



EMERALD

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EMERALD – an Erasmus+ Strategic Partnership – labour market needs analysis:

NEED FOR NATURAL RESOURCE EXPERTS IN THE LABOUR MARKETS

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NEED FOR NATURAL RESOURCE EXPERTS IN THE LABOUR MARKETS

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INTRODUCTION

This analysis of labour market needs was requested as background material to assess the need for natural resource experts to submit an application to establish a new master's programme (Erasmus Mundus Joint Master's Degree on Sustainable Natural Resource Management and Long-Run Economic Development, acronym: EMERALD). The goal is to launch a two-year, full-time international MA programme (120 ECTS) that provides students with knowledge and understanding of the long-term political and economic aspects of natural resource governance and management. Although students with both BA and BSc degrees can be accepted into the programme, the master's programme does not expect MA candidates to possess a BSc degree. Therefore, this report assesses the need for experts in sustainability and natural resources who do not have a background in engineering or the natural sciences.

In this report, present and future labour market needs are mapped through semi-structured interviews¹ of major employers or experts on the labour markets from countries part of the original project (Finland, Germany, Norway, Romania, Spain, Sweden) and analysis of recent labour market reports on a national and international level. This report considers both recent fluctuations and structural tendencies over the past few decades in the global labour markets.

The importance of sustainably managing natural resources cannot be overstated. Due to climate change, the greatest crisis of our times, the management of limited natural resources is an unavoidable topic for governments and businesses. As summarised by the International Panel of Climate Change:

Climate change is the result of decades of unsustainable production and consumption patterns, as well as governance arrangements and political

¹ See Appendix 1.

economic institutions that lock in resource-intensive development patterns. (IPCC 2022, p. TS-141².)

If the effects of climate change are to be mitigated, such an effort requires making strong changes to the way production and consumption have operated thus far. Natural resources are the fuel of human life and ingenuity. Where and how they are managed, by whom and according to what standards will determine the course of human history.

A global initiative for the better management of natural resources is currently being discussed in high-profile forums. For example, *Transforming our world: the 2030 Agenda for Sustainable Development* (the Agenda 2030) is a joint global work plan coordinated by the United Nations (UN) to end poverty, combat inequality and stop global warming before 2030. Governments from all six countries covered by this EMERALD report have signed the Paris Agreement and Agenda 2030 and are committed to meeting sustainable goals in multiple ways.³ Apart from NGOs and governments, many businesses have implemented their own sustainability initiatives and believe sustainable strategy is necessary for competitiveness (Haanaes 2006–2019). All our interviewees both from private and public sector recognise that the sustainable management of natural resources is essential. However, some also highlighted that the role

² The IPCC report has a two-tier numbering system, where the first part (a number or letter sequence) refers to a section and the second to the page number in that section.

³ Finland: <https://valtioneuvosto.fi/-/10616/hallituksen-kestavyystiekartta-kokoa-yhteen-sosiaalisen-taloudellisen-ja-ekologisen-kestavyden-nykytilan-ja-tavoitteet-vuodelle-2030>;

Spain:

<http://www.exteriores.gob.es/Portal/en/PoliticaExteriorCooperacion/NacionesUnidas/Paginas/ObjetivosDeDesarrolloDelMilenio.aspx> TAI https://ec.europa.eu/environment/ecoap/spain_en;

Sweden: <https://sweden.se/climate/sustainability/sweden-and-sustainability>;

Norway: <https://earth.org/country/norway/> (agenda 2030; Paris Agreement; NOU 2020, p. 81);

Germany: <https://www.bundesregierung.de/breg-en/issues/sustainability/germany-s-national-sustainable-development-strategy-354566>;

Romania: <https://www.eea.europa.eu/themes/sustainability-transitions/sustainable-development-goals-and-the/country-profiles/romania-country-profile-sdgs-and>.

of the markets and legislation in driving business decisions is on par with sustainability questions. Sustainability needs to fit into market logic.

Megatrends like changing demographics, climate change, digitalisation and globalisation are all major causes of fluctuations in the labour markets and are likely to influence them in the future as well (OECD 2018, p. 2). As a result, the business environment is becoming ever more complex, networked and in a continuous state of change (Technology Industries 2018, p. 4; see also, e.g. SACO 2021, p. 6). The education system must equip students with a variety of abilities, knowledge and skills,⁴ including both generic as well as subject-specific skills to help them thrive in working life (NOU 2020, p. 97).

All six countries examined in this report will be facing demographic imbalances in their labour markets in the near future. Baby boomers throughout the developed world are currently retiring, creating major labour shortages especially in markets requiring high-skilled work. The 2018 OECD report has noted that shortages will be severe particularly in fields requiring high-level cognitive skills, such as various forms of written expression, deductive reasoning, fluency of ideas, originality and memorisation. Such skill gaps have only increased since the ten-year period of inspection was completed five years ago (OECD 2018, p. 5). The need for people in high-skill occupations is only increasing and needs to be taken into account when planning future education. This will lead to even more new positions requiring that employees possess higher education (SACO 2021, p. 8).

Estimations of how the implementation of sustainability policies will influence the structure of future labour markets varies among the reports. According to the ILO (2018, p. iii), actions limiting global warming to 2 degrees Celsius will result in net positive job creation. The IPCC (2022, p. TS-48) is less certain about possible future outcomes: estimations on job creation

⁴ They are defined here as the OECD *Skills for Jobs* 2018 report describes the terms:

Knowledge: refers to the body of information that makes adequate performance of the job possible (e.g. knowledge of plumbing for a plumber; knowledge of mathematics for an economist).

Skills: refers to the proficient manual, verbal or mental manipulation of data or things (e.g. complex problem solving; social skills)

Abilities: refers to the competence to perform an observable activity (e.g. ability to plan and organise work; attentiveness; endurance) (OECD 2018, p. 13).

are either slightly positive or negative depending on the models used and assumptions regarding them. The reports also disagree on whether sustainability policies will lead to more jobs in high-skilled, middle-skilled or low-skilled occupations.⁵ But they share the view that political commitment in the transition to low-carbon, resource-efficient, greener economies will contribute to greater mobility between sectors and occupations (ILO 2018, pp. iii, 54; see also SACO 2021, p. 8; IPCC 2022, pp. 3-8; OECD 2018, p. 16). The IPCC report suggests providing education and training programmes to smoothen the labour market transition (IPCC 2022, pp. 4-56, 11–98; *cf.* OECD 2018, p. 2; ILO 2018, p. 99.) Not only will occupations change but existing jobs will also require new skills by workers to adapt to the new realities (ILO 2018, p. 53; ILO 2015, p. 14; ILO 2011, p. 164; OECD 2018, p. 16; IPCC 2022, p. TS-48). However, the ILO report states that progress in developing skills for advancing environmental sustainability lags in comparison to meeting other sustainability goals (ILO 2018, p. 131).

There is no consensus on a reliable definition for or data-based recognition of what kinds of skills are required for sustainable production and the ‘green transition’, as authorities define green competences differently (ILO 2018, p. 4; NOU 2020, p. 81). However, there is widespread agreement on the need for greater environmental awareness and that green competence will be required in all sectors and at all levels in future labour markets (ILO 2018, p. 138; NOU 2020, pp. 81–82). Core skills required in the context of a green transition include non-vocational and non-technical skills needed in the workplace, such as enhanced environmental awareness and the ability to learn about sustainable development (ILO 2018, p. 138). Self-reflection, critical thinking, climate-risk competence and ethical assessments are all important skills needed in the green transition as well (NOU 2020, pp. 82–83). The 2011 ILO report (p. 165) already noted that core skills are at least as important as technical skills for the green economy (see also NOU 2020, p. 83). Many actors recognise the role of the public sector in the green transition (NOU 2020, p. 96). This will highlight the need for additional legislation and management measures as well as the enhanced role of assessing

⁵ For example, the development of renewable energy may compensate for the job loss in other energy sectors, but it will create a demand for new skills, especially in the high-skill labour market (IPCC 2022, pp. 4-54.) Some experts estimate that the skill composition will remain more or less the same, whereas job creation and job loss will be greatest for low-skilled jobs (IPCC 2022, pp. 4-56.) This prediction contrasts with the OECD’s assessment that increased demand for high-level cognitive skills will increase, while the demand for work requiring routine and physical skills will decrease (OECD 2018, p. 4). The ILO report, on the other hand, estimates that the low-carbon economy will increase the need for middle- and low-skilled workers (ILO 2018, p. 44).

risks (NOU 2020, p. 96.) In general, administration and management knowledge areas are in short supply at the moment (OECD 2018, p. 15).

The changes taking place in the labour markets due to digitalisation are multiple. Digitalisation affects a firm's competitiveness, the demand for skills and the distribution of and access to resources (IPCC 2022, p. TS-132). Approximately 14% of jobs are at high risk of becoming automated, with workers replaced by machines, while 32% will undergo significant additional changes in the near future (OECD 2018, p. 21; see also IPCC 2022, pp. 16-20). Somewhat reassuringly for university students, expertise involving a high level of cognitive skill is extremely difficult to automatise and is in growing demand (OECD 2018, p. 23). Change has also resulted in job polarisation; the number of low- and high-skill jobs has grown of late, while the number of medium-skill jobs has decreased (OECD 2018). Those with advanced education will find jobs more easily than those with lower-level degrees (SACO 2021, p. 7).

Digitalisation and technologisation unsurprisingly have created the need for technical and ICT-related skills (OECD 2018, p. 13). But as the report states:

--many observers argue that recent technology trends are going to require, at an increasing pace, workers with high-level cognitive and non-routine skills, able to cope with unpredictable and non-codifiable tasks while, at the same time, being able to clearly communicate and understand new ideas and concepts. (OECD 2018, p. 13)

For example, critically evaluating how to use data in an ethical manner will become more important as technological development increases (NOU 2020, p. 80). The 2018 OECD report notes that labour market needs on a sectoral level are greatest in the education and information and communication sectors. It likewise found that greater reading comprehension and critical thinking are demanded in the IT sector (OECD 2018, p. 16). This applies not just for ICT experts. Greater cognitive abilities in relation to reading, understanding, processing information and ideas, and applying general rules to solve specific problems were already in high demand in 2004 and have only been increasing in importance in the decades since (OECD 2018, p. 20). Cognitive abilities are the tools needed to make critical analyses and ethical assessments and evaluate the results from conflicting sources

(NOU 2020, p. 116). Technical experts will need to adopt a broader perspective, while decision makers will need to understand information technology better.

Technological solutions play an important role in the sustainable use of natural resources, but the long-term perspective shows that engineering, programming and mathematical skills have now bridged the gap between supply and demand. In its 2011 report, the ILO (p. 462) highlighted the need for engineering and mathematical skills for green jobs and reported that they are constantly in low supply. The 2015 ILO report on green jobs estimates that a strong need will exist for operative and technician skills as well as high-quality skills in effective planning, leadership and implementation (p. 14). The 2018 OECD report on skills recognises that programming, technology design, knowledge of mathematics, engineering mechanics and technology and physics are all important, but it does not place them at the very top of the list (p. 15). The OECD's 2022 *Skills for Jobs* report notes that programming skills are still in short supply but significantly less so than in 2012. The same trend applies for other digital skills as well (OECD 2022b, p. 7).

In a highly technical world, transmitting innovations is as essential as creating new solutions. Technology must be invented, developed, produced, marketed, sold, maintained and recycled. This requires 'human creativity, ingenuity, social interaction, sensuality, ethical, moral and political solutions, motivation, learning, unlearning and relearning' (Dufva et al. 2017, p. 11). Unless technology can be implemented on a global scale, there is a risk of providing efficient solutions only for environments already rich in technology (IPCC 2022, pp. 16-24). Knowing the local field of operation becomes crucial in managing this task, so the need for language and cultural sensitivity is great, as is the need to successfully cooperate and interact with countries where problems need to be solved. A lack of technological knowledge, an inability to formulate a clear message, a lack of skilled staff, an incorrect focus on courses at universities and the gap between knowledge produced at universities and what is needed in practice may prevent renewable energy technologies from reaching their full potential (IPCC 2022, pp. 16-32; cf. ILO 2011, p. 462).

The start of the 2020s has been exceptionally prone to fluctuation. The Covid-19 pandemic resulted in the worst economic crisis in decades, while the war in Ukraine has slowed down the curve for new growth (UN 2022). The pandemic accelerated many labour market

tendencies that were already underway, like digitalisation and the transition to remote work, but it also halted some positive trajectories.⁶ The results show that high-technology industries performed better and recovered faster than their lower-tech counterparts (UN 2022, pp. 44–45). But working life in general has been in a constant state of flux since the 1990s, and new modes of action and operation do not have the chance to stabilise before the next wave of change is already on its way (Dufva et al. 2016, p. 2). Work will be mentally harder even as it becomes physically less demanding and spatially and temporally more flexible (Dufva et al. 2017, p. 19).

The more complicated world of work has created a growing need for experts and occupations to act as intermediaries in bringing people from different fields together (Technology Industries 2018, p. 16). The importance of thinking and interaction skills might even overpower the need for substance knowledge in the future (Dufva et al. 2017, p. 21). This means that occupations requiring expertise, networking and creative and innovative cooperation will increase (Dufva et al. 2017, p. 15). Fragmented, temporary and non-hierarchical working environments require so-called ‘survival skills’ or ‘meta-skills’⁷ for workers to manage: they will need to know how to update their skills, navigate their way through global networks, manage their time and work independently, think critically and be ever more flexible (Dufva et al. 2017, pp. 17–21, 48; Dufva et al. 2016, p. 4). Also, so-called ‘soft skills’, such as communication, problem-solving skills, leadership, teamwork, a strong work ethic and a positive attitude, are especially in need in post-pandemic times⁸ (OECD 2018, pp. 7, 15; NOU 2020, p. 80). This includes the ability to understand different cultures and traditions when working in multicultural teams. On the one hand, the need for social skills have grown, but on the other so have the skills of the labour force. The result is that there is currently a balance in social skills (judgement and decision making, persuasion and negotiation, coordination, social perceptiveness) in the labour markets (OECD 2022b). All in

⁶ For example, for the first time in decades the share of workers living in poverty rose, as did between-country inequality (UN 2022, pp. 26, 47).

⁷ Similar skills have also been called transitional skills (OECD 2018) or portable skills (ILO 2011, p. 164).

⁸ Definition by EURES, which is a European cooperation network of employment services covering all EU countries as well as Iceland, Liechtenstein, Norway and Switzerland: https://ec.europa.eu/eures/public/index_en. See also: https://ec.europa.eu/eures/public/six-soft-skills-you-need-post-pandemic-workplace-2022-04-20_en.

all, workers will devote a larger share of time to technological, social and emotional aspects of work in 2030 than ten years prior (NOU 2020, p. 76).

COUNTRY-LEVEL INSPECTION

The following section takes a closer look at six European countries and the labour market situation in them. The findings are based on semi-structured interviews and reports on the labour market and economic situation of each country. Semi-structured interviews, as the name suggests, falls somewhere in between structured questionnaires and unstructured life stories, and it is the most common form of interviews nowadays (Brinkmann 2015, p. 286). The semi-structured interviews allow for a deeper assessment of specific companies and organisations and their recruitment needs as well as a broader take on what people working with sustainability issues see as most important for future labour markets. During the interviews, we asked about the present and future need for natural resource experts in the labour markets. All partner universities interviewed two or more experts for this report. It includes eight interviews from the private sector, five from the public sector and two from the third sector, covering most of the fields suggested by the ILO's practical guidelines for anticipating the skills needed for green jobs (ILO 2015, p. 52).

FINLAND

“Companies working according to sustainability standards to produce new circular economy solutions will receive better funding with better conditions than companies stuck in the past, which will be more expensive to fund. People from your education programme are needed for doing this kind of evaluation.”⁹

The Finnish economy has revived since the Covid-19 pandemic quite quickly, although Russia's war against Ukraine and its ramifications have slowed down some of the more promising aspects of the economic upturn. Despite uncertainty in the global markets, the employment situation in Finland has not only recovered to the pre-pandemic level but also

⁹ (U. Hiekkänen-Mäkelä, personal communication, 31 January 2022).

risen to levels not seen in decades. Combined with the baby boomers now retiring, the labour markets are experiencing major labour shortages, especially concerning high-skilled work. In Finland, as many as nine out of ten professions are currently experiencing labour shortages in high-skilled sectors, whereas the average ratio in OECD countries is five out of ten. Apart from health care, employers in the fields of public administration, social work and education are facing a shortage of workers (OECD, *Economic Surveys: Finland 2022*).

Finland has a long tradition of aspiring for more sustainable production, but it is also currently struggling to fulfil the most recent and more ambitious goals.¹⁰ National and international sustainability goals carry great weight in terms of what the largest industries of Finland require from their experts. A recent survey by Technology Industries of Finland found that 60% of new recruits in the industry are expected to have a higher education degree, 70% of whom should have a degree in technology and 30% from other fields (Technology Industries of Finland 2019, p. 7). Apart from machine learning and data analytics, such business areas as sales, marketing, purchasing and intellectual property rights need people with a deeper understanding of clients' business interests (Technology Industries of Finland 2018, p. 12). Employers working in various technology industries would wish to see the following skills covered in higher education courses:

- leadership and management of both individuals and teams as well as a focus on group work, networks, international projects and human resources
- global mindset, readiness to engage in group work in an international environment and as part of global networks
- Understanding complicated systems, concepts and general guidelines
- Understanding the customers' viewpoint
- Environmental management, energy efficiency, lifecycle thinking
- ICT skills
- Recognition of personal skills, abilities and knowledge and the ability to add to their value.

¹⁰ Finland has decreased 33 % of its greenhouse gas (GHG) emissions since 1990, whereas the average OECD country reaches to 6 % cut; and renewable energy covers more energy consumption than fossil fuels. Finland seems to be able to meet its sustainability goals regarding gross greenhouse gas abatement for 2030 and 2035 but its goals regarding forest and land use are in danger to fall short without major changes in policy and practise. (OECD Economic Surveys: Finland 2022)

- Ability and motivation to continuously learn and see new opportunities (Technology Industries of Finland 2018, p. 14).

Actors in the chemical industries field stressed the importance of the natural sciences as the key basis for greener economies (Ikonen et al. 2021, p. 21). Apart from the natural sciences, the report emphasises possessing an understanding and knowledge of carbon neutrality, multidisciplinary expertise, a knowledge of science, permit and grant application expertise, influencing and lobbying expertise, data analytics expertise, sales and marketing expertise, and communication and media expertise (Ikonen et al. 2021, pp. 5, 12.)

Riikka Heikinheimo, director of skills and innovation for the Confederation of Finnish Industries (Elinkeinoelämän Keskusliitto, EK), also stressed the internal motivation for achieving sustainability in business life. EK is the largest and most influential employer organisation in Finland, comprising more than 15 000 member companies that employ a total of approximately 900 000 workers.¹¹ Heikinheimo, in the interview, divided the need for natural resource experts into three categories: leaders, changers of organisational culture and innovators. Leaders need the ability to have vision about the future and implement innovations in practice. Changers of organisational culture are mid-level leaders able to endure a high level of risk and stress and effect further changes in working habits. Innovators need to create and adopt new technologies to achieve carbon neutrality. They need to be able to connect substance knowledge with the ability to communicate their results and ideas to larger audiences, such as politicians, consumers and businesses. Her main message for those planning education programmes was that the future experts in natural resources should have a sufficient background in natural sciences to best serve the needs of the industry. In addition, future experts should be highly skilled in using digital tools and have the ability to work in international networks on high-functioning teams. This includes the skills to direct one's own actions and those of others in a constantly changing and fluid working environment. Heikinheimo also highlighted the importance of being able to deal with

¹¹ <https://ek.fi/tietoa-meista/mika-on-ek/>

disappointment and establish healthy boundaries to prevent burnout¹² (R. Heikinheimo, personal communication, 21 January 2022)

Arto Salonen, a professor at University of Eastern Finland and member of the Finnish Expert Panel for Sustainable Development, also emphasised to us the changing working environment and the need to hop between occupations. He said that such change is inevitable since ‘the road that brought us here will not be the same that leads us to the future’. Salonen then proceeded to emphasise critical thinking as the basis for developing creative problem-solving skills. Team-work skills are especially important for bringing forth the best co-working solutions across a range of fields. With respect to creative problem solving, Salonen noted the importance of fruitful dialogue between different kinds of people and reaching out beyond one’s ‘bubble’. As he put it: ‘The core of innovation is to have an idea that does not exist as of yet’ (Helsinki Alumni 2022).

Business Finland – a public organisation for innovation funding and investment promotion operating under the Ministry of Employment and the Economy – and their ‘talent-boost’ leader, Ulla Hiekkänen-Mäkelä (U. Hiekkänen-Mäkelä, personal communication, 31 January 2022), provided a state-level perspective on the changing nature of employment. Hiekkänen-Mäkelä sees immense employment potential for students who possess the latest skills and abilities to apply technical solutions and business models to managing natural resources. Financial institutions have a growing need to understand the role of investment in the green transition. She stressed in the interview the need to understand global problems from different perspectives and the need to work globally to solve them. It would be especially useful to include experts from different linguistic and cultural backgrounds in such an effort. While the current education system does provide students with top-level technical skills, it does less well in providing them with the ability to commercialise and apply new innovations and processes in different environments. Future experts need to have the skills to pose questions and offer solutions for how best to make use of natural resources from an economic, political and societal standpoint. On a practical level, new students are expected

¹² In Finland, mental health issues constituted the main reason for receiving workers’ compensation in the latest 2020 review: <https://www.terveystalo.com/fi/tyoterveys/ajankohtaista/tietopaketti/tyokyvyyttomyyselake/#:~:text=Ty%C3%B6kyvytt%C3%B6myyden%20aiheuttaneen%20sairauden%20suurimmat%20ryhm%C3%A4t,ollut%20suurin%20vuodesta%202000%20l%C3%A4htien>.

to engage in real-life debates and publish their arguments on a public platform that stimulates conversation between universities and society at large. She also raised the concern that in the northern countries, where master's degree students possess a deep subject knowledge, they are lacking in argumentation skills when facing a critical conversation. In a world where not everyone necessarily appreciates knowledge-based argumentation, graduates with a master's degree in a field facing strong opposition globally in terms of making changes for the sake of greater sustainability must have strong skills in convincing people who initially do not agree with them.

GERMANY

***'The applicability of theoretical knowledge is a core competence and should be represented in the entire programme.'*¹³**

The outbreak of Covid-19 in 2020 put a stop to a decade of economic growth and decline in unemployment rates, even though unemployment rates had recovered to pre-pandemic levels by March 2022 (OECD, *Economic Surveys: Germany 2020*; EURES, *Labour market information: Germany 2023*). Still, Germany has the largest economy in the EU and the 4th largest in the world, while it is the 3rd largest exporter of goods in the world (EURES, *Labour market information: Germany 2023*). The pandemic highlighted latent structural issues in Germany, concerning digitalisation, the ageing population and energy transition initiatives. The German Ministry of Employment and Social Affairs estimates that those issues will result in more job losses than gains.

The working-age population will decrease by 7% in the 2020s, while the risk of automation will affect 18% of jobs, with additional 36% of jobs confronting significant change (OECD, *Economic Surveys: Germany 2020*; OECD 2021d). The OECD presents digitalisation not only as a challenge but also as an important tool for mitigating such problems. For a rapid and efficient digital transition, they propose strengthening education in foundational skills, such as literacy, numeracy and the ability to solve problems in a digital environment, especially with ICT specialist skills. The growth in labour productivity has slowed down globally of late,

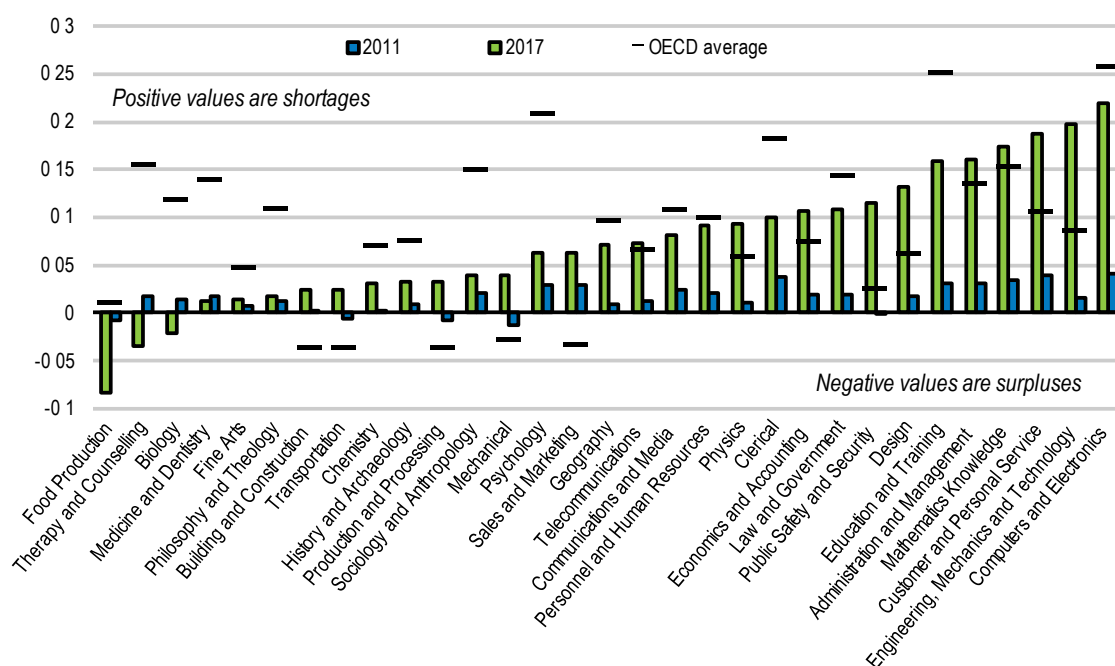
¹³ F. Müller & J. Kosmol, personal communication, 20 August 2022.

indicating that productivity growth cannot on its own solve problems in the labour markets. But Germany still has a way to go along its path to the digital era, and it has the potential to increase productivity as well. The public sector particularly, in addition to firms currently using few advanced ICT tools and activities, has yet to offer services in digital form (OECD, *Economic Surveys: Germany 2020*)

Germany took significant steps in 2019 to reduce its emissions by introducing emissions pricing for transport and heating, thereby increasing support for electric vehicles and charging stations and committing itself to ceasing the coal-fired generation of energy by 2038 at the latest. On the other hand, the country's greenhouse emissions are, though lower than the OECD average, still high from a European standpoint (OECD, *Economic Surveys: Germany 2020*)

A lack of workers with the right skills may hinder the country in meeting its previously mentioned goals. Germany exhibits a peculiar contradiction, as noted in the OECD report: 'Germany is a world leader in technology and engineering but lags behind on digital transformation.' Germany is facing a significant shortage of workers especially in high-skilled occupations that require a higher degree in ICT skills, in the health-care profession and in occupations related to mechatronics and automation technology (OECD, *Economic Surveys: Germany 2020*). A EURES summary of the German labour markets states that anyone wishing to work in Germany should either seek a job as a doctor, nurse, engineer, life scientist, computer scientist or childcare worker or else apply for a job with less demand but have excellent German language skills (EURES, *Labour market information: Germany 2023*). More than seven out of ten shortages are in high-skilled occupations, one of the highest shares among OECD countries. Special needs are related to computer and electronics engineering and mathematics. Still, the top five knowledge areas in need of workers include administration and management, while the top ten include economics, accounting, law and government, with an emphasis on proper education and training (OECD, *Economic Surveys: Germany 2020*). Although EURES strongly emphasises the need for engineering skills, there is a need for other experts as well.

FIGURE 1. KNOWLEDGE DOMAINS EXPERIENCING A SHORTAGE OR SURPLUS IN GERMANY.¹⁴



Tauw Consulting (*Technisch Adviesbureau van de Unie van Waterschapsbonden*) is a Dutch-German consulting firm that transitioned from an original emphasis on water supplies consulting to being a general consultant on environmental issues in the field of construction management. We interviewed Rebecca Kaess from the Human Resources Division, who works with environmental standards and European regulations. According to her, the company hires and sees a high demand for senior managers with specialised knowledge of and experience in the legal and institutional frameworks that businesses must work within to comply with sustainability regulations. Their company would highly value applicants with abilities to cope with such topics as carbon footprint regulations, circular economy management and geoscience. They desire students with a background competence in how to comply with EU legislation and regulations on the environment, especially lifecycle analysis, the circular economy and waste management. They need people who can manage ESG (environmental,

¹⁴ Note: The title has been changed, but all other information in the figure is as it appears in the original. The OECD *Skills for Jobs* database defines skills either in terms of a shortage or a surplus. It measures the imbalances by following a two-step approach. First, an ‘occupational shortage indicator’ is calculated for 33 occupations based on an analysis of wage growth, employment growth, hours worked growth, the unemployment rate and any change in under-qualification rates. For each country, long-run trends are compared to the economy-wide trends. Based on the O*NET database, the ‘occupational shortage indicator’ is then used to build indicators of skill shortages and surpluses. Knowledge domains refer to the body of information that makes adequate performance of the job possible (for example, knowledge of mathematics for an economist) (source: OECD *Skills for Jobs* database); StatLink: <https://doi.org/10.1787/888934201401>.

social and governance) topics in business and understand SFDR (Sustainably Finance Disclosure Regulation) protocols. (R. Kaess, personal communication, 22 August 2022.)

Felix Müller and Jan Kosmol work at the German Environment Agency's (UBA) Department for Resource Management and the Circular Economy in Dessau. They employ mostly chemists and other natural scientists with an in-depth understanding of economics. In addition, they employ engineers and actual economists. They expect their natural resource experts to be able to apply theoretical knowledge in practice. They are expected to know how to conduct lifecycle assessments, as formalised by the ISO scheme, as well as material flow and input-output examinations with special respect to environmental issues. They had some initial reservations about adopting such a multinational and interdisciplinary approach, stressing that this kind of programme needs to take particular care when coordinating the content and timetables between programmes and countries to create a useful degree from a labour market perspective. Future workers should have the skills to apply practical theoretical knowledge on a practical level, understand the legal frameworks guiding sustainability initiatives and possess institutional knowledge about raw material markets and the industry's operations. They stress the importance of cooperation between business and university programmes with respect to future employment needs.

NORWAY

“Private enterprise will in the near future be increasingly confronted with a need to have a sustainable perspective on their operations. There will therefore be a growing demand for candidates with a good grasp of the green economy and with an ability to understand the interplay between technology, the bottom line, and societal needs.”¹⁵

The Covid-19 pandemic on average influenced the economy and employment in Norway less than it did other OECD countries. The year 2022 saw the economic situation already return to close to its pre-pandemic level. Norway is still a country with a high level of employment and high wages, low earning inequalities and high job quality. Labour force participation places it

¹⁵ T. Lien, personal communication, 23 September 2022.

among the top ten performing OECD countries, although not in the top three, as it was at the start of the millennium (OECD, *Economic Surveys: Norway 2022*).

Norway's wealth is greatly dominated by petroleum production, which accounts for half of all goods exports, while related companies employ 5% of the workforce in Norway. The OECD's *Economic Survey on Norway* summarises the dilemma of Norway's efforts at charting a course between sustainability and economic growth in Norway's case by stating that, 'with attention to climate change gathering momentum globally, the risk of a faster-than-expected decline in cash flow from petroleum activities over the medium and long term has increased'. Norway has responded to the challenge of meeting sustainability goals by committing itself to cutting net emissions by half from 1990 levels by 2030 and achieving low emissions throughout society by 2050. The country has traditionally already had high carbon pricing, but the new government elected in 2021 has proposed increasing carbon pricing and research funding for carbon capture and storage (OECD, *Economic Surveys: Norway 2022*).

According to Norwegian Official Report (NOU 2020), the country is currently experiencing its fourth industrial revolution, characterised by new business models, new forms of division of labour and a significant degree of digitisation and automation. Apart from technical drivers, climate change and demographic changes are also key drivers of future skills needs. Sustainability goals affect the structure of the labour market as well since the demand for fossil fuels is predicted to decline while the economy as a whole is expected to emphasise more the renewable industry, maritime industry, aquaculture and fisheries, and the process industry (NOU 2020, p. 84). The OECD (*Economic Surveys: Norway 2022*) recommends that Norway push to create more opportunities for the green transition by funding those firms most committed to it through faster digitalisation.

Norwegian businesses and those in positions of authority¹⁶ in general express satisfaction with recent university graduates (NOU 2020, p. 98). Their reported level of satisfaction was highest with graduates in the areas of legal studies and the natural sciences, with more than 80% of businesses being satisfied with the candidates from those fields (86% and 82%, respectively), 75% being satisfied with job candidates from the humanities and 70% with candidates from the social sciences (NOU 2020, p. 99). Businesses reportedly need candidates

¹⁶ All Norwegian industries, counties and companies of various sizes represented in a survey conducted in 2019.

with strong subject-specific and vocational skills, but also strong collaboration skills and communication skills (NOU 2020, pp. 98–99). They expressed far less satisfaction with how little recent graduates with a degree in legal studies or the humanities understood numbers and statistics (NOU 2020, p. 99). The Norwegian Agency for Quality Assurance in Education (NOKUT) emphasises that universities need to prepare and plan good and precise learning outcome descriptions based on collaboration between academic personnel and supervisors from various companies (NOU 2020, p. 116). Also, the OECD recommends that Norway strengthen the level of cooperation between employers and higher education institutions through, for example, internships (NOU 2020, p. 98).

We interviewed Jo Kristian Stræte Røttereng, a senior advisor at Enova SF, and Tord Lien, a director at NHO Trøndelag and former Minister of Petroleum and Energy in Norway. Enova SF is a state enterprise located in Trondheim. It is owned by the Ministry of Climate and Environment and contributes to the reduction of greenhouse gas emissions by supporting technology development and diffusion of innovation. NHO Trøndelag is the regional office of the Confederation of Norwegian Enterprise (NHO), Norway's largest organisation for employers.

Tord Lien from NHO Trøndelag expects a labour shortage in the near future, especially as a result of the ageing of the population. Another significant trend that he highlighted is that changes will need to be implemented due to climate change in everything from preparing infrastructure and buildings for inevitable shifts in the environment to the effects such preparations will have on industry and society. Since renewable energy sources usually are area specific, this will spark societal debates about where and why new infrastructure should be built. This means that it will be necessary for regulators and industry to convince local and regional communities about the importance of such changes, but it must also be done in a way that ensures that it will also benefit local communities. In general, businesses must be able to successfully argue for their license to operate also in a societal context. If European actors wish to be independent of major suppliers like China and Russia, then increased mining activities in Europe will drive up the demand for mining engineers, but also for candidates who are able to weigh the benefits of mining against the environmental challenges. Lien summarised his views by saying that private enterprise will in the near future be increasingly confronted by the need to have a sustainable perspective for their operations. If not, then

new regulations will make it more difficult for them to have access to credit, find investors and attract well-educated employees. There will therefore be an increasing demand for candidates with a good grasp of the green economy and with an ability to understand the interplay between technology and societal needs. (T. Lien, personal communication, 23 September 2022.)

Enova employs 85 people and hires graduates with a background either in technology or economics. Social economics, law and political science backgrounds are also represented among the employees. It is not unlikely that in the future it will also have more of a need for candidates with a broader environmental knowledge base. Røttereng sees the importance of the link between human activities and climate. Land use will only increase in the future, and graduates with a solid understanding of societal planning in a broad sense will be needed. In addition, candidates who can connect knowledge about the climate, natural resource use and business development will have a role to play. In that regard, a master's degree programme that provides candidates with a generalist knowledge about sustainable natural resource management and allow them to translate knowledge between different professions, such as economics, engineering, ecology and law, will be quite useful. The candidates should therefore gain a conceptual understanding of different sectors and be able to operate between the disciplines. The international component of the master's degree programme (both being located at different sites and having students from all over the world) will make it a very promising learning environment. (J. Røttereng, personal communication, 12 September 2022)

ROMANIA

“We consider that the future of the company can be secured through the responsible development of a sustainable management of natural resources in the energy industry.”¹⁷

Romania has experienced rapid economic growth since the 1990s, with particular growth occurring in the ICT, electronics and car manufacturing sectors. The COVID-19 pandemic and ensuing energy crisis resulted in an economic depression and the highest inflation in EU

¹⁷ M. Milea, personal communication, 18 March 2022.

during the year 2021 (ILO 2022). However, officially both employment and unemployment rates have been close to the OECD average and remained relatively stable during the pandemic.,¹⁸ (OECD, *Economic Surveys: Romania 2022*). The official employment statistics show most open vacancies in low-skilled jobs, such as assembly workers, commercial workers, construction workers and salespeople. Simultaneously, the country has a constant surplus of low-skilled workers (EURES, *Labour Market Information: Romania 2022*). The mobility of low-skilled workers in the Romanian labour markets is high. The World Bank and the Romanian business interest group *Coaliția pentru Dezvoltarea României* (CDR) both recognise shortages also in construction, health care, education and the ICT sector (OECD, *Economic Surveys: Romania 2022*). The labour markets are not equal: labour participation by women, young people and the Roma is disproportionately low, resulting a high risk of poverty (OECD, *Economic Surveys: Romania 2022*)

The Romanian labour markets face many challenges. Informal labour markets, undesirable demographic development, rapid automation and digitalisation, and skills mismatch all pose a threat for economic performance in the future. Depending on the method, the estimated level of informal labour in Romania varies between 14% and 30%. Worth noting is the fact that the high level of informal labour, globally accounting for 60% of all employment (UN 2022, p. 43), is not reported in the official labour statistics, influencing their accuracy. Informal labour markets are prominent especially in the countryside. This may result in a cycle of low-skilled labour, where state investment in greater productivity is not appealing given the existing fear that not enough workers have the required skill sets. Romania is ageing faster than most OECD Central Eastern European (CEE) countries.¹⁹ Many people have emigrated, and the population has been in continuous decline since 1991. The emigrants have been young and relatively well-educated. Although the fertility rate is among the highest in the EU (1.8 annual births per woman), it does not compensate for the losses due to migration, and neither does immigration (OECD, *Economic Surveys: Romania 2022*).

¹⁸ In March 2022, the unemployment rate was 5.7% when calculated based on ILO standards, but only 2.6% according to the National Employment Agency (EURES, *Labour Market Information: Romania 2022*). The unemployment rate in 2020, as calculated by the OECD, was 5% (OECD, *Economic Surveys: Romania 2022*).

¹⁹ EEC countries include: Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia, and the three Baltic States, Estonia, Latvia and Lithuania (OECD 2001). The report refers to these countries as Peers to Romania.

The global trend in automation can impact Romania more severely than most other countries due to the high number of low-skilled workers in the country. Nedelkoska and Quintini (2018) estimate that 14% of jobs in OECD countries are highly automated, whereas McKinsey (2018) estimates that in Romania nearly 54% of workplace activities could be automated by 2030 (OECD, *Economic Surveys: Romania 2022*). Also, Romania is less prepared for digitalisation than other OECD countries, on average, with citizens lacking in basic digital skills, even though the infrastructure for it does already exist (OECD, *Economic Surveys: Romania 2022*). Both technical and management skills are required for the successful application of digital platforms, as well as strong cognitive, interpersonal and organisational skills (OECD, *Economic Surveys: Romania 2022*).

A large number of students do not complete basic education. Romania ranks fifth among OECD countries for students leaving school before reaching the upper secondary level, which has been recognised as the minimum level of education for operating in a knowledge society. Romania shows a higher than average mismatch between education and work, with the field of study not corresponding to the job description. The level of satisfaction with education having sufficiently prepared people for work life was lower than in other EEC countries, on average, with the results showing 37% of students satisfied with it compared to an EEC average of 50%. Also, 40% of employers reported a lack of sufficient education as a major hindrance to their business. Romanian employers reported that workers lack basic socio-emotional skills, such as motivation, problem-solving skills, knowledge of teamwork and basic communication skills (OECD, *Economic Surveys: Romania 2022*).

Regarding sustainability-related skills, we interviewed three operators from the energy sector on their views and needs concerning the workforce. They all listed management of natural resources as a priority. All of them employ natural resource experts with higher education degrees extending all the way up to the doctoral level and from engineering backgrounds. Their responses varied in terms of how satisfied they are with the current supply of natural resource experts: Sorin Gal, general manager (acting as president) of Agenția Națională pentru Resurse Minerale (ANRM) (National Agency for Mineral Resources) stated that the education system does provide enough experts for the Romanian energy sector, whereas

Corneliu Munteanu, recruitment consultant for Engie Romania, noted that the gaps pertain more to sufficient environmental knowledge and engineering skills for mitigating pollution (C. Munteanu, personal communication, 24 March 2022; S. Gal, personal communication, 16 February 2022).

Prospecțiuni S.A., a private company that provides geological and geophysical prospecting services in Romania, has the difficult task of meeting its goal of sustainably managing natural resources in the case of fossil fuels. Its business strategy is to capitalise on the responsible and sustainable use of natural resources in the oil and gas industry. The company expects a high level of technical skill in physics, especially in geology, from its experts. Former CEO Marius Milea thinks that the education system should train natural resource experts with sufficient skills in calculating and minimising the carbon footprint resulting from industrial activities. In addition to employing people with a strong knowledge of geophysics and geology, the company also expects a strong level of environmental awareness and good computational skills. It also values workers with an understanding of legal, administrative and business matters (M. Milea, personal communication, 18 March 2022).

With respect to the Romanian case, the need to transition to a digital society is even more pressing than the need to shift to a greener economy. It may well be that the digital shift precedes the green shift, where the latter cannot be approached before achieving the former. To achieve both goals, the overall level of education and competence needs to increase. The Romanian work force lacks the basic digital and soft skills required in working life. In addition, stronger technical, managerial and cognitive abilities are required before digitalisation can proceed further. The companies working with natural resources heavily rely on fossil fuels, which requires advanced technical knowledge as well as strong engineering skills. The importance of sustainability is emerging even in these sectors, and the need for engineers to grasp the basic knowledge and tools for making responsible use of natural resources was evident in the interviews.

SPAIN

“We know that without sustainable management, we won’t have a sustainable business and we cannot expect a sustainable future for jobs and communities.”²⁰

Due to the Spanish economy relying heavily on tourism, which accounts for 12% of both GDP and total employment in Spain, the Covid-19 restrictions negatively impacted the Spanish economy more than in most EU countries. With the unemployment rate being high even before the pandemic, it peaked at 16% and before remaining at approximately 14% during the pandemic, which is almost three times the OECD average (5.4%). Such a high unemployment rate has proven especially problematic since the old-age dependency ratio is expected to double by 2050. Unemployment hit young, low-skilled and temporary workers particularly hard; the long-term unemployment rate for such workers had already been among the highest in OECD countries even before the pandemic (OECD, *Economic Surveys: Spain 2021*; OECD 2022a).

Spain’s national Recovery, Transformation and Resilience Plan of 2020 emphasises the need for digital and green objectives to protect the labour markets from future job loss (OECD 2021b, p. 20). The OECD estimates that the digitalisation level in Spain is lagging (2021c, p. 2). While Spanish companies adopt digital technologies at an average rate in relation to other OECD countries, the public sector especially could improve further (OECD, *Economic Surveys: Spain 2021*). During the pandemic, obstacles in transitioning to distance work occurred in part due to the slowness of employers to adopt digital tools (OECD, *Economic Surveys: Spain 2021*). Labour productivity is low compared to other OECD countries, with the growth in productivity being only half the OECD average (OECD 2021b, p. 57). Since there is room to grow, the risk of automation is higher than in other OECD countries, on average, with an estimated 50% of work tasks in Madrid facing the risk of significant change due to automation (OECD 2020, p. 3). However, additional efforts at shifting to a digital and information society could increase productivity and thus economic growth.

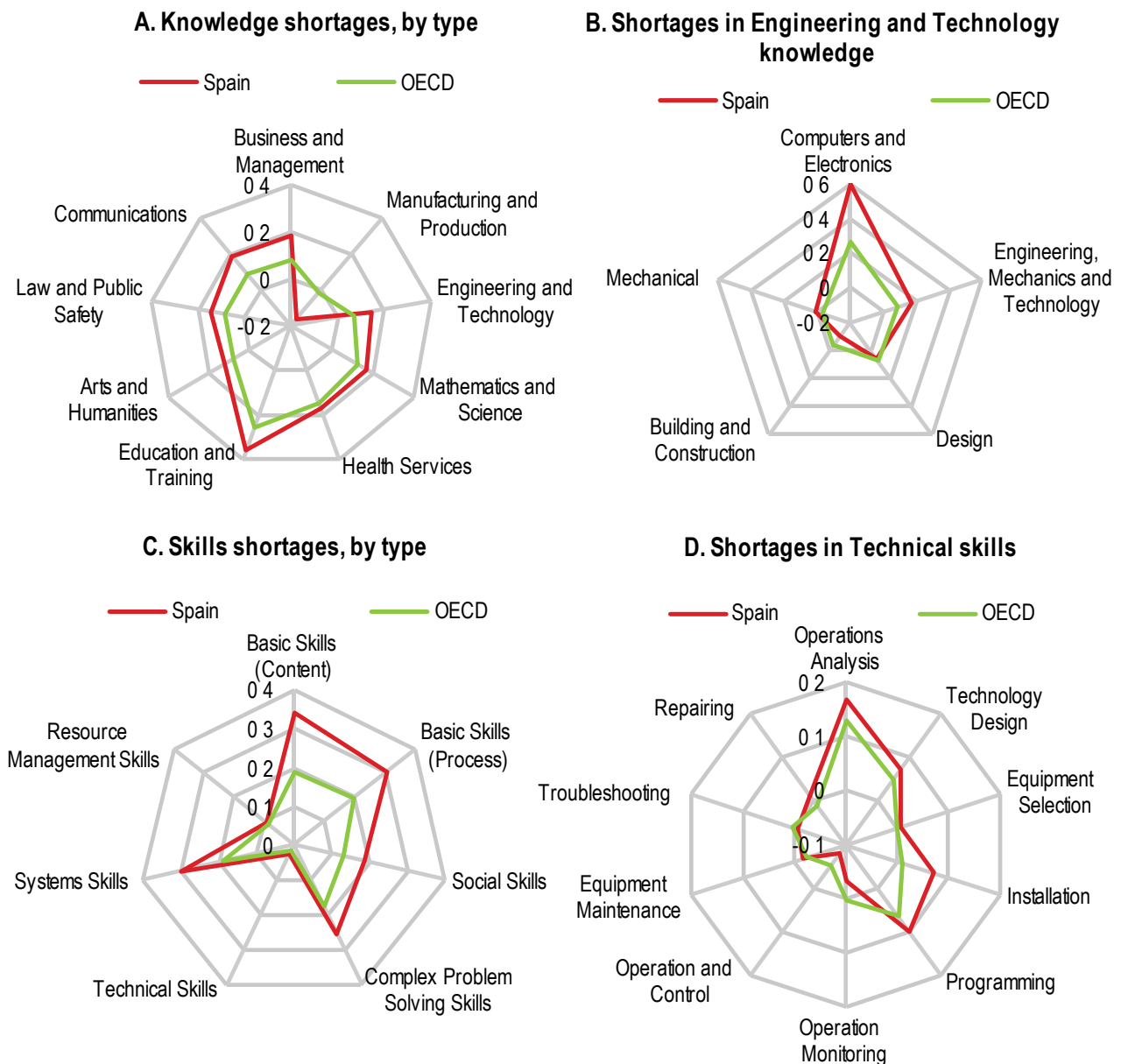
²⁰ S. Romero, personal communication, 15 September 2022.

Spain has many goals regarding sustainability and greening the economy. In addition to making an international commitment to abide by the Paris Agreement in 2014 and 2030 Agenda, it has adopted its own initiatives, such as the Law on Climate Change and Energy Transition, the National Integrated Energy and Climate Plan, the Just Transition Strategy, the Energy Poverty Strategy, the National Climate Change Adaptation Plan and a long-term strategy to create a modern, competitive circular and carbon-neutral economy by 2050 (OECD, *Economic Surveys: Spain* 2021). Experts estimate that these and other actions will create 1.13 million new green jobs in the next ten years (Unir and Infoempleo 2021, p. 134).

Like everywhere else in Europe, the OECD notes that with Spain too, '[t]he changing nature of work, including due to the COVID-19 crisis, higher-quality jobs and faster productivity growth require a skilled labour force' (2021c, p. 2). The OECD found that most shortages in the knowledge area fall under the category of 'education and training' rather than 'engineering and technology', as noted in the figure 2. Skills shortages mostly pertain to basic skills (OECD, *Economic Surveys: Spain* 2021). Although digitalisation and sustainability require engineering and ICT skills, it seems the greatest gaps occur with respect to other skills.

The report *Empleo en sostenibilidad y medio ambiente* ('Employment in sustainability and the environment') focuses on ten occupations in the environmental sector, with five of them being suitable for a natural resources expert with a humanistic approach. The report was compiled by Infoempleo, a private employment service company in Spain, and UNIR, an online university, and is based on interviews with professionals in green industries about their views on current labour markets. According to the report, apart from an occupation title of a cultural manager specialising in sustainability, all those aspiring to become natural resource experts were advised to acquire a degree in the natural sciences and preferably attain skills in ICT as well. However, experts in environmental sustainability, environmental education with sustainable solutions analysts and environment and CSR (Corporate Social Responsibility) technicians could perform well in their work with a social sciences background (Unir and Infoempleo 2021).

FIGURE 2. SKILL SHORTAGES IN SOME SEGMENTS ARE SIGNIFICANT.²¹



²¹ Note: positive values indicate skill shortages, while negative values indicate skill surpluses. The larger the absolute value, the larger the imbalance. The OECD *Skill for Jobs* indicators are constructed via an index measuring the labour market pressure on occupations, which is multiplied by an index measuring skill intensities. First, they identify labour market pressure (shortage/surplus) at the occupation level using such labour market data as wage growth (measured in terms of deviation from the long-term trend for the whole economy). Then, this result is used to map occupations experiencing a shortage or surplus based on the underlying knowledge types/skills requirements (e.g. computer and electronics) for these occupations. The underlying knowledge types/skills requirements for each occupation are defined in O*NET and measured in terms of a min-max scaling ranging from 0 to 1. For more details, see the OECD's description (2017).

Source: OECD *Skills for Jobs* (database).

Statlink: <https://doi.org/10.1787/888934233188>.

Undoubtedly, a deep enough understanding of environmental and energy management is needed combined with an in-depth knowledge of related legislation and regulations. All these professions emphasise communicational skills and people skills both in terms of leading others and teamwork. For those persons aspiring to leadership and management positions, the report recommends pursuing studies in lean technologies and acquiring sufficient occupational risk prevention (PRL) tools. For circular economy experts, the report encourages applicants to be skilled at analysing the lifecycle (LCA) of the product within the company and calculating its carbon footprint (Unir and infoempleo 2021).

We interviewed specialists from an IT consulting company and two different hotel businesses. Fuensanta Jover works at NTT Data, a consultancy company and global technology services provider employing over 40 000 people worldwide. In a large company like them, the sustainable management of natural resources is mandatory. She states that business decisions are influenced more by market rules and prices than sustainability drivers, although European or local policies may influence business activities greatly as well. She feels that people with a good understanding of sustainable resource management are most sought after by industry and administrators, but currently they learn the sustainability aspects of their expertise at work rather than at university. It is essential that businesses understand both market mechanisms and the political landscape as well, especially for those working in the company's Energy Department, which deals with corporate social responsibility issues. (F. Jover, personal communication, 15 September 2022.)

Jover has noted in her work at the Energy Department that the impact of finding more sustainable ways to use energy can be great. She can imagine having people from almost any educational background at the company, although in general those with an engineering background and a strong knowledge of electricity and an understanding of the commercial point of view and IT knowledge are most needed in her department. She expects that natural resource experts will need to possess technological knowledge about energy markets and have sufficient understanding of IT fundamentals and data processing skills as well as knowledge about the circular economy, energy transition, smart cities and geothermal energy. Her department will only hire natural resource experts if they have sufficient engineering skills and knowledge about energy use. The company's engineers could benefit from a broader understanding of sustainability issues, in her opinion, and its marketing

strategy needs to account for the political and economic factors related to the proper management of natural resources. (F. Jover, personal communication, 15 September 2022.)

Soraya Romero López works as an engagement and internal communication global director for Iberostar Group, one of the 50 largest hotel chains in the world. Sustainability is an overarching goal in every step of the company's business strategy. It has a sustainability office with people whose job titles include marine biologist, science communicator, coastal health strategy coordinator, circular economy director and marketing and communications manager for sustainability. The company has also created a position for a climate change manager, while one person from each department informs the department about sustainability issues. In total, 350 people work in these positions and are exclusively dedicated to managing and coordinating sustainability projects. (S. Romero, personal communication, 15 September 2022.)

Most of the company's sustainability experts have a background in the natural sciences, business management or administration management, with their education level varying from a bachelor's degree to a PhD. The company expects recruits to possess up-to-date financial knowledge about green funds and investors, knowledge of environmental policies, regulations and legislation, knowledge of basic concepts regarding climate change and sustainability, and knowledge of the main actors influencing sustainability policies. New recruits should have excellent team-work skills and be able to work proactively. She stresses so-called 'soft skills' as greatly lacking in the Spanish educational system. (S. Romero, personal communication, 15 September 2022.)

Our final interviewee²² works in the Department of Human Resources for another large hotel business. The company also has a department dedicated to responsible business, with one of the major tasks being to preserve nature. In addition to its own experts, the company also uses external consultants. Company leaders feel that the current educational system should place more emphasis on sustainability, especially on the management of resources at the local level. They note that it is difficult to find people with a satisfactory legal, business, societal and administrative understanding of sustainable resource management issues. The

²² Since he answered the survey on a personal basis, he has asked us not to mention the name of the company.

degree should also be more practical than theoretical to best serve business needs. (Anonymous, personal communication, 5 September 2022.)

SWEDEN

“We are always interested in social scientists who have a holistic view of development and sustainability. Provided that the programme’s focus on natural resource management will enable the students to acquire such a holistic view, we are certainly interested in hiring them.”²³

The Covid-19 pandemic hit the Swedish economy hard, even though the country had less stringent mobility restrictions than many other OECD countries. Also in Sweden, the pandemic accentuated many developments that had already been lying just beneath the surface, such as digitalisation, rising unemployment and the need for health care professionals (OECD, *Economic Survey: Sweden 2021*; OECD 2016, pp. 40–41). Sweden is a forerunner in digitalisation compared to many other high-performing countries. It has a well-developed telecommunication infrastructure and services, which helped employees adjust to remote work during the pandemic. Swedish firms use both basic and advanced digital tools more than the average OECD country. Still, there is room for improvement since its adoption of more advanced tools still lags behind that of the best-performing OECD countries. In addition, the country has relatively few highly educated ICT specialists. All in all, Sweden is lacking specialists: 33% of the firms in Sweden contacted in 2016 reported that they could not fill positions with replacements due to a lack of skills among the applicants (OECD, *getting skills right: Sweden*, 2016, pp. 40–41; OECD, *Economic Survey: Sweden 2021*)

Sweden has also been a forerunner in the fight against climate change. The country reached its peak in carbon emissions already in 1970 and was among the first to introduce a carbon tax in 1991. Its share of renewable energy has been growing rapidly, reaching 52% in 2019. The new government’s goal is to produce all electricity in a fossil-free manner by 2040 and to

²³ E. Gedeck, personal communication, 26 August 2022.

reach net zero carbon emissions by 2045 (OECD, *Economic Survey: Sweden* 2021). The importance of green jobs will not decrease in the future.

The Swedish Confederation of Professional Associations (SACO) published a report in 2021 entitled *Framtidsutsikter – Här finns jobben for akademiker* ('Future visions: here you can find the jobs for academics'), which assesses current competition in different sectors as well as in the year 2026. From our programme's perspective, the report identifies five different types of experts needed now and in the future: social scientists, museum and cultural experts, statisticians, communications specialists, and economists. The report finds that social scientists, museum and cultural specialists, and communications experts especially need to compete with a range of other applicants both now and in the future. The need for economists is currently in balance, while there is some competition for programmers in the sustainability field. The results imply that in the Swedish case, economics and statistics may aid in the employability of social scientists. The report also encourages social scientists to take courses in the fields of digital communication, information technology, systems science, public administration, environmental science, law and business development (SACO 2021, p. 84).

We interviewed Erik Gedeck from the County Administrative Board of Västra Götaland. Västra Götaland currently employs experts from many fields, ranging from ecologists and biologists to architects, economists and political scientists. The experts are expected to be highly specialised, but the county also needs some generalists. (E. Gedeck, personal communication, 26 August 2022.) He values workers having the ability to assess the importance of different arguments and make good decisions based on the information at hand. Gedeck highlights that natural resource experts should have strong project management and process management skills and should be able to collaborate well with peers (E. Gedeck, personal communication, 26 August 2022). The county expects new recruits to learn legal codes and administrative policies quickly.

CONCLUSION

Climate change and the policies designed to address it have an impact on labour markets. In a constantly changing environment, the ability to take a long-term perspective on natural resources becomes a planetary survival skill. Skills for managing the transition as well as meta-skills and soft skills are crucial since the probability that workers will need to change sectors or occupations during their career has increased.

Green competences include both core skills and technical skills. Digital and ICT-related skills are more important than ever, but skill gaps are also smaller than five years ago. All technical and digital skills will improve students' employability in the labour markets. However, sustainability is not only a technical question, but one that also demands experts to understand complex economic, societal and physical preconditions as they direct their work toward achieving more sustainable ways of living. All countries need to solve the dilemma between sustaining economic growth thus far fuelled by fossil energy while addressing the ever-more pressing need to meet climate goals. Skills concerning transmitting information across fields have become of paramount importance for multinational and multilingual teams addressing global problems.

All countries focused on in this report have exhibited different signs of stress and recovery from the latest crises. However, long-term trajectories show similar tendencies. Each European country has recovered somewhat from the recent crises, creating a need for a new workforce. Apart from recent developments, the old-age dependency ratio is worsening in each of the studied countries, resulting in immense demand for skilled labour. The ongoing digitalisation of societies is at different levels in each country, but all need experts able to manage the increasing amounts of digital data and new tools. Those countries in an earlier phase of digitalisation need to first build the necessary IT infrastructure, while those with more advanced capabilities must focus on connecting different platforms, people, ideas and practices in complex digital surroundings. The central message from the reports and interviews is that regardless of the field, some level of knowledge and skills in using digital tools is necessary for survival in the future labour markets.

The industrial sector of business life is in the midst of a strong and rapid transition to carbon neutral production. The countries studied here all have ambitious sustainability goals, and all

the interviewees as well as the national and international reports highlighted the relevance of addressing questions about sustainability and the circular economy and that a general awareness of environmental questions is crucial for current and future employment and a part of their business model. The need for natural resources will only become more important in the next years, and since the problems of producing energy in a sustainable manner are as complex as ever, experts will be widely needed. The concrete skills, knowledge and abilities mentioned in relation to sustainability can be divided into science-related issues, ICT- and statistics-related issues, leadership- and management-related issues, and general issues related to working life.

The natural sciences are the basis of innovation and cannot be excluded from the equation, meaning that governments and firms will need to hire natural resource experts. Based on the interviews, future natural resource experts will need to have expertise in the natural sciences, though an assessment of how deep the knowledge should be varied among the interviewees. The goal of this report was to evaluate the need for experts who do not necessarily have degrees in sciences before attending the EMERALD master's degree programme. Many of the interviewees mentioned that applicants from the natural sciences would benefit from a broader understanding of sustainability. The Technology Industries report on the need for experts in various Finnish industries predicts future employment needs quite well in our opinion: although 70% of the estimated new workforce should have a technical background, the rest are expected to have some other type of education. Even in a very technical field, not all experts will necessarily be engineers.

In the broad context of digitalisation, technical skills are crucial, but computational and quantitative methods have become increasingly important in the context of sustainability as well. These concrete methods include Life Cycle Analysis (LCA) of a product, creating input-output examinations, calculating carbon footprints and the use of big data. An ICT specialist in the sustainability field must also understand existing regulations when conducting such analyses, for example LCA is rarely done without following the guidelines given by the International Organisation for Standardization (ISO). Although automatisisation in relation to technical development will change the regulatory requirements in these spheres as well, and knowledge and data will become more and more automatised, interpreting the results and posing new questions based on them cannot be outsourced. Automatisisation will not remove

the need for high-skilled workers with strong cognitive abilities and an ability to think critically about sustainability issues.

Leadership and management positions for managing sustainability issues will require substantial knowledge of the existing legal frameworks and regulations at both the national and international levels. Businesses need to know the conditions underpinning grant applications and funding connected to the green shift. Understanding sustainability-related concepts, such as the circular economy and carbon neutrality, need to be connected to applicable business models and innovations that can be commercialised. Leadership includes possessing nuanced emotional skills, for example when advocating lean methods and following environmental, social and governance protocols. Substance knowledge needs to be connected with an ability to communicate results and ideas to larger audiences, such as politicians, consumers and businesses. A networked way of understanding sustainability is both a substance-knowledge issue and a meta-skill for general working life. Global, networked, viral, multi-sited work is here to stay. After science- and ICT-related skills, the interviewees most often mentioned the need for good communication and argumentation skills.

Employees must be able to adapt rapidly to the changing work environment and job prescriptions. Transferrable skills include critical thinking skills, continuous learning skills, an ability to endure risks, stress and uncertainty as well as an ability to work on a team and work proactively. High-skilled work is becoming increasingly independent, insecure, flexible, networked and non-hierarchical. The ability to reflect on one's own abilities and resources as well as a certain resilience in the face of setbacks have become crucial survival skills in the shifting labour markets. So-called soft skills like communication, emotional labour and self-evaluation are playing a larger role in the professional sphere than before. This is even more true with sensitive topics and working with people from diverse backgrounds. One of the interviewees did express reservations regarding the internationality of a master's degree programme, but all others saw it as a great asset. Cooperation, interaction, teamwork, coordination and organisational skills as well as emotional intelligence, understanding and the ability to deal with different opinions and ways of thinking are becoming increasingly important.

TABLE 1. INTERVIEW ANSWERS TO QUESTIONS 11 AND 8²⁴

Interviews	Economics of natural resources	History of natural resources	Legislation on natural resources	Accounting for natural resources	would hire our trainees
FI1	5	3	4	5	yes
FI2	5	3	4	4	yes
ES1	5	3	4	3	no
ES2	5	3	5	4	yes
ES3	5	4	5	3	yes
RO1	3	3	4	4	yes
RO2	5	4	5	5	no
RO3	4	2	4	3	yes
SE1	3	3	5	2	yes
NO1	5	5	5	5	na
DE1	3	1	5	5	na
DE2	5	2	3	5	na
average	4,4	3,0	4,4	4,0	

For this report, we asked mostly qualitative and open-ended questions but also some questions of a more quantitative nature to make systematic comparisons between countries and their labour market needs. We asked all the interviewees about the importance of four themes that natural resource experts with a social science approach should possess when entering the workforce. The following table summarises the results; it also includes information as whether they would hire a trainee from the original EMERALD programme. The table shows that an understanding of the economics of natural resources and existing legislation are most valued (4.4/5). Some interviewees mentioned accounting as somewhat important, whereas others gave it full points. While interviewees recognised understanding the history of natural resource use as important, most felt it less important than the other themes. However, the skills related to studying the history of natural resource use might be unfamiliar to most of the business representatives since they elsewhere expressed great appreciation for skills related to the study of history in general, such as argumentation, critical thinking and a holistic approach.

²⁴ See Appendix 1.

The transnational reports show a trend of decreasing demand for technical and ICT-related skills, where the need to transmit skills from one area of knowledge to another outweighs the need for pure technical skills. For the most part, the country-specific reports emphasised technical skills more than global perspectives. The interviews reveal a more diverse range of opinions, with some valuing a holistic point of view immensely and others describing a natural resources expert first and foremost as an engineer. A certain amount of conservatism bias may exist when employers evaluate new experts based on their own past experience – predominantly with engineers. It is clear that natural resources experts need to have an understanding of natural resources that is not completely alienated from the natural sciences. However, lack of knowledge is not the most pressing issue for achieving current sustainability goals. Innovations need to be shared, political actions need to be pressed and decisions need to be made; in short, the direction of the future needs to be changed. It just may be that we need a whole new way of thinking, one which requires as multi-sided an approach as possible.

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APPENDIX 1. INTERVIEW QUESTIONS

1. How important is the sustainable management of natural resources to your organisation (or to the organisations you represent)?
2. What types of experts on natural resource management do you currently employ?
3. What kind of educational background do they have?
4. Are you planning to hire experts on natural resource management in the near future, or in five years' time?
5. What kind of skills and knowledge are you expecting from them?
6. Do you think that the current educational system produces people with the skill sets you need for sustainable natural resource management? Are there some particular gaps in skills or knowledge? Are you able to find people who have, for example, a satisfactory legal, business, societal and administrative understanding of sustainable resource management issues?
7. Are there some issues or aspects we should emphasise in our planned master's degree?
8. Would you be willing to hire one of our natural resource management students as a trainee at your organisation/corporation?
9. In your view, which sectors of society, industry or business need new natural resource experts the most?
10. Is there something important that we haven't covered, yet you think might be useful for us to know and think about?
11. Please rate from 1 to 5 the following topics, with 1 being 'very little [specific knowledge] needed for a master's degree in sustainable resource management' and 5 being 'quite a lot [of specific knowledge] needed for a master's degree in sustainable resource management':

1. Economics of natural resources

1	2	3	4	5
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2. History of natural resources

1	2	3	4	5
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3. Legislation on natural resources

1	2	3	4	5
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4. Accounting for managing resources

1	2	3	4	5
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