-solving skills, research skills at master's level and ability to manage time effectively at the bachelor's level. In Morocco, proficiency scores are also high at both degree levels for the ability to work in teams, while in Serbia, they are high for written communication. This reflects cultural and societal differences between Morocco and Serbia. Below-average proficiency scores are found for foreign language skills, entrepreneurial skills, digital skills, and conflict management and leadership skills, except for the Moroccan master's degrees. At the overall level, both "Current" and "Job skill" proficiency scores are higher than bachelor's and master's scores. This may reflect graduates having improved their skills through on-the-job learning and informal training since they finished their degrees. The older a graduate is, the more chance they have had to improve their skills, and to have progressed to a higher-skilled job.

In sum, the findings from this analysis suggest that (i) skill proficiency scores for Morocco are lower than for Serbia (except for master's skill proficiency), possibly due to cultural bias and (ii) Serbian graduates, in aggregate, did not gain additional skills in their master's degree studies compared to the skills they gained in the bachelor's degree studies. "Job proficiency" scores and "Current proficiency" scores are uniformly higher for Serbia than for Morocco.

5.5.2 Skill mismatch

The incidence of skill mismatch is estimated using an Individual Skill Mismatch Indicator (ISMI) constructed for this purpose. It is calculated using the ***skill proficiency ratings***. ISMI is calculated by subtracting each graduates' proficiency ratings for 15 skills at various stages of their professional development from the ***job skill proficiency ratings***. Formally:

ISMI (skill X) **=** Skill proficiency rating (skill X) - Job skill proficiency rating (skill X)

Since ISMI is calculated by subtracting two interval variables that take discrete values between 1 and 7, an ISMI can take any discrete value between -6 and 6. An ISMI can hold a positive value, a negative value, or a zero, capturing the three skill mismatch categories:

- **'Overskill'.** A positive ISMI value indicates that the skill proficiency of a graduate is higher than the level required by their job. In this case the graduate is 'overskilled' in that particular skill.

- **'Match'.** An ISMI could be 0, indicating that the skill/capability of the graduate is 'matched' to the job requirement for that skill or capability.
- **'Underskill.'** An ISMI is negative when a graduate's proficiency level for a particular skill is lower than the level required by their job. In this case the graduate is 'underskilled' for that skill.

After calculating the ISMIs, we observe their patterns with regard to these three categories. Since a simple mean would not be a good measure of the scale of a skill mismatch (as positives and negatives may even out), ISMI is re-defined as a categorical variable comprising three categories of skill mismatch, as follows:

$$ISMI = \begin{cases} 1, 2, 3, 4, 5, 6 \text{ Overskill } ISMI \\ 0 \text{ Matched } ISMI \\ -1, -2, -3, -4, -5, -6 \text{ Underskill } ISMI \end{cases}$$

In the first category, overskill, ISMI is positive, and takes discrete values on the interval [1,6]. This ISMI is an Overskill ISMI, an indicator on its own and a good measure of the overskill effect. The Overskill ISMI measures the strength of overskill mismatch: 1 represents the minimum level of overskill mismatch and 6 the maximum level. Similarly, in the third category, underskill, ISMI is negative and discrete on the interval [-1,-6]. This indicator is called the Underskill ISMI and is used to measure the intensity of underskill mismatch. Here -1 represents the lowest level of underskill mismatch and -6 the highest level. The second category represents matched skills. Here ISMI can only take the value of 0, as there is no mismatch. So, a graduate's ISMI of a skill is discrete on [-6, 6]. If ISMI>0, it is an Overskill ISMI, if ISMI>0, it is an Underskill ISMI, and if ISMI=0 it is a Matched ISMI. Each graduate, for each skill can be only in one of these three categories. Therefore, each graduate, for each skill will have exactly one of: Underskill ISMI; Overskill ISMI; or Matched ISMI.

Separating ISMI into the Underskill and the Overskill ISMI allows a separate mean to be calculated for each mismatch category. This measure of the intensity of skill mismatch is the Skill Mismatch Indicator (SMI). SMI measures the strength, or intensity of the skill mismatch, and it can be either an Overskill SMI or an Underskill SMI. An Overskill SMI of a skill is equal to the mean value of all Overskill ISMIs for that skill. An Underskill SMI is constructed in a similar way, using the Underskill ISMIs. Formally:

$$\text{Overskill SMI (skill X)} = \frac{\sum_{\text{ISMI}>0} \text{Overskill ISMI (skill X)}}{\text{No. ISMI (skill X)} > 0}$$

$$\text{Underskill SMI (skill X)} = \frac{\sum_{\text{ISMI}<0} \text{Underskill ISMI (skill X)}}{\text{No. ISMI (skill X)} < 0}$$

SMIs are constructed separately for Bachelor's, Master's and Current skill levels, using the Bachelor's, Master's and the Current ISMIs.

It should be noted that the data in this study are susceptible to *cultural bias*, since different cultural norms and social attitudes could influence the answers to the survey. This cultural bias can present a problem for cross-country comparisons, especially when comparing attitudes such as satisfaction and when comparing ratings. S*elf-reporting bias* is present in some of the questions, particularly the skill proficiency ratings. The self-reporting may vary across questions and may be different in Morocco and Serbia. The presence of cultural, self-reporting, or other bias, or at least their direction of influence, could be estimated by comparing the answers to similar questions. Judging by the answers on life satisfaction, where the Serbian sample average score is 5.79 and Moroccan 4.96, and on job satisfaction, where Serbia scores an average of 5.35 and Morocco 4.97, there appears to be an upward bias for Serbia. A similar upward bias is observed when comparing Serbian and Moroccan average scores throughout the database. It is particularly indicative that the job-appropriateness score is equally different between the two (5.46 in Serbia and 4.98 in Morocco). However, biases cancel out when comparing across the answers that contain the same bias. The self-reporting bias would, therefore, even out in calculating our skill mismatch indicators (ISMIs and SMIs).

Table 12: Aggregate frequency and intensity of skill mismatch

	Bachelor's degree			Master's degree			Current skill level		
	Over-skill	*Match*	*Under-skill*	*Over-skill*	*Match*	*Under-skill*	*Over-skill*	*Match*	*Under-skill*
ISMI, frequency									
Morocco, % sample	16%	32%	52%	22%	37%	41%	29%	48%	23%
Serbia, % sample	14%	26%	60%	15%	24%	61%	29%	47%	25%
SMI, average									
Morocco, score	1.66	0	-2.40	1.63	0	-1.96	1.79	0	-1.34
Serbia, score	1.83	0	-2.47	1.95	0	-2.64	2.01	0	-1.35

Source: Primary data

The frequency distribution of bachelor's and master's ISMI is skewed towards the negative end of the scale, with the modal value at underskill. When they graduated with a bachelor's degree, most graduates in Morocco (68%) and Serbia (74%) did not have the right skills to do the job they would later be doing at the time of the survey. In the case of Morocco, mismatch dropped to 63% for master's graduates, which suggests an improvement in the skills attained as they pass through further university education levels. But in Serbia it remained the same (76%), suggesting that master's degrees provide little value added in terms of skill proficiency attained at master's education level.

The bottom two rows of Table 12 show the SMI, i.e. the average intensity mismatch. The higher the absolute value of SMI, the stronger the mismatch effect. We find that skill mismatch intensity is consistently higher for Serbia. In general, we would expect the skill levels of the graduates to be higher, and the mismatch lower, as the graduates move along their career path. Due to additional education, skill mismatch at master's level should be below that at bachelor's level. This would imply lower underskill intensity. In Morocco there is a reduction in the intensity of underskill from bachelor's to master's level, but in Serbia the skill mismatch intensity increases, albeit marginally.

Moving to current skill levels, we would expect mismatch to be lower than at bachelor's or master's due to further formal or informal education, on-the-job skill development and experience. It should also reflect graduates being able to find jobs that are better suited to their skill levels with the passage of time. The current levels of skill mismatch in both countries indeed shows that. The modal value of ISMI moves from underskill to the match category; half the graduates have skills that are matched to their job requirements and 30% are overskilled.[29] At the current skill level, both countries have the same share of overskill and underskill mismatch, but the intensity of this mismatch is higher in Serbia.

5.5.3 Gender differences in skill mismatch

Skill mismatch also has a gender dimension. For bachelor-attained skills, the share of overskill, match and underskill is similar across genders in both countries, as is the intensity of skill mismatch (see Table 13). An exception is a higher overskill mismatch intensity for female compared to male graduates in Serbia (1.96 vs 1.25). Similarly, for master-attained skills the mismatch shares are identical across genders in Morocco and are fairly similar in Serbia. At the current skill level, however, the shares of mismatched graduates are no longer gender neutral. More male Moroccan graduates are overskilled than female graduates, while in Serbia it is the opposite – more female graduates are overskilled compared to male graduates. In Serbia, the female graduates have a tangible

[29] This can be compared to the World Bank STEP survey for Morocco in 2013 that found 15.9% of respondents were over-skilled and 39.2% were under-skilled (Draissi and Rong, 2023). While the mismatch rate was similar (55.1%) to the 52% current skill mismatch found in this study, these researchers found a higher level of under-skilling than we find in our study for current skills, but closer to the proportions for bachelor-attained skills.

disadvantage in overskill intensity, at 0.7 and 0.5 score points for the bachelor's and the current skill levels respectively.

Table 13: Skill mismatch by gender (ISMI, frequency %)

	Bachelor's ISMI, % share			Master's ISMI, % share			Current ISMI, % share		
	Over-skill	Match	Under-skill	Over-skill	Match	Under-skill	Over-skill	Match	Under-skill
Morocco									
Female	16%	32%	51%	23%	36%	40%	26%	49%	25%
Male	17%	31%	51%	23%	37%	40%	33%	45%	23%
Serbia									
Female	14%	25%	61%	16%	24%	61%	30%	44%	26%
Male	12%	28%	60%	12%	26%	62%	22%	56%	22%
SMI, average scores									
Morocco									
Female	1.67	0	-2.39	1.75	0	-1.93	1.89	0	-1.4
Male	1.69	0	-2.36	1.53	0	-1.88	1.74	0	-1.3
Serbia									
Female	1.96	0	-2.46	1.95	0	-2.59	2.09	0	-1.38
Male	1.25	0	-2.54	1.75	0	-2.82	1.58	0	-1.24

Source: Primary data

To summarise, our findings on skill mismatch suggest that both countries provide equal opportunities in higher education, while there is evidence of gender-biased skill mismatch in the graduate labour market. This phenomenon is particularly pronounced in the case of Serbia. Altogether, our findings suggest that the skill-mismatch position of Serbian female graduates is much worse than that of males and the gender disparity is worse for Serbian female graduates than for Moroccan female graduates in our sample.

5.6 The wage penalty of qualification mismatch

Qualification mismatch is known to have a negative effect on earnings. Overqualification (overeducation) and overskill, as well as underqualification (undereducation) and underskill, lead to efficiency costs, and so mismatched employees tend to receive lower wages. The evidence from various studies finds a "wage penalty" of 13.6% for an overeducated worker compared to the wage achieved by a well-matched worker with the same level of education (McGuiness et al., 2018). In addition, undereducated workers employed in jobs that are more sophisticated than their qualification (education) level, typically earn less than individuals with the level of education actually required in such jobs (Allen and Van der Velden, 2001). The wage penalty associated with overeducation has been estimated at 17% in Egypt and 50% in Tunisia (Elamin, 2023). In Serbia, Vuksanović et al. (2022) found a wage penalty of 20 p.p. for overeducated highly-skilled workers in the information and communication sector, the financial and insurance sector, the real estate sector, and in scientific and technical activities, and 25 p.p. for undereducated workers in these sectors. In Bosnia and

Herzegovina, Veselinović et al. (2020) found a 15% wage penalty for overeducation across all education levels.

Gender discrimination in the labour market has been observed in both Morocco and Serbia. A persistent wage gap was found in Serbia in the 2000s (Ognjenović, 2021), which persisted into the 2010s (Anić et al., 2019). In this section, we explore the gender wage gap for university graduates in Morocco and Serbia and the effects of labour market mismatch.

Table 14: Wage by higher education degree (monthly wage, EUR)

	Morocco	Serbia
Bachelor's degree	755	1,883
Master's degree	916	1,516
PhD degree	1,265	1,400
Total	**923**	**1,689**

Source: Primary data

The average monthly wage is positively related to graduates' education level in Morocco and negatively related in Serbia (see Table 14). In the Moroccan sample, the average wage is 20% higher for master's graduates and 67% for PhD graduates, compared to the bachelor's level. In the Serbian sample, in contrast, it is 20% and 25% lower for master's and PhD graduates compared to bachelor's graduates. Serbian graduates seem to be penalised on the job market for gaining a postgraduate qualification.

Table 15: Average monthly graduate wage by gender (EUR)

	Morocco	Serbia
Female	863	1,524
Male	972	2,200
Total	923	1,689

Source: Primary data

In both Morocco and Serbia, the average monthly wage is higher for male than female graduates (see Table 15). This is related to the fact that in Morocco, most female graduates are employed by the private sector while most male graduates are employed in the public sector where the wages are higher. In Serbia, most female graduates are employed in the public sector, where wages are significantly lower compared to the private sector. So, female graduates are mostly employed in the lower-paid sector in each country, which then results in the lower average female graduate wage. This could partly explain the female pay disadvantage.

Table 16: Qualification mismatch levels and average monthly wage

	Morocco				Serbia			
	% sample	Average monthly wage, EUR			% sample	Average monthly wage, EUR		
		Total	Female	Male		Total	Female	Male
Overqualified	38%	810	773	855	32%	1.352	1,190	2,200
Matched	49%	1,070	1,063	1,091	66%	1,860	1,721	2,200
Underqualified	13%	839	720	908	2%	1,200	1,200	-
Total		**938**	**895**	**982**		**1,689**	**1,524**	**2,200**

Source: Primary data. Note: The average wage for Morocco is higher than in Table 15 due to non-response.

On average, both overqualified and underqualified graduates receive a salary that is about a quarter less than their well-matched colleagues. For overqualified graduates, the wage penalty is 24.3% in Morocco and 27.3% in Serbia; for underqualified graduates the wage penalty is 21.6% in Morocco and 35.5% in Serbia) (see Table 16). The cost of qualification mismatch is higher for female than for male graduates. The wages of well-matched male and female graduates are quite similar in Morocco but are substantially higher for male graduates in Serbia. In Morocco, gender wage discrimination is limited to qualification mismatch, while the wages of well-matched graduates are gender neutral. In Serbia, the gender wage gap applies to the wages of both well-matched and mismatched female graduates. In summary, the employment position of female graduates is worse than for male graduates in both countries. Women have lower wages, take lower-paid jobs, and jobs for which they may be overqualified more often than men. The mis-qualification wage penalty is also much higher for the female compared to the male graduates. The gender wage bias is higher in Serbia compared to Morocco. The mismatch wage penalty is also higher for female graduates in Serbia than in Morocco.

Table 17: Qualification mismatch qualification mismatch by average monthly wage

	Morocco			Serbia		
	Total	Female	Male	Total	Female	Male
Public						
Total	1,133	1,094	1,164	1,132	1,125	1,200
Overqualified	1,029	886	1,130	1,150	1,150	0
Matched	1,220	1,178	1,280	1,121	1,108	1,200
Underqualified	1,133	1,800	1,000	-	-	-
Private						
Total	865	812	922	1,941	1,756	2,311
Overqualified	669	741	533	1,507	1,255	2,200
Matched	1,068	1,015	1,125	2,157	2,043	2,343
Underqualified	700	450	843	1,200	1,200	-

Source: Primary data

In the public sector, overqualification is the dominant type of mismatch. The penalty for being overqualified in Morocco is a 16% lower average wage compared to being well matched (see Table 17Table 17). There is no wage cost for being overqualified in the public sector in Serbia. In the private sector in Morocco, the wages of overqualified and underqualified graduates are a third less than the wages of well-matched graduates. Similarly in Serbia, in the private sector the overqualified graduates have 30% lower wages compared to the graduates with the right qualifications.

Gender bias varies across the private and public sectors (see Table 17). While the wages in the public sector are more or less equal across genders, large gender disparities are visible in the private sector. In Morocco, overqualified female graduates in the private sector receive a 27% lower wage compared to well-qualified female graduates, while overqualified male graduates receive a 53% lower wage. The situation is reversed for underqualified graduates, as underqualified female graduates receive a 57% lower wage, while male graduates receive a 25% lower wage. In Serbia, overqualified female graduates in the private sector receive 40% lower wages than well-matched female graduates. This compares adversely to male graduates whose wages are only 6% lower due to overqualification. This is on top of the general wage level being lower for women, which makes the overqualified male graduate better paid than a well-matched female graduate in Serbia.

This brings us back to the observed wage penalty of having a postgraduate degree in Serbia (shown in Table 14). Considering that in the Serbian sample, 82% work in the private sector and 18% work in the public sector, the average bachelor's-level wage is mainly determined by the private sector wages, which are 75% higher than in the public sector (Table 17). Among master's graduates, 63% are employed in the private sector and 37% in the public sector and their wages are also in larger proportion determined by higher private-sector wages. In contrast, PhD graduates mainly work in the public sector. Consequently, the average Serbian postgraduate earns significantly lower pay than the average bachelor's graduate.

In sum, there is a relatively high wage penalty for both under- and overqualified graduates in each country. However, this hides the differences between the public and private sector mismatch penalties. In the public sector there is little or no penalty for not having the right qualifications, while in the private sector the penalty of qualification mismatch is a loss of about a third of the wage compared to a well-matched graduate. Also, the average wages of Moroccan graduates are greater the higher the level of degree achieved. In contrast, in Serbia, average wages are lower with a higher degree level. This is mainly due to the discrepancy between public and private sector wages in Serbia.

5.7 Conclusions

Our research provides initial insights into the intersections of education and employment in countries of the EU neighbourhood, taking into account gender disparities, public/private sector distinctions, and the economic consequences of skill mismatches. Graduates face a difficult transition to work with master's studies being an important support in job search in Morocco; while in Serbia bachelor's studies are sufficient for that role. Personal initiative, work experience and family contacts are important for finding a job in both countries. Nevertheless, jobs found are not always the most suitable and graduate overqualification (overeducation) rates are relatively high at 38% in Morocco and 32% in Serbia (compared to 13.9% in comparable international studies), as are graduate overskill rates of 29% in both countries (compared to 7.5% in comparable studies).

These high rates of overqualification (overeducation) in both countries indicate an urgent need for university reforms to align better to the labour market and for better support for the graduate transition to work. Furthermore, there is a strong gender bias in skill mismatch, which may be partially explained by the relatively high supply of female university graduates in Serbia compared to Morocco, where women may be able to secure better jobs and wages than their counterparts in Serbia. In both countries, the share of overqualified graduates in the public sector is higher than in the private sector and the public sector seems to attract "too many" overqualified graduates compared to the private sector. We also find evidence of high levels of underqualification in Morocco, suggesting a shortage of highly skilled labour despite the overall labour surplus in the country.

Despite a general overqualification of graduates in both countries, in relation to skill mismatch we find that the general trend is towards under-skilled. There is some improvement in skill matching for Moroccan master's degree graduates compared to bachelor's level; while in Serbia, master's courses appear to offer no improvement in terms of skills. While skill matching improves over a graduate's career, just as with overqualification, in Serbia the gender gap in skill mismatch worsens over the course of the graduates' careers, a phenomenon that is not observed in Morocco. The skill-mismatch position of Serbian female graduates is much worse than that of males and the gender disparity is worse for Serbian female graduates than for Moroccan female graduates.

Our evidence also demonstrates a large economic cost expressed as a wage penalty associated with all types of qualification mismatch (e.g. 24.3% for overqualified graduates in Morocco and 27.3% in Serbia) well above the 13.6% wage penalty found in comparable international studies[30]. The mis-qualification wage penalty is also higher for female compared to male graduates and indicative of gender discrimination on the graduate labour market. In both countries, the public sector attracts more overqualified graduates than the private sector, but there is little wage penalty in the public sector on account of this. Wage penalties for mismatch are far higher in the private sector.

As Serbia progresses with its bid for EU membership it would be well advised to make efforts to ensure improved supply of jobs for its most well-educated graduates to reduce brain drain. Meanwhile Morocco, while seeking to improve ties with the EU, might consider a reduction in the supply of graduates destined for jobs below their level of formal education and an increase in the supply of graduates with more vocational training.

In addition, our approach and the tools we developed could serve as a foundation for further research, particularly if expanded to include additional universities in the two countries or the wider regions. While the study offers valuable insights, it is important to acknowledge its limitations. The relatively small sample size restricts the representativeness of the findings, limiting their generalisability. Also, the focus on only two universities limits the diversity of perspectives and experiences captured. In future research we aim to expand the scope of the survey to cover more higher education institutions and more countries in the two regions.

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CHAPTER 6: Identifying sectoral skills needs: Lessons from Poland and Wales for the Turkish steel industry

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6.1 Introduction

The identification of sectoral skill needs is a critical process in aligning workforce skills with the evolving demands of modern industries. Various methodologies and frameworks have been developed globally to address this issue, focusing on both current and future skills gaps (e.g. Cedefop, 2019; Cedefop, 2023; Hoftijzer, 2015; Maldonado-Mariscal et al., 2023; Wilson et al., 2016).

This paper examines two distinctive approaches – the Polish Sectoral Human Capital Studies (SHCS) and the European Steel Skills Alliance (ESSA) – and evaluates their applicability to the Turkish steel sector. The goal is to provide actionable recommendations for improving skills anticipation mechanisms in Türkiye's steel industry.

While Poland's SHCS offers a national framework for identifying sector-specific skills needs, ESSA provides a sector-focused European perspective, particularly within the steel industry. By comparing these methodologies, we aim to draw lessons that can be adapted to Türkiye's context. The choice of Poland and Wales is rooted in their methodological innovations and relevance to addressing skills gaps in dynamic and transformative industrial sectors. Although Türkiye is not part of the EU, the ESSA's tools and approaches offer valuable insights for structuring sectoral skill needs assessment.

6.2 Understanding the sectoral skills needs approach in Poland: SHCS – addressing the skills needs of 17 industry sectors in Poland

6.2.1 Local context and origins of the solution

Poland's skills needs analysis framework was developed in response to the country's rapidly transforming economic landscape. Following its transition from a centrally planned to a market-orientated economy, Poland experienced significant industrial and technological changes. These changes created a dynamic labour market with evolving demands for new jobs and skills.

The rapid growth of various sectors, including finance, IT, tourism, construction, and advanced manufacturing, highlighted the need for a systematic approach to identify and address skills needs. The integration of Poland into the European Union further intensified the need for a competitive and adaptable workforce. The influx of foreign investment and the adoption of EU standards required continuous improvement of workforce skills to meet international benchmarks.

Local businesses and industries faced challenges related to mismatches between the skills of the workforce and the demands of modern job roles. Employers often struggled to find qualified personnel with the necessary technical and soft skills, leading to productivity problems and hindering economic growth. This situation underscored the critical need for a robust competency assessment to guide education and training programmes.

Poland's economic strategy emphasised innovation, digital transformation, and sustainable development. To achieve these goals, it was essential to understand the specific skills required in different sectors and ensure that the workforce was adequately prepared. Information about the skills

needs of the economy has become increasingly important for policymakers, educators, and industry leaders to align workforce development initiatives with the strategic economic objectives of the country. By identifying the precise skills required for current and future job roles, Poland aimed to bridge the gap between education and employment, improve the employability of its citizens, and maintain its competitive edge in the global market.

Support to achieve these goals has come from systematic research on general skills needs, conducted since 2010 within the Human Capital Study project (Kocór et al., 2021). However, there was a growing recognition of the need to focus on the demand for sector-specific professional skills and to take more decisive action to develop these skills. The response to this need was the establishment of Sectoral Skills Councils in Poland.

The first such council was established in 2016. On the initiative of the Polish Agency for Enterprise Development (PARP), seventeen councils have so far been created in sectors as diverse as automotive and electromobility, construction, high-quality food, and development services. Each council consists of representatives of employers, trade unions, universities and other stakeholders related to the sector.

The tasks of the sectoral councils include:

- gathering knowledge from businesses about the qualification and professional needs in the labour market of a given economic sector;
- dissemination of information on professional qualifications and needs in the sector;
- initiating cooperation between businesses and universities or specific entities to integrate education and employers; and
- formulating recommendations for adjusting the workforce to the current needs of businesses in a given sector.

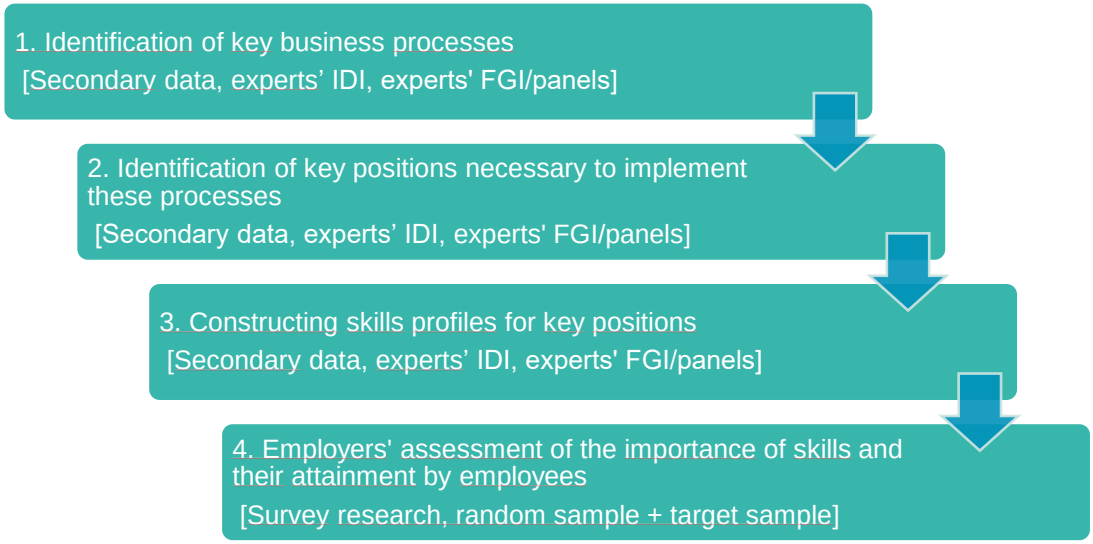
Support for Sectoral Skills Councils in identifying sector-specific skills needs came from research conducted within the Sectoral Human Capital Study (SHCS), carried out by Jagiellonian University in partnership with the Polish Agency for Enterprise Development. The SHCS methodology combines quantitative and qualitative research to provide a detailed analysis of sector-specific skills requirements.

6.2.2 Description of the methodology

The Sectoral Human Capital Studies (SHCS) in Poland aimed to identify the most urgent skills needs of entrepreneurs and mismatches in the labour market by sector and to identify trends that affect each industry and the challenges faced by entrepreneurs. Research has already covered 17 different sectors in Poland: finance; IT; tourism; construction; fashion and innovative textiles; automotive and electromobility; health care and social assistance; chemicals; water and wastewater management and remediation; trade; marketing communications; modern business services; material recovery of raw materials; aerospace; telecommunications and cyber security; development services; and quality food. In each sector, the research was carried out using the same methodology (with some exceptions due to industry specificities). Two editions of the study were carried out in each sector in Poland, the first was conducted in 2000, and the second in 2023.

This section describes this methodology in detail. It included both qualitative and quantitative research carried out on a sample of minimum 800 employers (random sample, multi-mode approach) and minimum 800 employees in key positions or students (separate surveys for each sector). The decision to survey either students or employees was based on the specific information needs of the sector. The approach involves triangulation at the level of sources, using all available foundational data – especially the already existing Sector Qualification Framework – and methods. In addition, both the current situation in the sector and its future were considered in the form of a prospective study. The research in Poland was implemented in several stages, which can be presented schematically in Figure 1.

Figure 1: Main steps of the SHCS methodology in Poland



Source: Own elaboration
Notes: (*) IDI (In-Depth Interview) is a research method used in the social sciences to gather detailed information and a deep understanding of the attitudes, beliefs, experiences, behaviours, and motivations of interviewees. This method produces rich descriptive data that are difficult to obtain through more quantitative research methods such as surveys or questionnaires.
(**) FGI (Focus Group Interview) is a research method used in the social sciences, marketing and market research that involves a discussion of a specific topic with a small group of people, facilitated by a trained moderator.
(***) "Experts" means both representatives of the sector in question (e.g. employers, members of sectoral associations) and representatives of universities or other research institutions that specialise in the field of interest.

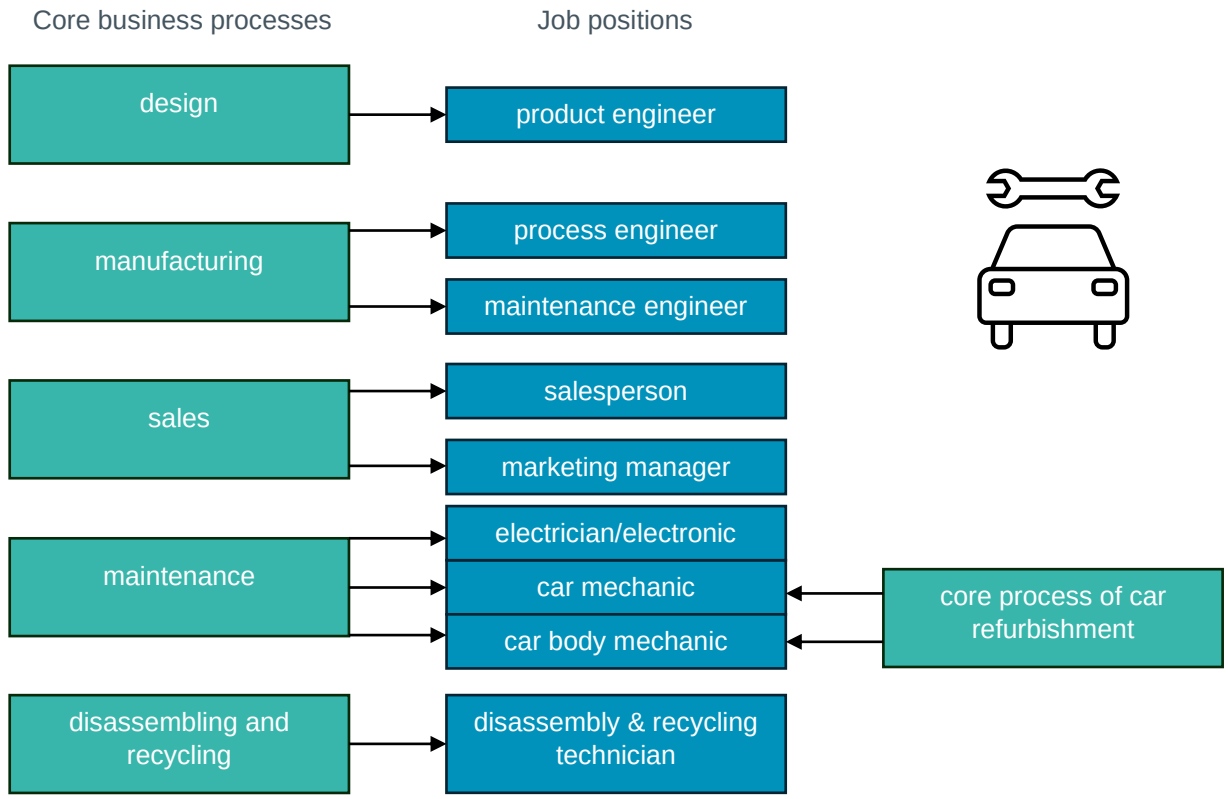
The first step in the research was the identification of the main business processes within a selected sector/industry[31]. A business process is a sequence of activities leading to a specific business objective. A business objective is an outcome that is both achievable and valuable to the customer of the process. On the basis of our experience, between three and ten such processes were identified per sector/industry. To pinpoint these main business processes, we took the following actions:

- Analysis of available secondary data.
- In-depth interviews with industry experts, including representatives from companies, the industry environment, and researchers.
- Creation of a preliminary list of main business processes.
- Verification of the list by an expert panel.

In the second step, key positions / occupational roles necessary for the implementation of the main business processes within a sector/industry were identified. Typically, a list of such key professional roles includes 10 to 20 positions. To create this list, secondary data analysis was used, along with in-depth interviews and verification of the occupational roles list by an expert panel. An example of the identified core business processes of an industry, along with the associated occupational roles essential for their execution is presented in Figure 2 for the automotive and electromobility industry.

[31] A business process is a set of related activities or tasks performed in a specific sequence to achieve a particular business goal or outcome. It involves various resources, such as people, tools, and technologies, working together to deliver value to a customer or the organization. Business processes can include activities such as manufacturing products, providing services, managing resources, or processing orders (Davenport, 1993).

Figure 2: Business processes and job positions in the automotive and electromobility industry



Source: Own elaboration.

The third step was to create skills profiles for each of the identified key jobs/job roles[32]. These profiles include elements of knowledge, skills, and attitudes that are necessary to perform the tasks of each occupation. Skills profiles were designed to be as simple as possible, with only the essential elements needed to perform professional tasks. The process of building these profiles followed a similar approach to that used in previous stages: analysis of available secondary data, including the Sector Qualifications Framework (if applicable); in-depth interviews with industry experts, such as company representatives and researchers; and verifying the profiles through an expert panel.

In the final (fourth) step, skill profiles were used to create questionnaires for employers and employees. As mentioned before, a sample of minimum 800 employers and minimum 800 employees in key positions were surveyed through these questionnaires. The study employed stratified random sampling, with strata defined by company size and voivodeship (Polish administrative level). The samples ensured statistical representativeness of the sector.

The survey aimed at managers and executives of selected companies aimed to assess:

- the importance of skills for specific positions (rated on a 1-5 scale, with 1 being marginal and 5 crucial); and
- the difficulty of finding candidates with these skills (rated on a scale of 1-2, with 1 being difficult and 2 easy).

Interviews were also conducted with employees in key positions, where they evaluated their own skill levels on a scale of 1-5.

Based on the results of these surveys conducted with both employers and employees, a skill balance was developed for specific job positions based on comparing the demand for a specific skill with its

[32] A skills profile is a description of the skills, knowledge, and behaviours needed to perform a specific role effectively, aligning employees' capabilities with organisational goals (Boyatzis, 1982; Spencer et al., 1993).

availability. This balance includes information on the importance of skills as declared by employers, anticipated changes in the importance of these skills, the difficulty of acquiring them, and the results of employees' self-assessment. In addition, "hot skills" were identified - these are skills that are currently of high importance and are expected to increase in importance in the coming years. Figure 3 provides an example of the 'skills balance' for the role of car mechanic.

Figure 3: Car mechanic - skill balance

Source: Own compilation based on BBKL moto - 2nd edition 2023 (employers N=274; employees N=157).
Notes: (k) – knowledge, (a) – abilities, (ss) – social skills.

In the given example, it is evident that both employers and employees rated the required and possessed skills relatively high – all above the theoretical mean on the rating scales, which is a value of 3. There are also no significant differences between the ratings of the importance of competencies for employers and the level of competencies possessed by employees in this position, indicating a lack of major mismatch.

Identification of skills gaps was based on the same questions and refers to the situation when employers indicate the existence of skills, which they consider relatively more important and, at the same time, difficult to obtain in the labour market.

The final stage of the research was the synthesis of results and conclusions of the studies conducted in the 17 sectors of the Polish economy. The aims of this synthesis were:

1. Identification of megatrends that affect each of the sectors analysed, intersectoral trends (affecting clusters of sectors) and trends specific to a given sector. The identified megatrends that impact the Polish economy overall include: technological changes; digitalisation and automation; demographic changes; green transition; and globalisation and deglobalisation. Among the intersectoral trends identified were: digitalisation; the development of remote services; the use of big data analysis; the internationalisation of labour markets and their interconnection; and changes in socially responsible consumption as a lifestyle choice.
2. Identification of sectors interconnected due to their field of operation, character, and range of services provided, similarity of trends that affect them, and critical factors for their development. Analysis of similarities in conditions and developmental opportunities resulted in the distinction of four main clusters, among which the IT sector together with telecommunications and cybersecurity hold a central position. For each sector within a given cluster, a realistic development scenario was developed, containing an indication of the trends that affect the sector, the critical factors for sustaining activity, and the resulting skills challenges.
3. Identification of intersectoral transferable skills that are in increasing demand across most of the analysed sectors as a result of the impact of identified trends. Examples of such skills include the ability to analyse data and make informed decisions, the processing and analysis of large data sets, the proficiency in using IT tools, and cybersecurity.

6.2.3 Post-solution reflection: successes and challenges

The approach implemented in Poland allowed for the creation of a comprehensive description of the situation in each sector in terms of its human capital needs, positions that companies are looking for and plan to seek employees for, skills for which demand is increasing (so-called hot skills), and current and future skills deficits. The applied methodology allows both to assess the current demand for skills in a given sector and to indicate the development directions of this sector and the resulting skills challenges.

Combining the analysis of existing data with qualitative and quantitative methods and diagnosis with techniques used for building future scenarios allows one to formulate recommendations regarding the current demand for human capital in a given sector and changes in this demand in the short and medium term. The advantage of the sectoral approach is the ability to identify not only universal and transferable skills common to different sectors and different job positions, but also skills specific to given professional roles.

One of the key findings of the SHCS research, which also presents a challenge, is the difference in how employers and experts assess the current and future situation in a given sector. Employers tend to focus on short-term perspectives and often do not recognise the long-term challenges that experts predict for the sector. This suggests that research on the future development of the sector should be more heavily based on existing data and expert opinions rather than solely on employer assessments.

Another major challenge for SHCS research is ensuring that their findings are more widely used in planning processes and interventions affecting the labour market, particularly in addressing skills shortages and mismatches. The results from these studies have already been utilised by sectoral councils from 17 industries of the Polish economy to formulate recommendations for both formal and non-formal education systems. They also helped identify priority areas for human capital development, supported by national and European Social Fund resources. The SHCS studies, Sectoral Skills Councils, and public funding mechanisms for skills development have become integral components of the workforce development system in Poland's economy.

6.3 Understanding the sectoral skills needs approach in Wales: ESSA – focusing on the steel sector across European, national and regional levels

6.3.1 Local context and origins of the solution

Unlike the Polish studies covering 17 national sectors in the previous chapter, the ESSA approach was applied to a single sector (steel industry) at several geographical levels: European, national and sub-national/regional. European Steel Sector Alliance (ESSA) was an EU-funded project to support multi-sectoral and multi-stakeholder cooperation through identifying current and future skill needs of the sector and developing an overarching upskilling/reskilling strategy to support a sustainable, efficient and competitive European steel industry[33]. Overall, it has included the steel sector from 13 EU countries and collaboration with more than 40 partners[34]. ESSA was an industry-driven initiative, and sector stakeholders sought solutions to identify skills shortages and mismatches – as a precondition for the efficient design of employment, skills and training policies and strategies.

The project has developed several tools for the development of skill intelligence such as steelHub; Technology and Skills Foresight Survey & Panel; Skills Assessment Template; National and Regional Rollout (to be explained later). The origin of the solution for the sector was found in developing (i) a Skills Alliance and (ii) a Blueprint Strategy to develop necessary approaches to sustain a competitive and environmentally responsible sector with innovation and the creation of highly skilled jobs. The project worked towards the transparency, comparability and recognition of the skill sets that comprise the typical occupations and job specifications in the European steel sector as a basis for developing training content in correspondence with national VET systems, utilising EU and international classifications, mechanisms and frameworks (Antonazzo et al., 2023a; Schröder, 2023). Based on the main findings, skills intelligence concerning the steel sector was not limited to the preparation and presentation of data/analysis, but also required the creation of a governance structure at regional levels to mitigate skills imbalances.

National and regional rollouts have been implemented to transfer the ESSA project results and tools to selected steel regions in UK (Wales), Spain, Czechia, Finland, Germany, Poland, Italy and Netherlands (Maldonado-Mariscal et al., 2023). The rollout tool is a pillar to implementing skills intelligence in practice by initiating co-creation processes in the countries and regions. It is a tool as it provides interaction at various levels, thus generating information exchange, synergies, increased stakeholder engagement and collaboration for large-scale upskilling and reskilling strategies. By identifying skill needs and demands, ESSA aimed to inform the development of training and help inform new vocational-programme content across the sector. However, this requires an understanding of how VET systems work and provide skills to the sector in different local contexts, as it is often at the regional level that such skill strategies are adapted and then implemented in a local context.

This chapter presents the approaches used by ESSA for the skills needs analysis of the European steel sector, but some particular observations are made on the situation in Wales to explain the dynamics between European, national and regional levels. The European steel sector has undergone substantial transformation, restructuring and consolidation, with ownership now largely in the hands of several large multinational companies, following mergers and acquisitions. This went hand in hand with technological innovation and changes in production processes and products. Such developments have had implications for the industry workforce, which is now much reduced i.e. as the sector has retrenched, plants closed and jobs have been shed – this process continues with thousands of steel

[33] For more info, see New Skills Agenda Steel: Industry-driven Sustainable European Steel Skills Agenda and Strategy (ESSA) | CEDEFOP, or ESSA homepage at ESSA.
[34] The countries involved are Belgium, Czechia, Finland, France, Germany, Italy, Lithuania, Netherlands, Poland, Romania, Spain, Sweden and UK.

jobs lost in the UK as plants in Wales and the north of England transition to Electric Arc Furnace (EAF)[35] production, as part of the need to decarbonise the industry.

Parallel to this – and driven by processes of consolidation, technological innovation, decarbonisation and changing market conditions – there have been changes in the workforce profile, which creates new human capital needs (see Stroud et al., 2024):

- First, new technologies (including digital transformation processes i.e. Industry 4.0) have contributed to a smaller, more streamlined and higher skilled workforce. Efforts to decarbonise production utilising new and established technologies is also having similar outcomes e.g. Wales and the transition to EAF production.
- Second, and related, old patterns of recruitment based on recruiting men from generations of family skilled by experience, have given way to recruitment of an increasingly diverse and more highly skilled and qualified workforce.
- Third, the reduction of workforce numbers, technological developments, and changes in patterns of recruitment have facilitated changes in work organisation and the introduction of high-performance work systems, which creates demand for a wider skill profile comprising T-shaped skills (transversal and technical).

Rapid and constant changes require the industry to continuously update the skills of its workforce. To remain competitive, the industry must facilitate the development of a highly qualified, specialised, and multi-skilled workforce. However, the industry faces skills shortages and gaps, recruitment difficulties, and talent management issues. Hence, it is necessary to improve the capacity of the industry to forecast, identify and anticipate skill needs, as well as tackle supply issues – towards the optimisation of skill use and skill utilisation in the immediate and long term, including recruiting skills.

Previously, emerging sector skill needs in broader areas have been identified (see, for example, Naujok and Stamm 2017; EC-EASME 2020), some of which are common across energy intensive industries (EIIs) more broadly, particularly skills related to Industry 4.0 technologies and decarbonisation. ESSA investigated more closely the precise character of the skill needs identified for the steel sector across several regions, including Wales. The importance of specific skills was identified in relation to technological advancements and decarbonisation at a job level, utilising surveys, interviews, and workshops.

Each steel-producing country presents specific institutional frameworks for skill formation. Institutions operating in a society are shaped by their historical path, and once considered in their joint combination, make up coherent models which can differ deeply from one another. Different institutional contexts produce different approaches with regard to market regulation, industrial relations and skill formation systems. Country comparison is of benefit in the definition of a new skills agenda and strategy for the steel industry as it allows to identify good practices and criticalities associated with the different institutional models, as well as common trends. Such comparisons can be considered within the context of technological developments, the decarbonisation agenda and related sector skill needs (see, for example, Vallejo-Peña et al., 2018; Antonazzo et al., 2023a and 2023b).

The approach of Wales to tackling skill needs is particular, as it will be for any country (and sometimes regions within countries). Wales is set within the wider context of the UK but is also a devolved administration with responsibility for education and training and so differs in some ways from the other constituent parts of the UK (England, Northern Ireland and Scotland), e.g. it develops its own qualifications and curricula. But, as with the UK more broadly, Wales' pattern of skill formation is market oriented. Similarly, it is often characterised as functioning with a low-skill/low-pay equilibrium and a voluntarist market-based training system, but this perhaps overlooks some concentrations of

[35] An electric arc furnace (EAF) is a furnace that heats material by means of an electric arc between electrodes. As the name implies, the process uses an EAF to melt the charge to make steel. It is a batch melting process producing batches of molten steel known as heats. It is more energy efficient while allowing for increased flexibility in the steelmaking process. Other methods include basic oxygen furnace (BOF) and induction furnace plants. While EAF steelmaking relies on electricity and recycled metals, BOF depends on raw materials like iron ore and metallurgical coke as part of a process where oxygen is blown into the furnace at a high velocity.

high-skill value-added economic activity in Wales (e.g. aerospace, steel production). In general, Wales and the UK are market-based models that rely on intense product-market competition, making firms more sensitive to shocks and triggering higher flexibility of employment. Social protection is underdeveloped and there is little incentive to invest in specific skills since these would not be protected by the welfare state or by job security and a rapid structural change would quickly devalue them (as is currently occurring in South Wales with the transition to EAF steel production).

In such a context, competition also extends to the education system, where colleges and universities compete for attracting the best students, and students for entering the best universities, with vocational education and training (outside of universities) a relatively neglected area of skill formation. Indeed, UK vocational education programmes, and apprenticeships specifically, are often compared unfavourably with those embedded within more corporatist and collectivised VET systems (e.g. Germany's dual apprenticeship) (Antonazzo et al., 2023b). ESSA aimed to understand the sector needs across Europe, but also to identify priorities and strategies to address them at the regional and national level.

6.3.2 Description of the methodology

Under the ESSA project, a Blueprint at sector level was developed for a sustainable steel industry overall, but also sensitive to the particularities of countries e.g. Wales. The particularities were drawn out through regional workshops with industry stakeholders (steel companies, trade unions, training providers, regional skills partnerships, Welsh Government) (see below for the workshop methodology). In Wales, initially three workshops were conducted. The specific focus was on South Wales, as the location of its major steel plants, to identify the challenges of digitalisation and decarbonisation for the steel sector, and to a degree address the skills questions facing EIIs in Wales more broadly (see Schröder et al., 2023b for detail).

The workshops across ESSA resulted in clear recommendations – the main focus in Wales was on decarbonisation and related skills, i.e. green skills. For industry in the South Wales region, it is recommended to conduct an independent audit on skill needs to meet decarbonisation goals. To be able to meet the ever-changing skills landscape, a continuation of the skill needs assessments between now and 2050 was recommended, with a dedicated role developed within devolved government to facilitate delivery of the skills needed. Above that, long-term funding and sharing of knowledge and resources are needed. There must be a long-term investment plan involving the central UK government and the Welsh government to address skills and training needs. The skills landscape for industry also needs further mapping, to fully understand the current system and how it addresses the needs of industry more generally, and the challenges of 'green skills' and decarbonisation specifically.

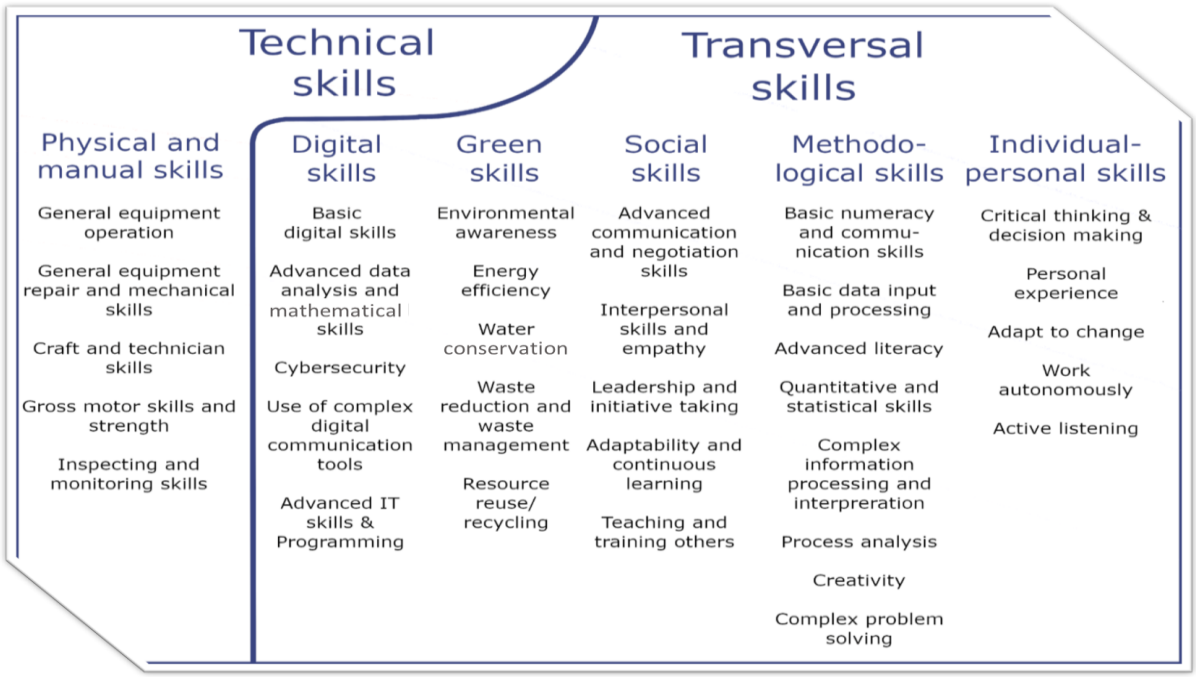
Another concrete recommendation revolved around the formation of a skills hub, or hubs, as a one-stop-shop for providing, and signposting to, courses and providers that can deliver skills quickly. To build collaboration between stakeholders to address the challenge of decarbonisation and green skills, it was recommended to develop a collaboration framework that involves representatives of all key stakeholders. The workshops also showed that there is a need for greater policy coordination, particularly between different government departments (Education and Skills, Economy, Climate Change). It was recognised that the identified skill needs were for the sustainability of the industry, which will also serve workers as long as they remain within the industry. What requires further consideration is the transferability of sectoral skill needs beyond its confines – particularly given recent events in South Wales and the loss of 2,800 jobs at Tata Steel.

Beyond these specific considerations for Wales, the wider blueprint is a European Steel Skills Agenda and strategy for meeting new skills demands in the sector, including in regions like Wales. This is a blueprint informed by the sector and designed by the sector. It aims at the development of modules and tools to build awareness and new skills for a globally competitive steel industry, ready to anticipate new skills demands and to allow proactive practical activities to meet the future requirements of the industry. Hence, the main objective and innovation has been to develop an industry-driven proactive skills strategy or Blueprint to:

- identify proactive, rather than reactive ways to meet the skill needs and demands of the industry, taking into account skills gaps and shortages, and forecasts of supply and demand;
- identify training and curricula requirements, including ways to implement new vocational education content in immediate and effective ways, within both companies and formal education and training institutions;
- improve and update training and develop new programmes for 'train the trainer' and leadership (key elements of a new skills agenda);
- identify, implement and secure necessary political support measures by mobilising and integrating stakeholders and policymakers at EU and national levels;
- identify and promote successful sectoral upskilling schemes (including exchange of existing tools, best/good practice & knowledge) and efficient management of knowledge;
- improve the attractiveness of the steel industry and careers for talented people (recruitment and retention), including the identification of strategies for overcoming recruitment difficulties and widening the talent pool for a more diverse workforce; and
- identify Key Performance Indicators (KPIs) to monitor success and needs continuously in respect of these goals and to adjust the agenda and strategy in time to respond to upcoming new developments and environments (Schröder, 2023).

The data generated was used to identify emerging skill needs across eleven job profiles (defined according to ESCO profiles): Maintenance and Repair Engineer; Process Engineer; Manufacturing Engineer; Process Engineer Technician; Production Supervisor; Industrial Electrician; Metal Processing Plant Operator; Metal Working Machine Tool Setter and Operator; Factory Hand; Training and Staff Development Professional; and Vocational Education Teacher. These job profiles were analysed using technical and transversal skill needs (T-shape approach), listed in detail in Figure 4 below:

Figure 4: ESSA T-Shaped Skill Needs: example of broader job profiles



Source: (Schröder, 2023).

Furthermore, the survey identified gaps between skill needs and current VET provision in the case-study countries, including Wales.

Document analysis: *An* extensive literature review and document analysis was carried out that focused on the following areas and topics:

1. Steel industry scenario at the national and European levels.
2. Skill formation systems.
3. Skills gaps and forecasting programmes at the national and European level.
4. National VET systems' regulatory frameworks, functioning and programmes.

The collected documents, which included scientific papers, institutional reports and national regulation, provided secondary data, insights and inputs for the further research and the Blueprint strategy.

Qualitative Data: Further to the results of the exploratory survey and desk research, semi-structured interviews with experts in steel production and vocational training, along with trade union and employer association representatives, and steel company HR officers, Production Managers and Training Centre Managers were conducted. The distribution of the interviews/responses points to a strong industry component, in accordance with ESSA's industry-driven approach. This has helped to identify national and cross-national trends in terms of emerging skill needs and national VET programmes that feed into the industry.

As indicated above in relation to Wales, national-regional workshops and roundtables were rolled out to discuss the results of the surveys and interviews and the tools and measures of ESSA within the context of national/regional skill needs concerns, using the following steps:

- ESSA partners develop a common Framework for the National-Regional Workshops.
- A first round of workshops in the pilot regions: information, verification of interest & willingness to participate of stakeholder groups in the region (companies, trade unions, training institutions, research institutes, public employment and education institutions, and civil society).
- Reviewing experiences, developments and events and their integration in the ESSA structures, tools and measures.
- Conducting more in-depth workshops on specific topics that were raised in the pilots (rounds 2 and 3), supporting additional activities within a social-innovation process. In Wales, this focused on the demand and supply of 'green skills'.
- Setting up of a European-national-regional European Community of Practice for supporting National-Regional Training Ecosystems, exchanging good practice and mutually learning from each other.

6.3.3 Post-solution reflection: successes and challenges

The outcome is a Blueprint for sustainably ensuring reliable alliances and strategies to adjust the skill needs of the steel industry proactively and continuously, within which Wales is integrated. A reliable and accepted governance structure for the main elements of the ESSA Blueprint on a European, national and regional level comprises three main elements (see Figure 5) and apply to Wales and all other steel producing regions of Europe:

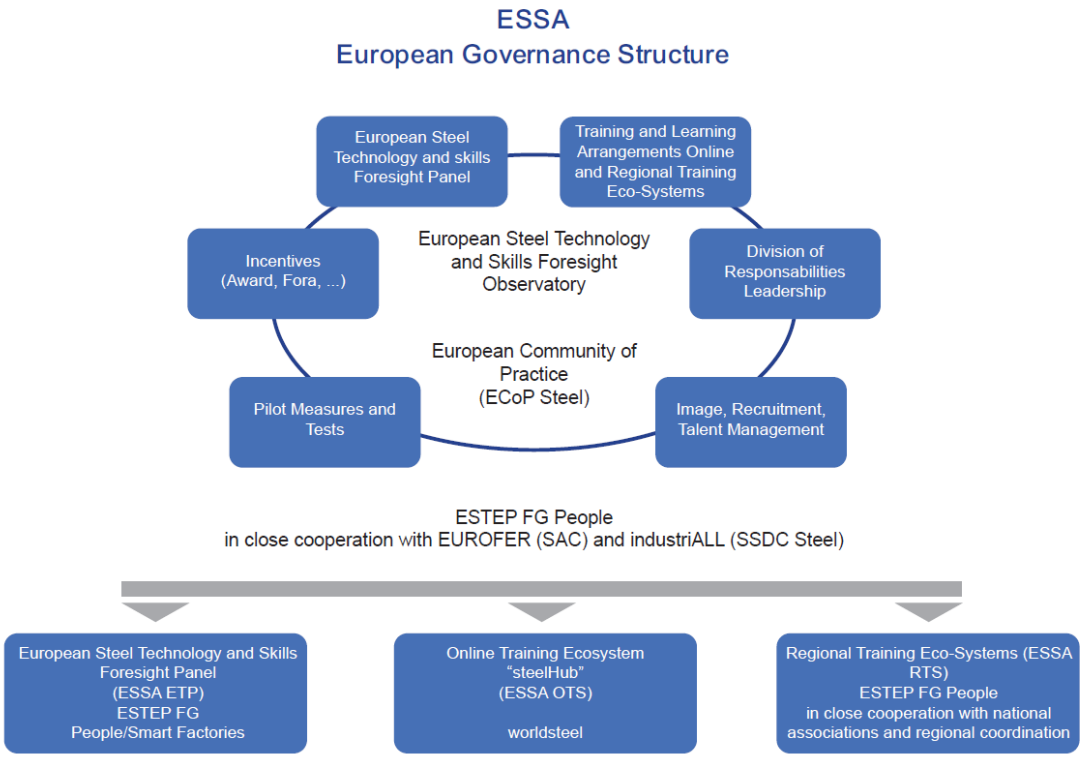
- ***The European Steel Technology and Skills Foresight Observatory*** (ESSA ETP) as the main European coordination unit, conducting a regular (annual or biannual) European Steel Technology and Skills Foresight Panel. Essentially, this comprises an iterative validation process that works to understand the skills anticipated by industry stakeholders and align them with available training provision.
- ***The Online Training Ecosystem "steelHub"*** (ESSA OTS) - this is responsible for meeting the supply of skills. It comprises an online platform that acts as a repository of training programmes

and is informed in its content by the skills demand research of ESSA. SteelHub is operated by the World Steel Association's steel university[36].

- ***The European Community of Practice of Steel Regions (ECoP Steel)*** - connecting and supporting steel-related member states and the main European steel regions as a European platform for the different National-Regional Training Ecosystems (ESSA RTS): exchanging, initiating, developing, and implementing good practice for skills and training. Wales is one steel region and will have its distinct skill needs within the broader parameters of the ESSA Blueprint and the skill needs identified. As indicated above, decarbonisation was identified as a key area of skill needs in Wales, with those needs met within the confines of a fragmented and market-orientated vocational education skills system.

This structure provides the demand side (skills requirements) and the supply side (training offers and exchange, industry image and recruitment activities) as well as an exchange and piloting / testing sphere for innovative solutions (Schröder, 2023).

Figure 5: ESSA European Governance Structure



Source: Schröder, 2023.

The European governance structure is already implemented and accepted by the main steel industry actors on the European level: ESTEP, EUROFER, and industriALL Europe. The core coordination unit is the Focus Group People of ESTEP which has agreed to run the Foresight Observatory and Panel and to establish a European Community of Practice of Steel Regions (National-Regional Training Ecosystems). The Observatory started its continued implementation and regular activities in July 2023.

The Observatory, steelHub, and European Community of Practice are part of the European Steel Community, connected with current European platforms and tools beyond the steel sector, ensuring exchange with the broader European process industry (e.g. within the Process for Planet programme of A.SPIRE and via the SPIRE-SAIS Blueprint). The governance structure of ESSA is built on a division of responsibilities, clarified and checked with the European Steel Associations and the social

[36] For more info on World Steel Association, see https://worldsteel.org/. For info on Steel University, see steeluniversity - Learning for the steel industry.

partners ESTEP, EUROFER, and industriALL. Connections with European platforms beyond the steel sector (e.g. Pact for Skills, Centres of Vocational Excellence) and tools (e.g. ESCO, Europass) are already part of the ESSA strategy, measures, and training (esp. in the steelHub and the Regional Training Ecosystems). To ensure a stronger integration of Small and Medium Sized Enterprises (SMEs), an "ESSA Task Force SME" was founded, ensuring and integrating the SME perspective, but reaching SMEs remains a challenge (see Schröder *et al*., 2023a).

There are still challenges integrating (and engaging) in uniform and even ways the perspectives of a wide range of stakeholders across, and to some extent beyond the sector, ensuring the widest array of voices are heard and included. The Covid-19 pandemic brought some specific barriers to engagement, but online interviews and surveys overcame most of the issues in this regard. However, one aim of ESSA was undeliverable: a sector skills matrix (SSM). The SSM was an attempt to systematically identify, evaluate and compare steel-sector relevant VET occupational qualification programmes (OQPs) in four European countries (Germany, Italy, Poland and Spain) – the matrix would not work for Wales because the VET system is too fragmented.

The matrix's intended three main functions were to (i) identify steel sector relevant VET occupational qualification programmes in several (initially five) case-study countries; (ii) provide a range of standardised and thus comparable formal information about each identified qualification programme and (iii) provide an assessment of each OQP in terms of adequacy of current and future transversal skills provision. However, as VET systems are almost exclusively a national domain with very limited influence, coordination or oversight at the EU level, documentation related to the OQPs is non-standardised and therefore hard to compare. Furthermore, the evaluation of current and future skills gap analysis, illuminating the discrepancy between current and future competence requirements and what OQPs currently offer in terms of skills provision, proved to be difficult to establish. The main issue in this regard is the lack of industry involvement, without which an industry-led skills gap assessment is simply not possible. This speaks to the necessity of stakeholder participation when addressing human capital needs (Weinel et al., 2023).

More broadly, ESSA offers a sector-wide strategy and methodology (Blueprint) for addressing steel industry skill needs, but the particularities of skill needs lessons from Wales (and elsewhere) are perhaps less transferable. Important here is to recognise that whilst sector skill needs might be quite common across countries (there are only so many ways that steel might be produced at an industrial scale), political and economic contexts shape the way skills are delivered from place to place. Furthermore, the pace of technological innovation will be driven by numerous factors and thus shape skill needs, and the extent to which decarbonisation is part of the skills agenda is often a political question.

6.4 Transferring local experiences from Poland and Wales to Türkiye

6.4.1 Turkish steel industry: context and background

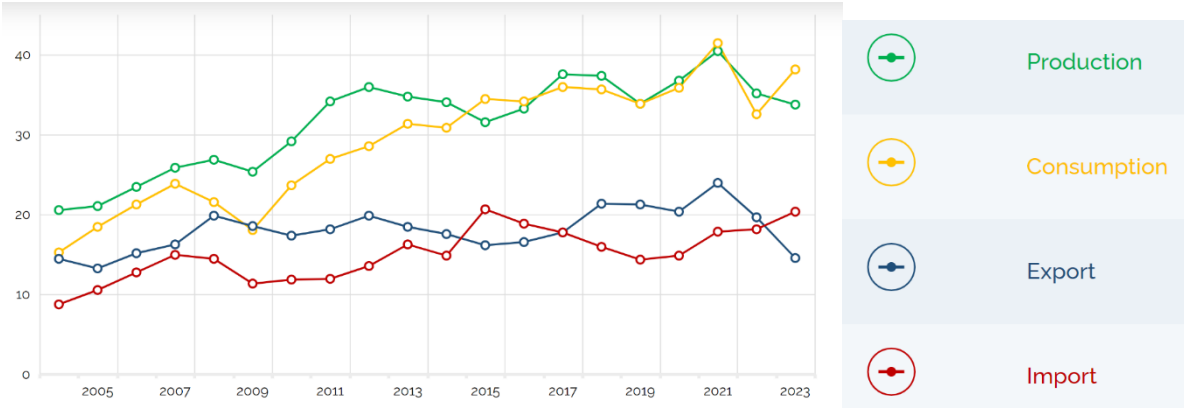
Türkiye is a country with a dynamic and diverse economy that has experienced rapid industrialisation and urbanisation over the past few decades. The steel industry plays a crucial role in this growth, contributing approximately 6.7% to the country's total exports, a value of around 14.9 billion dollars (Turkish Steel Producers Association, 2023). There are currently 41 crude steel production facilities in Türkiye, 27 of which are electric arc furnace (EAF) plants, 11 are induction furnace plants and 3 are basic oxygen furnace (BOF) plants (World Steel Association, 2023). EAF technology is considered more environmentally friendly compared to traditional blast furnace operations, as it reduces carbon emissions by using recycled steel scrap in the production process (European Steel Association, 2022).

Türkiye signed a 'Customs Union' agreement in 1995 with the EU to liberalise the trade of all industrial goods between the country and the EU. As part of this agreement, since 1996 Turkish iron and steel products can be traded without customs duties with all EU member states, in return for ceasing state subsidies to the domestic steel industry (European Commission, 1996). Today, all Turkish steel

companies are privately owned and manufacturers export worldwide, largely due to their competitive pricing and effective marketing strategies. In 2023, the EU was Türkiye's largest steel export market, receiving 4.5 million tonnes, which accounted for 31% of total steel exports. The Middle East followed with 3.3 million tonnes (22.8%) as second export market, followed by other European countries ranked third with approximately 2 million tonnes (14%). North Africa represented 10.9% of exports with 1.6 million tonnes, and Latin America contributed 7% with 1 million tonnes (Turkish Steel Exporters Association, 2023).

In 2022, global crude steel production saw a 4% decrease, which had a significant impact on the Turkish steel sector. Recession expectations in Türkiye's main export markets, particularly the EU and the USA, combined with rising energy costs, led to negative repercussions for the industry. Turkish steel exports decreased by 18% and imports fell by 3.6%. However, the value of imports increased by 8.5%, reaching 15.6 billion dollars, which was largely attributed to imports made at dumping prices (World Steel Association, 2022; Turkish Steel Exporters Association, 2023). By 2023, steel exports had decreased further by 25.8%, while imports saw a 12.5% increase, likely due to rising energy costs and Türkiye's growing reliance on domestic energy sources (Turkish Steel Exporters Association, 2023).

Figure 6: Turkish annual steel production (in million tonnes) (Turkish Steel Exporters Association)



Source: Turkish Steel Exporters Association, 2023, https://www.cib.org.tr/en/statistics.html
Notes: The x axis shows years, the y axis shows steel production in million tonnes.

As depicted in Figure 6, Türkiye has experienced a consecutive decrease in steel production and export over the past three years. This decline is largely attributed to rising energy costs, global economic challenges, and the country's increased dependence on imported energy (OECD, 2023). The rate of utilisation of Turkish steel plants fell from 75% in 2021 to 60-65% in 2022 and 2023. The reduction in capacity utilisation underscores the difficulties faced by domestic producers in maintaining competitiveness and profitability amid economic volatility (Turkish Steel Exporters Association, 2023; OECD, 2023).

Increasing energy and labour costs have eroded the competitive edge of Turkish steel producers. In particular, sharp increases in electricity and natural gas prices have had a substantial impact on production, contributing to the sector's challenges. The growth expectations for the Turkish steel industry are contingent on global demand and energy prices. If energy costs decrease and recession fears subside, production is expected to recover. Industry representatives also predict that new investments over the next 2-3 years could increase steel production capacity to 65 million tonnes (OECD, 2023).

Despite these challenges, Türkiye's strategic geographic location, serving as a bridge between Europe, Asia, and the Middle East, offers substantial opportunities for growth. The broad export markets of the country and ongoing urban transformation projects could help stabilise and potentially drive future growth in the sector (Turkish Steel Exporters Association, 2023). Furthermore, advancements in environmentally friendly technologies, such as the increasing use of electric arc

furnace (EAF) plants, could provide Türkiye with a competitive advantage in the global push for greener industrial practices (European Steel Association, 2022).

Nevertheless, legislative changes, such as the EU Green Deal and the Carbon Border Adjustment Mechanism (CBAM), will also play a pivotal role in shaping the future competitiveness of the Turkish steel sector. Iron and steel sector is one of the five sectors that are affected directly and immediately by CBAM[37]. Türkiye plans to introduce a national emissions trading system (ETS) and transition to cleaner energy sources in an effort to reduce carbon emissions. With more than 70% of Turkish steel production based on electric arc furnaces (EAF), which produce lower carbon emissions than traditional methods, the country is well-positioned to remain competitive if the energy transition is successful (European Steel Association, 2022; Turkish Steel Exporters Association, 2023). Thus, Türkiye's steel sector is at a critical juncture due to the challenges of rising energy costs, dependence on imported raw materials, and ongoing economic volatilities.

6.4.2 Human capital challenges of the Turkish steel sector

The steel sector in Türkiye is a significant contributor to the country's economy, employing approximately 150,000 people, which represents about 1.5% of the total workforce. The workforce in this sector is diverse, with a mix of ages, though a significant portion is between 30 and 50 years old. Gender distribution is predominantly male, with women making up around 10% of the workforce. Education levels vary, but a substantial number of employees hold technical or vocational qualifications, with a growing number of university graduates entering the field. Occupational profiles in the steel sector include roles such as engineers, technicians, machine operators and sales professionals (Türkiye Steel Exporters Association, 2023).

The Turkish steel sector, despite its importance in the country’s economy, faces numerous challenges of human capital that are directly influenced by both domestic economic conditions and international policies. The first challenge is the transition to greener production methods, as mentioned above by the EU Green Deal and CBAM. Despite 70% of steel production being based on EAF technology in Türkiye, the transition requires a workforce equipped with new technical expertise in sustainable practices. This creates a pressing need for large-scale retraining and upskilling programmes to prepare workers for greener production methods (European Commission, 1996; World Steel Association, 2022).

The second challenge is the mismatch between the current skills of the workforce and the evolving needs of the industry. As the steel sector increasingly incorporates automation, digitisation and advanced technologies such as artificial intelligence and robotics, the demand for highly specialised technical skills has increased. Unfortunately, Türkiye’s educational and vocational training systems have struggled to keep up with these rapidly changing demands, leaving a gap between the skills available and those required by modern steel production processes (Türkiye Steel Exporters Association, 2023; OECD, 2023).

Thirdly, the sector is also facing demographic problems, particularly an ageing workforce. Many experienced workers are approaching retirement, and there is an insufficient influx of younger workers to replace them. The industry is often perceived as less attractive compared to other sectors that are seen as more modern and innovative, such as technology and finance. Moreover, the working conditions in the steel industry can be demanding, with long hours and physically strenuous tasks, which can deter young people from pursuing careers in this field. This demographic shift poses a serious risk to the continuity of knowledge and expertise within the industry. Without structured mentoring and knowledge transfer programmes, the loss of experienced workers could lead to a significant depletion of critical skills (OECD, 2023).

[37] The EU’s Carbon Border Adjustment Mechanism (CBAM) is the EU's tool to put a price on the carbon emitted during the production of carbon intensive goods that are entering the EU, and to encourage cleaner industrial production in non-EU countries. The initial application of CBAM is foreseen to imports of certain goods and selected precursors whose production is carbon intensive and at most significant risk of carbon leakage: cement, iron and steel, aluminium, fertilisers, electricity and hydrogen.

Compounding these issues is the low participation of women in the Türkiye labour market, particularly in male-dominated industries such as steel, which is often perceived as physically demanding and less suitable for women. This perception, coupled with cultural biases and stereotypes, discourages many women from pursuing careers in this field. This lack of diversity limits the available talent pool, and addressing this imbalance through targeted initiatives could help mitigate labour shortages. Encouraging greater female participation in the steel sector through education programmes and workplace reforms is essential to build a more resilient and diverse workforce (World Bank, 2020).

Given the evolving landscape of the Turkish steel sector and the challenges faced above, it is critical to address the current and future skill needs of the workforce. The rapid adoption of new technologies, coupled with the transition towards greener production, underscores the need for a comprehensive skill needs analysis to align human capital with the sector's long-term goals. Due to increasing reliance on automation and digitisation in the Turkish steel sector, it is crucial to identify the skills necessary for these advancements and ensure that workers are trained accordingly to maintain the sector's competitiveness in global markets. At the same time, compliance with stringent environmental regulations requires equipping the workforce with expertise in renewable energy, energy efficiency, and low-emission technologies.

To strengthen their competitive edge, both locally and globally, Turkish steel producers must understand the specific skills required to navigate the challenges and opportunities of the sector. A targeted skill needs analysis can pinpoint existing gaps, allowing the design of effective training programmes and education strategies that will prepare the workforce for future demands. Furthermore, as the industry seeks to expand production capacity through planned investments, aligning workforce capabilities with growth expectations is vital for sustainable development.

6.4.3 Comparing Polish and Welsh approaches for their potential implementation in Türkiye

Before offering recommendations to monitor competence needs in the Turkish steel sector, based on the solutions developed in Poland and ESSA (Wales), it is essential to carefully consider the fundamental differences between these approaches. Understanding these differences allows us to relate them to the specific needs of the Turkish context. The following section provides a comparative analysis of these approaches and highlights their implications for the Turkish steel industry.

The first notable distinction lies in the objectives behind the studies conducted in Wales and Poland, as well as the methodologies employed. The underlying goals of each approach were shaped by different priorities. In the Welsh case, the primary objective was to create a proactive industry-driven skills strategy, commonly called a “Blueprint” and drawing on the outcomes of the European Steel Skills Alliance (ESSA). The ESSA Blueprint aimed to align the skills of the workforce with the evolving needs of the sector. Therefore, the process of generating specific recommendations was tightly integrated into the broader research framework from the outset, ensuring that the results were directly related to industry requirements. In Poland, however, the primary goal was to provide critical knowledge to Sectoral Skills Councils, which operate in close collaboration with ministries, governmental agencies, educational institutions, and international bodies. These councils are responsible for crafting recommendations that shape VET programmes.

Another key difference is seen in the scope and structure of the solutions adopted in each country. In Poland, the strategy was designed to establish a universal framework that could be applied consistently across a wide range of economic sectors. The advantage of this approach is its ability to facilitate comparisons across industries. By standardising solutions, it became possible to monitor the flow of skills between sectors, identify skills gaps that transcend specific industries, and recognise the importance of transversal skills, that are applicable in multiple sectors or job roles. This approach enabled a broader and more comprehensive view of the labour market and allowed policymakers to implement reforms that could benefit the economy as a whole.

In contrast, for ESSA and Wales, the approach was narrower in focus, concentrating on a single sector without extensive consideration of how trends in other industries might affect it. However, it did

take into account how the sector operated in different European steel producing countries, offering valuable information on how global and national factors intersect in shaping skill needs. By focussing on a sector undergoing significant transformations, ESSA was able to analyse how shifts in the economic environment led to changes in the desired skills of workers, including by country or region (e.g. South Wales). Furthermore, comparing this sector internationally provided valuable lessons on how institutional frameworks influence the links between the education system and the labour market.

When examining the analysis of skill needs, there are further methodological differences in how specific skills were identified. In both Poland and Wales (ESSA approach), the focus was on evaluating job profiles and identifying skill requirements for specific roles. However, in the ESSA solution and for steel producing countries across Europe, the approach to categorising skills was distinctive. Skills were first grouped into broader categories, such as technical and transversal skills, following the so-called T-shape approach. This method allowed for a general, yet versatile, framework to be applied to a range of occupational profiles, which provided flexibility in adapting the strategy to different job roles and industries (e.g. craft and technician skills).

In the Polish (SHCS) example, skills were identified throughout the research process, without an initial predefined list (the list was developed as the study progressed). This allowed for a more organic and dynamic approach to understanding the skill needs as they emerged during the study. It also allowed researchers to adapt the methodology to reflect real-time insights, ensuring that the final recommendations were more accurately aligned with the current demands of the sector.

As the steel industry undergoes substantial transformations – driven by technological advancements, environmental regulations, and changes in global supply chains – there is a growing need for flexibility in defining the required skills, which ESSA aimed to capture through ongoing Skills Foresight panels. In Türkiye, for example, the dynamic nature of the steel industry means that identifying skills at the beginning may not fully capture the evolving needs of the sector. Therefore, adopting a research methodology that allows for an iterative process, in which skills are continually refined throughout the study, could be more effective.

This approach, as used in Poland but also by ESSA, highlights the importance of responsiveness in skills analysis. For example, by developing the skills list in conjunction with the research findings, the Polish study was able to provide more relevant and actionable information. Furthermore, this flexible model ensured that the skills identified were not only relevant to the present but also forward-looking, preparing the workforce for future challenges and opportunities within the industry.

More rigid approaches, where skills lists are established at the beginning of the study, may fail to fully capture emerging trends or shifts in the sector. As industries such as steel undergo rapid transformation, the ability to adjust and respond to new information becomes increasingly important. Therefore, adopting a similar methodology in Türkiye could offer significant advantages, ensuring that the resulting recommendations are not only comprehensive but also adaptive to the changing landscape of the labour market. In this way, the detailed skills profiles created for specific professions/roles can be utilised by Sectoral Skills Councils in the development of specific solutions.

For ESSA, as in Poland, secondary data analysis was used to create scenarios for the industry. However, what distinguishes the Polish approach is the absence of a systemic and institutional analysis. On the contrary, a key component of the ESSA project was a comprehensive review of existing knowledge about skills formation systems, skills gaps, and forecasting programmes at both the national and European levels, as well as the regulatory frameworks, functioning, and programmes of national VET systems.

Considering that the material developed in Poland was intended to serve as significant support for the Sectoral Skills Councils, it could have been beneficial to supplement it with these additional elements. Members of these councils are not always educational experts, and having access to concise and synthesised knowledge about key institutions and systems of competence formation relevant to the industry could prove to be a valuable resource in assisting the councils in formulating their recommendations.

By incorporating this broader institutional perspective, the Polish approach could gain depth, allowing for a more informed process to address the needs for both current and future competence. Furthermore, providing Sectoral Skills Councils with information on how different VET systems function and how regulatory frameworks shape skills development at the national and European level could improve their ability to align their recommendations with broader industry and policy trends. This would ultimately allow for more strategic and informed decision making in response to the evolving demands of the labour market.

Table 1: Key differences in the approaches to monitoring skills needs in the Polish and ESSA/Welsh examples

Characteristics	ESSA/Wales	Poland
Goal and the implementation of results	To develop an industry-driven proactive skills strategy or blueprint.	Providing key information to Sectoral Skills Councils, which are responsible for developing recommendations.
Scope and structure	Specific to one sector, tested in various countries. Enabling the identification of transnational trends, characteristic of a single sector.	Universal solution, tested in various sectors. Focused on understanding broader market processes and intersectoral relationships, as well as their impact on human capital flows. Enabling the identification of cross-sectoral trends characteristic of a selected country.
Universality of the solution	The solution was developed to be implementable and comparable across different countries (partially achieved).	The solution was developed to be implementable and comparable in different sectors in Poland (objective achieved).
Definition of skills	Skills defined quite broadly, with the same groups for different professional profiles (T-shaped approach).	Detailed skills, specifically defined for different professional profiles.
Institutional context	Institutions and educational systems as a component of the study.	Exclusion of the analysis of systems and institutions.

Source: Own elaboration

In summary, before making a decision regarding the adoption of a specific solution in Türkiye, it is essential to address several strategic and political considerations. The first of these is to contextualise the skill needs study within the public policy framework. One must determine whether the research team will be responsible for formulating recommendations while public agencies will be responsible for their implementation, or if an intermediary organisation will be established to facilitate this process. In Poland, such intermediary roles are fulfilled by Sectoral Skills Councils, which also play a role in generating pressure on decision makers to implement optimal solutions. It appears that in the case of Türkiye, establishing a similar body would be necessary, particularly to influence the implementation of specific solutions by decision-makers.

The second issue concerns the nature of the solution: whether it should focus on a single industry from a transnational perspective or cover multiple sectors, perhaps Energy Intensive Industries (EIIs), within a national context. This decision is primarily driven by the knowledge we aim to acquire: whether we wish to understand the interactions between different sectors within a given country or focus on a specific narrow industry. Both approaches have their advantages and disadvantages. A solution that incorporates a transnational perspective and involves partners from other countries has an additional benefit. It appears that an internationally rooted solution enhances transparency in the recommendation development process and can also serve as a valuable tool for influencing decision-makers (including in the context of Türkiye's potential accession to the EU).

For Türkiye, conducting a thorough institutional and systemic analysis is crucial, as is the development of customised recommendations for educational institutions, sectoral bodies, and national administrative agencies. This approach mirrors the strategies used by ESSA, including in Wales,

which have proven effective in addressing similar challenges. Furthermore, considering the anticipated transformation in the steel sector, an in-depth qualitative forecast similar to the SHCS methodology used in Poland would provide valuable information.

A fundamental aspect is not merely assessing the current skills needs in Türkiye, but rather forecasting future changes in those needs. This forward-looking approach is essential given the potential shifts in regulatory and market environments influenced by significant international legislation. The ability to predict how the needed skills will evolve in response to such changes is critical to ensure that educational and training systems remain relevant and effective.

Furthermore, from a practical standpoint, it is vital to precisely define the skills required for various professional profiles. This precision, similar to the approach taken in Poland, helps ensure that educational programmes and workforce development initiatives are aligned with actual market needs, with ESSA doing this at a wider level. By clearly delineating the skills necessary for different roles, Türkiye can better tailor its educational and training programmes to address current and anticipated demands, thus improving the overall effectiveness of these programmes in preparing individuals for the evolving job market.

6.5 Conclusions and recommendations for Türkiye

The comparison of Polish and Welsh approaches highlights key methodological differences that can inform the development of skills monitoring systems in Türkiye. While the broader scope of the Polish method allows for the identification of cross-sectoral trends, the ESSA approach in Wales offers valuable insights into tailoring solutions for a single sector undergoing transformation, such as the steel industry. Given Türkiye's position as a major steel producer facing similar challenges, including technological advancements and environmental regulations, adapting these methods could significantly improve the country's ability to meet future skills needs. The following recommendations draw on the strengths of both approaches to propose a framework for the Turkish steel sector.

Sectoral skill needs analyses conducted in Poland and Wales offer robust frameworks that can be adapted to the Turkish context, particularly in the steel sector. Sectoral Human Capital Studies (SHCS) in Poland and the European Steel Skills Agenda (ESSA) in Wales have shown effective methodologies for identifying critical skills gaps and future requirements. These methodologies combine quantitative surveys with qualitative interviews, as well as stakeholder workshops, ensuring a comprehensive understanding of sector-specific skills and aligning vocational education and training (VET) systems with industry demands.

Adapting SHCS and ESSA methodologies to Türkiye's steel sector holds considerable promise. By incorporating these approaches, Türkiye can develop a detailed understanding of its workforce needs and create targeted training programmes to address current and future skills demands. Establishing sector-specific skills alliances, similar to those promoted by ESSA, which were cascaded down to the regional level could enhance collaboration among industry stakeholders, educational institutions, and policymakers. This would ensure that training programmes remain responsive to market demands and technological advances at the sector level and, where appropriate, regional level.

To effectively address the skills needs in Türkiye's steel sector, it is essential to integrate sector-specific insights with a flexible, future-orientated framework. Drawing from both the Polish and Welsh experiences, the following recommendations can be proposed:

- Sector-specific studies: Conduct comprehensive sectoral studies similar to Poland's SHCS to identify critical skills gaps and future requirements. This approach should include both quantitative surveys and qualitative interviews with industry experts.
- Stakeholder collaboration: establish sector-specific skills alliances to facilitate collaboration between industry stakeholders, educational institutions, and policymakers. This will ensure that training programmes are aligned with market needs and technological advances. ESSA provides a template for a sector skills alliance, drawing on all relevant stakeholders.

- Integration of green and digital skills: emphasise the development of skills related to green technologies and digitalisation, crucial for maintaining competitiveness in the global market. Training programmes should focus on renewable energy, energy efficiency, digital transformation, and advanced manufacturing technologies.
- Continuous monitoring and adaptation: implement a continuous monitoring system to regularly update skills profiles and training needs based on emerging trends and industry feedback. This will help keep the workforce's skills relevant and up to date. The ESSA foresight panels (ETP) provide an example of how this could be achieved.
- Inclusive employment practices: promote diversity and inclusivity in workforce development initiatives, ensuring equal opportunities for all individuals, regardless of their background and gender. This can help to tap into a broader talent pool and foster innovation.

It is important to be aware that integrating these solutions into the Turkish steel sector presents several promising opportunities and notable challenges. These must be taken into account when a decision is taken by the Turkish stakeholders.

Opportunities

- **Enhanced competitiveness:** implementing these methodologies can significantly improve the competitiveness of the Turkish steel sector. By addressing skills gaps and aligning training programmes with industry needs, Türkiye can better position itself in the global market.
- **Sustainable development:** the emphasis on green technologies and digitalisation aligns with global trends toward sustainability and Industry 4.0. This focus can help Türkiye's steel sector reduce its carbon footprint and adopt more efficient production processes.
- **Economic growth**: developing a skilled workforce capable of meeting future demands can drive economic growth. As the sector grows, it can create more job opportunities and contribute to overall economic stability.

Challenges

- **Implementation costs**: adapting and implementing these comprehensive methodologies may require significant investment. The costs associated with conducting extensive surveys, developing new training programmes, and establishing skills alliances could be a barrier.
- **Stakeholder coordination**: ensuring effective collaboration among various stakeholders, including industry leaders, educational institutions, and policymakers, can be challenging. Aligning interests and securing a shared commitment is crucial for the success of these initiatives.
- **Cultural and institutional differences**: the approaches developed in Poland and Wales may need to be tailored to fit Türkiye's unique cultural and institutional context. Differences in educational systems, industrial structures, and labour markets must be carefully considered.
- **Political and regulatory support**: obtaining consistent political and regulatory support is essential for the successful implementation of these initiatives. Political instability or changes in government policies could pose significant challenges.

To conclude, integrating skill needs assessment methodologies from Poland and Wales/ESSA into Türkiye's steel sector presents a valuable opportunity to improve workforce skills and industry competitiveness. Although there are notable challenges to implementation, including costs, stakeholder coordination, and the need for political support, the potential benefits in terms of economic growth, sustainable development, and global competitiveness are significant. By proactively addressing these challenges, Türkiye can develop a dynamic and resilient workforce capable of supporting the sustainable growth of the steel industry and ensuring long-term economic prosperity.

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CHAPTER 7: Youth digital-social entrepreneurship in Albania, Kosovo[38] and North Macedonia: Tackling the skills gap and identifying opportunities for growth

Geena Whiteman and Arta Istrefi[39]

7.1 Introduction

Many young people have grown up with technology influencing their knowledge of societal concerns since they are digital natives (Holzmann et al., 2020). A lack of employment options and the desire for financial autonomy have pushed many people to become entrepreneurs, especially in tech-driven, socially aware businesses. In line with national and international initiatives to harness young entrepreneurship for economic growth and sustainable development, programmes focused on "tech for good," "green tech," and "social tech" represent this trend (ILO, 2022).

Digital-social entrepreneurship (DSE) is a paradigm-shifting approach that incorporates digital technology with socially conscious commercial endeavours. According to Holzmann et al. (2020, p.2), DSE is the pursuit of "entrepreneurial initiatives with social purposes developed by incorporating digital technologies into their business model." It has drawn attention due to its potential to have a lasting effect (Ghatak et al., 2020). Entrepreneurs solve urgent social issues and promote economic inclusion by fusing digitalisation with social objectives (Canestrino et al., 2024).

Interest in DSE is rising in the Western Balkans due to external funding from international non-governmental organisations (INGOs) as well as internal demand from young people. By funding digital entrepreneurship, the European Commission's 2018 Digital Strategy for the Western Balkans highlights the region's efforts to transition to a digital economy (European Commission, 2018). DSE is also one of the answers to youth unemployment, which continues to be a problem. Although it decreased from 30.5% in 2019 to 24.9% in 2023, North Macedonia's youth unemployment rate (those aged 15 to 29) is still much higher than the EU average of 11.2% (ETF, 2024). Education and employment are strongly correlated, as the unemployment rate of low-educated people was 18.8%, compared with 13.3% for medium-educated and 8.9% for higher-educated people.

The skills gap is a major problem, as governments and young people struggle to match education to the demands of the job market, especially in the area of digital competences. According to the World Economic Forum (2016), 65% of children starting school today will work in jobs that do not yet exist. Today's fast-moving technology improvements necessitate constant upskilling and reskilling, in contrast to past generations when technical skills were applicable for decades (European Economic and Social Committee Employers Group, 2018). Young entrepreneurs' chances are further restricted in the Western Balkans by the tardy adoption of digital transformation strategies (RCC, 2021). The European Commission and the European Training Foundation (ETF), together with other organisations, provide support programmes and publish analyses on education, training and employment in Albania, Kosovo and North Macedonia to fill these gaps (ETF, 2024; ETF, 2025).

Through the identification of critical abilities, evaluation of existing support systems, and identification of persistent gaps in Albania, Kosovo and North Macedonia, this study seeks to close the knowledge gap on young DSE skills development. Using best practices and effective interventions from the area

[38] This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.
[39] The authors wish to thank Ana Zacharian for her contributions regarding the Albanian ecosystem.

and beyond, it will conclude with policy suggestions for bolstering the ecosystem of young digital-social entrepreneurship.

7.2 Methodology

The purpose of this study was to investigate the fundamental abilities needed by young DSEs, assess current efforts to build skills, and pinpoint ecosystem gaps in order to suggest focused improvement measures. This study aimed to:

- Determine the essential competencies that young DSEs need to be successful.
- Examine the DSE ecosystem's ongoing skill-development programmes and activities.
- Examine current skill development gaps and suggest ways for ecosystem participants to close them.

The project aims to address these goals by answering three research questions:

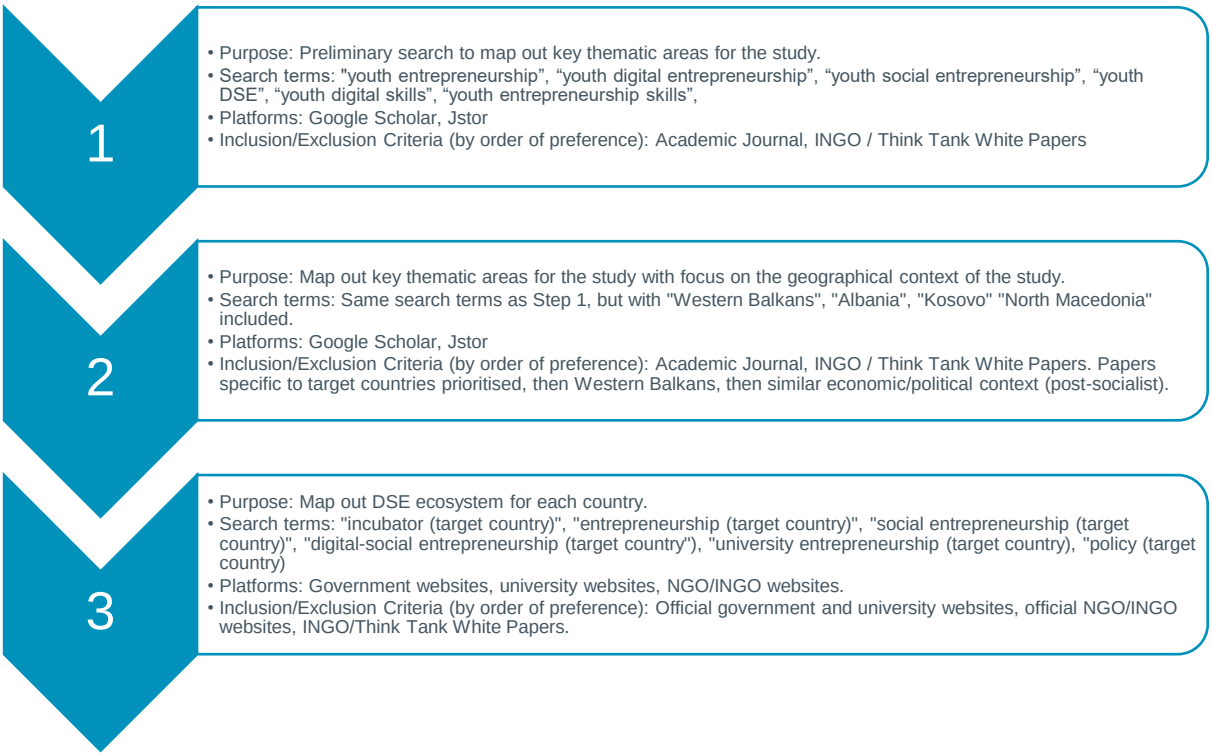
1. What are the necessary competencies for young social and digital entrepreneurs to be successful?
2. Which programmes and efforts now assist young DSEs in developing their skills?
3. How might ecosystem actors assist in filling in the skills development gaps?

The study used a secondary qualitative research design: a literature review approach. The literature review mapped the existing policy environment in each country regarding entrepreneurship, youth entrepreneurship, digital economy and digitalisation, and social entrepreneurship and innovation. This component is essential for establishing a theoretical foundation and understanding the current state of the DSE field, identifying key concepts, theories, and frameworks to provide an underlying context for the study. Through this review, we aimed to identify gaps and trends in this field, contributing to the overall understanding of the skills gap in youth DSE within this region.

The analysis was conducted through an exploration of literature regarding the broader entrepreneurial environment of each country, and applying contemporary knowledge to the unique context of DSE. This research reflects on the current understanding of the key thematic areas and places them in the context of the target countries, rather than creating new knowledge through primary research.

The mapping process is depicted in Figure 1, outlining the three stages of research involved in this study. Researchers all had experience working within the target countries, so had existing familiarity with the current DSE ecosystem to varying extents, which meant some of the knowledge (such as incubators and universities) was from institutional knowledge. Additionally, the use of search engines and engaging with entrepreneurship networks within the region was used to further map out existing initiatives. This paper did not include the Vocational Education & Training (VET) system in the analysis of entrepreneurship. Policy documents were accessed via government websites by searching each relevant government ministry, and analysed for relevance to youth DSE.

Figure 1: Research design (authors own)



7.3 Defining youth digital-social entrepreneurship

DSE is an emerging form of entrepreneurship, increasingly popular among young nascent entrepreneurs, which blends the values of social entrepreneurship with the innovativeness of digital entrepreneurship (Ghatak et al., 2020). Emerging technologies such as AI, mobile and cloud computing, internet of things (IOT), immersive technologies and social media have significantly altered the way in which entrepreneurship is done – facilitating disruptive innovation (Nambisan, 2017; Sousa et al., 2019). Digital entrepreneurship is the human effort to turn business ideas into real products and services, where these digital technologies act as facilitator and mediator in the entrepreneurial process, where technology is both the product itself and a core component of the business model (Giones et al., 2017; Steininger, 2019). It shifts the traditional way of doing business, by exploiting business opportunities through leveraging digital technologies (Younis et al., 2020). Therefore, digital entrepreneurs are typically highly digitally literate as well as demonstrating strong entrepreneurial competences.

Similar to traditional entrepreneurs, social entrepreneurs engage in commercial entrepreneurial activity. However, they identify and realise opportunities derived from societal problems, such as poverty and climate change (Zahra et al., 2009). The process of social entrepreneurship involves the innovative use of resources in pursuit of creating activities or practices that yield and sustain social benefits (Mair et al., 2006). Because social entrepreneurs strive for both social value creation and profit-making, this often results in conflicting institutional tensions between social and economic activities – tensions which do not occur in traditional enterprises (Pache et al., 2013; McMullen et al., 2016). Some scholars differentiate between sustainable entrepreneurship and social entrepreneurship, where sustainable entrepreneurship involves the pursuit of reducing environmental degradation (Dean et al., 2007; Thompson et al., 2011). However, this study considers sustainable entrepreneurship values as part of social entrepreneurship – in which the pursuit of environmentally friendly business practices yields and sustains social benefits in the same way that pursuing poverty alleviation or gender equality does. This requires social entrepreneurs to have high levels of social consciousness and compassion, while also demonstrating strong entrepreneurial competences.

Whereas digital entrepreneurship is the leveraging of digital technologies to exploit business opportunities, and social entrepreneurship is the pursuit of social value creation alongside profit-making activities, DSE sits within the middle. DSE refers to the use of digital technologies to create social value through entrepreneurial activities (Ghatak et al., 2020). It is often associated with digital-social innovation, tech4good, industry 5.0 and ICT4D, all movements that utilise the power of digital technologies to address social and/or environmental problems (Yáñez-Valdés et al., 2023). Young people are more inclined towards DSE due to their digital nativeness and their desire for 'purposeful work', as well as their heightened awareness of social and environmental challenges due to their proximity to the internet and its unlimited access to relevant information (Zhiyang et al., 2020). Growing up with the internet has removed geographical barriers, allowing young entrepreneurs to connect with global audiences, collaborate across borders, and access resources and markets that were previously out of reach (Lewis, 2019; Clarke et al., 2010). This global perspective encourages them to tackle social issues that affect not only their local communities, but also the world at large. Additionally, younger generations are often more open to new ideas, and less constrained by traditional business models (Lewis, 2019). Digital platforms provide the flexibility to experiment, pivot, and scale social ventures in innovative ways, which appeals to their dynamic approach to problem-solving.

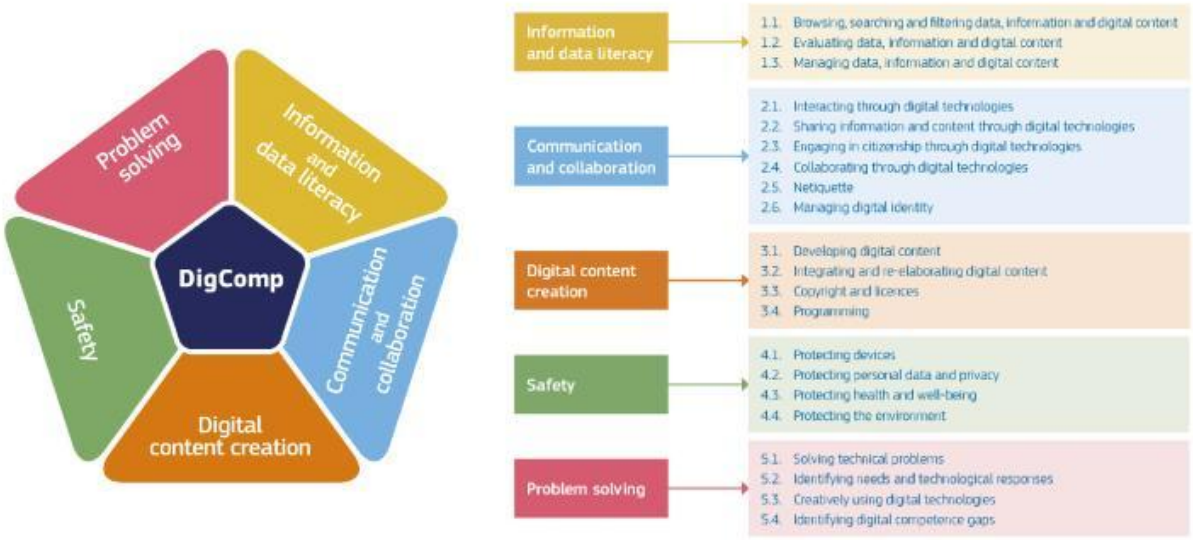
DSE is vital because it directly addresses pressing social, environmental and economic challenges. By combining technology with social impact, young entrepreneurs can develop scalable solutions that tackle issues like poverty, inequality, climate change, and access to education (Battisti, 2019). Digital-social enterprises contribute to economic growth by creating jobs, both directly and indirectly. They stimulate local economies, empower communities, and often reinvest profits into social causes, creating a positive cycle of economic and social benefits. In regions such as the Western Balkans where youth unemployment is high, young digital-social entrepreneurs create jobs for their peers and tackle key societal challenges facing their local communities (Milosevska et al., 2021). Additionally, the success and visibility of young digital-social entrepreneurs inspire others to follow in their footsteps, creating a ripple effect of social innovation and entrepreneurship. This helps cultivate a culture of responsibility and creativity in addressing global challenges.

7.4 Skills and competences required for youth digital-social entrepreneurship

Where there is currently no existing framework or consensus surrounding the skills required for DSE, this study seeks to develop a framework for digital-social entrepreneurial competences – based on existing understanding of digital entrepreneurship and social entrepreneurship competences.

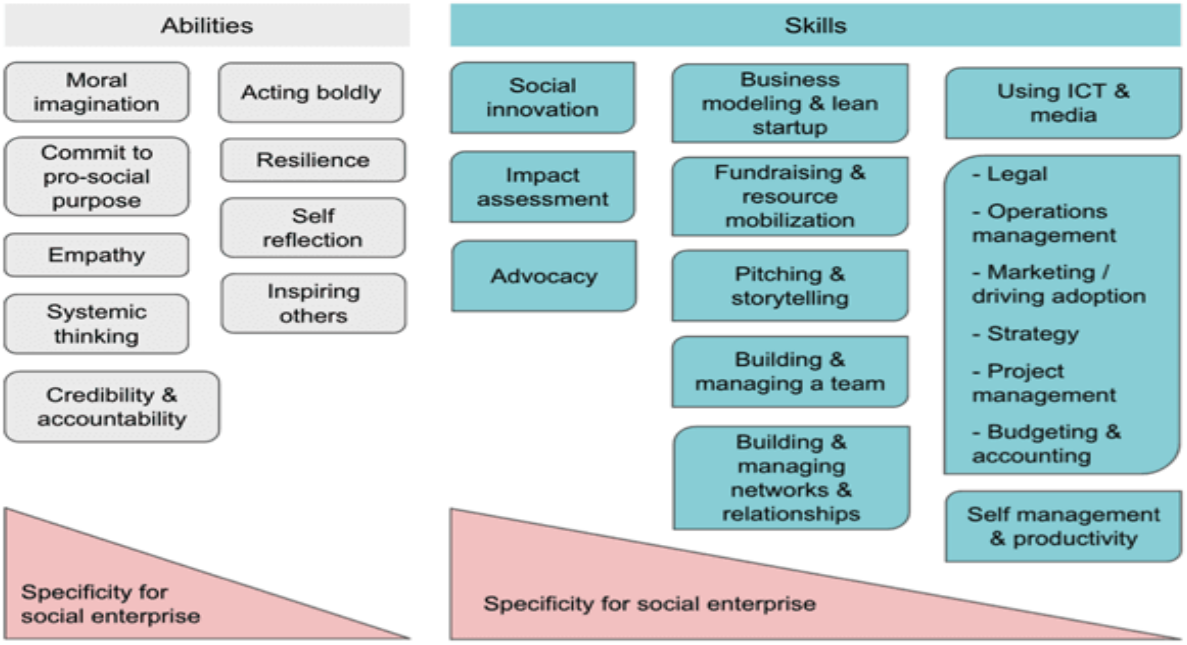
The development of digital technologies is having a massive impact on the labour market and the type of skills needed in the economy, and in society, as well as impacting the way in which people engage in entrepreneurial activity. Digital entrepreneurship is becoming a more appealing pathway for many young people, but the Digital Economy and Society Index (DESI) shows that 4 out of 10 adults and every third person who works in Europe lack basic digital skills. In line with the European Commission's Digital Education Action Plan 2021-2027 and European Skills Agenda, the European Commission recently updated their DigComp framework, which outlines five key skill areas and 21 competences important for the labour market (see Figure 2):

Figure 2: DigComp - the Digital Competence Framework for Citizens (2022)



DigComp is a measure of general digital competence, there has been great effort from academics to create a similar framework that is specific for digital entrepreneurs, such as EmDigital (Prendes, 2021). While there has been significant emphasis on the skills required for digital entrepreneurship, development of a framework for social entrepreneurship skills has been limited. Currently, there are three large-scale, pan-European projects seeking to develop a framework for social economy and social entrepreneurship skills (B-Wise, baSE and ESIC)[40], but these are still in the developmental stages with no outputs as of publication. Therefore, this study utilises the work of Kraemer (2016), who conducted a mapping exercise of 39 MOOCs relating to social entrepreneurship and social impact leadership, creating a framework of 9 abilities and 11 skills required for social entrepreneurs (see Figure 3).

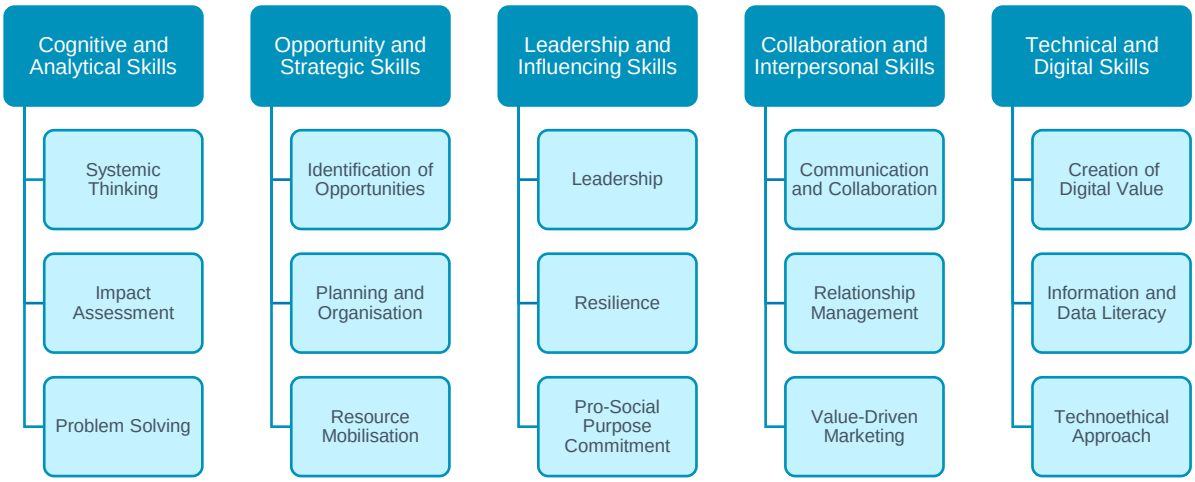
Figure 3: Competences required for social entrepreneurs (Kraemer, 2016)



[40] https://www.bwiseproject.eu/en/project; https://social-economy-gateway.ec.europa.eu/topics-focus/skills-social-economy_en

Where DSE is the meeting point between digital innovation and enacting social values, the skills required for a DSE are a blend of those required for digital entrepreneurship and social entrepreneurship. The skills required for DSE are classified under five headings by the authors of this paper (see Figure 4).

Figure 4: DSE Competences Framework (authors own)



As listed in Figure 4, the required skills and competences for a digital-social entrepreneur are explained as follows.

7.4.1 Cognitive and analytical skills

- **Systemic thinking:** This refers to the ability to understand the interconnected systems contributing to the problem they are addressing. This is important for DSEs as it helps them identify the key gaps and address the root causes of the problem.
- **Impact assessment:** This refers to the ability to measure social and financial impact, to ensure ventures are achieving their goals. This is important for DSEs in terms of self-reflection on alignment to values and achievement of purpose.
- **Problem solving:** This refers to the ability to navigate challenges and find innovative solutions. This is important for DSEs to navigate the multifaceted and challenging environments in which they are operating and the complexities of running a DSE, such as addressing low internet access by developing offline-compatible apps.

7.4.2 Opportunity and strategic skills

- **Identification of opportunities:** This refers to the ability to spot gaps in the market or areas for social improvement and is the foundation of entrepreneurship. This is important for DSEs as it aids them in recognising the need for specific interventions, such as online education platforms in areas with limited physical access to schools.
- **Planning and organisation:** This refers to the ability to strategically plan to ensure resources are used efficiently, and goals are met. This is important for DSEs as it aids them in developing and implementing a business plan, a fundamental component of starting and running a business.
- **Resource mobilisation:** This refers to the ability to secure and manage resources effectively. This is important for DSEs as it helps them accumulate resources, such as crowdfunding and securing grants.

7.4.3 Leadership and influencing skills

- **Leadership:** This refers to the ability to inspire and guide teams to achieve goals. This is important for DSEs as it aids them in leading a team to implement an intervention, such as developing a platform connecting small farmers to urban markets.
- **Resilience:** This refers to the ability to navigate difficult circumstances and stay motivated when operations are slow or challenging. This is important for DSEs when navigating the challenges that a start-up faces, such as persisting through funding rejections in the first few years.
- **Pro-social purpose commitment:** This refers to the focus on social impact which distinguishes digital-social entrepreneurs. This is important for DSEs to understand the 'why' of their business operations, and continuously align themselves with their pro-social values.

7.4.4 Collaboration and interpersonal skills

- **Communication and collaboration:** This refers to the ability to effectively convey a vision and work with diverse stakeholders. This is important for DSEs as it helps them communicate the values of their business to key stakeholders and collaborate with important partners to implement their intervention.
- **Relationship management:** This refers to the ability to build strong networks, secure partnerships and maintain stakeholder trust. This is important for DSEs as it helps them to manage relationships with investors, NGOs and local government to sustain their activity.
- **Value-driven marketing:** This refers to the ability to effectively communicate the pro-social values of the business in marketing material. This is important for DSEs as it helps them connect with pro-social consumers and align their product/services with the target markets.

7.4.5 Technical and digital skills

- **Information and data literacy:** This refers to the ability to locate, evaluate and use information effectively for making data-driven decisions. This is important for DSEs as it aids them in analysing market trends and user data to design interventions that address gaps in the market, such as rural healthcare.
- **Creation of digital value:** This refers to the ability to create products or services that leverage technology for social impact. This is important for DSEs as it helps them develop their business, such as building an app to help disabled individuals navigate urban spaces using real-time data.
- **Techno-ethical approach:** This refers to the ability to ensure responsible use of technology that respects ethical and societal values. This is important for DSEs to mitigate some of the ethical challenges that technology can bring, such as designing algorithms that avoid bias.

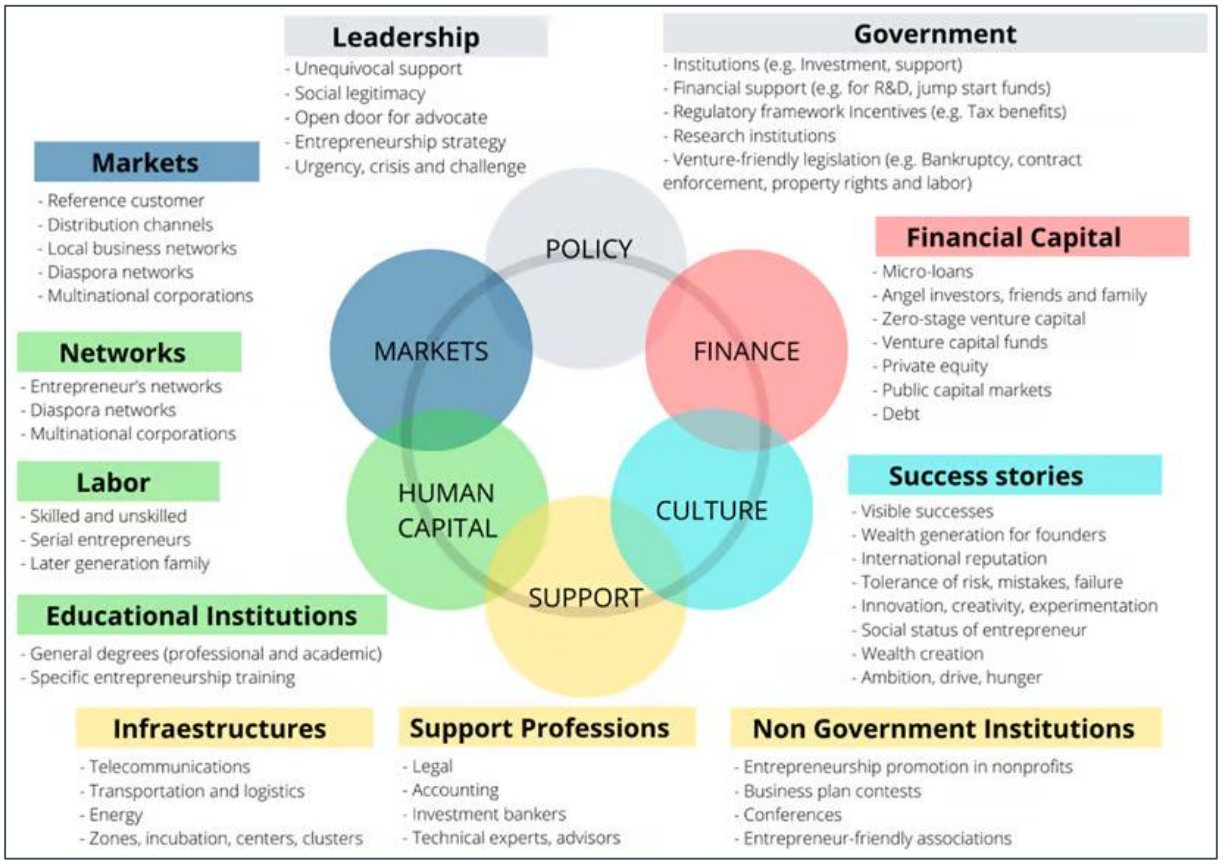
This provides a framework of the key skills that will be mapped throughout this study, and used to identify where training, policy and support provisions in Albania, Kosovo and North Macedonia are not currently supporting young digital-social entrepreneurs to develop the relevant skills and competences required.

7.5 The digital-social enterprise ecosystem of Albania, Kosovo and North Macedonia

7.5.1 The entrepreneurial ecosystem

Isenberg (2011) proposed the idea of an entrepreneurial ecosystem, identifying the components necessary for fostering a thriving environment for start-ups (see Figure 5). Isenberg's model outlines six domains that interact to create a supportive ecosystem for entrepreneurship: policy; finance; culture; support; human capital; and markets. This study focuses on exploring three domains of the ecosystem: policy; support; and human capital –the components most relevant to addressing skills gaps in entrepreneurs. Isenberg's model emphasises that the success of a start-up ecosystem depends on the collaboration and interaction between these domains.

Figure 5: Isenberg's entrepreneurial ecosystem model (Isenberg, 2011)



The policy domain refers to the governmental and regulatory environment, and identifies ways in which policies promote entrepreneurship – either through the removal of barriers (such as bureaucratic licensing arrangements) or the provision of incentives (such as tax cuts or grants). The support domain refers to the availability of resources and services that help entrepreneurs grow their businesses, such as NGOs, training programmes, incubators and accelerators. The human capital domain refers to the availability of skilled workers and experienced entrepreneurs, which requires the presence of high-quality educational institutions that produce graduates with relevant skills for entrepreneurship.

These components are interdependent, and interact dynamically to create an environment that fosters DSE activity. For example, the policy environment, which includes regulations, tax incentives and government programmes, directly influences the availability of financial resources. Favourable policies can encourage venture capital investments and banking institutions to support start-ups, while

financial capital availability impacts the development of support structures such as incubators and accelerators, which rely on funding to provide resources and mentoring for entrepreneurs.

Human capital is another critical element, where a well-educated and skilled workforce attracts investors and bolsters the market by enabling start-ups to develop innovative products and services. This influences the cultural component of the ecosystem, as success stories from entrepreneurial ventures inspire others to pursue entrepreneurship, shifting societal attitudes toward risk-taking and innovation.

Markets, including both domestic and international demand, also play a pivotal role in the ecosystem. Strong market demand motivates entrepreneurs to innovate and scale their ventures, which influences policy decisions aimed at facilitating business growth. For instance, governments may develop trade policies or infrastructure projects to support market expansion. Simultaneously, a thriving market environment encourages cultural shifts toward entrepreneurship and increases the appeal of financial investments in start-ups.

The following section will explore the DSE ecosystem in each country, primarily focusing on the human capital, policy and support mechanisms in place, before further discussion occurs in Chapter 6 regarding the challenges each country's ecosystem faces.

7.5.2 Albania

Albania is located in the Balkan peninsula in south-eastern Europe and has a population of 2.7 million people. Over the past few decades, it has shifted from a centrally planned economy to a market-oriented one, experiencing significant reforms and growth. Albania's economy has grown steadily, with GDP primarily driven by services, industry and agriculture. Albania faces challenges like high unemployment, a large informal economy, corruption and infrastructure deficits. The country is working towards EU membership, and aligning with EU standards is driving reforms in various sectors. Ongoing reforms focus on improving the business environment, reducing corruption, and enhancing public services to boost economic growth and integration with European markets.

Table 1 provides a list of four policy documents identified in Albania, which are found to be relevant to DSE. The National Strategy for Employment and Skills enables the development of labour market appropriate skills which can be conducive to entrepreneurship, while the Employment Promotion Law includes a commitment to a Youth Guarantee Scheme to further develop labour market skills for young people. The National Youth Strategy is designed to facilitate the development of an enterprising culture among young people, including the promotion of 'youth innovation' through IT skills development, which is conducive to DSE. The Business and Investment Development Strategy promotes the development of an entrepreneurship ecosystem, including the provision of financing and training, which provides a broader supportive environment for young DSE.

Table 1: Policy environment for DSE in Albania

Policy document	Year	Details
National Strategy for Employment and Skills 2023-2030	2023	The National Strategy for Employment and Skills 2023-2030 has two goals and five objectives. Policy goal 1: Skills development and better matching of demand with supply in the labour market for more employment Policy goal 2: Enabling decent employment for women and men through the implementation of inclusive labour market policies
Employment Promotion of Law 2019 Amendment 2023	2023	New programmes/schemes are provided in this Amendment which aim to engage unemployed jobseekers in various employment programmes, public works, self-employment, professional practices, or training such as: a) Youth Guarantee Scheme - As part of the youth guarantee scheme, young people are offered with an employment /continuing education/professional practice within a four-month period from the moment of registration with the respective employment office.

Policy document	Year	Details
		b) Voucher scheme for financing professional training - The voucher scheme is provided to unemployed jobseekers to cover partially or totally the costs and tariffs of any professional training course attended at any private professional training centre.
National Youth Strategy 2022-2029	2022	The National Youth Strategy 2022-2029 has outlined the following goal: Youth innovation is supported and encouraged, including an increase of skills and professionalism of young people through quality education in ICT and other areas of digital development, thus increasing and improving the opportunities to enter the labour market.
Business and Investment Development Strategy 2021-2027	2021	The Business and Investment Development Strategy 2021-2027 has three investment areas which are associated with three goals. Investment attraction and internationalisation: Fully unlock investment potential for economic development and foster integration in international markets and value chains SME development, entrepreneurship and innovation Develop a dynamic and sustainable ecosystem for entrepreneurship and innovation Human capital development Explore new ways to foster collaborative human capital development

Entrepreneurship programmes in Albanian higher education

Several universities in Albania offer entrepreneurship programmes, with some incorporating elements of digital entrepreneurship and social entrepreneurship. This section will discuss the best-case examples.

- University of Tirana: The University of Tirana, Albania's largest and oldest public university, offers entrepreneurship courses within its Faculty of Economics. While specific programmes focused solely on digital or social entrepreneurship might not be standalone, these topics are often covered in courses on business innovation, digital marketing and sustainable development. The university also hosts various workshops and seminars that address contemporary trends in entrepreneurship.
- Epoka University: Epoka University, a private institution, offers programmes in business administration and economics with a focus on entrepreneurship. Epoka University includes courses in digital entrepreneurship and social entrepreneurship, particularly within its programmes related to business innovation and technology management. The university has a strong emphasis on practical learning, with opportunities for students to engage in start-up incubators and entrepreneurial projects.
- European University of Tirana (UET): UET is known for its business and economics programmes, including a focus on entrepreneurship. UET offers courses that touch on digital entrepreneurship and social entrepreneurship. The university is involved in various initiatives promoting social impact and digital innovation, often partnering with international organisations to provide students with hands-on experience.
- Canadian Institute of Technology (CIT): CIT offers programmes in business and information technology with a strong focus on entrepreneurship. The university includes courses and modules that specifically address digital entrepreneurship, with a particular emphasis on integrating technology with business strategies. Social entrepreneurship topics are also covered, especially in courses related to sustainable business practices and corporate social responsibility.
- Polytechnic University of Tirana: While primarily focused on engineering and technology, the Polytechnic University of Tirana offers programmes that include entrepreneurship, particularly within the context of technology and innovation. The university offers courses that address digital entrepreneurship, particularly in relation to technology start-ups and innovation. Social

entrepreneurship might also be explored in the context of sustainable engineering and technology solutions.

These universities often collaborate with local businesses, NGOs and international institutions to offer workshops, seminars and practical projects that emphasise digital and social entrepreneurship.

- Youth Business Incubators in Albania: Albanian youth entrepreneurship is greatly aided by education, which gives young people the know-how, self-assurance and abilities necessary to thrive in an increasingly cutthroat business environment. As a result of programmes like Junior Achievement Albania and university-driven incubators like Tirana Inc., academic institutions are providing possibilities for hands-on learning and curriculum integration related to entrepreneurship. Programmes that emphasise work preparation, financial literacy and practical business experience are helping develop a generation of creative, forward-thinking students.

Similar to Kosovo, Albania does not have an acceleration programme. Table 2 provides information on seven best-case examples of youth business incubators.

Table 2: Youth business incubators in Albania

Name	Location	Description
Metropolitan Incubator (METINC)	Tirana	Metropolitan Incubator is the first "On Campus" incubator among Albanian universities. Its mission is to support the successful development of businesses, influencing regional economic development. METINC offers mentoring, technical support and academic advice, co-working space, as well as access to various funding programmes. More than 20 start-ups have benefited from incubation support at METINC, and 12 start-ups or businesses are currently registered in mentoring programmes.
RISE (Regional Incubator for Social Entrepreneurs)	Tirana	RISE (Regional Incubator for Social Entrepreneurs) is a project that supports social business ideas that will make the region a better place. RISE improves access to social entrepreneurship for youth in the Western Balkans, and focuses on cooperation, ideas exchange and peer learning. RISE creates a regional network of Risers, and young social entrepreneurs, and supports them in making their ideas a reality. After the success of the first cycle, the RISE project has been renewed for three more years with the support of its partners.
Tirana Inc.	Tirana	Tirana Inc. is the first multi-university incubator in Albania supporting student-led entrepreneurship through training, mentoring and networking in the local and regional ecosystem.
Junior Achievement Albania (JAA)	Tirana	The mission of Junior Achievement in Albania is to promote and support economic education and entrepreneurship among Albanian youth. JAA's main goals are to raise awareness and increase knowledge on financial and entrepreneurial competencies, and develop the culture of self-employment and entrepreneurship among young people.
Dua Partner Invest	Tirana	Dua Partner Invest comprises a unique opportunity that enables all types of investors (businesses, venture capital firms, impact investment schemes, development programmes and individuals) around the world to invest in regional start-ups generating a social or environmental impact. It enables innovative start-ups in the Western Balkan region to access expertise from a large community of experts.

Name	Location	Description
Yunus Social Business (YSB)	Tirana	YSB Balkans is part of YSB Global Initiatives, a network of entities supporting the creation and growth of social impact businesses around the world. It aims to address social issues through supporting the development of start-ups/businesses that have the potential to create positive social impact in the Western Balkans. YSB does this through running entrepreneurship promotion campaigns, implementing incubation/acceleration and investment readiness programmes, facilitating access to financing, and supporting the development of an enabling entrepreneurship ecosystem in the region.
Innovation Hub Tirana	Tirana	The project´s objective is to promote and support social inclusion and sustainable employment programmes for young people by enhancing their active involvement both in ICT entrepreneurship, and in creative, innovative and competitive actions – through capacity building, partnership development and the growth of entrepreneurial activity, start-ups and SMEs.

7.5.3 Kosovo

Kosovo has an emerging economy characterised by steady growth and significant challenges. Since declaring independence in 2008, its economic growth was driven mainly by consumption, remittances and public investment. However, its GDP per capita remains low compared to other European countries. Political uncertainty, both domestically and in relations with Serbia, impacts economic stability and investor confidence. Limited access to international markets due to partial recognition of its independence by other countries also hinders trade and investment opportunities. Efforts to attract foreign investment and integrate into the global economy are ongoing, but the country's development is constrained by these significant challenges. The country has a relatively young population, which is a potential asset for economic growth. However, high unemployment, especially among youth, remains a critical challenge as emphasised by the Regional Cooperation Council.

Table 3 below provides a list of four policy documents identified in Kosovo, which are found to be relevant to DSE. The Kosovo Strategy for Youth aims to develop support for youth entrepreneurship, by improving training and providing financing (grants) for young entrepreneurs. The Kosovo Economic Reform Program, the National Strategy for Innovation and Entrepreneurship, and the Kosovo ICT Strategy, highlight the government's digitalisation strategy, including an emphasis on improving access to digital support and youth access to entrepreneurship support.

Table 3: Policy environment for DSE in Kosovo

Policy document	Year	Description
Kosovo Strategy for Youth 2019-2023	2019	For non-formal education, the Ministry of Culture, Youth and Sport (MCYS) identifies the need to develop entrepreneurship education activities, as currently, entrepreneurship education in Kosovo is considered to be 'inadequate' – outlining different methods of provision of these activities (such as workshops, training and conferences). For opportunity creation, the MCYS commits to developing guidelines for entrepreneurship programmes for youth in alignment with National and European best practice, establishing a cross-sectoral coordinating party to implement youth entrepreneurship projects and providing grants and creative initiatives for new youth-led businesses.
Kosovo Economic Reform Program 2019-2023	2019	This document outlines 20 priority measures for economic reform, including: Measure 12) Improving entrepreneurship and innovation environment; Measure 13) Expansion of relevant ICT network infrastructure and services for socioeconomic development; and Measure 19) Increasing the access of youth

Policy document	Year	Description
		and women to the labour market through the provision of quality employment services, active employment measures and entrepreneurship. Measure 19 commits to "implementing active labour market measures focusing on young people and women and the development and implementation of the self-employment and entrepreneurship programme" and "supporting voluntary work initiatives, contributing to youth employment" (p95).
National Strategy For Innovation And Entrepreneurship (2019-2023)	2019	Pillar B commits to "implement a programmatic and institutional innovation and entrepreneurship support scheme in an efficient manner" (p38) through "generic programmatic innovation support schemes (e. g. funds, subsidies etc.)" (p38) and by "strengthening and streamlining the innovation intermediary landscape" (p38) Pillar C identifies how "currently neither vocation training schemes nor higher education curricula correspond to the needs of the economy… students and graduates are not fully able to apply their knowledge in economics, important elements with regard to innovation and entrepreneurship are missing". (p39) Pillar C commits to three operational objectives, that are: the modification of curricula to include "digital and entrepreneurial skills, media competencies, soft skills as well as innovative teaching methods" (p40); to "align vocational and higher education curricula with entrepreneurship and economic demands" (p40); and to "better integrate women in business through specific support programmes".
Kosovo IT Strategy 2019-2023	2019	This document outlines nine strategic pillars, in which Strategic Pillar 7 discusses the role of, and development of entrepreneurship. It identifies IT as having the potential to play a crucial role in increasing the capacity for innovation of Kosovo's economy. In addition, the IT sector could also serve as a catalyst for entrepreneurship and the establishment of a vibrant start-up scene. It discusses the institutional framework for the "innovation system as well as its entrepreneurial ecosystem still at a very early stage" and highlights the biggest barrier as being a lack of access to finance.

Entrepreneurship programmes in Kosovar higher education

Higher education institutions in Kosovo are growing more conscious of the growing interest of young people towards entrepreneurship, and the new trend is to engage students in youth incubation programmes. Kosovo has several universities that offer entrepreneurship programmes, and some of them also include courses or specialisations in digital entrepreneurship or social entrepreneurship. However, none yet are focused on DSE. Notable examples are listed below.

- University of Prishtina (UP): The University of Prishtina, the largest public university in Kosovo, offers various programmes in business and economics, which include entrepreneurship as a core subject. While specific programmes focused solely on digital or social entrepreneurship might not be prominent, courses related to innovation, business development and digital transformation are often integrated into their business and economics curricula.
- RIT Kosovo (AUK): RIT Kosovo offers programmes in applied arts and sciences, including a focus on entrepreneurship. They provide courses and workshops that focus on digital entrepreneurship and social innovation, often emphasising practical, project-based learning and engagement with the local start-up ecosystem.
- Universum College: Universum College is known for its business and management programmes, including entrepreneurship. They offer courses and modules that touch on digital marketing, business innovation and social entrepreneurship. They also collaborate with international institutions to provide students with a broader perspective on these fields.
- AAB College: AAB College offers programmes in business administration with components of entrepreneurship. While digital and social entrepreneurship might not be standalone programmes, relevant topics are covered within broader business and management courses. The college also

hosts various events and workshops on entrepreneurship, sometimes with a focus on social impact.

- University of Business and Technology (UBT): UBT offers a range of business and technology programmes with a strong emphasis on innovation and entrepreneurship. UBT includes digital entrepreneurship and social entrepreneurship in its curriculum, particularly through its focus on the intersection of technology and business.

These universities often collaborate with local and international organisations to offer workshops, seminars and incubator programmes that specifically address digital and social entrepreneurship. Table 4 provides eight best-case examples regarding the youth business incubators in Kosovo.

Table 4: Youth business incubators in Kosovo

Name	Location	Description
Gjakova Innovation Centre	Gjakova	Gjakova Innovation Centre is a business incubator with the mission of promoting and supporting young entrepreneurs in the construction and development of new companies. They offer ongoing incubation support, whilst also providing short-term projects such as Ideas to Success and Training for Women's Entrepreneurship (TWE).
Innovation Centre Kosovo (ICK)	Prishtina	Innovation Centre Kosovo is a business incubator that was founded to support entrepreneurship, innovation and commercially based business development, with a focus on information and communication technology. They offer ongoing incubation support, as well as short-term training opportunities, workshops, events, and competitions for young entrepreneurs, such as BOOST x Kosovo.
Makers Space Prizren	Prizren	Makers Space Prizren is a business incubator that aims to develop and promote a digital ecosystem in the area of Prizren through interconnecting science, education and the business sector. They offer ongoing incubation support through the Idea-to-Scale programme, while also offering short-term projects and events, such as CodeQueen's.
Venture Up	Prishtina	Venture Up is a business incubator based out of the University of Prishtina, serving as a bridge between education and the labour market. They offer ongoing incubation support, and run specific short-term incubation programmes for green start-ups (Green Hub Programme) and social impact start-ups (Social Impact Programme).
Balkan Green Foundation (BGF)	Prishtina	BGF is a regional NGO that promotes inclusive and equitable progress in the Western Balkans within the sustainable development domain. They run various short to mid-term programmes for aspiring young social innovators, such as Regional Incubator for Social Entrepreneurs (RISE) and Balkan Green Ideas, providing skills training, mentorship and start-up grants to youth-led social impact businesses.
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Office	Prishtina	GIZ is a German Development agency that funds many youth entrepreneurship and employability related initiatives in Kosovo, such as the Green Entrepreneurship Academy – which formed part of the 'Youth, Employment and Skills in Kosovo' project. The Green Entrepreneurship Academy has provided young people in North Kosovo with the knowledge and skills to develop their own green start-up ideas, which were pitched, and finalists included for the 'Sustainable Start-up Award Kosovo'.
Sustainability Leadership Kosova	Prishtina	Sustainability Leadership Kosova is an NGO aiming to catalyse the adoption of sustainable development practices for a fair, biodiverse and climate-positive circular economy. They propose various short-term programmes that provide young people with training and

Name	Location	Description
		mentorship opportunities surrounding green and social entrepreneurship, including the 'SEKA 1.0' programme – which is an introduction to social enterprise bootcamp for young people unfamiliar with social entrepreneurship.
UNICEF Innovation Lab	Prishtina	UNICEF Innovation Lab catalyses positive social change by harnessing the creative potential of Kosovo's young people, empowering them to become responsible citizens and community advocates. They run a series of UPSHIFT workshops and short-term training programmes in partnership with incubators and NGOs in Kosovo that offer social enterprise and impact training for young people, including mentorship opportunities and financial support for starting ventures.

7.5.4 North Macedonia

North Macedonia's economy has grown steadily since gaining independence in 1991. It has transitioned from a socialist economy to a market-oriented one, with efforts to integrate into the EU driving many of its economic reforms. North Macedonia's economy has experienced moderate growth, with GDP driven by industrial production, services and agriculture. North Macedonia faces challenges such as high unemployment, especially among youth, regional disparities, and a large informal sector. Foreign investment is encouraged through incentives, and the country benefits from strong trade ties with the EU. EU accession remains a key goal, and aligning with EU standards continues to drive economic reforms.

Table 5 provides a list of three policy documents identified in North Macedonia, which are found to be relevant to DSE. The Economic Reform Program aims to enable the development of a strong entrepreneurship ecosystem, whereas the National Youth Strategy includes support for young people in developing entrepreneurship skills for the labour market. The National Strategy for Social Enterprises supports the development of a social enterprise culture in North Macedonia, which further enables the development of DSE.

Table 5: Policy environment for DSE in North Macedonia

Policy document	Year	Description
Economic Reform Programme 2024-2026	2024	Competitiveness Enabling a business-friendly environment and further integration in the EU single market Ensuring stable and sustainable food supply Sustainability and Resilience Strengthen resilience to climate change and reduce environmental pollution Building efficient digital public services Human Capital and Social Policies Labour force efficiency improvement Further implementation of social reform package
National Youth Strategy (2023-2027)	2023	The National Youth Strategy 2023-2027 is a strategic document that establishes medium-term goals and priorities for the development of youth policies and the promotion of the interests of young people in the Republic of North Macedonia. The National Youth Strategy 2023-2027 covers eight key thematic areas: *Youth participation, *Youth information, *Youth work, *Education, *Culture, *Health, *Entrepreneurship and pre-employment support, *Security (protection from violence)
National Strategy for Development of Social Enterprises 2021-2024	2021	The goal of this strategy is to develop a sustainable eco-system that will be encouraging and enabling for the social enterprises in this country. It predicts measures and activities that are grouped into four strategic priorities: Creating a culture of social entrepreneurship;

Policy document	Year	Description
		Development of capacities of social enterprises and the actors in the eco-system; Development of markets for social enterprises; Building a financial eco-system for social enterprises.

Entrepreneurship programme in North Macedonian higher education

The necessity of encouraging young entrepreneurship is increasingly recognised by the North Macedonian school system. Entrepreneurship is emphasised as a primary priority in initiatives like the National Youth Strategy (2023–2027) which encourages educational institutions to include entrepreneurial skills in their curricula. North Macedonia has several universities that offer entrepreneurship programmes, with some focusing on digital entrepreneurship or social entrepreneurship. A few notable institutions are listed below.

- Ss. Cyril and Methodius University in Skopje: Ss. Cyril and Methodius University, the largest and oldest public university in North Macedonia, offers programmes in economics and business administration with a strong emphasis on entrepreneurship. While specific programmes in digital or social entrepreneurship might not be stand-alone, courses related to these areas are integrated into their broader entrepreneurship, innovation and business management curricula.
- University American College Skopje (UACS): UACS is known for its business and economics programmes, which include entrepreneurship. The university offers courses and specialisations in digital entrepreneurship and social entrepreneurship. UACS often collaborates with international institutions to provide students with a global perspective on entrepreneurship. They also host workshops and seminars on digital innovation and social impact.
- South East European University (SEEU): SEEU offers programmes in business administration with a strong focus on entrepreneurship. The university includes digital entrepreneurship and social entrepreneurship topics in its curriculum, especially within courses on innovation, technology management and business ethics. SEEU is also known for its emphasis on practical experience and engagement with the local entrepreneurial ecosystem.
- University of Tourism and Management in Skopje (UTMS): UTMS offers business-related programmes with components of entrepreneurship, particularly within the tourism and hospitality sectors. While digital and social entrepreneurship might not be the central focus, the university integrates these topics into courses related to innovation in tourism, sustainable business practices and digital marketing.
- International Balkan University (IBU): IBU offers programmes in economics and administrative sciences, which include entrepreneurship. The university provides courses and activities that emphasise digital entrepreneurship and social entrepreneurship. IBU frequently organises events, competitions, and incubator programmes that encourage students to develop innovative and socially responsible business ideas.

These universities often collaborate with various local and international organisations to offer students practical experiences through workshops, internships, and incubators focused on digital and social entrepreneurship. Though practical training and entrepreneurial attitudes are not yet widely integrated in the educational system, there is still opportunity for development in terms of the extensive integration of entrepreneurship education across all levels. In addition, ETF has also offered entrepreneurship coaching to two Regional VET Centres[41] in the context of the Centres of Excellence project[42]. Table 6 provides seven best-case examples of youth business incubators and accelerators in North Macedonia.

[41] North Macedonia, Nikola Karev Regional VET Centre
North Macedonia, DSU RCSOO (Secondary Vocational Municipal School) Kole Nedelkovski
[42] https://www.etf.europa.eu/en/what-we-do/entrepreneurial-centres-vocational-excellence

Table 6: Youth business incubators and accelerators in North Macedonia

Name	Location	Description
Start-up Macedonia	Skopje	This is one of the most active associations offering support from pre-start-up (idea stage) to scale-up. It plays a vital role in investment promotion to attract both local and international investment. Additionally, it runs initiatives to bridge start-ups to policy makers.
SmartLab / Skopje Innovation Lab	Skopje	This organisation focuses on youth training, with a target that reaches beyond start-ups. They offer an innovation lab with a focus on addressing the challenges and problems facing the city.
ARNO Social Incubator	Skopje	ARNO is an organisation for Social Innovation. They provide solutions to large global challenges with small, local actions. They ran programmes on “Green Ideas Competition” for many years and are known for Green Entrepreneurship.
InnoFeit	Skopje	Center for Innovation within Ss. Cyril and Methodius University in Skopje. This is a hub for interaction among Faculty of Engineering staff, students and industrial partners that will foster connections and the transfer of technology. The centre is a co-founder of the Accelerator UKIM and was selected as a candidate by the European Investment Bank (EIB) to become a Centre-of-Excellence in its fields of interest.
SEEU Tech Park (700 Accelerator)	Tetovo	SEEUTechPark is a technology park located on Southeast European University campus in Tetovo, with the mission to develop knowledge-based start-up companies at SEEU, designed to create and foster an entrepreneurial culture among the faculty, researchers, and students of SEEU, as well as the commercialisation of scientific and technological knowledge.
UKIM Accelerator	Skopje	Business Accelerator UKIM is tech accelerator, dedicated to supporting the development of technology entrepreneurs, start-ups, spin-offs and scale-ups. UKIM also offer funding and investments. Services they provide are fundraising help, strategic company development aid, mentorship, and access to global markets and business networks.
Business Impact Lab	Skopje	They offer support for social entrepreneurs in Macedonia through education, know-how exchange, mentors and experts, international investors, grants and a vast network of contacts for young people and students with the purpose of supporting entrepreneurship that will make social difference.

7.6 Key findings

DSE in the Western Balkans is currently in an underdeveloped yet growing state. In each country, there is a growing interest in DSE, demonstrated by the availability of short-term training programmes, but there is limited institutional support for DSE. In each country, nascent young DSEs experience unique challenges, despite being significant potential contributors to socio-economic development.

7.6.1 Albania

In regard to human capital, while Albania has an abundance of higher education institutions, both public and private, there is still a significant mismatch between education and industry needs. Higher education institutions fail not only to equip young people with the practical skills and specific knowledge required for the current labour market, but also to harness and nurture the entrepreneurial capacities and interests of students (Barjaba et al., 2023; Mekuri et al., 2024). The current education system does not provide adequate entrepreneurship education, nor does it embed entrepreneurial

skills and competencies into the curriculum, due to an outdated pedagogical approach to higher education (Nano et al., 2024; Demeti et al., 2017).

Additionally, there are limited opportunities for hands-on learning, and limited investment into the development of a strong vocational education sector – such as through the provision of internships and apprenticeships – which hinders skills acquisition required for DSE (Merkuri et al., 2024). This extends to a lack of professional development resources available in Albania, either in the local language (where most online professional development is taught and assessed in English), at an affordable cost (where cost of education is a barrier to access), or in regard to physical provision (where most in-person training is provided in Tirana, disadvantaging rural youth) (Barjaba et al., 2023). Regional disparities in access to education and technology have resulted in lower levels of digital literacy in rural areas, hindering the development of DSE among rural youth and exacerbating the urban-rural skills divide (Qerimi et al., 2023).

Culturally, there is a scepticism towards entrepreneurship and start-up culture, with a societal preference for more 'traditional' employment over entrepreneurship. This is due to both the socialist legacy and its detrimental attitude towards entrepreneurs, and the high rates of youth unemployment making entrepreneurship a more risky and less viable option for young people (Demeti et al., 2017). Additionally, a negative cultural attitude towards failure hinders the development of an entrepreneurship culture, which is a wider issue in the Western Balkans (Ramadani et al., 2023). Due to this cultural attitude of, and stigma towards, entrepreneurship, there are limited mentorship opportunities, as few established entrepreneurs are visible within the ecosystem. Many established entrepreneurs in Albania, similar to Kosovo and North Macedonia, end up emigrating to Western Europe or the USA, resulting in a brain drain of the talented entrepreneurs who could further support the development of the digital-social entrepreneurial ecosystem (Gëdeshi et al., 2021).

Institutional environment barriers represent a significant challenge for the development of DSE, with political instability and corruption creating an unpredictable regulatory environment for young entrepreneurs to navigate, while a lack of transparency makes the business environment risky for investment (Ramadani et al., 2023). The bureaucratic red tape surrounding registering and running a business discourages young entrepreneurs from starting a business, due to their limited experience navigating institutional constraints. Additionally, Albania's position on the periphery of many European institutions (such as the EU) creates significant geographic and economic barriers for young nascent DSEs seeking to build and grow their own businesses, restricting their ability to attract international clients and expand their operations (Kruja et al., 2020).

In terms of finance and support for DSE, young Albanian DSEs lack access to funding and investment, due to the limited availability of venture capital and angel investors in Albania – particularly those with an interest in DSE (Barjaba et al., 2023). This is due to institutional constraints for entrepreneurship limiting the attractiveness for investment, and a lack of knowledge about DSE among investors hindering investment into the sector. Additionally, the private sector plays a limited role in the DSE ecosystem, with large corporations not adequately investing in, collaborating with or supporting the start-up culture (Mekuri et al., 2024). This lack of collaboration from the private sector means the majority of support for DSE comes from the NGO sector, where financial support is limited to grants. These grants, however, are dependent upon donor interests, and thus not a reliable source of financing.

7.6.2 Kosovo

The accumulation of human capital is important for young DSEs; however, the education system is outdated, particularly in regard to business and entrepreneurship education (Qorraj, 2017). The curriculum focuses on theoretical knowledge, with little emphasis on digital and entrepreneurial skill sets. While this is improving in private institutions due to their connection with the private sector, access to private institutions is costly, which is a barrier to participation in relevant and effective entrepreneurship education. Public institutions, such as the University of Prishtina, have their own business incubators, but these operate relatively separately from what is taught by lecturers, and they have a limited capacity for providing support to young nascent entrepreneurs (Sahiti, 2021). This over-

reliance on traditional education and lack of exposure to contemporary entrepreneurial methodologies further hinders the ability of young DSEs to innovate and excel (Qorraj, 2017).

Weak institutional capacity in schools and training centres also hampers skills development. These institutions often lack the resources and infrastructure necessary to deliver modern, industry-relevant education. The provision of support for DSE is done in the NGO and private sectors, with most incubators and short-term training programmes provided through these sectors (Saranda et al., 2019). This means that the support provided is often required to be aligned with the current 'trends' of the private sector, which is criticised in Kosovo for not embracing the values of social economy enough. This means many DSEs are left to seek support from NGOs, in which the majority of support is grant-funded, and based on the funder's own short-term priorities. This means support is unreliable and requires the DSE to morph their business to align with funders' current priorities (such as clean energy), which adds an additional barrier to support for DSE.

Kosovo has a fragmented entrepreneurial ecosystem, characterised by insufficient collaboration between educational institutions, the government and the private sector (Ramadani et al., 2023). Such fragmentation undermines the development of a cohesive support structure that could facilitate the growth of DSE. Kosovo's entrepreneurs also face challenges in connecting to global markets and practices due to limited international partnerships. Without these connections, they miss opportunities for exposure to innovative ideas and resources that could enhance their competitiveness. This situation is exacerbated by political instability, where ongoing political tensions create an environment of uncertainty and deter foreign investment, which is crucial for nurturing a robust entrepreneurial ecosystem.

Access to funding remains another critical issue. The scarcity of venture capital and other financing mechanisms leaves young entrepreneurs heavily dependent on personal savings or grants, limiting their ability to scale their operations (Avdiaj et al., 2024). This restricts young DSEs from lower-income backgrounds from pursuing DSE, and means entrepreneurship is only accessible for those from higher-income socioeconomic backgrounds. This is exacerbated by a persistently high youth unemployment rate. Economic pressures often make entrepreneurship an unattractive or unattainable option for many young people, as they prioritise stable income sources over the uncertainties of launching a venture. This is tied in with negative cultural attitudes towards entrepreneurship, which are pervasive across the Western Balkans, where entrepreneurship is viewed more negatively than traditional employment.

7.6.3 North Macedonia

Outdated curricula in schools and universities fail to prioritise skills such as coding, data analysis or digital marketing, leaving graduates ill-prepared for the demands of the digital economy (Penaluna et al., 2020). Additionally, while a growing number of higher education institutions provide some form of entrepreneurship training, this is limited and does not align with global market needs (Temova et al., 2021). There is limited teaching on social entrepreneurship, and a lack of embedding entrepreneurship into the broader curriculum (Thanasi-Boçe et al., 2023). Low awareness of entrepreneurial career paths further diminishes the appeal of DSE as a viable option for young people (Ramadani et al., 2023).

The limited number of state-funded programmes for digital skills development or entrepreneurial education limits the ability of young people to acquire the necessary competencies to succeed in this space. Where programmes exist, fragmentation and poor coordination lead to inefficiencies and unequal access, leaving many potential entrepreneurs without the support they need (Penaluna et al., 2020). This challenge is further compounded by high rates of brain drain, as talented individuals often emigrate in search of better opportunities, depleting the country's pool of potential innovators.

A weak entrepreneurial culture characterised by risk aversion and fear of failure discourages many from pursuing start-up ventures (Ramadani et al., 2023). These cultural barriers are exacerbated by systemic issues such as corruption and nepotism, which create unequal access to resources and opportunities, marginalising young entrepreneurs and eroding trust in the ecosystem. Additionally, a lack of government incentives, such as tax breaks or financial support tailored to DSE, acts a

significant barrier to the development of DSE. Without such support, start-ups struggle to survive and scale (Thanasi-Boçe et al., 2023).

Low levels of public-private sector collaboration further weaken the entrepreneurial landscape. Insufficient partnerships mean that start-ups miss out on valuable mentorship, funding opportunities, and access to established markets (Temova et al., 2021). Socio-political and economic instability compounds these issues, creating uncertainty that discourages investment in new ventures. Innovation in North Macedonia is also stifled by insufficient research and development (R&D) support. Minimal funding and inadequate infrastructure for innovation reduce the competitiveness of local entrepreneurs. Additionally, the country's delayed integration into the EU limits access to EU funding programmes and regional markets, further constraining the growth of DSE.

7.7. Conclusions and recommendations

Although the Digital-Social Entrepreneurship (DSE) ecosystems of Albania, Kosovo and North Macedonia are mostly comparable, there are some significant distinctions between them in terms of institutional capability, available funding, and entrepreneurship-related cultural attitudes. Based on the findings of the paper, we can draw six broad conclusions, listed below.

7.7.1 Youth DSE is an emerging phenomenon in the Western Balkans, but it faces many challenges

There is an increased interest among young people to pursue DSE, reflected by a growing number of popular initiatives by NGOs and incubators providing support for DSE. However, due to the underdeveloped nature of the DSE ecosystem, and broader social and economic challenges facing each country, young DSEs face a series of challenges in pursuing DSE. These include high unemployment rates and a fear of company failure. Wage employment is favoured in Albania and Kosovo, where there is significant cultural scepticism towards entrepreneurship (Ramadani et al., 2023). Despite being risk averse as well, North Macedonia has a more positive view of start-ups than its neighbours, due to increasing knowledge of entrepreneurship brought about by donor-led and NGO-led initiatives. Moreover, all three countries are experiencing brain drain, with many talented entrepreneurs migrating to Western Europe or the USA, limiting local mentorship opportunities and weakening the ecosystem (Gëdeshi et al., 2021).

7.7.2 Until now, no framework existed for analysing the skills required for DSE, but this report provides a framework to bridge this gap

Where DSE is a relatively new and emerging phenomenon and academic literature is limited, there has been no existing framework for analysing the skills required for DSE. Where DSE is at the intersection of digital and social entrepreneurship, this report maps out existing frameworks for digital entrepreneurship and social entrepreneurship skills. Based off of this, a DSE skills framework is proposed which encompasses the skills for digital and social entrepreneurship, outlining the importance of each of the fifteen skills.

7.7.3 The DSE ecosystems in all three countries are disconnected, but this is slowly changing

In all three countries, the DSE ecosystem is currently disconnected, which is a broader reflection on the underdeveloped state of entrepreneurship in each country. However, in each country, there are ongoing attempts in civil society and government to reduce this disconnection and facilitate stronger connections between the key actors within the ecosystem. This is reflected in government policies, a growth in working groups relating to digital and social entrepreneurship, and a growth in DSE-oriented training programmes that connect different components of the ecosystem.

7.7.4 Policy suggests DSE is a priority, but there are complex institutional constraints to navigate

In each country, youth entrepreneurship, digital entrepreneurship and social entrepreneurship are outlined as policy priorities, tying into broader themes of digitalisation, economic development, sustainability and supporting youth. However, due to limited financial resources and a lack of understanding about the needs of DSE, the implementation of initiatives tackling these policy priorities is weak. Additionally, the social and economic environment in each country means that DSE is less high on the policy agenda than EU accession, or the development of a stronger private sector. This means that broader actors within the DSE ecosystem, such as higher education, incubators and NGOs, are neglected.

7.7.5 University curricula do not adequately support the development of DSE, but there is progress

The current consensus in each of the three countries is that the university system is outdated, the curricula need updating, and the pedagogy needs modernising. This is particularly prominent in state institutions, due to a lack of financial resources and incentives to modernise the curricula. Private institutions are developing more entrepreneurial curricula and stronger industry connections to enhance the experience for students. There is significant emphasis on digital entrepreneurship and digital skills in private institutions, however, there is limited progress in tying this to social entrepreneurship, and developing programmes aligned to the values of DSE. This leaves many young people unaware of DSE. Incubators and NGOs help bridge that gap, and are the primary support mechanisms for young and nascent DSE.

7.7.6 Incubators and NGOs bridge the gap, but need further support to be sustainable

Incubators and NGOs bridge the gap in each country, but they have limited capacity, are financially constrained, and often dependent on unreliable grant funding. Growing incubator networks that assist social entrepreneurs, such ARNO in North Macedonia, Balkan Green Foundation in Kosovo, and RISE in Albania, are present in all three nations. But there are still few acceleration programmes available, which makes it difficult for growing firms. Seed funding is limited, with most coming from INGOs, whose outlined priority target areas (such as gender equality) change regularly, meaning DSEs working on challenges outside target areas are unable to access funding. In all three countries, there is a lack of venture capital due to perceived economic volatility, meaning there are limited financing sources for young DSEs. Albania established the Challenge Fund to address scalability concerns, while North Macedonia stands out with its Innovation Fund, which provides funding to young entrepreneurs. In contrast, Kosovo is mostly dependent on projects that are supported by donors, which raises questions about long-term viability. Despite a robust incubator scene, Albania faces governmental obstacles and a misalignment between business and education.

Based on the conclusions drawn above, we develop recommendations below for three target groups: policymakers; higher education institutions; and support organisations.

7.7.7 Policymakers

- Introduce grants and subsidies specifically for digital-social enterprises.
- Simplify regulatory processes for starting and scaling businesses to reduce administrative burdens.
- Strengthen intellectual property rights to protect digital innovations and encourage investment.

7.7.8 Higher Education Institutions

- Revise curricula to include practical digital and entrepreneurial skills such as coding, data analytics and business planning.

- Establish partnerships with tech companies to provide internships and real-world experience for students.
- Provide training for faculty members to stay updated on digital trends and entrepreneurial teaching methods.

7.7.9 Support Organisations

- Develop specialised training programmes for coding, digital marketing and social innovation.
- Organise networking events and forums for young entrepreneurs to connect and collaborate.
- Provide seed funding or microloans to help start-ups overcome financial barriers.

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ACRONYMS

AAPS	Agricultural Advisory and Professional Services
AI	Artificial Intelligence
AL	Albania
ANETI	National Agency for Employment and Self-Employment, Tunisia
ATFP	Tunisian Agency for Vocational Training
ATOFU	Tunisian Directory of Training Courses in Higher Education
AUB	American University of Beirut, Lebanon
BA	Bosnia and Herzegovina
BAU	Beirut Arab University, Lebanon
BGF	Balkan Green Foundation, Kosovo
CBAM	The EU's Carbon Border Adjustment Mechanism
CEDRO project	United Nations Development Programme CEDRO 5 project
CIT	Canadian Institute of Technology, Albania
CITET	Tunis International Centre for Environmental Technologies
CNFCPP	National Centre for Continuing Training and Professional Development, Tunisia
CoVEs	Centres of Vocational Excellence
CVET	Continuing Vocational Education and Training
DESI	Digital Economy and Society Index
DSE	Digital-Social Entrepreneurship
EDDIE	Education for Digitalisation of Energy
EGD	European Green Deal
EIT	European Institute of Innovation and Technology
EQF	European Qualifications Framework
ESCO	European Standard Classification of Occupations
ESD	Education for Sustainable Development
ESJS	European Skills and Jobs Survey
ESSA	European Steel Skills Agenda
ETF	European Training Foundation.
EU	European Union
FAO	Food and Agriculture Organization
FGB	Fondazione Giacomo Brodolini
GBCI	Green Business Certification Inc
GDP	Gross Domestic Product
GIS	Geographic Information Systems

GXR	Global X-ray
IBU	International Balkan University, North Macedonia
ICK	Innovation Centre Kosovo
IEA	International Energy Agency
ILO	International Labor Organization
IoT	Internet of Things
IRENA	International Renewable Energy Agency
ISCED	International Standard Classification of Education
ISMI	Individual Skill Mismatch Indicator
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JAA	Junior Achievement Albania
LEED	Leadership in Energy and Environmental Design
LESP	Lebanese Solar Energy Plan
LU	Lebanese University
MK	North Macedonia
MPS	Ministry of Agriculture, Forestry, and Water Management
NACE	European Classification of Economic Activities
NEEAP	National Energy Efficiency Action Plan, Lebanon
NGOs	Non-Governmental Organisations
O*NET	Occupational Information Network, USA
OSHEE	Electric Power Distribution Operator, Albania
p.p.	Percentage point(s)
PARP	Polish Agency for Enterprise Development
PhD	Doctor of Philosophy
RGPEVT	Directory-guide of the potential of green jobs in Tunisia
RISE	Regional Incubator for Social Entrepreneurs, Albania
RTMC	Tunisian Directory of Professions and Skills
SDGs	Sustainable Development Goals
SECOVE	Sustainable Energy Centres for Vocational Excellence
SEEU	South East European University, North Macedonia
SHCS	Sectoral Human Capital Studies
SMEs	Small and Medium Enterprises
SMI	Skill Mismatch Indicator
SNBC	National Low-Carbon Development Strategy, Tunisia
TSP	Tunisian Solar Plan
TVET	Technical and Vocational Education and Training

UA	Université Antonine, Lebanon
UACS	University American College Skopje, North Macedonia
UBT	University of Business and Technology, Kosovo
UET	European University of Tirana, Albania
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UP	University of Prishtina, Kosovo
USE	Université Saint-Esprit, Lebanon
USEK	Holy Spirit University of Kaslik, Lebanon
USJ	Université Saint-Joseph, Lebanon
UTICA	Tunisian Union of Industry, Commerce and Crafts
UTMS	University of Tourism and Management in Skopje, North Macedonia
VET	Vocational Education and Training
WB	Western Balkans
YSB	Yunus Social Business, Albania

TA-01-25-004-EN-N

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ISBN 978-92-9157-750-7