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COMMISSION STAFF WORKING DOCUMENT

EMPLOYMENT AND SOCIAL DEVELOPMENTS IN EUROPE 2023
Chapter 2

CHAPTER 2

Structural drivers of labour shortages in the context of changing skills needs

1. INTRODUCTION ([1])

Labour shortages occur when the demand for workers qualified in a particular area of the labour market exceeds the supply of those workers. This can arise for a variety of interrelated reasons, such as insufficient labour supply in certain segments of the labour market or in certain geographical locations (quantitative shortages), or a discrepancy between the skills and qualifications sought by employers and those held by individuals seeking employment (qualitative shortages). In order to successfully fill a vacancy, people with the right skills and qualifications must be in the right place at the right time and must be willing to work under the conditions offered. Accordingly, individuals seeking employment must have adequate information about the requirements, working conditions, and availability of vacant positions.

Although the trend in increasing labour shortages was interrupted by the COVID-19 crisis, labour shortages have now reached or exceeded pre-pandemic levels in many EU countries (see Chapter 1). Labour shortages represent a longstanding challenge for some sectors and occupations, while others are newly facing these challenges. According to the Business and Consumer Survey (BCS) and job vacancy statistics for Q1 2023, sectoral labour shortages are most prevalent in healthcare, hospitality, professional, scientific and technical activities, transportation and construction. ([2]) Based on the 2022 European Employment Services (EURES) report – which provides information at occupational level – labour shortages and surpluses are most evident for software and healthcare-related occupations, construction and engineering craft workers. ([3])

Labour shortages are shaped by structural determinants (including skills) and cyclical drivers. According to the 2022 Labour Market and Wage Developments in Europe review, the geographical, occupational and sectoral patterns of labour shortages in the COVID-19 recovery have followed pre-pandemic trends, suggesting important underlying structural drivers. ([4]) These drivers include the influence of skills shortages and mismatches (exacerbated by companies unwilling or unable to invest in training), ([5]) creation of jobs and demand for additional skills linked to the ongoing green and digital transitions, decline in the labour force due to demographic trends, low labour market participation of

([1]) This chapter was written by Jakub Caisl, Karolina Gralek, Gabor Katay, Linda Kunertova, Anna Lalova and Nora Wukovits-Votzi, with contributions from Alessia Fulvimari, as well as Cedefop experts Stelina Chatzichristou, Ilias Livanos, Konstantinos Pouliakas, Giovanni Russo and Giulia Santangelo, Joint Research Centre (JRC) experts Matthias Weitzel and Rafael Garaffa, and Eurofound experts Agnes Parent-Thirion and Barbora Makova.

([2]) Critical labour and skills shortages have also been identified in the agricultural sector, which is not covered by BCS or job vacancy statistics (OECD, 2023c).

([3]) (ELA, 2023).

([4]) (European Commission, 2022h).

([5]) (Pouliakas and Wruuck, 2022).

certain population groups (such as women, persons with disabilities, or people with a minority racial or ethnic background), labour market segregation across occupations and sectors, influence of labour mobility and migration, poor working conditions in some sectors and occupations, inefficient recruitment and human resources management (HRM) practices, incentives provided by the tax and benefit systems, and changing workers' preferences. ([6])

While temporary labour shortages might be a sign of an economic upswing and give workers some bargaining power, persistent labour shortages are likely to have negative effects on the wider economy. ([7]) Labour shortages may provide an opportunity for workers to demand higher wages, better working conditions, or investment in their skillsets, as well as enabling marginal workers to enter or remain in the labour market. However, they may also negatively impact existing workers, potentially increasing their work intensity and worsening their work-life balance. Labour shortages may limit the economic activity of companies and public institutions, lower their capacity for innovation, ([8]) or force them to reduce the quality of their services and products. They may also lead to outsourcing, offshoring, remote work, or automation. ([9]) At macro level, countries with labour and skills shortages may become less attractive for innovation and investment in research and development (R&D), which could weaken their competitiveness in the medium and long term. In addition, a shortage of workers with the required skills could impede the green and digital transitions. Given the prevalence of structural drivers even when economic conditions worsen, understanding them is crucial to developing the right policy responses.

In light of the European Year of Skills in 2023, this chapter analyses the structural drivers of persistent labour shortages, with a specific focus on changing skills needs in the context of the green and digital transitions. Chapter 1 presented the latest developments in labour shortages, and this chapter identifies sectors and occupations that have faced persistent labour shortages over the last 10 years. Section 2. analyses the skills needed in those occupations and presents future projections for labour shortages. Section 3. looks at how demand for new skills in the context of the green and digital transitions changes the demand for labour and contributes to labour shortages. The remainder of the chapter presents an in-depth analysis of other structural drivers of persistent labour shortages: section 4. looks at the impact of demographic trends of population ageing and lower labour market participation of some population groups; section 5. examines gender segregation in sectors and occupations with persistent labour shortages and its contribution to shortages in certain skilled occupations in science, technology, engineering and mathematics (STEM) and healthcare; section 6. considers the labour market participation of migrants born outside the EU in occupations facing persistent labour shortages; and section 7. describes the extent to which working conditions might contribute to persistent labour shortages in some sectors and occupations. Section 8. concludes with a brief overview of the chapter findings.

2. LABOUR SHORTAGES, INCLUDING SKILLS SHORTAGES, IN THE EU

There is no universally agreed methodology on how to measure labour shortages in the EU. One of the most common approaches is to use the BCS, which collects quarterly survey data from employers in the industry, manufacturing and services sectors, asking whether labour is a major factor limiting their production. ([10]) Often, job vacancy rates are used as an alternative measure to identify demand for labour, as they cover more sectors, albeit with less sectoral disaggregation and with a bigger time lag. The European Labour Authority (ELA) also collects information from the public employment services (PES) on labour shortages and surpluses, by occupation and Member State. However, that information is more qualitative than quantitative, and the time series is short. This section combines all three approaches to map the sectors and occupations with persistent labour shortages in the EU – referred to as 'labour shortage sectors' and 'labour shortage occupations', respectively. The available approaches, however, do not provide a single reliable estimate of the size of labour shortages, i.e. the number of vacancies that cannot be filled due to labour shortages.

Skills shortages are often approximated by the share of employers reporting difficulties in finding employees with the right skills. Firms' recruitment difficulties may be driven by various factors. These

([6]) (IMF, 2022), (OECD, 2022e).
([7]) (European Commission, 2022h).
([8]) (Horbach and Rammer, 2022).
([9]) (Erickson and Norlander, 2021), (World Economic Forum, 2023).
([10]) The survey is limited to information from private businesses and does not cover public services, such as public administration and defence, compulsory social security, education, human health and social work activities, and agriculture and mining sectors.

can include the lack of skills among job applicants, ([11]) but also poor recruitment, retention ([12]) and HRM practices, ([13]) high replacement demand due to retirement, the need to fill new jobs created as a result of the green and digital transitions, or companies unwilling or unable to offer competitive wages and working conditions (see section 7.). Recruitment also varies over the business cycle, as employers tend to be more selective (e.g. raising skills requirements in their vacancies) when the pool of unemployed people is larger. ([14]) ([15]) Exploratory research based on employer interviews suggests that employers are often unable to define and measure the specific skills they are looking for when recruiting. ([16])

Analysis of European Company Survey (ECS) 2019 data ([17]) shows that the lack of skills among job applicants is not the main reason for companies' overall difficulties in finding people with the right skills. Rather, the likelihood of experiencing recruitment difficulties is strongly driven by the inability to retain workers, ([18]) with its impact being 10 times larger than that of skills requirements (at 14.2 pp and 3.4 pp, respectively) (Table 2.1). ([19]) ([20]) There is also an institutional dimension to firms' recruitment difficulties, with the presence of a recognised body of employee representation associated with a reduced chance of experiencing difficulties in recruiting workers. Recruitment difficulties are less likely in larger firms, which are better able to recruit from a larger available talent pool (both externally and internally), as well as more likely to have an employee representation body. ([21]) To shed more light on the skills demanded in occupations facing persistent labour shortages in the EU, this section analyses skills needs based on the European Centre for the Development of Vocational Training (Cedefop) European skills and jobs survey (ESJS2) 2021 data. ([22])

Table 2.1

Companies' difficulties in finding people with the right skills are strongly driven by the inability to retain workers

Marginal effects of selected variables on the likelihood of experiencing difficulties in finding employees with the required skills (pp)

	Recruitment difficulties for required skills		
	Few	*Some*	*Many*
Difficulties in retaining employees	-13.7	-0.6	14.2
Workers in jobs offering continuous training (%)	-1.1	-0.04	1.1
Workers in jobs in which there is no need to learn new skills (%)	1.3	0.06	-1.4
Importance of training for organisational goals (index)	-3.3	0.1	3.4
Level of employee motivation	2.3	0.01	-2.4

Note: Estimated percentage change in the likelihood of reporting difficulties in finding employees with the required skills.

Source: European Foundation for the Improvement of Living and Working Conditions (Eurofound) and Cedefop ECS 2019.

Click here to download table.

2.1. Identifying persistent labour shortages and their skills needs

The first approach uses BCS data and identifies persistent labour shortages in construction, manufacturing, information and communication technology (ICT), transportation and storage, professional, scientific and technical activities, and administrative and support services. In order to identify subsectors with persistent labour shortages by country over time, several methodological

([11]) As shown in Labour Market and Wage Developments in Europe 2022 (European Commission, 2022h), the share of low-skilled workers in an economy is positively associated with labour shortages.

([12]) Employee retention is inversely related to job tenure.

([13]) (Ployhart, Schmitt and Tippins, 2017), (Ryan and Ployhart, 2014), (Cappelli, 2012), (Cedefop, 2015), (Cedefop, 2018).

([14]) (Modestino, Shoag and Balance, 2020).

([15]) In countries where unemployment is particularly high, the share of firms reporting few difficulties in finding applicants with the right skills tends to be high, while the share of those reporting many difficulties tends to be low (Cedefop, 2015).

([16]) (Goulart, Rodríguez-Menés and Caroz Armayones, 2022).

([17]) Information about the 2019 wave of the ECS, jointly developed by Eurofound and Cedefop, available here.

([18]) For example, poor HRM practices, or uncompetitive wages and working conditions.

([19]) ECS 2019 variables used to proxy whether a high or low skill level is required in a company are: job design features, including the incidence of jobs with autonomy and problem-solving; those where there is no need to learn new skills (low skill or stagnant jobs); if there is continuous training; and if the pace of work is set by machines or routines. An additional proxy for firms' commitment to investment in their human resources is an index derived from variables capturing the importance of training to achieve organisational goals, specifically (i) to improve employees' ability to suggest ways to improve things, (ii) to ensure that all workers have the skills they need, (iii) to improve employee morale, and (iv) to increase flexibility by allowing workers to move across different positions. The index ranges from one to four. High values of the index signal that training is important to attaining many of the goals listed.

([20]) Among the variables proxying for skills requirements, the index describing the importance of training to meet organisational goals has the strongest association with the likelihood of recruitment difficulties.

([21]) In some countries, a representation body is mandatory for a given number of employees.

([22]) Available here; see also (Cedefop, 2022f).

assumptions ([23]) were made about the length of time series, the threshold at which labour shortages were considered severe, the threshold for considering severe labour shortages persistent, and the criteria for identifying subsectors with persistent labour shortages at EU level. ([24]) Table 2.2 presents the full list of subsectors (NACE ([25]) 2-digit level and the corresponding NACE 1 level) identified as facing persistent labour shortages across the EU over the last 10 years (2012-2021). ([26])

([23]) Methodological assumptions used to define thresholds:

- Last 10 years (since 2012);
- In every quarter, a subsector (at NACE 2-digit level) was considered to experience substantial labour shortages if the reported value exceeded the average across all subsectors in the country and amounted to at least 20%, or if at least half of the employers in the subsector per country reported labour shortages;
- For each subsector and country, the number and share of quarters with substantial labour shortages was calculated;
- Labour shortages were considered persistent in a subsector where substantial labour shortages occurred in at least one-third of the quarters;
- At EU level, the subsector was considered to experience persistent labour shortages if more than 10 Member States faced persistent labour shortages in that subsector.

([24]) The BCS is limited to information from private businesses and does not cover public services such as public administration and defence, compulsory social security, education, human health and social work activities, and agriculture and mining sectors.

([25]) Developed in the EU, NACE is the Statistical Classification of Economic Activities.

([26]) Employment activities (N78) were also identified as facing persistent labour shortages. However, they were not considered among the labour shortage sectors in further analyses, as they include activities of listing employment vacancies and referring or placing applicants for employment, where the individuals referred or placed are not employees of the employment agencies, supplying workers to clients' businesses for limited periods of time to supplement the workforce of the client, and the activities of providing other human resources, which might themselves be driven by other labour shortages.

Table 2.2
Persistent labour shortages are most common in the manufacturing and construction sectors
Subsectors in persistent labour shortage, 2012-2022

Subsector, NACE 2-digit level	Number of Member States facing substantial labour shortages in a given subsector	Employment in subsector (number of people in million, % of total employment) 2021	Change in employment since 2012
43 Specialised construction activities	19	7.5 (4%)	0.4
62 Computer programming, consultancy and related activities	17	4 (2%)	79%
41 Construction of buildings	17	3.9 (2%)	-2%
33 Repair and installation of machinery and equipment	16	1.1 (0.6%)	16%
49 Land transport and transport via pipelines	15	5.4(2.9%)	7%
25 Manufacture of fabricated metal products, except machinery and equipment	14	3.4 (1.8%)	2%
31 Manufacture of furniture	13	1.1(0.6%)	3%
13 Manufacture of textiles	13	0.6 (0.3%)	-8%
81 Services to buildings and landscape activities	13	3.4 (1.8%)	10%
71 Architectural and engineering activities; technical testing and analysis	12	2.8 (1.5%)	24%
30 Manufacture of other transport equipment	12	0.8 (0.4%)	4%
42 Civil engineering	11	1.3(0.7%)	-7%
80 Security and investigation activities	11	1.1 (0.6%)	3%
86 Human health activities	-	12.1 (6.4%)	11%
87 Residential care activities	-	3.9(2%)	6%
88 Social work activities without accomodation	-	5 (2.6%)	30%

Note: Analysis and selection based on BCS, except for subsectors 86, 87, 88, which use job vacancy rate at NACE 1-digit level.

Source: BCS and EU-LFS, 2012-2021.
Click here to download table.

The second approach uses Eurostat job vacancy rates and identifies persistent labour shortages in human health and social work activities. This sheds light on the labour demand in some sectors that are additional to the ones identified by the BCS such as human health and social work. Since 2012, overall vacancy rates ([27]) are high and increasing in arts and entertainment, administrative and support services, construction, information and communication, professional, scientific and technical activities, accommodation and food services, and transport and storage (Chart 2.1). The vacancy data support the findings of the BCS and also show increasing shortages in human health and social work. A sharp decrease in overall rates was observed in 2020 due to the COVID-19 outbreak, with the exception of healthcare. From 2021, the rates increased and reached historical highs for all sectors except mining and quarrying. Looking at the latest quarterly data at the end of 2022, the overall vacancy rates slightly decreased but remained historically high, at 2.8% (Chapter 1). A significant drawback of this measure is that it does not distinguish whether high job vacancy rates in a sector are driven by high turnover or by labour shortages.

Total employment in the subsectors experiencing persistent labour shortages has increased by 11% since 2012, according to the EU-LFS (Table 2.2). The share of vacant posts in the sectors is increasing (Chart 2.1), indicating greater labour demand. Total employment is also high, due to the expansion of these economic sectors. The highest employment increases are recorded in computer programming (+79%), architectural and engineering activities (+24%), and social work activities (+30%) (Table 2.3). In 2021, approximately one-third of employed people, including the self-employed, were

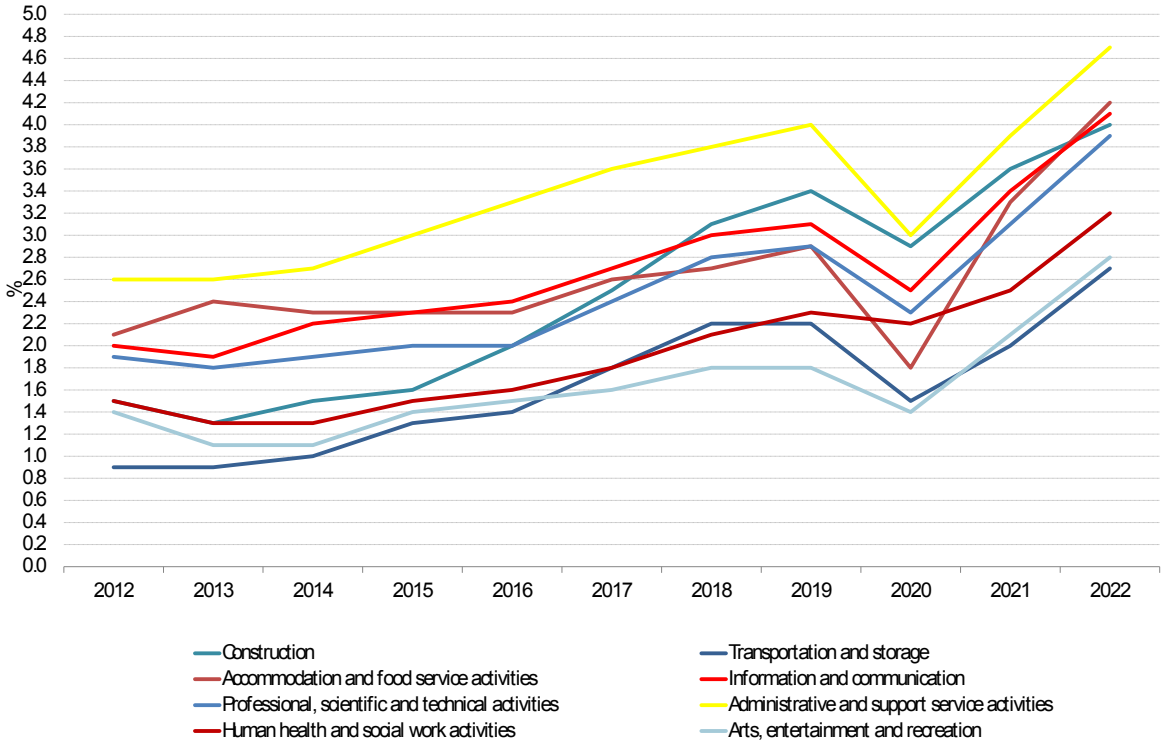
([27]) There are certain limitations to this approach, e.g. it does not allow for investigation of shortages at EU level before 2012, or for the full set of NACE 2-digit sectors (see Chart 2.1 notes).

working in shortage subsectors. Increasing employment, coupled with reported shortages and vacancies in the specific group of sectors, provides evidence for persistent shortages over time.

Chart 2.1

Shortage subsectors despite increasing employment suggests persistent shortages over time

Job vacancy rate (%), NACE 1-digit level, annual (%), 2012-2022, EU-27



Note: Vacancy rate data for NACE Rev. 2, 1-digit level; data shown for NACE Rev. 2 sectors, which experience levels higher than the average; data missing for: agriculture, forestry and fishing; water supply; public administration and defence; compulsory social security; data for human health and social work activities, and arts, entertainment and recreation are only available and shown for 20 countries in the euro area (2023).

Source: Eurostat (online data code: jvs_a_rate_r2).

Click here to download chart.

The third approach lays the foundation for the analysis of structural drivers of persistent labour shortages at occupational level. It identifies persistent labour shortages for health, ICT professionals, personal services, sales, personal care, building and related trades, metal, machinery and related trades, and electrical and electronic trades workers, as well as drivers and mobile plant operators, and cleaners and helpers (Table 2.3). The approach is based on the occupation classifications developed by the International Labour Organization (ILO) and data collected by EURES national coordinating offices in the Member States. Since 2016, these offices have provided annual data on shortage occupations for European-level reports on labour shortages and surpluses. ([28]) ([29]) In order to identify labour shortage occupations at International Standard Classification of Occupations (ISCO) 3-digit level ([30]) in the EU over time, certain assumptions were made and two criteria created. ([31]) However, shortage occupations at 3-digit level might include some occupations at 4-digit level without persistent labour shortages. At the same time, the selection criteria mean that some occupations with persistent labour shortages at 4-digit level might be excluded from a shortage occupation group when aggregated to 3-digit level. ([32])

([28]) (ELA, 2023), (European Commission, 2020a), (European Commission, 2016a).

([29]) Caveats linked to the data collection on shortages in occupations include: variation in the geographical scope of the exercise over time; different reference periods covered in the same reporting year; different sources used by the PES when reporting shortages (i.e. PES administrative data, national occupation forecasts, occupation barometer, PES survey only, combination of different sources); data at Member State level available at a higher aggregated level.

([30]) ISCO-08 contains 436 specific occupations at 4-digit level and 130 groups at 3-digit level. Data on shortages exist at 4-digit level for all years except 2016 and 2015. Data missing in 2018.

([31]) Occupational shortages selection criteria:

- In order to aggregate occupations at ISCO 4-digit level to ISCO 3-digit level, at least half of occupations at ISCO 4-digit level under the ISCO 3-digit level needed to be in shortage in the recorded year;
- An occupation at ISCO 3-digit level was identified to face persistent labour shortages if it experienced labour shortages in at least three of the years between 2016 and 2021.

([32]) A selection of 4-digit shortage occupations was added to Table A.1.

Table 2.3

Persistent labour shortages in various types of occupations

Occupations in persistent labour shortage, ISCO-08, 2016-2021

ISCO 3-digit code	Description of occupation	Employment in 2021 (number of people in million, % of total employment)	Change in employment since 2012
221	Medical doctors	1.9 (1%)	16%
222	Nursing and midwifery professionals	1.6 (0.8%)	22%
251	Software and applications developers and analysts	3.3 (1.7%)	88%
512	Cooks	1.7 (0.8%)	-3%
513	Waiters and bartenders*	1.9 (1%)	-34%
522	Shop salespeople	10.2 (5.3%)	-6%
532	Personal care workers in health services	4.2 (2%)	9%
711	Building frame and related trades workers	4 (2%)	4.50%
712	Building finishers and related trades workers	2.3 (1.2%)	-2%
721	Sheet and structural metal workers, moulders and welders, and related workers	1.7 (0.8%)	-16%
723	Machinery mechanics and repairers	3.6 (1.8%)	19%
741	Electrical equipment installers and repairers	2.4 (1.2%)	4.60%
833	Heavy truck and bus drivers	3.8 (1.9%)	-1.30%
911	Domestic, hotel, and office cleaners and helpers	6 .1 (3%)	-10.50%

Note: *Professions not in shortage for three years in the analysed period and not in shortage during the 2020-2021 period, probably due to the COVID-19 pandemic. A complete list of 3-digit and 4-digit occupations is available in Table A.1.

Source: ELA (2023) and EU-LFS 2012-2021.

Click here to download table.

The required skills differ across occupations with and without persistent labour shortages. Based on ESJS2 2021 data, labour shortage occupations have a higher frequency of workers requiring manual skills and lower values of literacy, numeracy and digital skills than non-shortage occupations (Chart 2.2). ([33]) ([34]) Descriptive analysis shows that the differences between labour shortage and non-labour shortage occupations are less pronounced on social skills, routinisation, and job complexity.

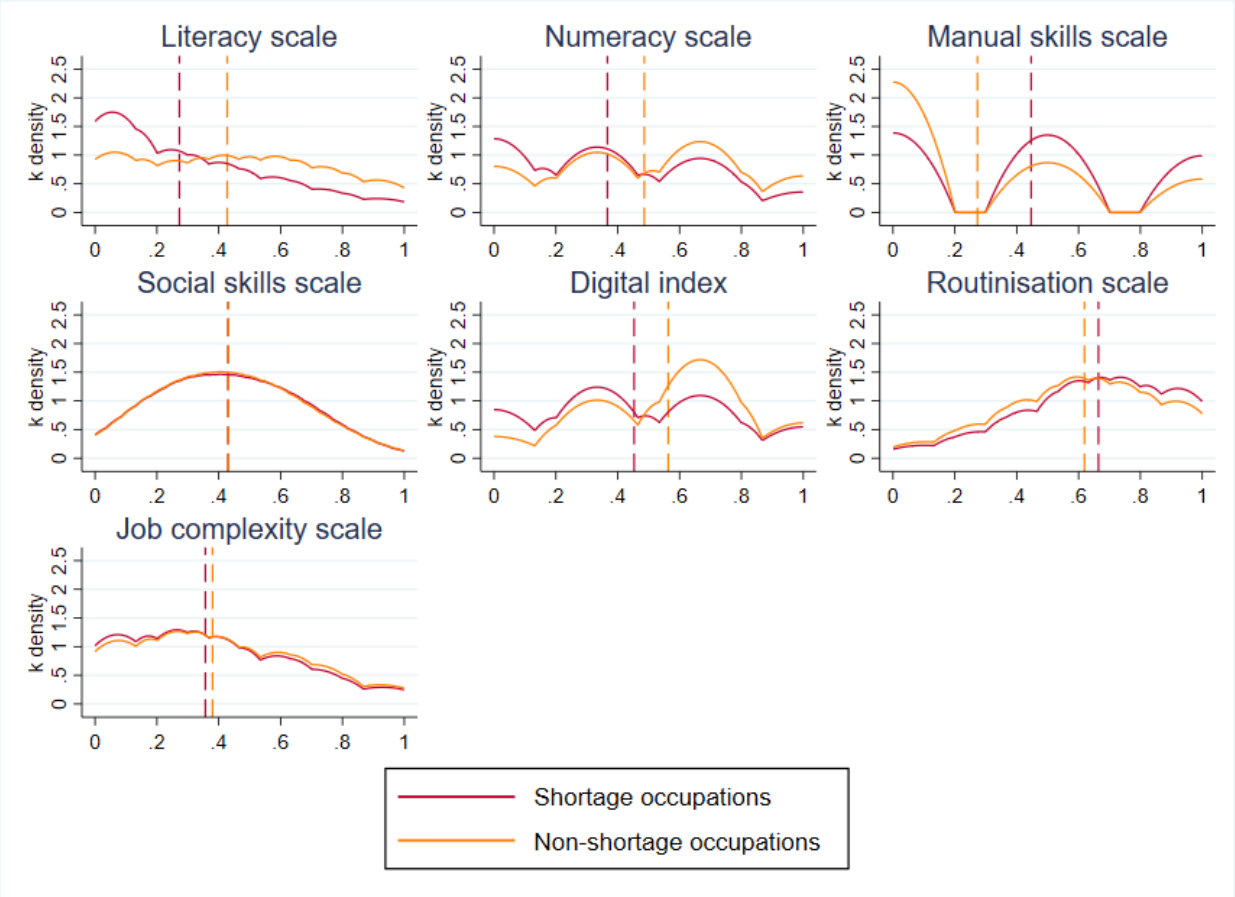
([33]) Occupations at ISCO 3-digit level might include occupations with different skill requirements.

([34]) ESJS2 measured the intensity of foundation (literacy (reading and writing), numeracy), digital, interpersonal, problem-solving and manual skills required in the jobs of adult workers in the EU ((Cedefop, 2022e)).

Chart 2.2

Labour shortage occupations require greater manual skills and lower digital skills

Skill demand for labour shortage and non-labour shortage occupations, 2021, EU-27, Norway and Iceland



Note: Plots show the variables k-density (smoothed estimate of the probability density function), which shows the probability of having specific skills (e.g. social, digital, literacy) demand in the context of both shortage and non-shortage occupations (as indicated by red and orange lines). X-axis shows the values of the scales in the respective skill domain, rescaled to a value range from 0 to 1, with 0 representing 'no skill content' and 1 'very high skill content' of respondents' jobs in the respective task domain.

Source: Cedefop ESJS2 2021.

Click here to download chart.

Even when controlling for different characteristics of occupations facing persistent labour shortages, labour shortage occupations are still more likely to be comprised of jobs with lower skill demand (Table A.3). ([35]) This might explain the relatively low impact of skills in driving firms' recruitment difficulties. Labour shortage occupations are more likely to experience skills gaps. Once other factors are taken into account, employees in labour shortage occupations perform routine tasks less frequently and are more likely to exercise greater discretion in organising and planning their work and in learning or adapting to unexpected situations or varying tasks. This suggests that persistent occupational shortages might be an outcome of firms' human resource practices and their expectations of finding workers with high non-cognitive skills. ([36]) The findings also suggest that there is scope to further develop the skills of those employees to move towards better job performance.

There are significant differences across broad occupation skill groups in the skills needed (Table A.3). ([37]) For example, skilled shortage occupations typically rely more on physical rather than cognitive tasks, compared to skilled non-shortage occupations. However, they tend to be characterised by higher upskilling and digital skill needs, higher demand for better-educated workers, and greater job complexity, compared to skilled non-shortage occupations. Semi-skilled and manual shortage occupations are more likely to depend on less routine and more social tasks, compared to the same non-

([35]) A probit model is estimated using the available information on skill demand in occupations, skill mismatch, job quality, turnover, firm size and urban dimension, along with demographic characteristics of workers. In terms of skill mismatch, ESJS2 measures the extent to which the skills of EU workers need to be developed so that they can carry out their jobs proficiently. It also detects whether individuals' education levels are higher or lower than those needed to do the job. ESJS2 contains several proxies for work quality in EU labour markets. These include: (i) job complexity, as measured by the extent to which EU workers have autonomy or leverage to plan in their jobs, or have to learn and adapt to unexpected situations and varied tasks; (ii) routinisation, specifically whether EU workers have to do short, repetitive movements or tasks, or follow fixed, standardised procedures; (iii) workers' subjective job satisfaction; (iv) workers' net monthly earnings.

([36]) Including soft skills such as team-work, planning, communication.

([37]) Differences are even more pronounced when considering narrowly defined occupational clusters that are part of the same ISCO 2-digit group.

shortage skill groups, with a higher demand for lower-educated workers. In addition, semi-skilled shortage occupations depend more heavily on manual skills, while elementary shortage occupations primarily involve highly routinised tasks. All groups, with the exception of skilled shortage occupations,bibi require a relatively basic or very low digital skill level, implying that a lack of digital skills is not the main driver of many persistent labour shortages.

2.2. Future labour shortages

Many occupations already facing persistent labour shortages are projected to experience high labour shortages in the future. Cedefop's 'future shortage indicator' ([38]) is constructed from three areas of information: labour market imbalances, expansion, and replacement demand (Box 2.1). It shows that for science and engineering professionals, health professionals, ICT professionals, personal services workers, and personal care workers, labour shortages are likely to be strongly driven by the overall level of occupational employment growth. For health professionals, personal care workers, drivers and mobile plant operators, and cleaners and helpers, replacement needs will also play a key role. Among shortage occupations, labour market imbalances are estimated to have a strong impact for personal services workers, sales workers, building, metal, machinery and related trades workers, drivers and mobile plant operators, and cleaners and helpers.

Future labour shortages at occupational level will be primarily driven by growth in employment and mismatches in education composition, with differences across broad occupation skill groups (Table 2.4). While future shortages in high-skilled non-manual occupations will be strongly driven by expansion and replacement needs, elementary and skilled manual occupations will be significantly affected by labour market imbalances. Across broad occupation skill groups, elementary occupations and high-skilled non-manual occupations are projected to face the strongest shortages by 2035. This includes some occupations in the high-skilled and elementary occupation groups that are not currently identified as experiencing persistent labour shortages. ([39]) However, given the lower skill requirements of elementary occupations, their shortages are less likely to create significant bottlenecks in availability of staff with the required educational credentials. Rather, the challenge in these occupations relates to over-education and job satisfaction, and to retaining and attracting staff under existing wage and working conditions. By contrast, shortages in higher-skilled occupations, such as legal and business professionals, may require additional efforts in education and training, given the higher educational credentials typically required in these professions. ([40]) Also, shortages of science and engineering professionals can benefit from supporting diversification in researchers' careers. ([41]) Finally, shortages of some skilled manual and non-manual occupations are expected to be high, largely due to labour market imbalances.

([38]) Based on Cedefop's Skills Forecast to 2035, which offers quantitative projections of the future trends in employment (Cedefop, 2023a).

([39]) In Table 2.4, ISCO 2-digit: 11, 13, 26, 33, 34, 93, 94, 95, 96.

([40]) The role of migration in attracting talent is discussed in section 6.

([41]) (European Commission, Directorate-General for Research and Innovation, 2022).

Box 2.1: Cedefop's future shortage indicator

To measure likely future labour shortages, the indicator uses expansion demand, replacement demand, and labour market imbalances, drawn from the Cedefop's Skills Forecast. ([1]) The indicator ranges from 1 (weak or no shortage) to 4 (strong shortage). ([2]) The overall future shortage indicator is then constructed by an arithmetic average assuming equal weights. This forecast uses data and assumptions that capture recent policies and phenomena, such as the European Green Deal, COVID-19 impacts, changes in energy and commodity prices, and the ongoing Russian war in Ukraine.

Expansion demand ([3]) captures the extent to which the overall level of occupational employment by 2035 will grow or contract. It focuses on future demand for employment and can reflect trends in sectoral employment, changes in the occupational structure of employment, and overall trends in the economy. Whether or not that demand materialises will depend on the available supply of labour ready to take up such employment. However, strong employment growth may create future shortages for the occupation in question and the outcome will depend on the responsiveness of the wage mechanism, working conditions, and the availability of education and training to meet future demand.

Replacement demand ([4]) looks at employment needs that will arise as workers leave an occupation due to retirement, career changes, health, or other reasons. Replacement needs generally provide more job opportunities than new jobs, meaning that significant job opportunities arise even in occupations declining in size. Similar to expansion demand, the outcome will depend on other factors, as companies and organisations may decide not to replace retiring workers for budget reasons or because they can substitute labour with technology in highly routinised jobs.

Labour market imbalances capture the share of occupational employment likely to encounter difficulties due to a mismatch of supply and demand in formal education composition. Those imbalances could go in either direction: one occupation may experience insufficient numbers of highly educated workers to meet its needs, leading to skill gaps and low productivity, while another occupation may see the level of available education exceed that demanded, leading to over-education, low job satisfaction, high turnover, or increased costs for the employer.

The findings from the Cedefop future shortage indicator at occupational level should be read with caution. The comparison of different (types of) occupations is only indicative, as the indicator does not adjust for the size of occupations (i.e. it does not apply any weights). In addition, the disaggregation stops at ISCO 2-digit level, which might comprise quite different occupations and hide substantial labour shortages in some occupations. There may also be large country variations in shortages. Given the limitations of the sectoral approach, this chapter focuses on an occupational future shortage indicator, except for section 4.1. which contains sectoral analysis. ([5])

([1]) Cedefop's European Skills Forecasts are available here: https://www.cedefop.europa.eu/en/projects/skills-forecast

([2]) More specifically, 4 (1) indicates that the value is a standard deviation above (below) the average, while 2 (3) indicates that the value is between the standard deviation above (below) the average and the average itself. The overall future shortage indicator is then constructed by an arithmetic average assuming equal weights.

([3]) 2021-2035 per annum percentage net occupational employment change.

([4]) 2021-2035 per annum occupational replacement change.

([5]) The sectoral future shortage indicator is only available for 17 sectors at NACE 1-digit level, expect for some selected sectors identified as key to the green transitions (see section 4.1.), for which the indicator is available at NACE 2-digit level. As the imbalance indicator is only estimated for occupations, its value for a sector is set equal to the arithmetic average of the dominant occupations (those that add to at least 50% of employment within the sector and typically have an individual share of 8% or more), assuming equal weights.

Table 2.4
Future labour shortages are strongest in high-skilled non-manual and elementary occupations
Future occupational shortages to 2035, ranging from 1 (weak or no shortage) to 4 (strong shortage)

	ISCO	Occupation	Expansion	Replacement	Imbalance	Future shortage indicator
High-skilled non-manual occupations	11	Chief executives, senior officials and legislators	2	4	2	2.7
	13	Production and specialized services managers	3	3	2	2.7
	21	Science and engineering professionals	4	2	1	2.3
	22	Health professionals	3	4	1	2.7
	25	ICT professionals	4	1	1	2.0
	26	Legal, social and cultural professionals	3	3	2	2.7
	33	Business and administration associate professionals	3	3	2	2.7
	34	Legal, social, cultural and related associate professionals	4	3	2	3.0
Skilled non-manual occupations	42	Customer services clerks	3	3	2	2.7
	51	Personal services workers	3	2	3	2.7
	52	Sales workers	2	2	3	2.3
	53	Personal care workers	3	3	2	2.7
Skilled manual occupations	71	Building and related trades workers (excluding electricians)	2	2	3	2.3
	72	Metal, machinery and related trades workers	2	2	3	2.3
	74	Electrical and electronic trades workers	2	2	2	2.0
	82	Assemblers	3	2	3	2.7
	83	Drivers and mobile plant operators	2	3	3	2.7
Elementary occupations	91	Cleaners and helpers	2	4	4	3.3
	93	Labourers in mining, construction, manufacturing and transport	3	2	4	3.0
	94	Food preparation assistants	3	2	4	3.0
	95	Street and related sales and services workers	2	2	4	2.7
	96	Refuse workers and other elementary workers	3	2	4	3.0

Note: Selection of occupations at ISCO 2-digit level, including those with the highest projected future shortages (indicator of 2.7 or higher) and those characterised by persistent labour shortages (in grey) (see Table 2.3); for the full list, see Table A.2; yellow to red colouring represents low to high indicator levels.

Source: Calculations based on Cedefop Skills Forecast 2023.

Click here to download table.

3. THE TWIN TRANSITION AND CHANGING SKILLS NEEDS

For the twin transition to happen, education and training systems must ensure sufficient numbers of specialists equipped with the right skills to develop and implement new technologies and infrastructure. ([42]) The green transition is expected to have an overall positive effect on employment, but there are considerable differences in expected impacts across sectors, regions, and skill groups. As the green and digital transitions are strongly interlinked and entail an economy-wide transformation, investments in adult learning, upskilling and reskilling will be needed in most sectors to implement green-digital solutions. ([43]) More specifically, the twin transition will increase the need for the digital skills already in strong demand today. ([44]) This is likely to exacerbate labour shortages and skill gaps, especially in the short term. Given the priority to meet green and digital objectives and their significant impact on future skills needs, this section provides a separate analysis of how each of the transitions is expected to change skills and affect labour shortages.

3.1. Impact of green transition on labour and skills shortages

Policies under the scope of the European Green Deal are expected to have positive effects on employment. There is a wide range of estimates of the expected employment effects, depending on the

([42]) (Muench et al., 2022).

([43]) For example, see (Cedefop, 2021), (Cedefop, 2022c), (Cedefop, 2022g), (Cedefop, 2023a).

([44]) Technological advancement, including in sectors that are key to the green transition, increase the requirements for digital skills across the economy. For example, ICT and advanced electronic machinery are increasingly used to perform tasks in the building sector, including in the development of smart buildings, while improvements in fisheries and forestry sectors are increasing the demand for technological skills (Asikainen et al., 2021).

underlying assumptions (Box 2.3). According to some forecasts, if supported by the right employment and education policies, ([45]) net-zero policies could create between 1 million and 2.5 million jobs by 2030 in sectors with enhanced economic activity due to greening, as well as in other sectors indirectly affected (Box 2.2, Box 2.3). ([46]) The commitment to reach climate neutrality in the EU by 2050 and to shift to cleaner production modes was enshrined for the first time in the European Climate Law adopted in July 2021 ([47]) and is binding at national level. This commitment is accelerated by the European Green Deal Industrial Plan ([48]) and the Net Zero Industrial Act, ([49]) which are expected to significantly boost the demand for workforce in many industries (Box 2.4). Job losses are also projected, particularly in carbon-intensive industries, such as mining, manufacturing of steel and iron, or fuels. ([50]) Despite this, the transformation towards climate neutrality is predicted to generate net employment gains across all broad economic sectors by 2030, according to the impact assessment of the European Green Deal. ([51]) Nevertheless, labour shortages could hinder these employment gains.

Almost all occupational categories are expected to benefit from the implementation of the European Green Deal. Cedefop's European Green Deal scenario forecasts significant additional employment increases for science and engineering associate professionals (3.0%), science and engineering professionals (2.4%), administrative and commercial managers (2.1%), chief executives, senior officials and legislators (1.7%), ICT professionals (1.5%), and business and administration professionals (1.2%). ([52]) However, those jobs may prove difficult to fill, given that skills in those areas are already scarce and the labour demand for these occupations is expected to grow. Among medium-skilled occupations, the highest impact is expected for refuse workers, building and related trades workers, electrical and electronic trades workers, and drivers, most of which are already experiencing persistent labour shortages. Although scientists, R&D researchers, specialised engineers and associate professionals may face only small changes in their employment share, they are indispensable to the development, design and implementation of green technologies, including the relevant infrastructure. ([53])

The majority of EU citizens believe that policies to tackle climate change will create more jobs than they will remove and that those will be better quality jobs, at 57% and 61%, respectively. ([54]) More than half (55%) of the respondents to the Special Eurobarometer in 2022 reported that being in a job that contributes to the green transition is important to them personally, with 15% stating that they 'totally agree'. However, only around one-third believe that their current job contributes to that transition. Those proportions vary considerably across Member States, potentially reflecting regional differences in general public awareness of the green transition's impact and relevance to their lives.

Skills needed for the green transition include technical job-specific skills and more transversal skills. ([55]) Technical skills are required to adapt or implement standards, processes, services, products and technologies to protect ecosystems and biodiversity, to advance the production and roll-out of net-zero technologies, and to reduce energy, materials and water consumption. They should be viewed as complementary to transversal skills such as the knowledge, abilities, values and attitudes needed to live, work and act in resource-efficient and sustainable economies and societies. Moving towards a more sustainable EU economy relies heavily on technological advancements and innovation, linked to digitalisation, automation, connectivity, artificial intelligence (AI) and blockchain, making digital skills extremely important to the green transition. While new employment opportunities stemming from climate policies are projected across all skill types until 2030, ([56]) – mitigating the protracted decline in middle-

([45]) Policies increasing labour market and skills matching and labour market participation will play a key role in realising employment gains. For example, estimations in (European Commission, 2020f) show that using carbon revenue to reduce labour taxation for lower-skilled workers could increase employment by 0.45% in 2030 by stimulating low-skilled labour supply.

([46]) (Cedefop, 2021); (Asikainen et al., 2021).

([47]) More information available here.

([48]) (European Commission, 2023c).

([49]) (European Commission, 2023h).

([50]) For example, up to 286 000 workers in the energy sector were predicted to experience job loss due to subdued economic activity in their sectors (Cedefop, 2021).

([51]) (European Commission, 2020f).

([52]) (Cedefop, 2021).

([53]) (Cedefop, 2022a).

([54]) Special Eurobarometer on fairness perceptions of the green transition (European Commission, 2022j).

([55]) (Inter-Agency Working Group on Work-based Learning: Cedefop, European Commission, European Training Foundation, ILO, OECD, UNESCO, 2022).

([56]) (European Commission, 2019b), (Asikainen et al., 2021).

Box 2.2: Approaches to define green jobs

Scenarios to estimate impacts of the net-zero economy transition show a complex picture of multiple demand and supply channels, influencing employment patterns in different ways and at different intensities. Analysis of the actual employment trends, including labour and skills shortages in key sectors, is not clear-cut, as an established definition of 'green jobs' is not yet firmly in place. Generally, two approaches can be taken to define green employment. Firstly, the top-down approach takes a sectoral lens and establishes the greenness of a job based on the importance of the sector's output in reaching climate targets and other environmental objectives. Secondly, the bottom-up approach denotes greenness in an occupation by measuring the extent of green skills, ([1]) tasks or knowledge, as well as the technology required in that occupation. Each of these approaches has distinct advantages and disadvantages. The top-down approach is better suited to sectoral analysis, as it denotes the greenness of jobs based on their output. However, it is limited to the initial definition of 'green' and can overlook indirect impacts of the transition. The task based-approach can be used for holistic analyses of the job impacts of greening. However, capturing the composition and relevance of tasks in jobs in the varied and dynamic labour market is a complex exercise that comes with caveats on data availability, transferability and durability.

One example of the top-down approach is Eurostat's 2021 estimates on employment in the environmental goods and services sector (EGSS) based on national accounts. According to this metric, the European economy had 4.5 million green jobs in 2019 (3.2 million in 2000), around 2% of total employment. This should be considered a narrow proxy for green jobs, as it excludes other activities making a substantial contribution to climate and environmental objectives.

A number of attempts have been made to analyse green employment based on the task-based approach. Most build on the Green Jobs Framework initially introduced by O*NET in the United States (US), ([2]) which categorises occupations based on the combination of the top-down and bottom-up approaches. This creates a four-fold division of all occupations:

(i) New unique occupations introduced due to new nature of activities in the economy;
(ii) Jobs that existed prior to the transition but see a considerable share of their tasks changed as a result of green activities;
(iii) Those whose nature remains unaffected but whose demand increases due to accentuation of green activities in the economy;
(iv) Jobs with no impacts due to the transition ('non-green' jobs).

With some limitations, this classification is adaptable to the EU labour market. ([3]) Using this framework, one study estimates that up to 40% of employment in the EU contributed to green goals in 2016. ([4]) Further explorations suggest that around 17% of jobs in the OECD countries include a substantial share of green tasks. ([5])

Given the high variation between the estimates of different approaches, they should be interpreted with caution.

([1]) List of 'green skills' can be found in the European Classification of Occupations, Skills, and Competences (ESCO). These are defined as the skills, competences, abilities and knowledge needed to live in, develop and support a society that reduces the impact of human activity on the environment (Cedefop, 2012).
([2]) More information available on the website of O*NET Resource Center.
([3]) This approach applies a cross-reference between O*NET classification used in the US and ISCO classification used in the EU. One of its main weaknesses is the necessary aggregation, as O*NET is available at 8-digit level and ISCO at 4-digit level. Also, it assumes that EU Member States have broadly the same occupational structure as the US.
([4]) (Bowen and Hancke, 2019).
([5]) (OECD, 2023b).

skilled jobs ([57]) – recent literature shows that green employment creation has been more prevalent among higher-skilled professions. ([58])

([57]) (European Commission, 2022c), (Asikainen et al., 2021).
([58]) (OECD, 2023b), (Saussay et al., 2022), (Vona, 2019).

Box 2.3: Macroeconomic modelling of employment impacts of climate scenarios

Macroeconomic simulations of labour market impacts aid policy-making to reach climate goals in the EU. These models take into account the most recently adopted climate and environmental targets and consider different scenarios, with various sets of underlying assumptions on regulation (e.g. different tax systems complementing the reforms, energy price policy mixes), as well as socioeconomic assumptions (perfect labour markets with smooth transitions and no skill shortages, assumptions on population and growth). Accordingly, the estimates vary and should be taken as purely indicative. The models outline future employment development based on different production targets in the relevant sectors and compare the final employment snapshot in a given year (either 2030 or 2050, with an analysis based on new 2040 targets forthcoming) to the baseline scenario without the climate targets. Caveats include little flexibility to incorporate unexpected shocks (such as COVID-19) and the inability to capture possible shifting employment patterns within sectors (e.g. accelerated growth in demand for specific skill-intensive occupations). Nevertheless, macro-modelling tools are crucial to identifying future labour trends and corresponding policy needs.

(Cedefop, 2021): The green employment and skills transformation - insights from a European Green Deal skills forecast scenario	Up to **2.5 million net jobs** (1.2%) could be created **to 2030**, compared to the business-as-usual scenario
Joint Research Centre (JRC) (Asikainen et al., 2021): The future of jobs is green	Green transition policies could lead to a **net increase in jobs** of up to **884 000** (+0.45%) **by 2030**, compared to the business-as-usual scenario
(European Commission, 2020f): Impact assessment accompanying the Communication 'Stepping up Europe's 2030 climate ambition - investing in a climate-neutral future for the benefit of our people'	With the right accompanying polices in place, the green transition could create around **one million additional quality jobs** in the EU **by 2030** and **two million by 2050.** **Without the right policies,** potential losses could reach up to 494 000 jobs (-0.26% at aggregate level by 2030, and up to 1.7 million jobs (-1.4%) in market services, in the worst-case scenario)
Employment and Social Developments in Europe (ESDE) 2019 (European Commission, 2019b): Towards a greener future: employment and social impacts of climate change policies (based on the impact assessment for the Climate Target Plan)	**Create 1.2 million jobs by 2030** and up to **between 1.5 million and 2 million jobs by 2050**

Box 2.4: Investment needs for additional skilled workers related to net-zero technologies

Delivering on the European Green Deal and reaching the targets of the Fit for 55 package and the RePowerEU plan requires significant acceleration of the clean energy transition in the EU. To scale up manufacturing of clean technologies (wind, solar, batteries, heat pumps, electrolysers), the European Commission has proposed the Net Zero Industry Act (NZIA). ([1]) This will increase the need for investment in physical infrastructure, as well as additional skilled workers.

Up to 2030, the investment needs for retraining, reskilling and upskilling in manufacturing of strategic net-zero technologies are estimated at EUR 1.7 billion under the status quo (maintaining 2022 market shares of EU manufacturing of net-zero technologies), EUR 3.1 billion under the NZIA policy proposal (increasing the shares to the indicative technology-specific objectives set in the NZIA), and EUR 4.1 billion under the NZIA+ scenario (100% of demand satisfied by EU manufacturing) (Table 1). This corresponds to 198 000 additional jobs under the status quo, 350 000 under the NZIA policy proposal and 468 000 under the NZIA+ scenario. These numbers also depend on factors such as the specific technologies used, the pace of adoption and innovation, the scale of investment, and policy frameworks.

Table 1: Additional jobs in manufacturing and related investment needs until 2030

Scenario	Status quo		NZIA policy proposal		NZIA+ scenario	
Technology	Additional jobs (thousand)	Investment (EUR million)	Additional jobs (thousand)	Investment (EUR million)	Additional jobs (thousand)	Investment (EUR million)
Wind	31	270	31	270	40	353
Solar photovoltaics	<1	3	25	223	66	578
Heat pump	28	243	28	243	60	529
Battery cell	139	1 214	261	2 284	294	2 578
Electrolysers	0	0	5	41	7	59
Total	198	1 730	350	3 062	468	4 097

Source: (European Commission, 2023g).

Additional skilled workers will also be needed for the increased installation and deployment of these key technologies. For wind and solar photovoltaics alone, this could lead to about 100 000 additional jobs by 2030 under all three scenarios (the installation of both domestically produced and imported net-zero technologies will take place in the EU). The job creation is mainly expected in construction and services (Table 2). ([2]) The associated investment in skills could amount to EUR 885 million.

Table 2: Additional jobs in deployment of wind and solar photovoltaics, and related investment needs to 2030

	Additional jobs (thousand)				Investment (EUR million)
	Construction	Services	Transport	Total	
Wind	32	31	5	68	593
Solar photovoltaics	23	10	-	33	291
Total	54	41	5	101	885

Notes: JRC calculations, based on deployment capacity expansion in (European Commission, 2023g), current deployment levels from Clean Energy Technology Observatory reports for wind and solar photovoltaics ((Chatzipanagi et al., 2022), (Telsnig et al., 2022)), Global Energy and Climate Outlook 2021 macroeconomic baseline, and training expenses from ESDE 2020 (European Commission, 2020d).

While different assumptions generate different estimates, it is clear that energy transition will require a significant increase in the number of skilled workers in a range of sectors. Persistent labour shortages in the EU at both professional and technician levels can lead to delays in the design, implementation and the deployment of the net-zero technologies.

([1]) (European Commission, 2023h), (European Commission, 2023g).

([2]) For solar photovoltaics, the number of jobs depends on the scale of the systems installed, with a higher share of smaller scale rooftop installations increasing the numbers.

Across the EU, over one-third of respondents believe that they do not have the necessary skills to support the green transition. According to the Special Eurobarometer, 38% of respondents do not feel equipped for the coming transition. This points to the need for reskilling and upskilling, which might further contribute to labour shortages, especially as several projected future labour shortages are concentrated in higher-skilled occupations (Chart 2.4). On a positive note, the majority of respondents (54%) agree that

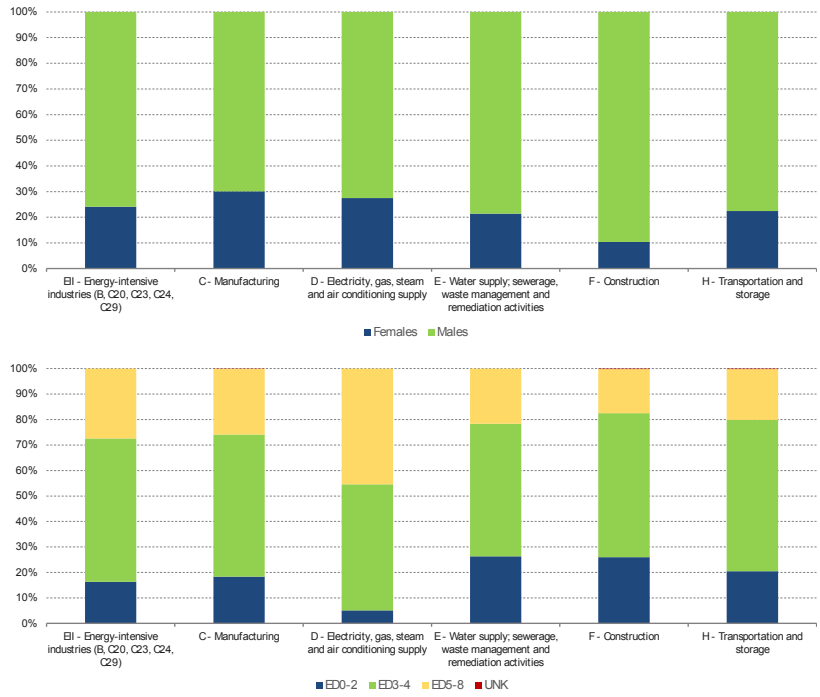
their current skills allow them to contribute to the green transition (14% 'totally agree'), with strong heterogeneity across countries. ([59])

There are significant differences in employment patterns across sectors crucial to climate neutrality. Sectors considered key to the green transition are energy-intensive industries and sectors undergoing transformation due to greening of economic activities. ([60]) Employment in those sectors showed a slow growth trend in previous years, with the exception of some energy-intensive industries, where a slight decline is noted since 2018. ([61]) With the exception of manufacturing of motor vehicles and basic metals, energy-intensive industries are projected to face moderate labour shortages in the future, with their employment share ranging from 0.3% (Ireland) to 8.1% (Czechia) in 2021 (Table A.4). The largest share of EU workers in transformation sectors can be found in manufacturing (16.1%) and construction (6.7%), which are also projected to face moderate-to-average overall shortages by 2035. ([62]) Transportation and storage, and water supply, sewerage, waste management and remediation activities which constitute 6.1% of the total EU workforce are considered key sectors in the context of the circular economy and the green transition, and have the highest projected future shortages.

Chart 2.3

Sectors in green transformation are male-dominated and employ a high proportion of highly educated workers

Employment shares by gender (first panel) and by education level (second panel) in energy-intensive industries and sectors in green transformation, 2021, EU-27



Note: ED0-2 - Less than primary, primary and lower secondary education (levels 0-2); ED3_4 - Upper secondary and post-secondary non-tertiary education (levels 3 and 4); ED5-8 - Tertiary education (levels 5-8); UNK – Unknown.

Source: DG EMPL calculations, based on Eurostat datasets lfsa_egan2 and lfsa_egan22d.

Click here to download chart.

Sectors that are key to the green transition, including energy-intensive industries, are typically male-dominated, albeit to varying extents. In the EU, mining is the sector with the smallest share of women, at just 9.1% (80 600 women, compared to 484 900 men) (Chart 2.3). In water supply and waste management – which has one of the largest positive projected employment impacts due to the green transition – women constitute 21.5% of the workforce. In transport and electricity industries, their shares amount to 22.2% and 27.7%, respectively. The gender employment gap is the smallest in manufacturing (30.2% are women) and in the energy-intensive subsectors (25.1% are women). Nevertheless, the gap remains considerably above the EU industry average, where women constitute 46.3% of the workforce. This creates a two-fold gender implication in the projected sectoral employment change. Firstly, while job losses due to the transition to a net-zero economy will leave deeper scars in sectors primarily occupied by men (mining), employment gains are expected in sectors where men are more represented (construction and waste management). Secondly, as projected job creation in sectors already important to the structure of the economy is greater than anticipated losses, employment gains will benefit men over women (assuming the current gender employment structure remains unchanged). Recent evidence aligns with this hypothesis, finding that

([59]) There is a strong positive association between the share of respondents agreeing that their current skills allow them to contribute to the green transition and country's GDP per capita (correlation coefficient of 88.5%).

([60]) Based on the greenhouse gas (GHG) emissions levels of their production or products, sectors considered energy intensive are: mining and quarrying (B05-09); manufacturing of other non-metallic minerals (C23); manufacturing of basic metals (C24); manufacturing of chemicals (C25); and manufacturing of motor vehicles, trailers and semi-trailers (C29). Sectors in transformation that are directly affected by increased greening are: electricity; water supply and waste management; manufacturing; construction; and transportation and storage. They cannot be qualified as either fully low carbon or high carbon, but are key in driving the implementation of net-zero on the ground, and/or are expected to face the largest employment impacts due to continued decarbonisation of the economy.

([61]) DG EMPL calculations, based on Eurostat dataset lfsa_egan22d.

([62]) With potentially high future shortages in some subsectors.

almost two-thirds of green-task jobs across Organisation for Economic Co-operation and Development (OECD) regions are held by men. ([63]) Gender segregation in sectors key to the green transition might therefore exacerbate labour shortages, as it may be more difficult to fill newly created positions, given the already high participation rates of men in those sectors (see section 5.). This underlines the need for policies enabling women to benefit from the opportunities arising from the green transition (see section 3.).

The absolute number of workers with tertiary education is rising in sectors relevant to the green transition. In 2021, within these sectors, the largest proportion of highly educated workers were employed in the electricity industry (45.4%), which saw the largest increase since 2015 (5.1 pp, compared to an industry average of 4.7 pp) (Chart 2.3). The proportion of workers with higher education also grew in other transformation sectors, but did not exceed EU average growth. This trend was reversed for the groups of workers with the highest educational attainment at elementary as well as secondary level, with workers with secondary education comprising the largest group in all transformation industries, notably transportation (59.4%) and construction (56.5%).

Despite the increasing demand for higher and vocational skills, industries that are key to the green transition report below-average worker participation in education and training. ([64]) Around 60% of employers in these sectors (e.g. manufacturing and construction) indicate that lack of the right skills is a barrier to climate-related business investment. ([65]) According to public authorities, obstacles to investment in climate change include the lack of environmental and climate assessment skills, together with digital skills, engineering and other technical skills, and regulatory understanding. ([66]) Although training provision tends to be better in large and medium companies, they identified skills gaps as a barrier to climate investment more often than small and medium-sized enterprises. This may indicate a positive relationship between firm size and integration of climate-related measures in investment planning. Investment in staff training in the construction and manufacturing sectors has not returned to pre-COVID-19 rates and has even begun to decline. ([67]) These developments could exacerbate labour shortages, particularly in the construction, manufacturing, and transportation and storage sectors, which are projected to experience high labour market imbalances in the future (imbalances indicator above 2, Table A.5).

Some sectors relevant for the green transition have been particularly badly hit by population ageing. Water supply and waste management has the highest proportion of older workers ([68]) in the EU (40.7% in 2021), followed by the electricity sector (36.1%). Since 2015, the share of older workers has increased by 5.5 pp in water supply and waste management, and by 5.0 pp in energy-intensive industries, compared to an all-industry average of 3.4 pp. This growth in older workers is not matched by similar growth in young workers, who typically account for less than 8% of employment in each of these industries. Among the green transition-relevant sectors, replacement needs are projected to be most pressing in construction, transportation and storage, and water supply, sewerage, waste management and remediation activities (future shortage indicator of 3, Table A.5).

([63]) According to (OECD, 2023b), 72% of green task jobs are held by men. This does not capture all ongoing employment impacts of the green transition, however, as it only focuses on jobs with green tasks and in selected sectors as defined by O*NET. Jobs outside these sectors, where the nature of tasks was unaffected but whose demand has increased due to greening of economic activity, are not covered in the analysis.

([64]) EU-LFS, participation of employees in education and training (last 4 weeks), by NACE 2-digit level, 2021.

([65]) European Investment Survey database: Tracking investment needs and constraints across Europe, available here. Data are based on survey wave 'EIBIS 2020', topic 'Climate change and energy efficiency', indicator 'Factors impacting investment in activities to tackle the impacts of weather events and emissions reduction: availability of staff with the right skills to identify and implement investments related to climate change'.

([66]) (European Investment Bank, 2023).

([67]) (Pouliakas and Wruuck, 2022).

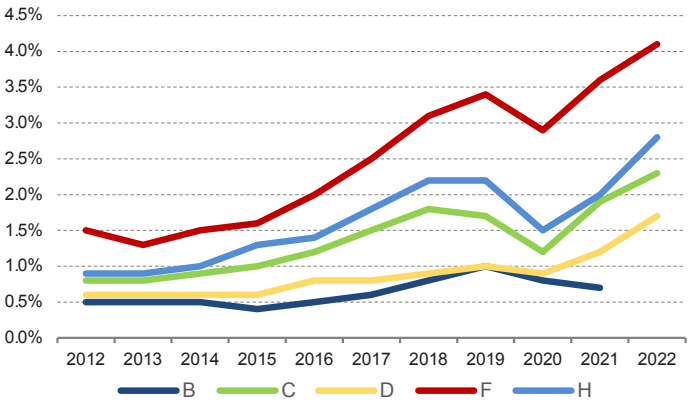
([68]) In this section, older workers are defined as the working cohort aged 50-74, based on EU-LFS data.

While data on green labour shortages are limited, available metrics hint at growing labour shortages in sectors crucial to the green transition. Between 2015 and 2021, the rate of vacant posts doubled in these sectors. ([69]) The average vacancy rate increased from 1.1% in 2015 (1.3% all-industry average) to almost 2.2% in 2021 (2.1% all-industry average), ([70]) indicating a slightly greater shortage of workers in these key sectors. Transformation sectors all showed a stable increasing trend in vacancies from 2015 to 2021, with a decline in 2020 that can be partly attributed to the economic shocks due to COVID-19. Looking at industry-specific trends of vacancy rates, broken down by five key sectors, the strongest increase is evident in construction, which grew from 1.6% in 2015 to 3.6% in 2021, reflecting increasing construction and renovation of buildings to support the 2030 climate goals (Chart 2.4). Overall, the total proportion of vacant posts has also grown in electricity, manufacturing, and transportation. By contrast, the vacancies in traditional energy-intensive industries such as mining and quarrying (0.7% in 2021) have grown only incrementally since 2015 (by 0.5%) and are well below the EU all-industry average (2.1%). With the exception of mining and quarrying, all of those industries contain subsectors with persistent labour shortages (see section 2.1.). Other data also suggest significant shortages in some energy-intensive industries in the Member States, such as manufacturing of minerals or chemicals. ([71]) In 2021-2022, occupations with green skills facing persistent labour shortages were identified in construction (bricklayers, carpenters and jointers; plumbers and pipe fitters), manufacturing (metal working machine tool setters and operators) and transportation (heavy truck and lorry drivers) (see Table A.1). ([72])

Chart 2.4

Labour shortages are growing in green transition sectors and decreasing in polluting activities

Job vacancy rate in transformation sectors (NACE 1-digit), 2012-2022, EU-27



Note: Data missing for sector E - Water supply; sewerage, waste management and remediation activities.

Source: DG EMPL calculations, based on Eurostat dataset jvs_a_rate_r2.

Click here to download chart.

3.2. Labour and skills shortages in the digital age

Advances in digital technologies are changing the type of work people do, as well as the digital intensity of that work (Box 2.5). Technological progress has led to automation of some occupations, transformation of others, and creation of some entirely new jobs. There is a broad consensus that the overall effect on the EU labour market has been an increase in demand for high-skilled work and a decline in demand for medium-skilled jobs. ([73]) The discussion on impacts of digital technologies on low-skilled jobs remains more ambiguous. ([74]) The transformation in the nature of work and skills needs has been accelerated by the recent advancements in AI. While this could have a positive impact on productivity, there are also concerns about job loss, stability, wages, and trust in employers to make the right decisions on AI. ([75]) Given the limited evidence, the impact of AI on labour shortages remains unclear.

([69]) The indicator vacancy rate measures the proportion of empty vacancies in the total number of vacancies. Although imperfect, it is one of the few metrics to give an indication of the extent of labour of shortages faced in all sectors in the EU.

([70]) Indicative figure, based on available data for 17 Member States.

([71]) (European Commission, 2022h).

([72]) Based on (ELA, 2023). Skills and knowledge requirements are based on the ESCO taxonomy on skills for the green transition (436 occupations at ISCO 4-digit level). Examples are identified based on their ESCO 'greenness' score and relevant sectors.

([73]) (Goenaga et al., 2019), (OECD, 2019a).

([74]) (European Commission, 2019d), (OECD, 2019a), (Autor, Levy and Murnane, 2003).

([75]) (OECD, 2023d).

Box 2.5: Digital intensity of work index

The digital intensity of work index ([1]) measures the proportion of digital skills among all required skills for each occupational group at ISCO 3-digit level. For example, if an occupation requires 10 skills and one of those skills is digital, the value of the index is 10%. This gives a useful approximation of the proportion of work requiring digital skills and competences, but has clear limitations in that it does not indicate the importance of digital skills in carrying out a given occupation, the level of those skills (e.g. basic or advanced), or how often they are used at work. ([2]) The digital intensity index is not the only measure used in the EU context. Other definitions developed in recent years ([3]) have identified similar occupations as highly digitally intensive, but with a number of differences in how occupations compare. Some of the findings presented here may depend on the specific measure of digital intensity of work adopted.

([1]) See detailed methodology in (Barslund, 2022).
([2]) See ESDE 2022 for more detail on the definition, its strengths and shortcomings (European Commission, 2022e).
([3]) See, for example: (Cedefop, 2022c) or (Cirillo et al., 2021).

Apart from changing job structure, digitalisation has increased the digital intensity of work across occupations and sectors, a process accelerated by the COVID-19 pandemic. ([76]) This transformation of employment structure and content may contribute to increased digital skill needs in certain sectors or occupations, potentially leading to shortages of workers with these skills. At the same, digitalisation may help to fill certain vacancies, due to increases in job flexibility (place and time of work). The following analysis aims to identify shortages in digitally intensive work, the workers who could fill those gaps, and the challenges that must be addressed for this to happen. It expands on the analysis of digital intensity of work presented in ESDE 2022 by relating it to labour shortages and developing the analysis determinants of digital intensity of work. ([77])

3.2.1. Labour and skills shortages in digitally intensive work

The relationship between digital intensity of work and persistent labour shortages is not straightforward. Rather, it reflects the ambiguous effects of digitalisation on employment. New digital technologies can automate routine tasks at the core of some (usually middle- or low-skilled) occupations. ([78]) This can reduce demand for digitally intensive work with a high proportion of routine content, ([79]) for example in certain administrative occupations. Where this happens, digitalisation may help to address existing labour shortages or prevent future gaps. However, adoption of new digital technologies can also generate new demand for jobs with diverse skill profiles. ([80]) For example, several highly skilled ICT occupations at the heart of the digital transformation have grown in recent years (Chart 2.5) and are projected to grow in the future (see section 2.2.). That growing demand, coupled with the need for advanced digital skills reflecting the newest technological developments, ([81]) opens these occupations to labour shortages. Increase in demand for less-skilled work can be seen in the context of the recent rise of work organised via digital platforms, for example.

([76]) (Cedefop, 2022f), (Cedefop, 2022b).
([77]) (European Commission, 2022e). For the original publication on digital intensity of work in the EU, see (Barslund, 2022).
([78]) (European Commission, 2019d), (OECD, 2019a), (Autor, Levy and Murnane, 2003).
([79]) See (Cirillo et al., 2021) for a national example of this effect.
([80]) (Goenaga et al., 2019), (OECD, 2019a), (Grundke et al., 2018), (Acemoglu, 2002).
([81]) (Centeno, Karpinski and Urzi Brancati, 2021).

Chart 2.5

Highest digital intensity of work observed in several ICT occupations

Digital intensity of work, by occupation (%), 2021, EU

Occupation (ISCO-08 3-digit)	Digital intensity (% of digital in all skills)	Shortage
High digital intensity		
ICT operations and user support technicians	37%	None
Database and network professionals	36%	Selected occupations
Software and applications developers and analysts	32%	All occupations
Telecommunications and broadcasting technicians	23%	None
Intermediate digital intensity		
Librarians, archivists and curators	17%	None
Mathematicians, actuaries and statisticians	16%	None
Numerical clerks	14%	None
Electrotechnology engineers	14%	Selected occupations
Information and communications technology service m	13%	None
Keyboard operators	12%	None
Authors, journalists and linguists	12%	None
Tellers, money collectors and related clerks	11%	None
Secretaries (general)	11%	None
Architects, planners, surveyors and designers	10%	None
Administrative and specialised secretaries	10%	None
Printing trades workers	10%	None

Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 3-digit level, i.e. excluding Bulgaria, Malta and Slovenia. High digital intensity covers occupations where at least 20% of all skills required are digital. Intermediate digital intensity covers occupations where 10-19% of all skills required are digital. Low digital intensity covers occupations where less than 10% of skills required are digital.

Source: EU-LFS 2021.

Click here to download chart.

Few occupations in the EU labour market require a high digital intensity of work and all are found in the ICT professional and technician occupational groups (Chart 2.5). In these occupations, digital skills account for more than one in five of all required skills. Together, ICT professionals and technicians accounted for about 3% of employment in the EU in 2021. ([82]) There are also several occupations with intermediate digital intensity, where at least 1 in 10 of all required skills are digital. These mostly comprise different types of professionals and clerical support workers (listed in Chart 2.5), accounting for a further 7% of EU employment in 2021. The remaining 90% of EU employment usually requires at least some basic digital skills, but these account for less than 10% of all skills required in a given occupation. These figures are broadly in line with another measure of digital intensity developed by Cedefop, which shows that around 16% of the EU workforce engages with advanced digital technology at work (Box 2.6).

Across the Member States, persistent labour shortages are common among ICT professionals, ([83]) notably software and applications developers and analysts. These occupations often combine high digital intensity (around one-third of all skills required are digital) with highly skilled work (more than 7 in 10 workers hold a tertiary degree). They registered considerable growth in employment over the last decade (Chart 2.6) and this growth is expected to continue, according to Cedefop forecasts (see section 2.2.). Shortages are less common in ICT occupations with technician status. These include a substantially lower proportion of tertiary-educated workers (around 40%), with employment growth also less pronounced between 2011 and 2021.

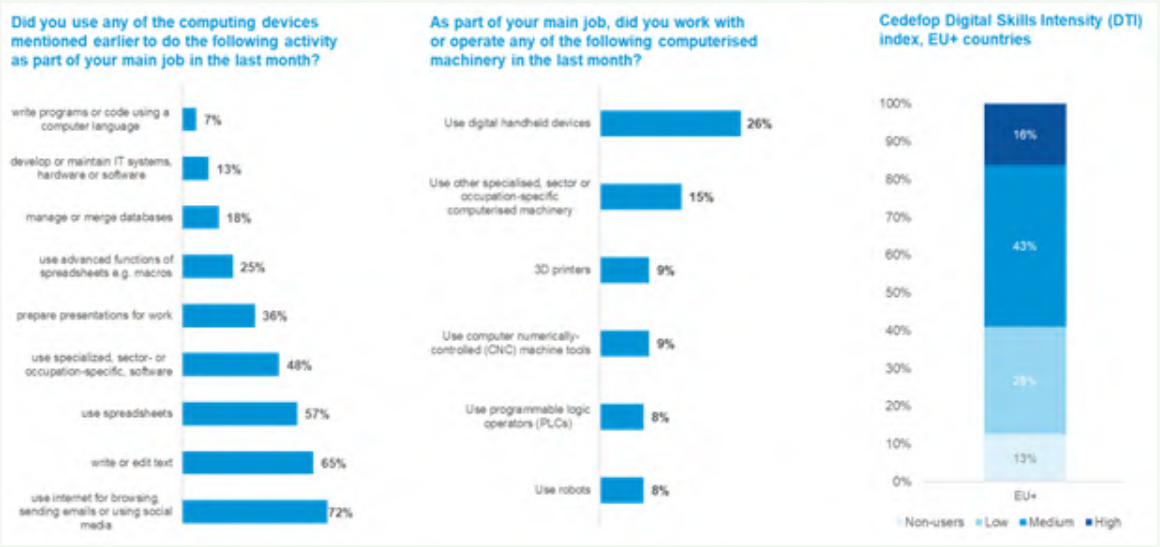
([82]) According to a broader definition of ICT specialists adopted in DESI (available here), ICT specialists accounted for 4.5% of employment in the EU in 2021.

([83]) This covers occupations under ISCO 2-digit code 25 (ICT professionals).

Box 2.6: Other measures of digitalisation - Cedefop's digital skills intensity (DSI) index

The Cedefop DSI index ([1]) uses a composite indicator approach to characterise jobs in terms of their intensity of use of digital technologies in 29 European countries. It blends quantitative and qualitative technology intensity: the number of computer applications Europeans use in their jobs and their skill complexity.

Chart 1
Digital skills intensity of EU+ jobs in 2021



Source: Cedefop ESJS 2021.

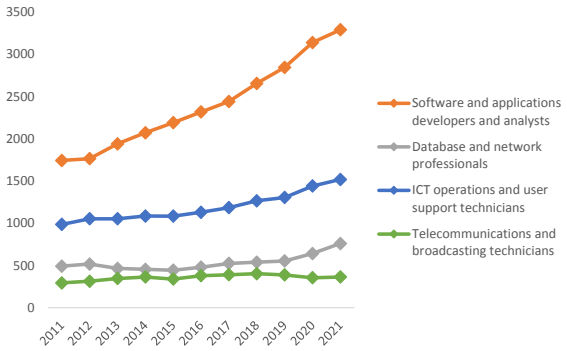
The Cedefop DSI index shows that around 16% of the EU+ workforce engages with advanced digital technology at work. This includes computer programming (e.g. use of AI algorithms) and ICT system maintenance and development. Of those, 43% are employed in posts with a medium-level DSI. Most carry out digital activities with an intermediate skill complexity (e.g. using sector-specific or occupation-specific software, using formulas and macros in spreadsheets, or merging and managing databases) that they do alongside more basic digital tasks. A further 10% of EU+ employees are in jobs with a very low DSI (e.g. exclusively browsing the web, sending emails, or using social media at work), while 18% are in jobs with a low DSI (e.g. using word processing and spreadsheets, or making presentations) and 13% do not use any computer devices to do their job.

([1]) Cedefop (2022c).

From a sectoral perspective, persistent labour shortages were widespread (reported by 17 Member States) in computer programming, consultancy and related activities (see section 2.1.). This subsector falls under the highly digitally intensive information and communication sector (Chart A.1), although data limitations prevent an assessment of digital intensity of work at subsector level. An alternative measure of digital intensity developed by Eurostat ranks around 90% of enterprises in this subsector as highly or very highly digitally intensive. ([84])

Other occupations and sectors facing persistent labour shortages across EU Member States are typically not very digitally intensive. Only the work of electro-technology engineers is of at least intermediate digital intensity. For the remainder, digital skills account for fewer than 1 in 10 required

Chart 2.6
Employment in ICT occupations grew since 2011
Number of workers employed in ICT occupations over time (thousands), EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 3-digit level for ICT occupations, i.e. excluding Bulgaria, Ireland, Malta and Slovenia.

Source: EU-LFS 2011-2021.

Click here to download chart.

([84]) See Eurostat dataset isoc_e_diin2.

skills. In fact, apart from ICT occupations, shortage occupations are, on average, somewhat less digitally intensive than non-shortage occupations. ([85]) Labour shortages in non-ICT occupations and sectors are therefore likely to be primarily driven by factors other than digitalisation (see section 2.2.).

3.2.2. Digital divides in the labour market

Addressing persistent labour shortages in digitally intensive work necessitates understanding who has the digital skills necessary to perform this kind of work. This section briefly explores the distribution of digital skills among the broader population, then analyses who performs work requiring digital skills. It concludes by analysing the key factors that affect the digital intensity of work.

There are several important digital divides in skills among the EU working-age population, including educational attainment, age, and employment status. ([86]) A recent report highlighted that in the EU in 2019, around 60% of individuals of working age (25-64) had at least basic digital skills, ([87]) ([88]) with the European Pillar of Social Rights action plan setting a target of at least 80% of the EU population aged 16-74 having basic digital skills by 2030. ([89]) The proportion of people with at least basic digital skills was much lower for low-educated individuals (24%), 55-64-year-olds (42%), and those who were either unemployed (45%) or inactive (33%). The evidence for a gender divide in digital skills is less conclusive, ([90]) but suggests that more men than women have certain advanced digital skills. ([91]) Overall, the research highlights the following priority groups for digital upskilling/reskilling actions: young people with low levels of education and NEETs; 55-64-year-olds; people with lower levels of educational attainment; those who are inactive and unemployed; those employed in low-skilled and semi-skilled occupations; those living in rural areas; and non-EU nationals. ([92])

The education divide in digital skills is mirrored in the digital intensity of work (Chart 2.7). For example, the work of highly educated men is far more digitally intensive than that of less-educated men, at around 10% and 2%, respectively. Gender differences in the use of digital skills at work are more pronounced than gender differences in digital skills among the overall population, especially among workers with tertiary education. Tertiary-educated men work in occupations where around 8% of all skill requirements are digital, whereas for tertiary-educated women this proportion is only about 5%. ([93]) Differences in the digital intensity of work of young and older workers are quite small compared to the age divide in digital skills among all people of working age.

([85]) (Cedefop, 2022f).

([86]) (Elena-Bucea et al., 2021), (Centeno, Karpinski and Urzi Brancati, 2021), (EIGE, 2020b).

([87]) Overall digital skills refer to five areas: information and data literacy skills, communication and collaboration skills, digital content creation skills, safety skills and problem-solving skills. To have at least basic overall digital skills, people must know how to do at least one activity related to each area. More information on the types of activities related to each skill available here.

([88]) (Centeno, Karpinski and Urzi Brancati, 2021).

([89]) According to the relevant Digital Economy and Society Index (DESI) indicator, including a broader age range (available here), 54% of individuals aged 16-74 in the EU possessed at least basic digital skills in 2021.

([90]) There are some gender gaps in online access and digital skills among young men and women, but older and less-educated women tend to be disadvantaged compared to their male peers (EIGE, 2020b).

([91]) Notably, above basic software skills (EIGE, 2020b).

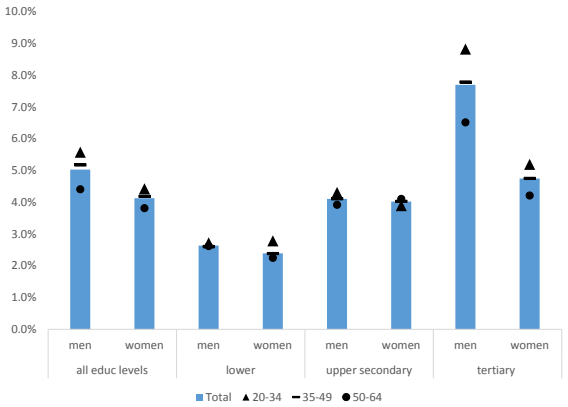
([92]) (Centeno, Karpinski and Urzi Brancati, 2021).

([93]) This gender gap is larger among young (aged 20-34) tertiary-educated workers (3.6 pp) than among those aged 50+ (2.3 pp).

Chart 2.7

Work of young, highly educated men is the most digitally intensive

Digital intensity of work, by age, gender, educational attainment (%), 2021, EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 3-digit level, i.e. excluding Bulgaria, Malta and Slovenia.

Source: EU-LFS 2021.

Click here to download chart.

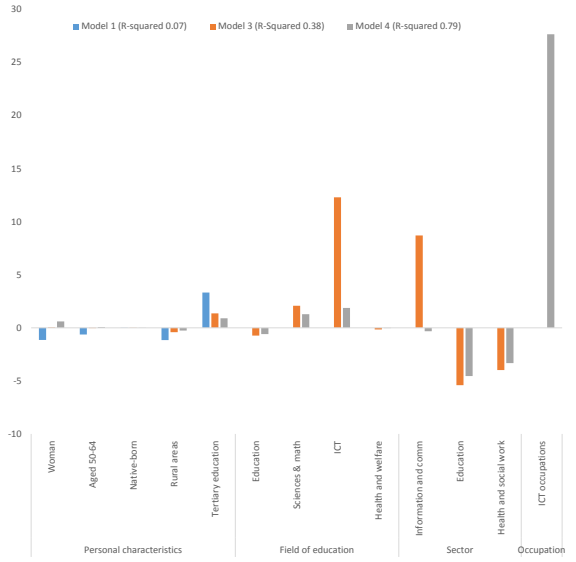
Most divides in the digital intensity of work stem from underrepresentation of certain groups of workers in specialist ICT work with high digital intensity. This can be demonstrated by a joint analysis of factors affecting the digital intensity of work through several ordinary least squares (OLS) regression models (Chart 2.8). ([94]) The results of this analysis should be interpreted with caution, as the data cover only some of the likely drivers of digital intensity of work.

Accounting solely for differences in basic worker and job characteristics explains less than half of the overall variation in digital intensity of work. Age, gender, country of birth, place of residence and level of educational attainment do not explain much of the variation. The same is true for several job characteristics, including the part-time or temporary nature of the work, supervisory responsibilities, employer size, and participation in training (Chart 2.8, Model 1). Together, these personal and job characteristics account for only about 6% of the overall variation in digital intensity of work at EU level. Differences in workers' fields of educational achievement and economic activity play a more prominent role. For example, the digital intensity of work increases by about 12.3 pp for workers with either secondary or tertiary qualifications in ICT, compared to those who have not achieved any secondary or tertiary qualification. Yet, accounting for these differences in addition to personal and job characteristics explains less than 40% of the variation in digital intensity of work (Chart 2.8, Model 2).

Chart 2.8

Broader divides in digital intensity of work often result from differences in participation in ICT work

Predicted changes in digital intensity of work, by selected worker and job characteristics, workers aged 20-64, 2021, EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 3-digit level, i.e. excluding Bulgaria, Malta and Slovenia. Specification of model 1 controls for: age, country of birth, education level, degree of urbanisation, country, part-time work, temporary contracts, supervisory responsibilities, training attendance and employer size. Specification of model 2 additionally controls for: field of education, sector of economic activity. Model 3 additionally controls for working in the following ICT occupations: Software and applications developers and analysts; database and network professionals; ICT operations and user support technicians; telecommunications and broadcasting technicians.

Source: EU-LFS 2021 data.

Click here to download chart.

Most differences in digital intensity of work (around 80%) can be traced to who does and does not work in ICT occupations. ([95]) Working in an ICT occupation increases the digital intensity of work by 27.7 pp compared to working in a non-ICT occupation, a far larger effect than for any other factor (Chart 2.8, Model 3). Taking this effect into account considerably reduces the importance of other factors, highlighting that their impact matters only insofar as they increase the chances of working in an ICT occupation. For example, tertiary-educated men have, on average, higher digital intensity of work than similarly educated women (Chart 2.7), largely as a result of higher male participation in ICT occupations. ([96]) Thus, attracting more women into ICT occupations has the potential to both alleviate certain labour shortages in this area (see section 3.2.3.) and reduce existing gender disparities in use of digital skills at work.

([94]) Starting from a model that covers basic worker and job characteristics, then adding information about types of qualifications workers hold and the sectors in which they work, and finally adding information about who does/does not work in ICT occupations.

([95]) This includes the following occupations according to ISCO-08 3-digit classification: software and applications developers and analysts; database and network professionals; ICT operations and user support technicians; telecommunications and broadcasting technicians.

([96]) How digital intensity of work is measured does not capture intra-occupation variation. This analysis therefore cannot capture situations where individuals work in an occupation that has low digital intensity on average, but their jobs are much more digitally intense than the average.

3.2.3. Persistent gender segregation in shortage ICT occupations

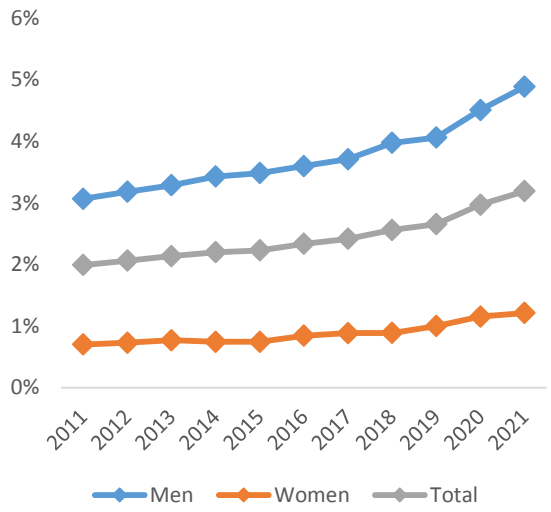
Addressing underrepresentation of certain groups of workers among ICT professionals can help to address persistent labour shortages in digitally intensive work. This follows a similar logic to the broader group of STEM occupations (see section 5.) to which ICT professionals belong. ICT work is primarily carried out by (young or middle-aged) tertiary-educated men with advanced digital skills. Their employment rates are already very high, limiting the potential to attract additional workers from this group. Increasing the labour supply of groups underrepresented in digitally intensive work is more promising, as activity rates of some of these groups (women and older workers, in particular) are still comparatively low (see section 4.). At the same time, new workers from these groups are unlikely to move into hard-to-fill vacancies in ICT unless measures are taken to address the factors underpinning their current underrepresentation and to address their upskilling and reskilling needs.

The following analysis considers key factors driving women's low participation in ICT occupations. ([97]) Gender segregation is known to contribute to labour shortages across all STEM occupations, including in ICT (see section 5.). However, the factors underlying the underrepresentation of women in ICT occupations differ somewhat from those for STEM as whole, reflecting the specific skill requirements, content, organisation and working conditions of ICT work.

Chart 2.9

Gender gap in ICT occupations has increased since 2011

Proportion of workers in ICT occupations, by gender (% of all workers), 2011-2021, EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 2-digit level, i.e. excluding Malta.

Source: EU-LFS 2011-2021.

Click here to download chart.

In 2021, there was a significant gender gap in ICT occupations (Chart 2.9). More specifically, 4.9% of all working men were employed in ICT occupations, compared to only about 1.2% of all working women, a gender gap of almost 4 pp. That gap increased considerably during the past decade (up from 2.4 pp in 2011) and may have accelerated since the start of the COVID-19 pandemic. Overall, women accounted for only about 17% of all EU employment in ICT occupations in 2021. ([98])

Key factors in the underrepresentation of women in ICT broadly correspond to those for STEM occupations, but reflect the particular nature of ICT work. Children are exposed to stereotypical images of ICT work and ICT workers from an early age, which contributes to gender divides in confidence in digital skills and aspirations to work in ICT. In the EU, by 15 years of age, around 1 in 10 boys expect to work in ICT, compared to only 1 in 100 girls. ([99]) Predictably, heavy overrepresentation of men in ICT studies follows, with men accounting for about 8 in 10 students in this field at EU level in 2020. ([100]) Even where women hold relevant qualifications, they have a lower likelihood of progressing into and keeping ICT jobs. This may be linked to certain aspects of employment in ICT, such as: reliance on full-time work patterns that are difficult to reconcile with unpaid care responsibilities; biases in recruitment practices, remuneration (gender pay gap), and promotion ladders; or masculine working cultures that may be particularly difficult for women to work within. ([101]) There are also some indications that women's employment in ICT may be concentrated in certain occupations and workplaces, with limited opportunities available elsewhere. ([102])

Around half of the gender gap in ICT occupations results from differences in worker characteristics, most notably the overrepresentation of men among workers with ICT-related qualifications and in ICT-intensive sectors (Chart 2.10). Several other gender differences explain smaller – albeit significant – parts of this gender gap, but these largely cancel one another out.

([97]) Analysis follows the same methodology used in (European Commission, 2023i).

([98]) When following the broader definition of ICT occupations outlined in DESI, this proportion was 19% in 2021. The definition of the ICT specialists' occupations in DESI is based on the ISCO-08 classification. It includes ICT service managers (code 133), ICT professionals (25), ICT technicians (35) and some other groups, from electronic and telecommunications engineers (215*) up to ICT installers and servicers (7422). More information available here.

([99]) (OECD, 2019b).

([100]) Eurostat dataset educ_uoe_grad02.

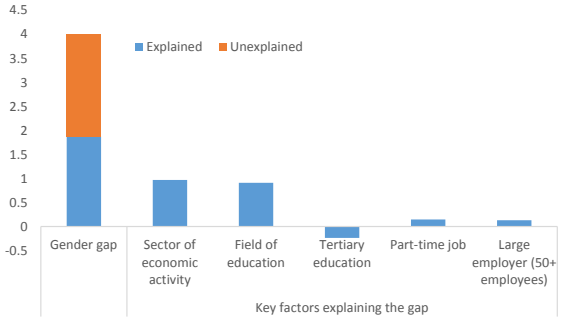
([101]) (Verges Bosch et al., 2021), (EIGE, 2020a), (Graham et al., 2016), (Valenduc, 2011).

([102]) Ibid.

Chart 2.10

Only one-quarter of the gender gap in ICT work is explained by men holding most ICT qualifications

Gender gaps in ICT occupations, by contributing factors (pp), workers aged 20-64, 2021, EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 2-digit level, i.e. excluding Malta.

Source: EU-LFS 2021.

Click here to download chart.

It is striking that around half of the gender gap in ICT remains unexplained by differences in worker characteristics. This is a much higher proportion than for STEM occupations more broadly (see section 5.). It may partly reflect the fact that certain worker characteristics significantly increase the probability of working in an ICT occupation for men, but less so for women. It may also reflect a lack of data on several important factors for participating in ICT jobs. For example, EU-LFS data do not capture information on gender discrimination and stereotypes at the workplace (including the gender pay gap), various aspects of organisational working culture, or the amount of unpaid care that workers undertake in addition to their paid work. Studies on women's participation in ICT have highlighted all of these important factors ([103]) and their omission may lead to biases and imprecise analysis.

Even when women hold relevant ICT qualifications, their chances of working in ICT occupations increase less than for men (Chart A.2). For male workers, holding at least a secondary qualification in an ICT field raises their chances of working in ICT occupations by more than 33 pp, almost twice as much as it does for women (less than 19 pp). Holding a qualification in science, mathematics and statistics increases men's chances of working in ICT occupations by about 5 pp on average, as does any generic qualification at secondary level or above. While these qualification types also improve the corresponding chances of women, their increases are less than half those of men. These findings support previous evidence suggesting that even where women achieve ICT-related qualifications, it is often harder for them to find and sustain employment in ICT jobs. ([104])

4. IMPACT OF POPULATION AGEING AND LABOUR FORCE PARTICIPATION ON LABOUR SHORTAGES

Several factors can limit labour supply over long periods of time. Demographic trends such as population ageing can reduce the size of the labour force, due to both an overall decline in the share of the working-age population and lower labour market participation rates among older people of working age. Structural issues limiting labour market participation of women can lead to substantial reductions in overall labour market participation rates. Low capacity to attract and integrate foreign workers into the labour market can also limit workforce size. These factors need to be considered jointly in order to understand their overall implications for the workforce and for labour shortages.

4.1. Population ageing

Given the projected demographic trends, maintaining and increasing labour supply will remain a major policy challenge. According to Eurostat's EUROPOP2023 baseline population projection (Chart 2.11), the number of people in working age (blue line) is expected to decrease in the coming decades. While the working-age population (20-64-year-olds) reached a record of 272 million people in 2009, it declined to 265 million by 2022 and is expected to fall further, to 258 million by 2030, 247 million by 2040, and 236 million by 2050. Assuming that the activity rates of people in various education groups (primary, secondary and tertiary educated) within each population subgroup (young, prime-age individuals, older people, female, male, mothers) remain constant, ([105]) the number of active people is expected to follow a very similar pattern. After rising from 191 million in 2002 to a record 205 million in 2022, the number of active people is estimated to decline to 201 million in 2030, 192 million in 2040, and 184 million in 2050.

These projected activity rates will bring additional workers into the labour market. In a scenario where the activity of women in the EU converged to the target value in the three top-performing Member States for this group (Chart 2.11; see the difference between the target activity and the projected number of active women in labour market in Table 2.6 in section 4.2.), an additional 17.3 million women would

([103]) (EIGE, 2020b).

([104]) (EIGE, 2020a), (Graham et al., 2016), (Valenduc, 2011).

([105]) This assumption does not take into account potential measures to increase the active population in the EU and should be interpreted with caution.

enter the EU labour market. Under the same assumption for men, an additional 8.8 million men would join the EU workforce.

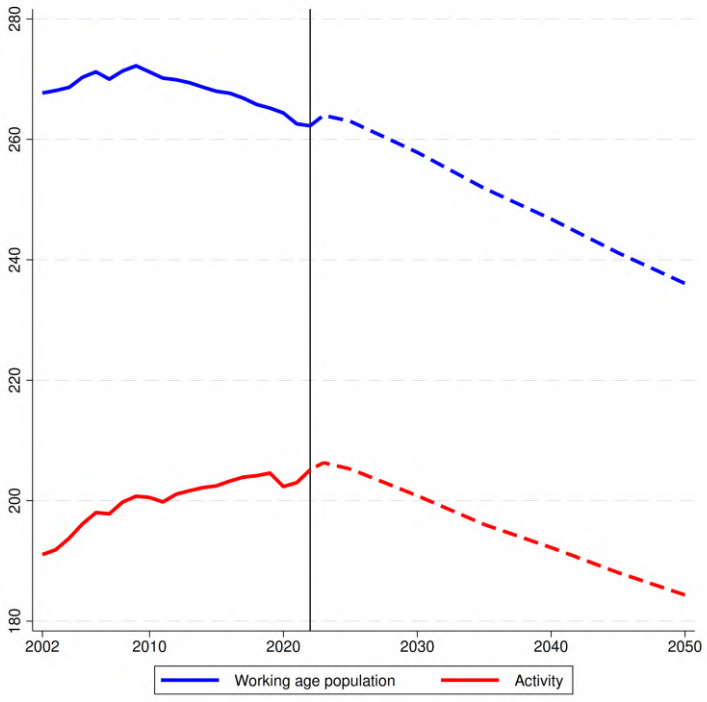
The challenges associated with a decreasing and ageing population vary significantly by country. The implications of these projected demographic changes are assessed using the European Commission's Labour Market Model (LMM). The impact of the projected demographic changes to 2030 and 2050 on the main national economic and labour market indicators were simulated for 11 Member States (Germany, Italy, Austria, Poland, Belgium, Czechia, Spain, Finland, France, the Netherlands and Slovakia), using Eurostat's baseline projections by age. Those figures were then compared with 2022 figures. The share of low-educated, middle-educated and highly educated people was assumed to remain unchanged for each age group. ([106]) In other words, the simulations do not take into account possible changes in education during the forecast period. ([107])

The population is projected to continue increasing in the next decade in the majority of the 11 Member States simulated (Table 2.5). It is expected to decrease slightly in Italy and Poland by 2030. By 2050, 4 of the 11 countries will face decreasing populations compared to 2022, with Poland experiencing the largest drop (-8%). Population ageing is a major challenge for all 11 Member States: the share of the older population (aged 70+) is expected to increase gradually in all countries in the short term (by 2030), then more sharply in the longer term (by 2050).

Chart 2.11

Working age population and activity are expected to decrease in the coming decades

Working age population and activity, EU, 2022-2050



Note: Share of working-age population defined as the ratio of the 20-64-year-olds to the total population in the EU. All other statistics also refer to the 20-64-year-old population.

Source: DG EMPL calculations, based on Eurostat and OECD data, and EUROPOP2023 population projections.

Click here to download chart.

Population decline and ageing will cause GDP to decline in the Member States to varying degrees (Table 2.5). By 2030, Belgium and Finland are projected to be the only countries benefiting from demographic changes, with GDP increases of 0.3% and 0.7%, respectively. In the other countries, demographic trends are expected to exert a negative effect on GDP, ranging from 0.2% (the Netherlands) to 9.1% (Poland). By 2050, however, the vast majority of these countries will be negatively affected by demographic changes. The projected GDP loss associated with demographic trends varies between 3.3% (Finland) and 24% (Poland). Over this period, demographic changes are expected to exert a positive impact on GDP only in Belgium (+2.6%) and the Netherlands (+0.7%). In six countries, GDP loss will be more significant than the decline in the population, due to the increase in the old-age dependency ratio. As a result, the GDP per capita (15-69-year-olds) will deteriorate in these countries: by 2050, it is expected to decline by between 1.4% (Italy) and 7.6% (Poland). On the other hand, the demographic trends in Belgium, Finland, France, and the Netherlands are expected to positively impact their GDP per capita by 2050, with Finland experiencing the largest increase (1.4%).

([106]) Population forecasts not available by education level in EUROPOP2023.

([107]) This does not take into account policies such as reskilling and upskilling, or reinforced integration efforts; however, the baseline EUROPOP2023 projection considers projected immigration flows.

Table 2.5

Population decline and ageing are expected to have profound effects on the economy

Impact of demographic trends in selected Member States: 2022-2030 and 2022-2050

	DE	IT	AT	PL	BE	CZ	ES	FI	FR	NL	SK
Population change 2022-2030 (thousands)	2 047	-256	236	-234	391	335	1 834	83	1 514	751	15
(% in parentheses)	(2.46)	(-0.43)	(2.63)	(-0.62)	(3.37)	(3.18)	(3.87)	(1.5)	(2.23)	(4.27)	(0.28)
- 15-69	-49	-298	29	-1 141	205	148	1 327	27	288	225	-139
	(-0.08)	(-0.73)	(0.45)	(-4.21)	(2.54)	(2.03)	(3.92)	(0.71)	(0.63)	(1.82)	(-3.53)
- 15-24	138	96	17	373	110	219	493	38	257	-109	43
	(1.65)	(1.66)	(1.84)	(10.09)	(8.28)	(22.38)	(10.02)	(6.17)	(3.16)	(-5.03)	(8)
- 25-54	-169	-1 878	-130	-846	42	-198	-767	62	-327	195	-169
	(-0.53)	(-8.2)	(-3.53)	(-5.23)	(0.92)	(-4.5)	(-3.88)	(2.99)	(-1.31)	(2.89)	(-7.09)
- 55-69	-18	1 484	142	-668	53	127	1 601	-73	357	138	-14
	(-0.1)	(12.05)	(7.93)	(-9.17)	(2.4)	(6.58)	(17.51)	(-6.82)	(2.85)	(4.01)	(-1.3)
- 70+	1 268	1 074	186	1 362	279	215	1 322	144	1 861	495	184
	(9.41)	(10.21)	(14.69)	(28.91)	(17.19)	(14.22)	(18.96)	(15.54)	(18.03)	(19.72)	(30.4)
GDP (%)	-1.03	-7.62	-2.64	-9.05	0.28	-3.01	-4.93	0.69	-1.80	-0.15	-6.68
Capital stock (%)	-0.99	-7.65	-2.60	-9.07	0.24	-3.10	-5.10	0.66	-1.83	-0.14	-6.69
Employment (%)	-0.65	-2.89	-1.73	-4.72	1.78	0.00	1.93	1.70	-0.20	2.34	-5.45
Employment (thousands)	-268	-645	-74	-780	86	0	380	43	-54	215	-139
Participation rate - 15-69 yrs. (pp. change)	-0.46	-1.07	-1.17	-0.97	-0.46	-1.72	-1.29	0.18	-0.40	0.51	-1.48
Active population - 15-69 yrs. (thousands)	-301	-614	-55	-973	93	-20	455	26	6	239	-153
Wages (%)	-0.38	-4.77	-0.97	-4.43	-1.37	-2.89	-6.34	-1.07	-1.47	-2.21	-1.28
Population change 2022-2050 (thousands)	1 577	-1 512	548	-3 031	942	231	3 027	-89	2 770	1 153	-255
(% in parentheses)	(1.89)	(-2.56)	(6.11)	(-8.05)	(8.1)	(2.19)	(6.38)	(-1.61)	(4.08)	(6.56)	(-4.69)
- 15-69	-2 873	-5 776	-184	-4 449	160	-424	-2 542	-177	-1 364	-74	-610
	(-4.94)	(-14.08)	(-2.87)	(-16.4)	(1.98)	(-5.79)	(-7.51)	(-4.68)	(-2.99)	(-0.6)	(-15.43)
- 15-24	399	-1 160	-4	-555	-26	77	-688	-92	-588	-130	-33
	(4.77)	(-20.03)	(-0.48)	(-15.04)	(-1.97)	(7.88)	(-14)	(-15.16)	(-7.23)	(-6.03)	(-6.21)
- 25-54	-1 486	-2 849	-244	-4 398	125	-637	-1 943	-97	-574	148	-651
	(-4.64)	(-12.44)	(-6.62)	(-27.22)	(2.75)	(-14.47)	(-9.83)	(-4.63)	(-2.3)	(2.19)	(-27.35)
- 55-69	-1 785	-1 767	64	504	61	136	89	12	-202	-92	74
	(-10.02)	(-14.35)	(3.59)	(6.92)	(2.79)	(7.03)	(0.98)	(1.15)	(-1.61)	(-2.68)	(7.07)
- 70+	4 485	5 291	767	2 630	842	738	6 188	227	4 883	1 259	484
	(33.3)	(50.28)	(60.58)	(55.84)	(51.86)	(48.92)	(88.75)	(24.49)	(47.31)	(50.2)	(79.81)
GDP (%)	-6.60	-15.45	-6.07	-24.00	2.55	-10.78	-11.30	-3.30	-2.39	0.68	-21.89
Capital stock (%)	-6.65	-15.35	-6.06	-23.93	2.59	-10.87	-11.26	-3.19	-2.34	0.74	-21.91
Employment (%)	-4.91	-12.59	-4.77	-21.69	2.37	-8.12	-7.09	-4.04	-2.55	0.27	-20.72
Employment (thousands)	-2 013	-2 811	-204	-3 584	115	-419	-1 397	-102	-703	25	-528
Participation rate - 15-69 yrs. (pp. change)	-0.58	0.77	-1.07	-2.77	0.29	-2.14	0.05	0.81	0.31	0.55	-3.40
Active population - 15-69 yrs. (thousands)	-2 422	-3 205	-198	-3 433	126	-456	-1 725	-99	-757	10	-536
Wages (%)	-1.71	-3.25	-1.41	-2.71	0.13	-2.59	-4.32	0.46	0.07	0.21	-1.40
Population change 2022-2100 (thousands)	880	-8 836	598	-8 138	938	129	-2 311	-763	171	720	-882
(% in parentheses)	(1.06)	(-14.97)	(6.66)	(-21.61)	(8.08)	(1.23)	(-4.87)	(-13.76)	(0.25)	(4.09)	(-16.24)
- 15-69	-6 926	-11 151	-605	-9 468	-452	-792	-6 977	-931	-5 022	-1 249	-1 228
	(-11.91)	(-27.19)	(-9.42)	(-34.9)	(-5.61)	(-10.82)	(-20.62)	(-24.68)	(-11)	(-10.1)	(-31.04)
- 15-24	-138	-1 461	-34	-873	-103	91	-869	-181	-1 385	-407	-68
	(-1.66)	(-25.24)	(-3.6)	(-23.65)	(-7.77)	(9.29)	(-17.68)	(-29.7)	(-17.03)	(-18.88)	(-12.63)
- 25-54	-3 594	-6 691	-481	-6 450	-375	-792	-5 165	-548	-3 066	-696	-879
	(-11.23)	(-29.21)	(-13.01)	(-39.93)	(-8.27)	(-17.99)	(-26.12)	(-26.26)	(-12.26)	(-10.28)	(-36.93)
- 55-69	-3 193	-2 999	-90	-2 145	27	-91	-943	-202	-570	-146	-281
	(-17.93)	(-24.35)	(-5.05)	(-29.44)	(1.21)	(-4.71)	(-10.31)	(-18.77)	(-4.55)	(-4.24)	(-27.05)
- 70+	7 992	4 036	1 241	3 256	1 625	1 120	5 925	438	7 463	2 212	557
	(59.34)	(38.35)	(98)	(69.14)	(100.03)	(74.22)	(84.99)	(47.38)	(72.32)	(88.18)	(91.86)
GDP (%)	-13.64	-30.47	-13.27	-40.29	-7.30	-15.53	-26.62	-25.22	-11.58	-10.07	-34.54
Capital stock (%)	-13.67	-30.36	-13.26	-40.29	-7.24	-15.63	-26.59	-25.12	-11.48	-9.90	-34.58
Employment (%)	-11.90	-26.94	-11.27	-37.10	-6.91	-12.69	-21.43	-24.90	-11.30	-10.25	-33.35
Employment (thousands)	-4 879	-6 013	-482	-6 130	-334	-656	-4 226	-629	-3 120	-942	-850
Participation rate - 15-69 yrs. (pp. change)	-0.73	-0.10	-1.30	-2.24	-0.57	-2.18	-0.99	0.23	-0.01	0.24	-2.74
Active population - 15-69 yrs. (thousands)	-5 442	-6 743	-505	-6 365	-333	-717	-5 038	-669	-3 300	-941	-924
Wages (%)	-1.94	-4.77	-2.33	-4.86	-0.45	-3.01	-6.23	-0.59	-0.40	0.10	-1.73

Note: Simulations do not take into account possible changes in education during the forecast period, and the distribution of the highest level of education is assumed to remain constant for each age group.

Source: DG EMPL simulations using the LMM, based on EUROPOP2023.

Click here to download table.

Both production factors – capital and labour – are affected by the expected demographic trends. The impact on the aggregate participation and employment rates results from two opposing effects: firstly, the increase in the old-age dependency ratio negatively impacts the average activity and employment rates; and secondly, the decreasing proportion of young people of school age partly counterbalances the negative effect of the increasing share of older people. As a result, by 2050, both the active population (15-69-year-olds working or actively seeking employment) and the number of employed people are expected to shrink in all countries except Belgium and the Netherlands. Poland is expected to see the largest employment drop, both in absolute numbers (-3.6 million people) and as a percentage (-21.7%). Overall, in these 11 countries, the active population is expected to decrease by about 12.7 million, and the number of employed people by 11.6 million.

The decreasing working-age population, together with constant consumption patterns by an increasing older population, are likely to drive up labour shortages as long as the population age structure continues to shift towards older ages. This is the case because retired people continue to consume, maintaining the demand at a relatively high level, while supply decreases due to the shrinking of the working-age population. The impact of population ageing on labour shortages is even stronger when fiscal policy is expansionary. ([108])

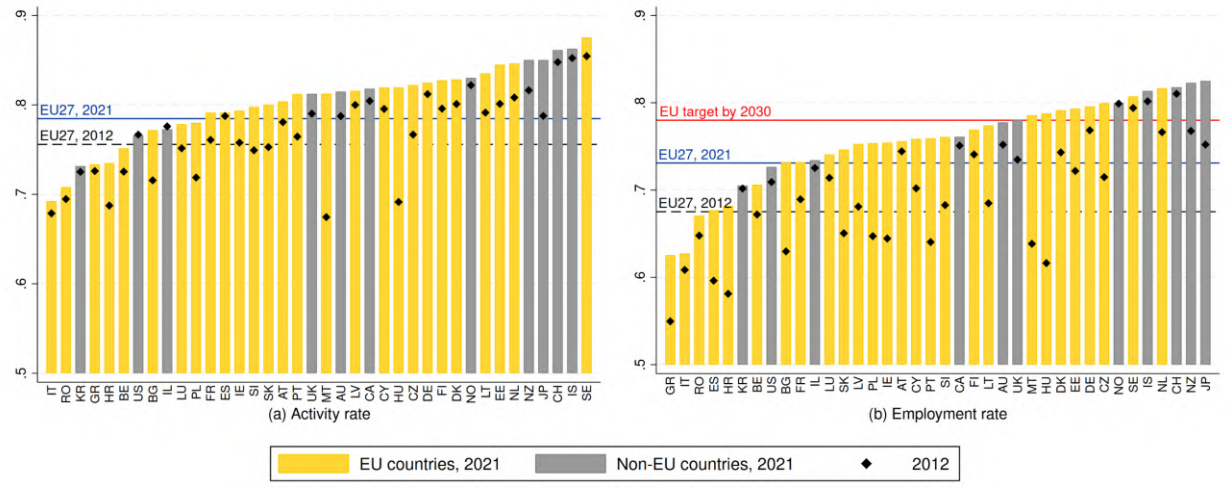
4.2. Untapped labour potential to fill existing shortages

Insufficient labour market participation is one of the factors underlying labour shortages. The activity rate in the EU in 2021 was 78.5%, higher than in 2012. It showed considerable cross-country heterogeneity, being lowest in Italy (69.2%) and highest in Sweden (87.5%) (Chart 2.12). In 2021, on average, labour market participation in the EU was slightly lower than in other developed OECD member countries. ([109]).

Chart 2.12

Activity rates and employment rates in selected countries

Activity rates and employment rates, people aged 20-64, 2021, EU-27 and selected OECD member countries



Note: European Pillar of Social Rights action plan sets a target of at least 78% employment rate at EU level by 2030; KR=South Korea; IL=Israel; AU=Australia; CA=Canada; NO=Norway; NZ=New Zealand; JP=Japan; CH=Switzerland; IS=Iceland.

Source: OECD (YYYY).

Click here to download chart.

In 2021, the EU employment rate was 73.1%. This was some 5 pp lower than the 2030 employment target of 78% at EU level set out in the European Pillar of Social Rights action plan. While eight EU Member States had already reached this level in 2021, Greece and Italy continue to have a substantially lower employment rate, at 62.6% and 62.7%, respectively. Assuming a constant population, reaching the targeted employment rate of 78% by 2030 requires an additional 12.7 million people to work in the EU in the coming years.

The EU employment rate has increased gradually over the past decade. In the past nine years, it grew by more than 5.5 pp. Hungary experienced the largest increase (17%), due in part to a large-scale public work programme introduced in 2011, radical changes in its tax-benefit system over the past

([108]) An expansionary fiscal policy boosts demand by inciting people to consume more. As retired people do not contribute to the production of goods and services, but create additional demand for those goods and services, the demand increases even more compared to the supply when the population is ageing. For example, the analysis in European Commission (2022a) suggests that labour shortages increased more in periods when fiscal policy was expansionary.

([109]) Of the 11 non-EU countries considered, only three lagged behind the EU average: South Korea, US, and Israel.

decade, ([110]) and the 2021 reclassification of mothers on parental leave as being in employment (mechanically raising the employment rate). The employment rate increased by more than 10 pp in six other countries: Croatia, Bulgaria, Poland, Ireland, Portugal and Malta. With the exception of Croatia, they all reached or surpassed the EU average by 2021, and Malta even reached the employment target.

The employment target cannot be reached at EU level without increasing labour market participation. If the participation rate were to remain unchanged, at 78.5%, the employment rate target would be consistent with an unemployment rate of 0.6%, implying practically non-existent involuntary unemployment and a frictionless labour market. ([111])

Cross-country differences in participation and employment rates are at least partly explained by differences in tax-benefit systems. For example, a recent study ([112]) shows that more than two-thirds of the (3.6 pp) difference in participation of the prime-age population (25-54-year-olds) in Czechia and Hungary in 2008 could be explained by differences in their tax-benefit systems. The largest difference explained by the differences in the tax-benefit systems is identified for low-educated individuals and for married women. These differences related to higher personal income taxes for low earners and more generous maternity allowances in Hungary than in Czechia. Other possible drivers explaining the cross-country differences in participation rates include differences in schooling, pension schemes, or access to social services such as childcare. Chapter 3 looks at a selection of possible policy measures to incentivise people to work.

Chart 2.13

Marginal effects of selected individual characteristics on participation probability

Effects of individual characteristics on participation probability among people aged 20-64, 2004-2020, EU-27

Note: Marginal effects calculated on sample mean based on an estimated logit model. Model also includes country and year dummies. Reference categories are: primary education, male, prime-age individuals, and single. Confidence intervals not presented, but extremely narrow.

Source: DG EMPL calculations, based on EU-LFS 2004-2020.

Click here to download chart.

Individual characteristics are significant predictors of people's participation probability. The effects of individual characteristics on the probability of being active (i.e. the marginal effects of individual characteristics) are estimated using EU-LFS microdata. ([113]) Students in regular education are less likely to work (-35 pp) (Chart 2.13). The highest level of education attained has a strong impact on the probability of being employed or actively seeking work: on average, secondary education increases participation probability by about 11 pp compared to lower levels of education, and a person who has completed tertiary education has a 23 pp higher probability of working or actively seeking employment. ([114]) Women are less likely to be active on the labour market (-12 pp), especially mothers of infants under three years (marginal effect of -10 pp). People aged 55+ participate in the labour market significantly less than younger generations (-28 pp compared to prime-age individuals), partly due to early retirement schemes. Marital status (being single, separated or married) has only a limited influence on people's participation decisions.

Individual characteristics as determinants of labour market participation show similar patterns across countries. A separate regression for each Member State shows that the impacts of these factors are very similar (Chart A.3). The largest variation is observed for the participation of students. In Luxembourg, Croatia, Romania, Hungary and Greece, the

([110]) See (Benczur, 2011) and (Mihály Szoboszlai, 2018) on the effects of past tax and benefits reforms in Hungary.

([111]) Unemployment rate: 1 – (employment rate / activity rate) = 1 – (0.78 / 0.785) = 0.006, i.e. about 0.6%.

([112]) (Galuscak, 2019).

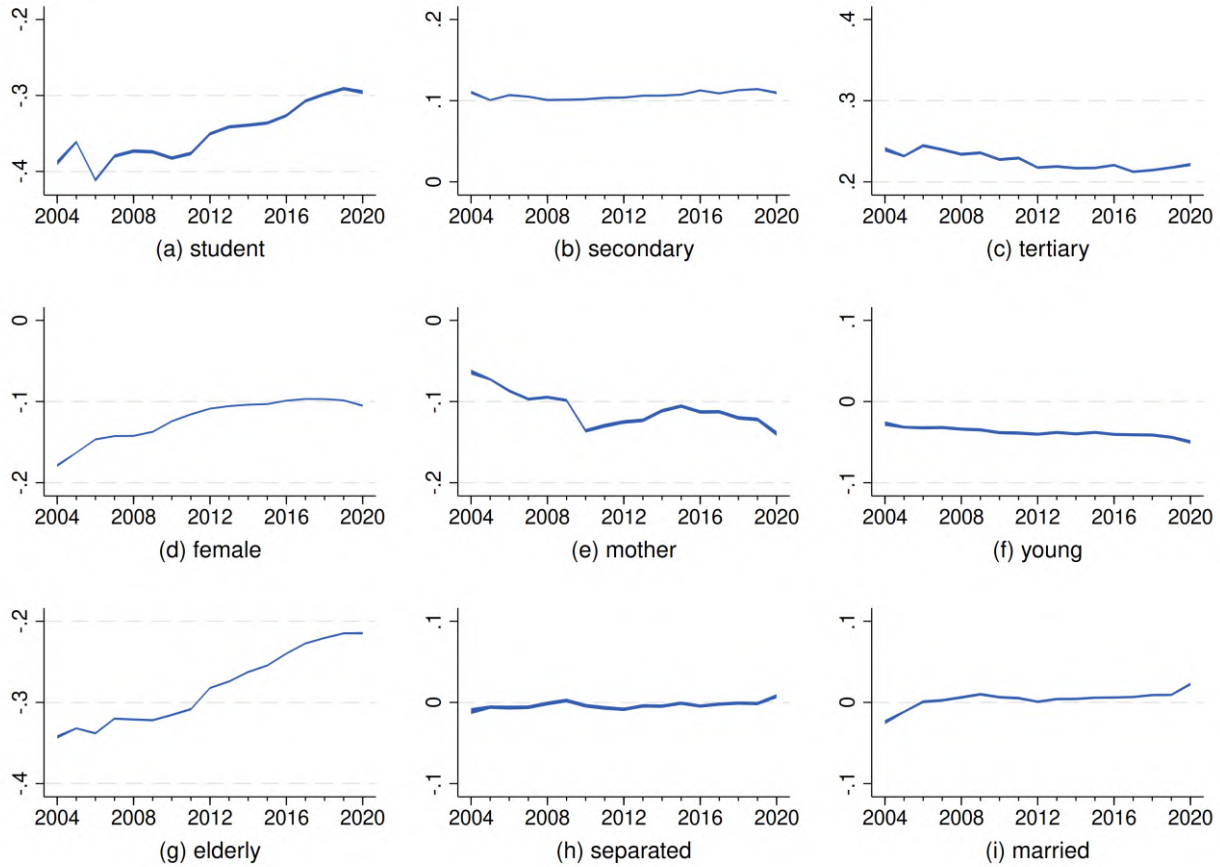
([113]) Logit models are estimated on the panel of EU countries, with individual characteristics presented in Chart 2.13 as explanatory variables. The model also includes country and year dummies.

([114]) There are major differences, such as between graduates from general upper secondary education versus vocational education. A summary indicator of 'secondary education' simply shows the average impact of secondary education in relation to primary education.

Chart 2.14

Marginal effects of individual characteristics on participation probability in the EU, by year

Effects of individual characteristics on participation probability among people aged 20-64, 2004-2020, EU-27



Note: Marginal effects (and 95% confidence intervals) calculated on sample mean based on estimated logit models for each year. Model also includes year dummies.

Source: DG EMPL calculations, based on EU-LFS 2004-2020.

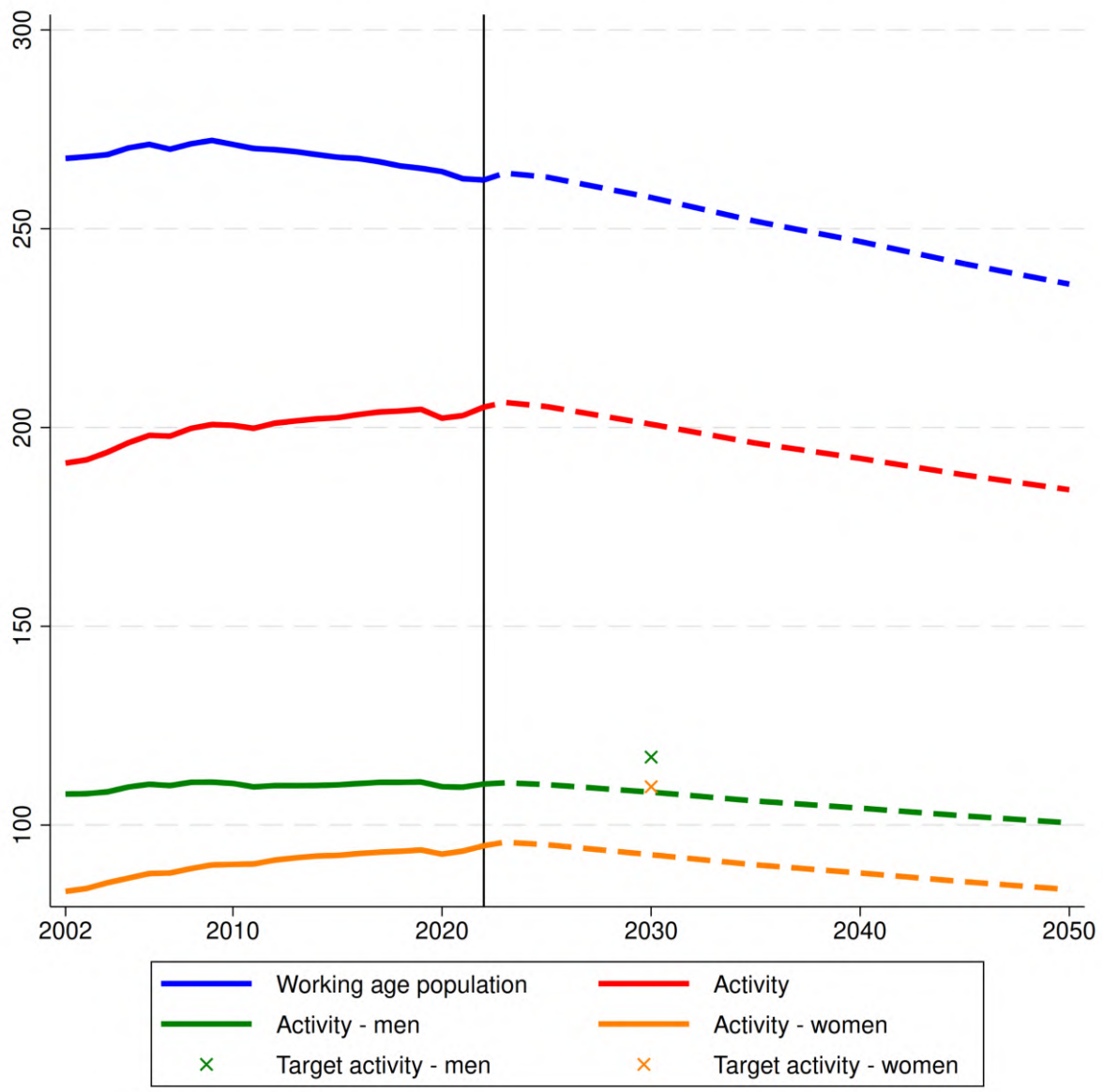
Click here to download chart.

marginal negative impact of regular education (formal education, including schools, colleges and universities) exceeds -60 pp, while in the Netherlands it is about -10 pp. The participation of older people also shows important cross-country variation, albeit to a lesser extent. Interestingly, Czechia, Hungary and Slovakia stand out for their activity rates of mothers with infants. This may be explained by their comparatively generous maternity benefit systems (together with parental leave, these can cover the first three years of a child's life) and the lack of sufficient early childcare provision (0-3 years of age). ([115]) In these countries, the marginal impact is between -34 pp and -44 pp, about twice as large as the next country in the ranking (Bulgaria).

Most of the estimated effects of individual characteristics on labour market participation probability have remained quite stable over time (Chart 2.14). However, the past 20 years have seen students and older people participate more in the labour market. To a lesser extent, the gap between men and women also narrowed, until 2012, when the marginal effect for women stabilised at around -10 pp. Nevertheless, the labour market activity of mothers with infants has deteriorated over the past two decades (in 2020, the estimated marginal effect was close to -14 pp). The impact of other individual characteristics has remained fairly stable, including for those with tertiary education.

([115]) In 2021, parental leave was redefined and counted as 'in employment' for these countries in the EU-LFS, considerably increasing mothers' employment rates.

Chart 2.15
Working age population and activity in the EU, by gender, 2022-2050



Note: Working-age population defined as the population from 20-64-year-olds in the EU. All other statistics also refer to the 20-64-year-old population.
Source: DG EMPL calculations, based on Eurostat and OECD data, and EUROPOP2023 population projections.
Click here to download chart.

It is therefore important to understand which underrepresented population groups have the highest potential to contribute to increasing overall participation in the labour market. The following analysis assumes that the potential to contribute to the aggregate participation rate of a selected population group is determined by the weight of the particular subgroup in the total active population and the difference between the activity rate of this subgroup and the average activity rate of the same subgroup of the three best-performing countries (target activity). ([116])

([116]) In reality, increasing the participation rate of a subpopulation would likely influence the activity rate of other population groups as well, and cumulating the untapped potential of subgroups would be misleading. See Box 2.7 for the methodology.

Box 2.7: Estimating the potential contribution of selected population subgroups to the aggregate activity rate

The potential contribution of selected population subgroups to the EU activity rate is estimated in two steps. First, we forecast the future aggregate activity rate in 2030 by assuming that subgroup-specific activity rates remain constant between 2021 and 2030. Therefore, the change in overall activity rate is solely driven by the demographic changes, forecasted by EUROSTAT population projections in the EU (EUROPOP2023). Second, we assume that the overall activity rate is influenced by the increase of the activity rate of a specific subgroup, keeping constant the activity rate of the rest of the population. More specifically, we consider a scenario in which the labour market subgroup activity rate reaches the same level as the average of the three highest activity rates for this specific subgroup currently observed among EU27 countries, according to the Labour Force Survey data for 2021.

Results are presented in Table 2.6. The first two columns of the table present the current subgroup-specific activity rates and the target activity rates, the latter defined as the average activity rate of the three best performing EU countries for the specific subgroup. The third and the fifth columns show the estimated aggregate activity rate and the estimated number of active people in the EU by 2030, assuming that the population will change according to Eurostat's EUROPOP2023 baseline forecast and group-specific activity rates remain constant. The fourth and sixth columns show how the aggregate activity would change in the EU by 2030 if the activity rate of the specific labour market subgroup reached the target.

By 2030, female, older workers and secondary educated people represent the largest untapped potential workforce in the EU. Table 2.6 shows an indicator of the potential to influence the aggregate activity rate and the number of active people for nine selected labour market subgroups: young, prime-age individuals, older people, female, male, mothers, as well as primary, secondary and tertiary-educated people. ([117]) Women have the potential to increase the activity rate by 7.1 pp, adding around 17.3 million more active people by 2030 (Chart 2.15, difference between orange dotted line and target activity rate), primarily because they represent more than half of the population. Men's potential for contribution is considerably more limited (8.8 million). Secondary-educated people contribute 5.4 pp to the aggregate activity rate, representing about 13 million people. Similarly, this potential is mainly driven by the relatively high share of secondary-educated people (51.1%) in the total active population. Older people could also have a high impact on the activity rate in the EU, with a contribution of 4.7 pp, or about 11 million additional active people, due to the relatively large lag in the activity rate of older people in the EU compared to the best-performing countries.

([117]) The analysis does not include third-country nationals as a separate population group because the EUROPOP2023 projections do not include future gross migration (data are available only for net migration). Section 6. is dedicated to the labour market participation of migrants born outside the EU.

Table 2.6

Female, secondary-educated and older people represent the largest untapped potential workforce in the EU

Potential contribution of various population groups to the aggregate activity rate by 2030

Subgroup	Subgroup-specific activity rate in 2021 (%)	Target subgroup-specific activity rate (%)	Resulting EU activity rate in 2030 if the target is reached (%)	Contribution of the subgroup to the EU activity rate (p.p.)	Resulting number of active people in the EU in 2030	Contribution to the number of active people in the EU in 2030
Young	69.8	84.5	81	3.2	208,751,872	7,431,456
Prime	86.9	93.1	81.6	3.8	210,341,056	9,020,640
Elderly	63	80.9	82.4	4.7	212,499,952	11,179,536
Female	71.9	85.4	84.8	7.1	218,637,600	17,317,184
Male	83.7	90.5	81.5	3.8	210,146,800	8,826,384
Mother	68.2	86.9	78.7	1	202,904,512	1,584,096
Primary	61.3	77.7	81.1	3.4	209,167,840	7,847,424
Secondary	76.7	86.6	83.1	5.4	214,375,600	13,055,184
Tertiary	89.3	93.2	79.2	1.5	204,302,400	2,981,984

Note: Calculation based on a purely hypothetical simulation of how much the overall activity rate would increase by 2030 if the activity rate of any of the listed labour market subgroups was equal to the average of the three highest group-specific activity rates currently observed among the EU-27. Activity rates of the other subgroups are assumed to remain constant. This calculation should not be confused with a realistic activity rate growth, nor is it intended to serve as a forecast or impact assessment.

Source: DG-EMPL calculations, based on Eurostat data and EUROPOP2023 projections.

5. LABOUR SHORTAGES IN A GENDER-SEGREGATED ECONOMY

Gender segregation contributes to persistent labour shortages to the extent that it hampers efficient functioning of the labour market. ([118]) There are two key channels in which labour market efficiency can be impaired. Firstly, the efficiency with which available workers are allocated to jobs that best match their skills and talents can be reduced by discrimination in hiring, pay and promotions, specific aspects of working conditions (such as availability of the flexible working arrangements important for work-life balance) or undervaluation of certain types of jobs (such as care work) and expectations about who works in them. Secondly, gender segregation can affect the current and future supply of certain skills in ways that make suboptimal use of women's and men's talents. Segregation in different fields of education is of paramount importance. It tends to start early in life, when children first encounter gender stereotypes signalling that some subjects are typically male and some typically female, for example in educational materials, or through teacher/parent perceptions. Such stereotypes are not grounded in (or exaggerate) gender differences in early educational outcomes, ([119]) but nevertheless affect children's long-term aspirations and self-confidence, contributing to stereotypical subject choices irrespective of individual ability. For example, girls with similar scientific and mathematical achievements to boys enter STEM studies considerably less often. ([120]) Together, these factors can result in labour markets where many occupations and sectors are dominated by either men or women, with limited efforts to use and/or develop labour supply from the underrepresented gender. This limits the pool of people available to fill new vacancies in times of rising demand, making certain jobs more prone to persistent labour shortages.

([118]) (European Commission, 2009), (EIGE, 2018).

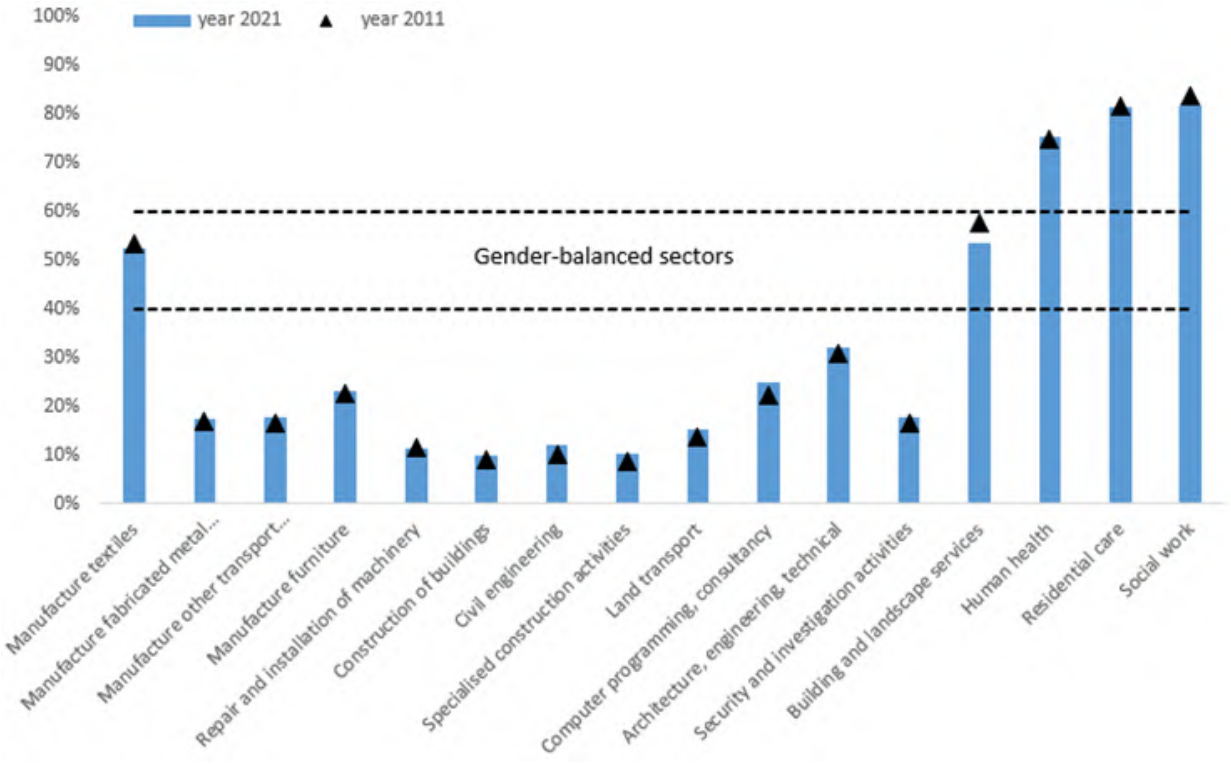
([119]) For recent studies discussing gender differences in maths performance, see e.g. (Bertoletti et al., 2023a) and (Bertoletti et al., 2023b).

([120]) See, for example, (EIGE, 2018).

Chart 2.16

Low shares of women in shortage sectors

Proportion of women in shortage sectors (% of all workers in a given sector), 2021, EU-27



Source: EU-LFS 2021.

Click here to download chart.

The EU labour market is heavily gender segregated across occupations and economic activities. ([121]) In 2021, fewer than one in four occupations were gender balanced, ([122]) accounting for less than one-fifth of the overall EU workforce. Almost 4 in 10 workers in the EU worked in an occupation where one gender accounted for more than 80% of all workers. Aggregate measures of gender segregation ([123]) by occupation imply that roughly every second man or woman would need to change occupation (e.g. more men becoming nursing professionals rather than ICT specialists, and vice versa for women) if all occupations were to become perfectly gender balanced. The picture was similar across sectors and subsectors of the EU economy – less than one-third of subsectors were gender balanced in 2021, comprising about one-quarter of the EU workforce.

Historically, increases in women's activity rates have led to increases in their employment rates, but without substantially changing existing patterns of gender segregation in the EU labour market. Around 82% of the increase in the employment of women since 2011 happened along existing patterns of gender segregation, i.e. without changing the 2011 shares of women in different occupations. The last two decades have seen little change in existing aggregate measures of gender segregation across occupations. ([124])

5.1.1. Gender segregation in sectors and occupations with labour shortages

In the EU, persistent labour shortages are more common in economic activities with low shares of women workers. Most of the sectoral labour shortages common across the Member States (see section 2.1.) are in male-dominated activities, including: computer programming, consultancy and related activities; civil engineering; land transport; several construction and manufacturing activities; repair and installation of machinery and equipment; and security and investigation (Chart 2.16). Women account for most workers in three shortage sectors: health, residential care and social work. In 2021, only 2 out of 16 shortage sectors were gender balanced (manufacture of textiles, and building and landscape services).

([121]) (EIGE, 2018), (Eurofound and Joint Research Centre , 2021), (Mariscal-De-Gante et al., 2023). Gender segregation by occupation is a fairly widespread problem that also occurs frequently in non-EU countries, as shown in a recent study by the World Bank (Das and Kotikula, 2019).

([122]) Occupations with 40-60% of each gender are considered gender-balanced. Occupations are taken at ISCO-08 3-digit level. The analysis is based on all Member States where occupational statistics at this level are available, i.e. excluding Bulgaria, Malta and Slovenia.

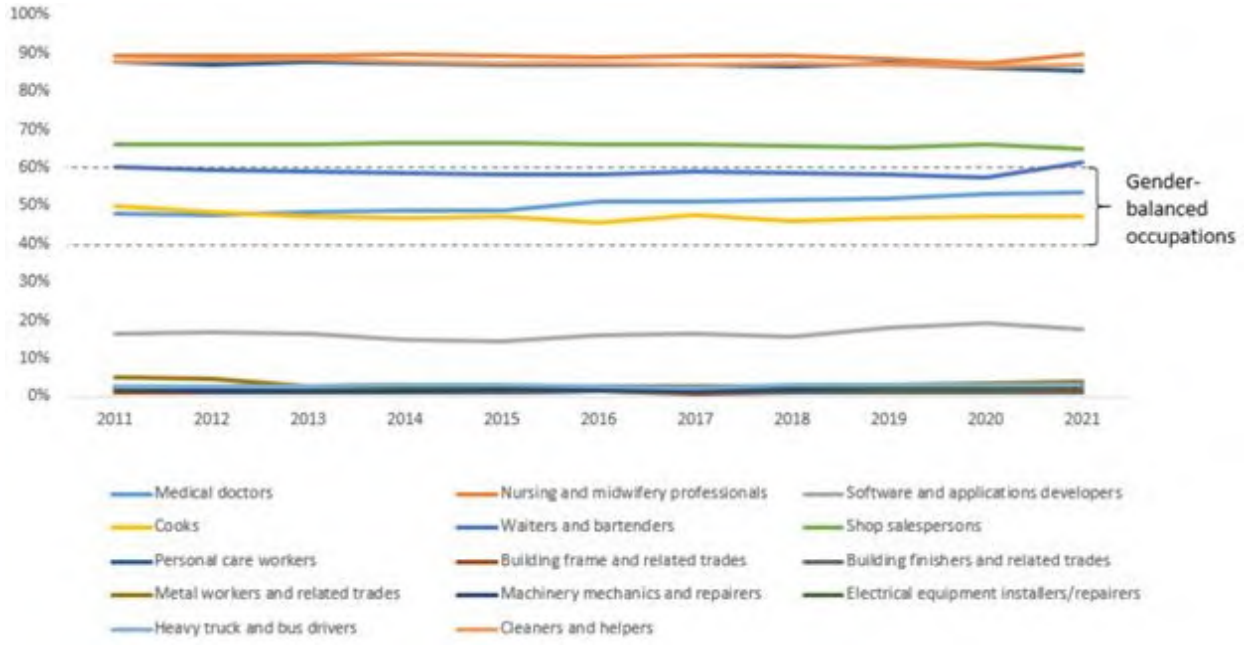
([123]) Gender segregation is captured by the Duncan dissimilarity index (see (Eurofound and Joint Research Centre , 2021)).

([124]) (Eurofound and Joint Research Centre , 2021).

Chart 2.17

Most shortage occupations are segregated by gender

Proportion of women in shortage occupations (% of all workers in a given occupation), 2011-2021, EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 3-digit level, i.e. excluding Bulgaria, Malta and Slovenia.

Source: EU-LFS 2011-2021.

Click here to download chart.

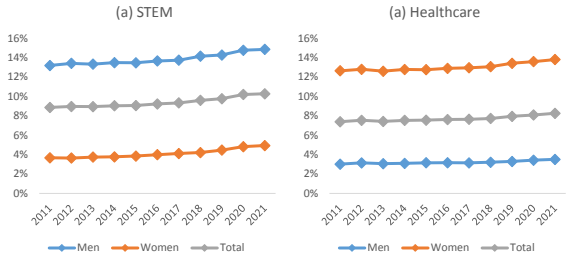
Around half of all occupations showing persistent labour shortages across the Member States are male-dominated (Chart 2.17). Shortage occupations where men accounted for more than 80% of workers in 2021 included several STEM occupations (civil engineers, highly skilled ICT occupations), several specialist construction occupations, machinery mechanics and repairers, electrical equipment installers and repairers, and heavy truck and lorry drivers.

Conversely, three occupations characterised by persistent labour shortages are jobs in which women account for more than four-fifths of workers. These are nursing and midwifery professionals, personal care workers, and domestic and office cleaners. Gender representation is approximately balanced in only two of the shortage occupations – medical doctors and cooks. For doctors, recent evidence points towards segregation by specialty (e.g. in paediatrics or surgery) in high-income countries. ([125])

Chart 2.18

Persistent gender segregation in STEM and healthcare occupations

Proportion of workers in STEM and healthcare occupations, by gender, EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 2-digit level, i.e. excluding Malta.

Source: EU-LFS 2011-2021.

Click here to download chart.

Gender segregation in occupations facing persistent labour shortages has not changed over time (Chart 2.17). Where either women or men accounted for more than 80% of all workers in an occupation in 2011, this was also the case in 2021, with little or no change in the gender composition of the relevant workforce. This implies that in the absence of measures to tackle gender segregation, increases in women's labour market participation will address labour shortages only in occupations where women already account for substantial shares of all workers.

5.1.2. Gender segregation in skilled STEM and healthcare occupations facing shortages

Reducing gender segregation in skilled occupations characterised by persistent labour shortages offers a significant opportunity to attract additional talent. In order for this to happen, the key factors contributing to underrepresentation of either men or women in these occupations must be addressed.

([125]) (Pelley and Carnes, 2020), (World Health Organisation, 2019).

This section focuses on factors that lead to segregation in two broader occupational groups known to contain skilled occupations facing shortages: STEM and healthcare. Not only are these two groups already facing labour shortages, they are also projected to see employment demand expand substantially in the coming years (see section 2.1.), making efforts to attract additional talent ever-more pressing.

STEM and healthcare occupations remain gender segregated despite persistent labour shortages. At EU level, in 2021, around 15% of all male workers were employed in STEM occupations, compared to about 5% of all female workers, leading to a gender STEM gap of about 10 pp (Chart 2.18). A similar gender gap can be observed in healthcare occupations, in this case with women as the overrepresented gender – around 14% of all female workers were employed in healthcare occupations in 2021, compared to about 3% of all male workers. While the overall share of employment in STEM and healthcare occupations grew slightly since 2011, the gender gap remained broadly the same in both occupational groups.

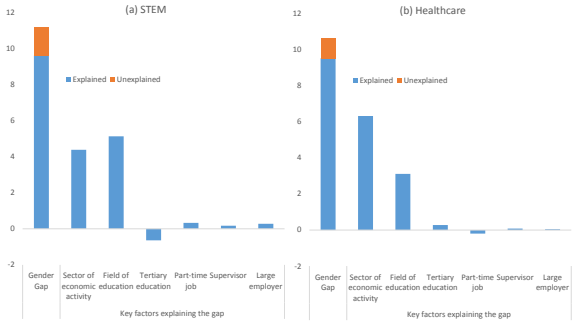
Several factors contribute to persistent gender segregation in STEM and healthcare work. Gender segregation in relevant educational fields is crucial. ([126]) Women account for about one in four tertiary education graduates in engineering, manufacturing and construction, and one in five graduates in ICT, ([127]) but more than two-thirds of tertiary education graduates in health. Similar patterns can be observed in VET. ([128]) Various gender stereotypes contribute to gender segregation in both STEM and healthcare from early in life. For example, stereotypes in teachers' perceptions or depictions of engineers or nurses in school textbooks help to shape children's future work aspirations. ([129]) Other factors are more specific to the area. For example, the underrepresentation of women in STEM is linked to the gender divide in advanced digital skills, masculine organisational cultures in some workplaces, and a lack of work-life balance options and role models in certain STEM fields. ([130]) In healthcare, women particularly dominate occupations that can be linked to their expected roles as unpaid caregivers in society, ([131]) such as nurses or personal care workers. Given this link to unpaid care, these occupations are often undervalued in status, working conditions and salary. By contrast, some well-paid, high-status healthcare professions associated with technical skills, such as surgery, tend to be performed primarily by men. ([132])

([126]) (McNally, 2020), (EIGE, 2020a), (European Parliament, 2015).
([127]) Eurostat educ_uoe_grad02.
([128]) (European Commission, 2022d).
([129]) See, for example, (Thebaud and Charles, 2018) for a detailed discussion of how stereotypes contribute to segregation of STEM work.
([130]) (EIGE, 2020b).
([131]) (Shannon et al., 2019), (World Health Organisation, 2019).
([132]) (EIGE, 2018), (World Health Organisation, 2019).

Chart 2.19

Higher probability of working in STEM or healthcare for women and men with relevant qualifications

Predicted changes in probability of working in healthcare and STEM occupations, by selected worker and job characteristics (pp), workers aged 20-64, 2021, EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 2-digit level, i.e. excluding Malta. The available data distinguish education by study field and ISCED level, but do not distinguish between types of education (e.g. post-secondary vocational vs university tertiary education).

Source: EU-LFS 2021.

Click here to download chart.

Differences in study fields of qualifications ([133]) held by women and men explain large shares of gender gaps in STEM and, to a lesser extent, healthcare occupations (Chart 2.19). ([134]) They account for almost half of the underrepresentation of women in STEM and about one-third of underrepresentation of men in healthcare at EU level, with considerable variation across Member States. ([135]) This reflects the high skill and knowledge intensity of STEM and healthcare work. In 2021, almost two-thirds of workers in STEM occupations held tertiary qualifications, with men holding most of the qualifications directly relevant to STEM work. For example, around 10% of all male workers in the EU achieved a tertiary qualification in engineering, manufacturing and construction, while a further 3% held an ICT qualification. Corresponding proportions for female workers were much lower, at 3% and 1%, respectively. Similar but less pronounced patterns applied to healthcare workers in 2021 – about half were tertiary educated, with women holding the majority of healthcare-related qualifications.

The fact that women and men tend to work in different sectors accounts for much of the remaining gender gap in STEM and healthcare occupations. The drivers of gender segregation outlined at the beginning of this section often operate at sectoral, as well as occupational, level. This includes broader gender norms and stereotypes around work in certain sectors, ([136]) sectoral differences in remuneration, ([137]) and sector-specific aspects of working conditions (e.g. option to combine work with unpaid childcare) or work culture. ([138]) For example, gender segregation in healthcare occupations tends to be far more pronounced in the female-dominated healthcare sector (8 out of 10 workers in healthcare occupations in the EU are women) than in the more gender-balanced professional, scientific and technical activities (where healthcare occupations employ roughly as many men as women).

([248]) Analysis controls for the following broad fields of education in respect of (at least) secondary qualifications: generic programmes and qualifications; education; arts and humanities; social sciences, journalism and information; business, administration and law; natural sciences, mathematics and statistics; ICT; engineering, manufacturing and construction; agriculture, forestry, fisheries and veterinary; health and welfare; services.

([134]) For details on analytical methodology, see (European Commission, 2023i). The results of this analysis need to be read with caution, as considerable data limitations affect the robustness of analysis. The data do not directly capture a number of factors identified as important contributors to occupational gender segregation, such as certain important working conditions (e.g. pay), unpaid childcare obligations, or certain gender norms and stereotypes.

([135]) For details on variation by Member State, see (European Commission, 2023i).

([136]) See, for example, (Thebaud and Charles, 2018) for a detailed discussion of role of stereotypes in STEM sectors.

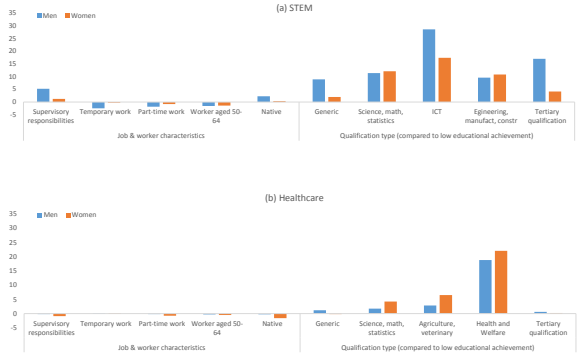
([137]) For example, declining wages in the health sector have been associated with the increasing proportion of women in this sector in high-income countries (Shannon et al., 2019). There also appears to be a sizeable gender pay gap in the health sector, indicating that men tend to enter in better paid positions (Boniol et al., 2019), (EIGE, 2018).

([138]) (EIGE, 2020a).

Chart 2.20

Higher probability of working in STEM or healthcare for women and men with relevant qualifications

Predicted changes in probability of working in healthcare and STEM occupations, by selected worker and job characteristics (pp), workers aged 20-64, 2021, EU



Note: Analysis based on all Member States where occupational statistics are available at ISCO-08 2-digit level, i.e. excluding Malta. Data distinguish education by study field and ISCED level, but do not distinguish between types of education (e.g. post-secondary vocational vs university tertiary education).

Source: EU-LFS 2021.

Click here to download chart.

Holding relevant qualifications increases the likelihood of working in STEM or healthcare occupations for both women and men, but this effect tends to be stronger for the dominant gender (Chart 2.20). For men, holding an ICT qualification increases the chance of working in STEM occupations by almost 30 pp, ([139]) compared to less than 20 pp for women. ([140]) A similar, albeit weaker, pattern can be observed for healthcare qualifications, which increase a woman's chances of working in a healthcare occupation by 22 pp, compared to 19 pp for men.

For men, the probability of working in STEM occupations also increases with achieving at least a secondary generic ([141]) qualification and with the level of achieved qualification (regardless of field). Men holding at least an upper secondary generic qualification are almost 9 pp more likely to work in STEM occupations than those who did not complete upper secondary education, and the probability increase is even sharper for those holding any tertiary qualification (by about 17 pp). For women, the corresponding increases are far smaller, at less than 5 pp.

6. MIGRANT EMPLOYMENT IN OCCUPATIONS WITH LABOUR SHORTAGES

In the light of the ageing EU population and increasing labour shortages, improved participation of migrants in the labour market would strengthen their potential contribution to sustaining economic performance (see section 4.). Previous sections have discussed additional reskilling and upskilling needs, in particular related to the green and digital transitions, and the potential of increasing participation of other underrepresented groups to mitigate labour shortages, and this section considers the possible contribution of migrants in that context. More specifically, it analyses their occupational distribution and the main obstacles that could explain their lower labour market participation rates. Here, migrants are defined as people born outside the EU but residing in the EU, while people born in the country of residence are termed the native population. ([142])

([139]) Compared to workers with lower educational achievement (ISCED 0-2).

([140]) This corroborates existing evidence showing that achieving a tertiary qualification in a STEM-related field improves men's chances of working in that field more than women (EIGE, 2018).

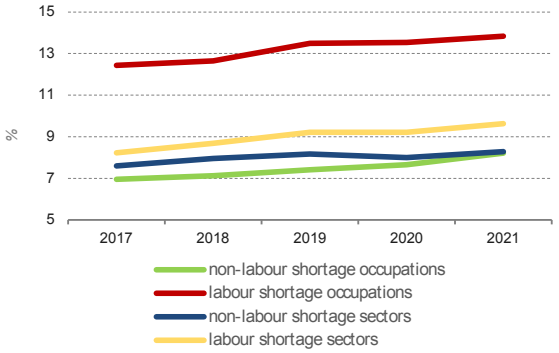
([141]) This includes basic programmes and qualifications, literacy and numeracy, personal skills and development, and other generic programmes and qualifications not further defined.

([142]) EU-LFS does not include information on nationality and its change over time. This makes it impossible to use the definition for third-country nationals and EU citizens with migration background suggested in the European Commission Action Plan on Integration and Inclusion 2021-2027, which defines EU citizens with a migration background as nationals of EU Member States who had a third-country nationality and became EU citizens through naturalisation in one of the EU Member States, as well as EU citizens who have a third-country migrant background through their foreign-born parents (European Commission, 2020b). Given the data limitations, this section defines migrant and native workers based solely on their country of birth, without taking account of background. This leads to a much higher number of migrants than using the concept of nationality (around 25.6 million people born outside the EU, compared to 16.8 million third-country nationals in 2021). The analysis does not account for the possible persistence of intergenerational inequalities linked to migration for the native-born children of migrants (OECD, 2018). In addition, it only focuses on migrants residing in the EU and does not consider outsourcing to non-EU countries (which might have a significant impact for teleworkable jobs, such as call centres or ICT assistance), or offshoring to non-EU countries (which might be particularly relevant for manufacturing). This section does not cover intra-EU mobile workers, as their occupational mobility is extensively analysed in the European Commission Annual Report on Intra-EU Labour Mobility 2022 (European Commission, 2023a). That report showed a limited impact for intra-EU mobile workers in mitigating labour shortages in the short-term.

Chart 2.21

Higher share of migrants in labour shortage occupations and sectors

Share of migrants within labour shortage and non-labour shortage occupations and sectors, 2017-2021, EU



Note: Migrant and native workers identified based on country of birth. Analysis limited to population aged 20-64. Excludes data on Bulgaria, Hungary, Malta, Poland and Slovenia, as the EU-LFS files do not provide country of birth for people born outside Europe.

Source: EU-LFS 2017-2021.

Click here to download chart.

In 2021, the share of migrants was higher in occupations characterised by persistent labour shortages in the EU. That share stood at 13.8%, compared to 8.2% in non-labour shortage occupations (Chart 2.21). There was strong heterogeneity in migrant share across labour shortage occupations, ranging from <10% for nursing and midwifery professionals, electrical equipment installers and repairers, machinery mechanics and repairers, and shop salespersons, to over 20% for cooks and domestic, hotel and office cleaners. Between 2017 and 2021, ([143]) the share of migrants increased almost equally in both labour shortage and non-labour shortage occupations, by 1.4 pp and 1.3 pp, respectively. In labour shortage occupations, the strongest increase in migrant share was observed for software and applications developers and analysts (+3.9 pp), followed by building finishers and related trade workers (+3 pp) and personal care workers in health services (+2.9 pp).

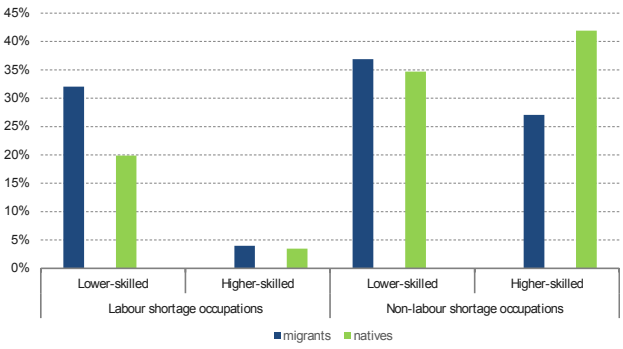
In 2021, sectors facing persistent labour shortages had a higher share of migrants compared to non-labour shortage sectors in the EU. Those shares were 9.6% and 8.3%, respectively (Chart 2.21). This difference was less pronounced than the gap in migrant share between labour shortage and non-labour shortage occupations, at 1.3 pp and 5.6 pp, respectively. In labour shortage sectors, the highest shares of migrants were in services to buildings and landscape activities (22.4%), residential care activities (12.4%), specialised construction activities (10.7%), and computer programming, consultancy and related activities (10.6%), with shares below 7% in repair and installation of machinery and equipment, human health activities, architectural and engineering activities, manufacture of other transport equipment, and manufacture of furniture. Between 2017 and 2021, the share of migrants increased more strongly in labour shortage sectors (1.4 pp) than non-labour shortage sectors (0.7 pp). The highest increases were observed in services to buildings and landscape activities (2.9 pp), computer programming, consultancy and related activities (2.8 pp), and residential care activities (2.5 pp).

Among occupations characterised by persistent labour shortages, the majority of migrants were concentrated in lower-skilled occupations in 2021 (Chart 2.22). ([144]) At 88.9%, this was significantly higher than their corresponding share within non-labour shortage occupations, at 57.7%. Overall, migrants were distributed quite equally between lower-skilled labour shortage occupations, lower-skilled non-labour shortage occupations, and higher-skilled occupations (around one-third in each), while native workers were more concentrated in higher-skilled non-labour shortage occupations (41.9%) and lower-skilled non-labour shortage occupations (34.7%). Around 1 in 10 migrants indicated that their current job requires lower skills than the last job they held before migrating, particularly for higher-educated migrants (14.5%), pointing to possible overqualification. However, around half did not have any work experience before migrating and likely accepted jobs that were less popular among native workers, potentially easing their entry into the labour market.

Chart 2.22

Migrants are concentrated in lower-skilled occupations

Segregation of migrant and native workers across occupations, by skill level, 2021, EU



Note: Migrant and native workers identified based on country of birth. Analysis limited to population aged 20-64. Excludes Bulgaria, Hungary, Malta, Poland and Slovenia, whose EU-LFS data do not provide country of birth for people born outside Europe.

Source: EU-LFS 2021.

Click here to download chart.

Strong growth in the share of migrants was observed in higher-skilled occupations facing persistent labour shortages in the EU between 2017 and 2021. That share increased by 2.4 pp,

([143]) Comparison to earlier years is not possible – there is a break in time series for migrants as Germany's EU-LFS data do not report country of birth for people born outside the country of residence before 2017.

([144]) Skill levels '1, 2 and 4' and '2' were grouped as lower-skilled; skill levels '3', '3 and 4' and '4' were grouped as higher-skilled. All labour shortage occupations had a corresponding skill level of either '2' or '4'.

compared to average increases of 1.4 pp in other occupations. For labour shortage occupations, the gap between the share of migrants in occupations with lower and higher skill levels decreased from 4.5 pp in 2017 to 3.5 pp in 2021, but remained stable for non-labour shortage occupations.

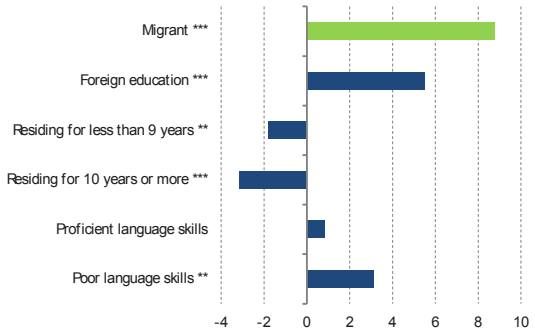
EU countries reporting shortages in occupations identified as experiencing persistent labour shortages tend to have a lower share of migrants working in those occupations. ([145]) In those countries, the share of migrants was 13.5% in 2021-2022, compared to 14.3% in countries not reporting labour shortages in shortage occupations. ([146]) ([147]) However, there were significant differences across labour shortage occupations. ([148]) For example, the share of migrants among building frame workers, and waiters and bartenders was more than 7 pp higher in countries with no labour shortages. For other occupations, such as machinery mechanics and repairers, sheet and structural metal workers, drivers, and personal care workers, the opposite was true, with the share of migrants higher in countries facing labour shortages. ([149]) This points to a positive contribution of migrants in alleviating labour shortages in certain occupations.

In addition to migrant status, completing the highest level of education abroad or possessing poor language skills ([150]) increase the likelihood of employment in occupations with persistent labour shortages. Here, being a migrant contributes +8.7 pp, while achieving the highest level of education abroad increases the likelihood by 5.5 pp, and low language skills by 3.1 pp (Chart 2.23). ([151]) The two latter factors may point to lower hiring requirements and indicate a lower skills demand in labour shortage occupations (see section 2.1.). The analysis shows that people residing in a country for a longer period are less likely to work in occupations characterised by persistent labour shortages than those who arrived more recently. This might indicate that integration prompts people to move to occupations that require higher skills and offer better pay or working conditions (see section 7.). Also, the higher concentration of migrants in lower-skilled occupations does not fully explain their higher probability of being employed in labour shortage occupations. After the skill level of the occupation is taken into account, the probability of migrants to be employed in labour shortage occupations decreases (to 5.5 pp), but remains significant and sizeable, confirming their role in mitigating labour shortages (Figure A.2).

Chart 2.23

Migrants are more likely to be employed in occupations with persistent labour shortages

Factors connected to the probability of being employed in labour shortage occupations vs non-labour shortage occupations, 2021, EU



Note: Regression on full sample (migrants, natives, EU-mobile workers, identified based on country of birth). Analysis limited to population aged 20-64. Excludes Bulgaria, Hungary, Malta, Poland and Slovenia, whose EU-LFS data do not provide country of birth for people born outside Europe. Chart shows a selection of key variables of interest where the deviation from zero shows the difference with respect to the reference group in parenthesis: migrant (people born in the country of residence), foreign education indicates highest level of education achieved abroad (highest level of education achieved in country of residence), residing for less than nine years or residing for 10 years or more (born in the country of residence), proficient language skills comprising advanced and intermediate language skills or poor language skills comprising basic, hardly any, and no language skills (mother tongue). *** significant at 1%, ** significant at 5%, * significant at 10%, no * = not significant. For full set of results, see Figure A.1.

Source: EU-LFS 2021.

Click here to download chart.

([145]) Reported shortages by country taken from the 2022 EURES report on labour shortages and surpluses, primarily referring to the period between Q3 2021 and Q2 2022, depending on the country (ELA, 2023).

([146]) Part of this result could be driven by other country-specific factors, such as overall tightness of the labour market. For example, following the same methodology and based on (ELA, 2023), the migrant share in occupations facing persistent labour shortages was 4.4 pp higher in EU countries that did not report labour shortages in those occupations in 2020-2021 (compared to 0.8 pp in 2021-2022). This suggests that in recent years, persistent labour shortages in some occupations have (re-)emerged in some countries not previously facing labour shortages in occupations characterised by persistent labour shortages.

([147]) This result is in line with the 2022 EURES report on labour shortages and surpluses (ELA, 2023), which shows that in 2021, the share of people born outside the EU-27 and working in most widespread shortage occupations (11%) was higher than the share of those people in all occupations (8%).

([148]) Most of the countries reported severe labour shortages in the labour shortage sectors (at NACE 2-digit level) in 2021 (based on BCS and definition of severe labour shortages described in section 2.1.).

([149]) This may be related to the differences in regulation of those professions across countries (see Regulated Professions Database here).

([150]) Following the methodology in the EU-LFS 2021 ad hoc module on the labour market situation of migrants and their immediate descendants, analysis on language skills here focuses on the main host country language. For multilingual countries, the main host country language is the official language of the region where the respondent lives.

([151]) When controlling for degree of urbanisation, level of education, gender, length of residence in a country, age, temporary work, part-time work, size of the firm, country where highest level of education was achieved, and current language skills in the main host country language.

Some untapped potential may remain in the current available pool of migrants. In 2021, the share of employed migrants (63.1%) was significantly lower than that of the native population (74.0%). This difference was more pronounced for women (53.9% of migrant women in employment, compared to 69.4% of native women). This may be linked to the fact that 58.7% of migrant women left their country for family reasons, compared to only 17.2% leaving for employment. Migrant women not in employment indicated care responsibilities as the most common reason for not searching for work. By contrast, family and employment were of about equal importance for men, each reported by around one-third of male migrants. ([152]) This suggests that a better care offer might increase the labour market participation of migrant women.

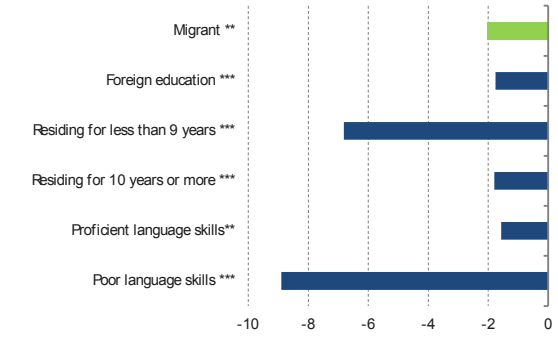
More than one-quarter of migrants reported facing obstacles to finding a suitable job in 2021. Host country language skills (24%), recognition of formal qualification obtained abroad (16%), and absence of suitable jobs (15%) were the most frequently cited obstacles. Indeed, 37.4% of migrants reported having little or no host country language skills before migrating, and also showed the highest share of participation in a language course (61.5%). More than one-fifth of migrants reported that their formal qualification obtained abroad was not recognised, they were unaware of the job possibilities or application procedures, or it was too costly, complex or not possible to apply. Only around one-third of migrants found their first job in the host country within the first three months, with slightly more than half finding work within the first year. Over one-tenth of migrants reported that it took longer than four years to find a job, or they did not manage to find a job at all, increasing the risk of long-term unemployment and depreciation of skills.

Having little or no skills in the main host country language reduces the likelihood of employment (Chart 2.24). That reduction is significant, at 8.9 pp. A recent study shows that the positive effect of better language skills is equally important across very different types of occupations, including low-skilled and medium-skilled jobs and occupations where immigrants are overrepresented. ([153]) Having achieved the highest level of education abroad decreases the probability of being employed by 1.8 pp, indicating some potential difficulties in recognising and fully utilising foreign qualifications. ([154]) The negative impact on the likelihood of employment decreases the longer a person resides in a country, but does not fully disappear, even after living there for 10 or more years. However, even when controlling for workers' characteristics, ([155]) people born in a non-EU country have a lower probability of being employed than native workers (by 2.0 pp). A separate analysis limited only to migrants shows that migrating for employment reasons increases the probability of employment by 14.5 pp (Figure A.4). These results confirm the obstacles highlighted by migrants and imply unused potential among current migrants to mitigate labour shortages.

Chart 2.24

Migrants are less likely to be employed

Factors connected to the probability of being employed vs being not employed, 2021, EU



Note: Regression on full sample (migrants, natives, EU-mobile workers, identified based on country of birth). Analysis limited to population aged 20-64. Excludes Bulgaria, Hungary, Malta, Poland and Slovenia, whose EU-LFS data do not provide country of birth for people born outside Europe. Figure presents a selection of key variables of interest where the deviation from zero shows the difference with respect to the reference group in parenthesis: migrant (people born in the country of residence), foreign education indicates highest level of education achieved abroad (highest level of education achieved in country of residence), residing for less than nine years or residing for 10 years or more (born in the country of residence), proficient language skills comprising advanced and intermediate language skills or poor language skills comprising basic, hardly any, and no language skills (mother tongue). *** significant at 1%, ** significant at 5%, * significant at 10%, no * = not significant. For full set of results, see Figure A.3.

Source: EU-LFS 2021.

Click here to download chart.

When in employment, migrants more often report experiencing discrimination. In 2021, the reported discrimination rate was 8.6% among migrants (5.4% for native workers), with most (65.2%) indicating their foreign origin as the most common reason. By contrast, native workers believed that the discrimination they perceived stemmed from gender (20.5%) or grounds other than age, disability or

([152]) Studies show that migrating for family-related reasons is associated with poorer labour market outcomes than moving for employment or other reasons ((Gillespie, Mulder and Thomas, 2021), (Kanas and Steinmetz, 2021), (Lens, Marx and Vujic, 2018)).

([153]) (Carlsson, Eriksson and Rooth, 2023).

([154]) Overall, receiving some part of their education abroad (i.e. through Erasmus or other exchange programmes) might be linked to higher employability and earnings' potential ((Kratz and Netz, 2018), (Wiers-Jenssen, Tillman and Matherly, 2020)). However, this analysis considers the country where the highest level of education was successfully completed rather than international education experience more generally. While the findings suggest that completing the highest level of education abroad is likely to lower the probability of being employed, the results might be more diverse when considering the impact on earnings, which is outside the scope of this analysis (Wiers-Jenssen and Try, 2005).

([155]) Characteristics considered: degree of urbanisation, level of education, gender, length of residence in the country, age, country where the highest level of education was achieved, and current language skills in the main host country language.

foreign origin (64.2%). Many studies show that higher-educated migrants are more likely than lower-educated migrants to report feeling discriminated against, with higher perceptions of discrimination associated with higher perceptions of being overqualified for their job. ([156]) Finally, anti-immigration attitudes have a negative and significant impact on migration inflows to the EU, which might hinder governments' efforts to attract migrants with the required skills. ([157])

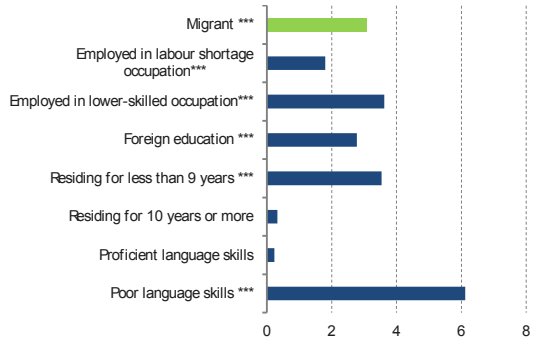
Migrants more frequently work in non-standard forms of employment. ([158]) In 2021, one in five migrants was employed on a temporary contract, compared to around one in eight native workers. More migrants were employed on a contract with a temporary employment agency (4.7%, compared to 2.5% native workers). Migrants worked part-time more often (23.9%, compared to 18.2% native workers), a difference that was even more pronounced in labour shortage occupations, with around 10 pp more migrants in part-time jobs. This could indicate a missed opportunity in not increasing the working hours of migrants to mitigate labour shortages, particularly as 45.1% of migrants working part-time reported their willingness to work more hours (10.5 pp more than native workers).

Migrants are more likely to have non-standard work arrangements (+3.1 pp) even when accounting for personal factors and employment in lower-skilled occupations or those characterised by persistent labour shortages (Chart 2.25). ([159]) This could be linked to social stigma or other characteristics not captured by the model, making it more difficult for migrants to find full-time permanent employment. This might increase their risk of detachment from the labour market and reduce their potential to contribute to alleviating labour shortages.

Chart 2.25

Migrants are more likely to work in non-standard forms of employment

Factors connected to the probability of non-standard forms of employment vs full-time permanent employment, 2021, EU



Note: Regression on full sample (migrants, natives, EU-mobile workers, identified based on country of birth). Analysis limited to population aged 20-64. Excludes Bulgaria, Hungary, Malta, Poland and Slovenia, whose EU-LFS data do not provide country of birth for people born outside Europe. Chart presents a selection of key variables of interest where the deviation from zero shows the difference with respect to the reference group in parenthesis: migrant (people born in the country of residence), employed in labour shortage occupation (employed in non-labour shortage occupation), employed in lower-skilled occupation (employed in higher-skilled occupation), foreign education indicates highest level of education achieved abroad (highest level of education achieved in country of residence), residing for less than nine years or residing for 10 years or more (born in the country of residence), proficient language skills comprising advanced and intermediate language skills or poor language skills comprising basic, hardly any, and no languages skills (mother tongue). *** significant at 1%, ** significant at 5%, * significant at 10%, no * = not significant. For full set of results, see Figure A.5.

Source: EU-LFS 2021.

Click here to download chart.

Further policies might be needed to strengthen the potential of migrants already residing in the EU to fill future labour shortages (see section 2.2.). Around 47.2% of migrants work in jobs that are likely to experience strong future shortages, compared to 37.6% of natives. ([160]) However, among those occupations, migrants are primarily concentrated in elementary occupations (38.6% of migrants, compared to 16.2% of native workers) and are strongly underrepresented in high-skilled non-manual occupations (23.4% of migrants, compared to 48.1% of native workers). Complementary to policies targeted at increasing participation rates of other population groups underrepresented in the labour market, such as women, policies addressing the inefficient use of skills of migrants already residing in the EU (due to difficulties in recognising their qualifications or overqualification related to discrimination) and insufficient investment in their upskilling and reskilling (including language skills) could help to reduce future labour shortages, especially in higher-skilled occupations.

([156]) (OECD, 2018), (Schaeffer, 2019), (Steinmann, 2019), (Migration Policy Group, 2022).

([157]) (Di Iasio and Wahba, 2023) show that a 10% increase in negative attitudes reduces migration inflows by 0.4%. However, this effect is smaller than for other economic factors, such as income and unemployment.

([158]) Defined as having a temporary job, or a contract with a temporary employment agency, or working part-time.

([159]) Controlling for degree of urbanisation, level of education, gender, length of residence in a country, age, temporary work, part-time work, size of the firm, country where highest level of education was achieved, current language skills in the main host country language, and employment in labour shortage or lower-skilled occupations.

([160]) Occupations with a future shortage indicator with a value of at least 2.7 (Table 2.4).

7. EMPLOYMENT AND WORKING CONDITIONS IN SECTORS AND OCCUPATIONS WITH PERSISTENT LABOUR SHORTAGES

Improved working conditions and quality jobs (Box 2.8**) are potential drivers of increased labour force participation but also depend on productivity gains.** ([161]) Employment and working conditions potentially affect the prevalence and extent of labour shortages in certain sectors and occupations, particularly when relevant skillsets and experience are not lacking within the available workforce (see section 3.). More specifically, job quality, employment conditions, and earnings can be relevant supply-side factors in attracting labour to sectors and occupations with persistent labour shortages. ([162]) Training opportunities can also increase the overall attractiveness of work environments and workers' potential to grow earnings (see Chapter 3, section 3.3.), as well as improving worker retention and preventing skills mismatches through upskilling and reskilling. Variations in employment and working conditions can be the outcome of multiple factors. Differences across sectors and occupations can result from a country's production structure, differences in productivity gains and demand for labour, as well as the management practices of organisations and firms. They can also stem from a country's labour supply, including the characteristics and skills of the available workforce. ([163]) For example, the COVID-19 crisis amplified poor working conditions and job insecurity in some sectors and occupations, such as healthcare, hospitality, and tourism, and for seasonal workers. This led to a growing share of workers moving away from low-quality jobs (low-paying, less flexible, contact-intensive, physically demanding), with a minor impact on the efficiency of EU labour market matching. ([164])

Fair working conditions are anchored in the European Pillar of Social Rights. They cover employment conditions, wages, and health and safety at work, among others. ([165]) The Pillar states that 'regardless of the type and duration of the employment relationship, workers have the right to fair and equal treatment regarding working conditions', adding that 'employment relationships that lead to precarious working conditions shall be prevented, including by prohibiting abuse of atypical contracts'. In addition, it stresses that 'workers have the right to a high level of protection of their health and safety at work'.

Definitions of working conditions vary and can include the physical, organisational, social, and economic dimensions of jobs. Broadly defined, a working condition is a characteristic, or combination of characteristics, of work that can be modified and improved. According to Eurofound, working conditions refer to the conditions in and under which work is performed, including the organisation of work and work activities, training, health, safety and working time. ([166]) For the ILO, the term also incorporates the economic dimension of work and its effects on living conditions. ([167]) While not always included in definitions of working conditions, ([168]) wages are correlated with workers' well-being and are widely considered a marker of job quality. The OECD's Job Quality Framework focuses on the measurement and assessment of job quality and encompasses three dimensions: earnings quality, labour market security, and quality of working environment. ([169]) Using OECD methodology to capture non-economic aspects of jobs, Eurofound's job quality indicator focuses on six dimensions, including working time arrangements and the nature and content of work (Box 2.8).

In 2018, substantial differences in median gross hourly earnings were recorded across subsectors with persistent labour shortages in the EU. ([170]) For nearly two-thirds (10 out of 16) of subsectors with persistent labour shortages, the median gross hourly earnings ([171]) expressed in

([161]) More generally, employment and working conditions also depend on the productivity of sectors. They also support and accommodate the inclusion of wider groups of people in the labour market and can prevent premature labour market exit, for example due to illness.

([162]) Given that they are offered by employers, they are also characteristics of labour demand.

([163]) The analysis of variation here does not allow for an assessment of a causal relationship between working conditions and persistent labour shortages.

([164]) (European Commission, 2022g), (European Commission, 2023a).

([165]) (European Commission, 2018).

([166]) More information available here.

([167]) According to the ILO definition, working conditions cover a broad range of topics and issues, from working time (hours of work, rest periods, and work schedules) to remuneration, as well as the physical conditions and mental demands of the workplace.

([168]) Article 153 of the Treaty on the Functioning of the European Union (TFEU) excludes pay from the scope of its actions in the area of working conditions.

([169]) More information available here.

([170]) Based on the latest available data of the Eurostat Structural Earnings Survey (SES).

([171]) Gross hourly earnings are defined as gross earnings in the reference month divided by the number of hours paid during the same period. The number of hours paid includes all normal and overtime hours worked and remunerated by the employer during the reference month.

purchasing power standard (PPS) ([172]) were below the EU average of 13.2. Security and investigation activities (8.9), and manufacture of furniture (9.1) and textiles (9.5) recorded well below average earnings. By contrast, computer programming, consultancy and related activities (18.9), manufacture of other transport equipment (17.3) and architectural and engineering activities (17.0) had far higher than average median hourly gross earnings (Chart 2.26). ([173]) Between 2010 and 2018, the largest increases in median gross hourly earnings were recorded for civil engineering (27%) and security and investigation services (24%), while increases were far lower for land transport and transport via pipelines (4%) and residential care activities (6%).

Chart 2.26

Subsectors with persistent labour shortages had both above and below EU average median gross hourly earnings

Median gross hourly earnings (PPS), by subsectors with persistent labour shortages, 2010-2018, NACE 2-digit level, EU-27

Note: Size classes in number of employees is for 10 employees or more.

Source: Eurostat SES (EARN_SES_PUB2N).

Click here to download chart.

Almost half of the subsectors facing persistent labour shortages recorded an above-average share of low-wage earners (7 out of 16). In 2018, the proportion of low-wage earners (i.e. those earning two-thirds or less of the national median gross hourly earnings) varied significantly across shortage subsectors. Many subsectors with lower than average median earnings also had higher than average (15%) shares of low-income earners, in particular for manufacture of textiles (44%) and construction of buildings (26%) (Chart 2.27). ([174]) However, nearly all subsectors with persistent labour shortages – with the exception of manufacture of furniture and manufacture of fabricated metals – experienced a decrease in the share of low-wage earners between 2010 and 2018.

([172]) Derived by dividing any economic aggregate of a country in national currency by its respective purchasing power parities.

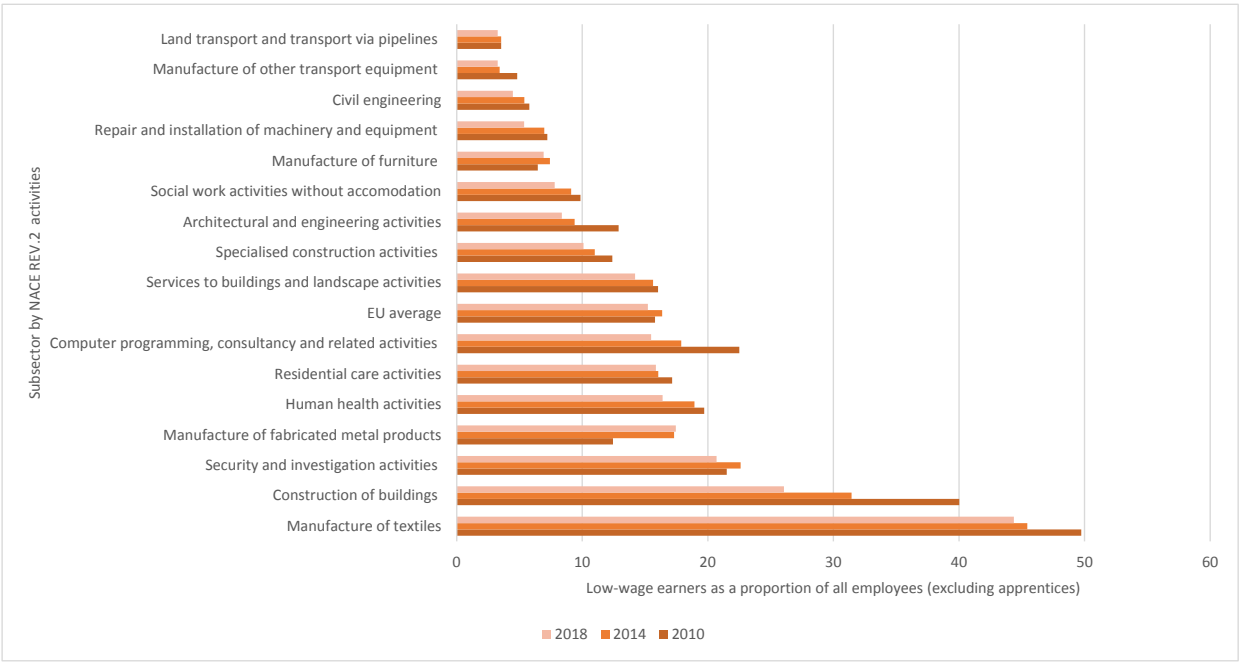
([173]) At sectoral level, the persistent shortage sectors administrative and support services and transport and storage activities recorded the lowest median hourly earnings in PPS, with information and communication activities recording the highest (Chart A.4).

([174]) At sectoral level, the persistent shortage sectors administrative and support services and transport and storage activities recorded the highest share of low-wage earners, while information and communication activities recorded the lowest (Chart A.5).

Chart 2.27

Several subsectors facing persistent labour shortages recorded an above-average share of low-wage earners

Low-wage earners as a proportion of all employees (excluding apprentices), by shortage subsector, 2010-2018, NACE 2-digit level, EU-27



Note: Size classes in number of employees is for 10 employees or more.

Source: Eurostat SES, NACE Rev.2, 2-digit level.

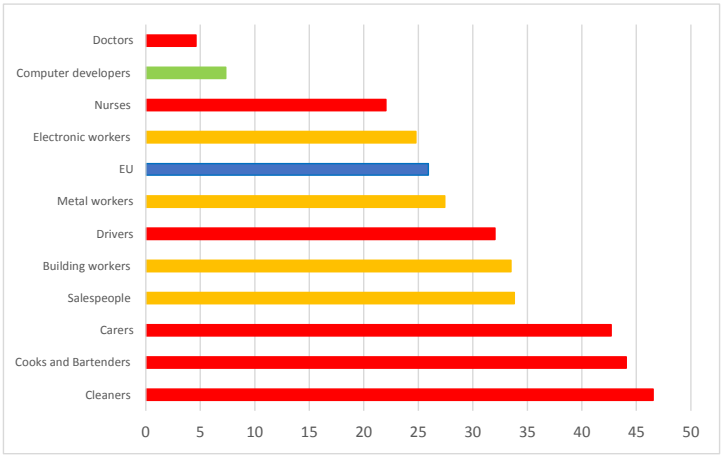
Click here to download chart.

In 2021, several occupations characterised by persistent labour shortages reported an above EU average proportion of workers having difficulties in making ends meet. ([175]) This was most notable for cleaners (47%), cooks and bartenders (44%), and carers (43%), against the EU average of 26% (Chart 2.28). Only medical doctors (5%) and computer developers (7%) had substantially lower than average shares of workers reporting difficulties in making ends meet. Occupations with persistent labour shortages reporting higher than average difficulties in making ends meet also had higher shares of workers unable to predict their earnings in the next three months, pointing to a link between lower pay and less stable earnings. At least one-quarter of cleaners, building workers, salespeople and cooks reported being unable to tell in advance how much they were going to earn in the next three months. In addition, certain shortage occupations did not believe they were fairly rewarded. For instance, only 40% of nurses felt that they were paid fairly in relation to their efforts and achievements (19 pp lower than the average).

Chart 2.28

Several shortage occupations have above-average difficulties in making ends meet

Proportion of workers in shortage occupations reporting difficulty in making ends meet, 2021, EU-27



Note: Red indicates significantly above EU average job strain, orange indicates slightly above EU average job strain, and green indicates below EU average job strain.

Source: Eurofound, EWCTS 2021.

Click here to download chart.

Workers' reasons for opting into temporary or solo self-employment are heterogeneous and can be markers of both a desired flexibility and comparatively higher job insecurity. Where job insecurity associated with non-standard forms of employment is indicative of less favourable employment and working conditions, this can make sectors and occupations less attractive for workers and contribute to driving persistent labour shortages. On the one hand, workers may seek out more flexible employment arrangements, and non-standard forms of work ([176]) can offer such autonomy. Self-employed, including

([175]) Data based on the Eurofound 2021 European Working Conditions Telephone Survey (EWCTS).

([176]) Non-standard forms of employment analysed here include temporary employment and solo self-employment.

solo self-employed (or 'own-account' ([177])) workers, can choose to work for multiple clients. Non-standard workers may also see such employment forms as a stepping-stone to more permanent contracts. ([178]) In addition, more fixed-term forms of employment relationship are common for jobs with a higher rate of seasonal employment, such as those in hospitality and tourism. On the other hand, due to its limited duration, temporary employment – which is by definition fixed-term – can be associated with higher job insecurity, especially when workers do not subsequently move to more stable and permanent jobs. ([179]) Solo self-employment can also be marked by job insecurity, involve elevated risks of precariousness ([180]) (not least because in many EU countries it implies more limited access to social protection compared to permanent employment ([181])), and may conceal dependent employment relationships and bogus self-employment ([182]), as well as signalling labour market segmentation within sectors and occupations. A recent European Commission report on the implementation of the 2019 Council Recommendation on access to social protection confirmed that many self-employed workers still face significant gaps in social protection coverage. ([183]) In 2022, 19 Member States had at least one branch of social protection for which self-employed people were not covered, and, where participation in social protection schemes was voluntary for the self-employed, take-up rates were generally low. Despite offering flexibility and lowering barriers to labour market access for some workers, employment statuses that involve lower job security and elevated risks of precariousness (including due to associated gaps in social protection) can contribute to less favourable employment and working conditions in certain shortage sectors and occupations, in particular where workers do not actively seek them out.

Temporary employment and solo self-employment are common in certain subsectors with persistent labour shortages but far less typical in others. In 2021, the share of temporary employment was substantially higher for social work activities without accommodation (17%) and residential care activities ([184]) (16%), compared to the EU average (12.1%). By contrast, these shares were lowest for architectural and engineering (7%) and computer programming, consultancy, and related activities (7%). Across shortage subsectors, architectural and engineering activities (20%), specialised construction activities (19%), construction of buildings (13%), and computer programming, consultancy and related activities (11%) recorded above EU average (10.3%) shares of solo self-employed workers. ([185])

Dependent self-employment is highest in the construction and human health and social work sectors, and comparatively low in the ICT sector. ([186]) With self-employed workers constituting a heterogeneous group of workers overall, their economic and organisational dependency are factors that are useful in assessing the boundaries between employment and self-employment. Across shortage sectors, the largest share (17%) of dependent self-employed workers without employees is in construction, followed by human health and social work activities (11%). Professional, scientific, and technical activities contain a substantial share of both dependent (10%) and independent (13%) self-employed people, with ICT (7%) recording a lower share of dependent self-employed workers. ([187])

([177]) Own-account workers are those who, working on their own account or with one or more partners, hold the type of job defined as a self-employed job, and have not engaged any employees to work for them on a continuous basis during the reference period.

([178]) (Filomena and Picchio, 2021).

([179]) While temporary contracts can facilitate entry to the labour market for low-skilled and young workers, there is a risk they may not move to more stable and permanent jobs (European Commission, 2022g).

([180]) Solo self-employed people in the selected Member States are particularly vulnerable to in-work poverty (Horemans and Marx, 2017). A recent report also analyses the AROP and SMSD rates for solo self-employed workers in selected Member States (De Becker et al., 2022).

([181]) (Spasova and Wilkens, 2018).

([182]) For example, labour market segmentation is a major challenge in Poland. One instrument that impedes social security coverage is bogus self-employment. Civil law contracts are the most common instrument replacing full-time employment, with data suggesting that 20-30% of workers have these precarious contracts.

([183]) (European Commission, 2023b).

([184]) Residential care includes activities for the elderly and people with disabilities, those with mental and substance abuse issues, nursing, and other residential care activities.

([185]) At sectoral level, the share of temporary employment was above the EU average for administrative and support services, and human health and social work activities. The share of solo self-employment was above the EU average for professional, scientific, and technical activities, construction and information and communication activities (Chart A.6 and Chart A.7).

([186]) Based on the 2017 EU-LFS ad hoc module on self-employment, which defined dependent self-employment as having one client or one dominant client in the past 12 months.

([187]) No reliable data for the subgroup of own-account workers by sector.

Box 2.8: Measuring job quality in subsectors and occupations with persistent labour shortages

Job quality is a multidimensional concept that is used to complement job quantity measures, with different actors and disciplines emphasising different dimensions.

Eurofound's 2021 EWCTS ([1]) captured six dimensions of job quality: physical and social environment; job tasks; organisational characteristics; working time arrangements; job prospects; and intrinsic job features. The job quality indicator uses a methodology developed by the OECD that compares job demands (which affect workers negatively) and job resources (which affect workers positively). When workers have more demands than resources, they experience poorer job quality or job strain.

The job quality index is positively associated with well-being. ([2]) The dimensions of work and employment included in the index have been selected for their positive/negative association with health and well-being, as demonstrated in high quality epidemiological prospective studies. Occupation and sector have been identified as important determinants of all job quality indices ([3]) and variation in job quality indices can be observed across both elements.

Where job strain is reported as high, this suggests that improving job quality in the sectors and occupations experiencing persistent labour shortages could potentially increase their attractiveness and participation rates. Job strain also entails higher risks to health and well-being.

([1]) EWCTS is a Europe-wide probability-based survey conducted between March and November 2021. It was carried out via telephone survey, unlike the previous 2015 European Working Conditions Survey (EWCS), which used face-to-face interviews. Data collection for the EWCTS took place when the specific demands of the COVID-19 pandemic may still have had an effect on jobs.

([2]) (OECD, 2022b).

([3]) (Eurofound, 2021).

In 2021, workers reported high levels of job strain in some sectors and occupations characterised by persistent labour shortages (Chart 2.29). This was particularly evident in the health (48%), residential care (notably in the context of the on-going COVID-19 pandemic) (47%), ([188]) and transport (41%) sectors, which were far above the EU average (30%). The share of extremely strained jobs was nearly double the average (4%) in residential care and health sectors (Chart 2.28). By contrast, computer programming, consultancy and related services (9%) and architectural and engineering activities (14%) reported levels of job strain well below the EU average. ([189]) ([190]) Across shortage occupations, job strain was substantially higher for nurses (61%), carers (55%), drivers (44%), cooks and bartenders (43%), doctors (43%), and cleaners (36%). It was about average for building, sheet metal, electrical workers, and shop salespeople, and well below average for computer developers (Chart 2.30).

([188]) Results should be interpreted within the context of the COVID-19 pandemic, with the EWCTS being carried out between March and November 2021.

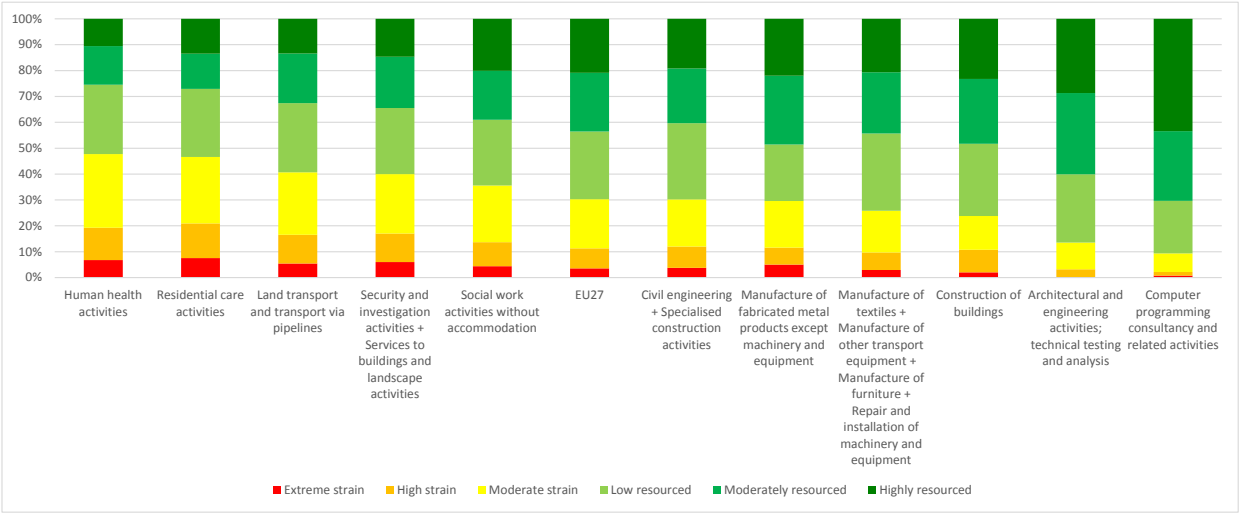
([189]) When the number of observations collected within a subsector/occupation of interest was too low to provide reliable statistical estimations, the respective subsector/occupation was merged with other subsector(s)/occupation(s) within the same sectoral/occupational group of close level.

([190]) Even though the EU average is referred to as a value distinguishing better and worse results, it is worth noting that not in all cases is the EU average itself is not always a satisfactory result.

Chart 2.29

Job strain was highest for health, residential care, and transport workers

Job quality index (%), by subsector, EU-27



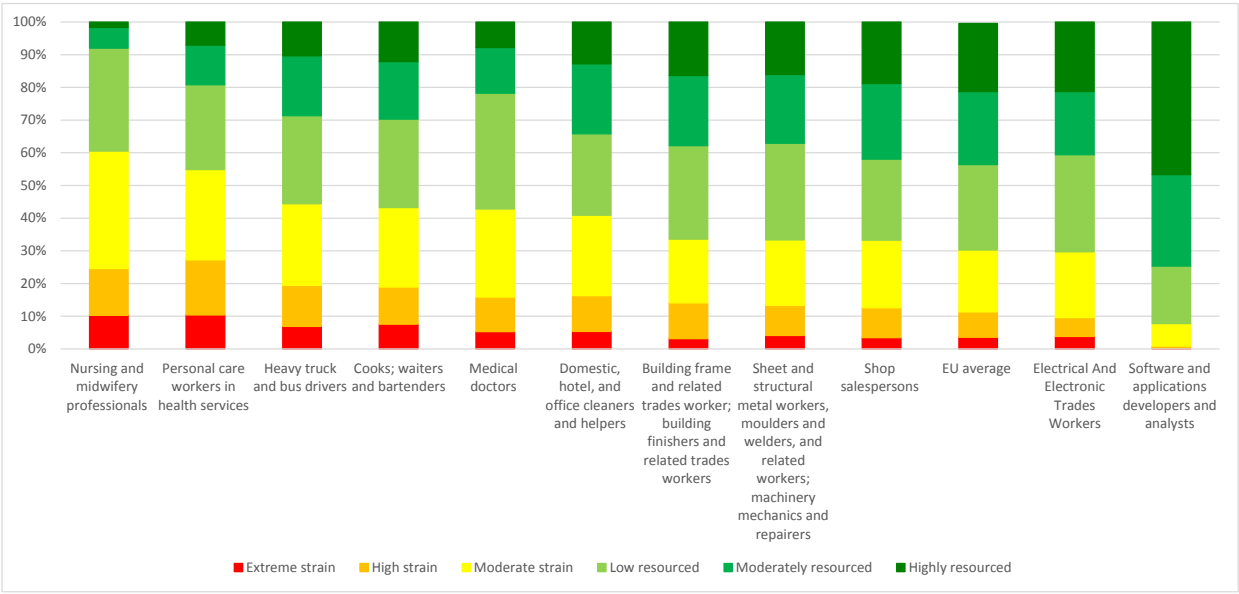
Source: Eurofound, EWCTS 2021.

Click here to download chart.

Chart 2.30

Job strain for nurses was double the EU average

Job quality index (%), by shortage occupation, EU-27



Source: Eurofound, EWCTS 2021.

Click here to download chart.

Nurses and carers indicated far higher than average exposure to all physical risks, physical demands, and social demands. A breakdown of the job quality index for shortage occupations experiencing above-average job strain reveals that work intensity is most severe for medical doctors and nurses, who report higher than average levels of working at high speed, to tight deadlines, and with elevated emotional demands. Looking at job prospects, between one-quarter and one-third of nurses, carers and cooks expect an undesirable change in their work situation. Nevertheless, workers in shortage occupations with above-average job strain (with the exception of cooks and bartenders) report a higher than average level of intrinsic satisfaction with their job, including feelings of carrying out useful work, being able to do their work well, and having enough opportunities to use their knowledge and skills in their current job.

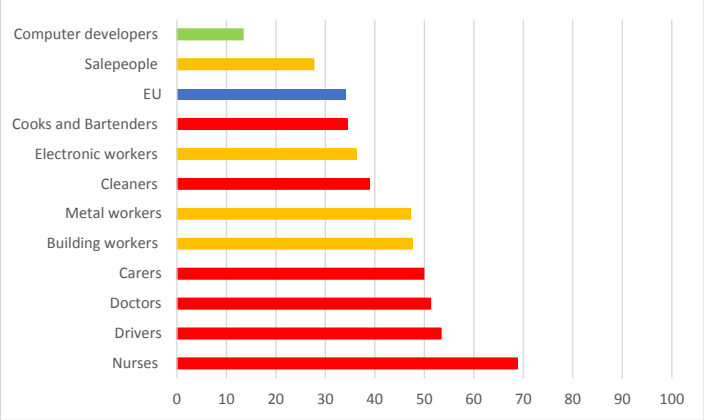
Workers in occupations experiencing persistent labour shortages and significantly higher levels of job strain more often report that their health and safety is at risk because of their work (Chart 2.31). In 2021, the highest levels of health and safety at risk at work were reported by nurses (69%), drivers (53%), doctors (51%) and carers (50%), while it was on par with the EU average (34%) for cooks and bartenders. Data on non-fatal accidents at work also show elevated risks in the construction sector, with 48% of building workers and 47% of metal workers reporting health and safety risks at

work. ([191]) Of the shortage occupations, only computer developers and sales workers report below average health and safety risks at work. Similar conclusions are drawn for shortage sectors experiencing higher levels of job strain, with over half (52%) of the workers in human health and land transportation, 47% of workers in residential care services, and 45% of workers in security activities reporting that their health and safety is at risk at work.

Chart 2.31

High shares of nurses, drivers, doctors and carers report health and safety risks at work

Proportion of workers reporting health and safety risks at work, shortage occupations, 2021, EU-27



Note: Occupations in red/orange/green have a job strain well above/close to/well below the EU average.

Source: Eurofound EWCTS 2021.

Click here to download chart.

Most of the occupations characterised by persistent labour shortages involve substantial customer contact and activities in numerous work locations. Customer contact is less common for cleaners, developers, and metal workers. Except for three shortage occupations (doctors, nurses, computer developers), the use of digital technology at work is below average (see section 3.2.). With the exception of computer developers, activities of shortage occupations mostly take place outside workers' homes, i.e. at their employers' or clients' premises, on the road, or from multiple locations.

When the gender segregation of occupations with persistent labour shortages is considered, three in four female-dominated occupations report higher than average job strain. These include nurses, carers, and cleaners. Gender-mixed shortage occupations, such as cooks and doctors, also report significantly poorer levels of job quality. Most male-dominated shortage occupations report average job strain, with substantially higher overall job quality for computer developers.

Overall, earnings, job strain and employment status could help to explain persistent labour shortages in certain subsectors. Analysing all factors across subsectors with persistent labour shortages, workers in social and residential care and workers in security and services to buildings activities have lower median gross hourly earnings, higher job strain and higher shares of temporary employment, compared to the EU average. ([192]) For the construction of buildings, non-standard employment forms are more common, with lower than average hourly earnings and job strain. By contrast, computer programming, architectural and engineering activities, and specialised construction services stand out as shortage subsectors with higher median gross hourly earnings, ([193]) lower job strain ([194]), and higher shares of solo self-employment than the EU average, with other factors (notably, skills) likely to determine their persistent shortages.

Job strain and adequate pay could play a role in explaining persistent shortages in certain occupations. Of the shortage occupations experiencing higher than average job strain, cleaners, cooks and bartenders, carers, salespeople, building workers, drivers and metal workers report above-average difficulties in making ends meet. Nurses indicate the highest job strain and health and safety risks at work and report less difficulty in making ends meet, but also feel they are not fairly rewarded. By contrast, computer developers and electronic workers report below-average job strain and less difficulty in making ends meet, pointing to other drivers (e.g. skills) as the primary cause of their persistent shortages.

([191]) In 2020, the highest incidence of non-fatal accidents at work in the EU was in construction, with 2 987 accidents per 100 000 people employed [HSW_N2_01].

([192]) Similarly, workers in health have much higher than average job strain and slightly higher shares of temporary employment, paired with above-average hourly earnings. Workers in transport and transport via pipelines activities report lower than average earnings and higher job strain, paired with lower shares of non-standard forms of work.

([193]) Aggregated due to sample sizes. In the case of civil engineering, median gross hourly earnings in PPS are reportedly in line with the EU average.

([194]) To note for the measurement of job strain the sub-sectors civil engineering and specialised construction services were merged, due to sample sizes.

8. CONCLUSIONS

A number of sectors and occupations in the EU are characterised by persistent labour shortages. Important underlying structural drivers include the influence of skills shortages and mismatches, new demands linked to the ongoing green and digital transitions, demographic trends, low labour market participation of certain population groups, occupational segregation by gender, the influence of labour mobility and migration, poor working conditions in some sectors and occupations, inefficient company practices, incentives provided by the tax and benefit systems, and changing worker preferences. In the future, new labour shortages are projected to emerge, likely intensified by the structural changes stemming from the twin transition.

In general, occupations with persistent labour shortages tend to be characterised by demand for lower skills. Employers' recruitment difficulties seem to be largely an outcome of poor HRM practices (e.g. retention issues) and unattractive jobs (e.g. poor working conditions, including high job strain), rather than workers' failing to meet high skills needs. However, there are significant differences across occupations (e.g. ICT professionals). Skills policies play an important role in reinforcing better job performance across all skill levels and enabling access to higher quality jobs. They are also central to addressing expected future labour shortages in higher-skilled occupations, which often require more time and investment to attain the necessary skills and credentials.

The green transition is expected to lead to net job creation of between 1 million and 2.5 million jobs by 2030, with resulting changes in skills needs potentially exacerbating current labour shortages. The estimated effect of the green transition on employment differs across sectors, countries, and skills groups, and will depend on the successful implementation of accompanying policies, including reskilling, upskilling and adult learning. High expansion needs and a strong segregation of men and older workers in some sectors relevant for the green transition, coupled with the increasing demand for technical, transversal and digital skills in those sectors, might contribute to existing and new labour shortages.

The digital transition is associated with increasing demand for ICT professionals, but there is little evidence of its effects on persistent labour shortages more broadly. The numbers of ICT professionals in the EU almost doubled in the last decade and are projected to expand further, driven by the interlinkages between the green and digital transitions. ICT occupations are by far the most digitally intensive form of work in the EU, with around one-third of ICT professionals' skills being digital, compared to less than one-tenth for most other occupations. Lower digital intensity of work among women, older workers, and those with lower levels of educational achievement stems largely from underrepresentation of these groups in ICT work.

Ageing population and insufficient labour market participation of certain groups are key drivers of labour shortages. The decreasing working-age population, together with sustained consumption by a growing older population, will likely drive up labour shortages. The EU suffers from a relatively low participation rate among older people, women (especially mothers of children younger than three years old), lower-educated people, migrants, particularly migrant women, and young people. Increasing the labour market participation of these groups could help to tackle persistent labour shortages. It will also be necessary if the EU is to reach the 2030 Porto target of 78% employment rate and address the higher employment needs resulting from the green transition.

Gender segregation in the labour market contributes to persistent labour shortages. This is true in occupations where men account for the majority of workers (e.g. STEM, including ICT) and in occupations where women are overrepresented (e.g. healthcare). Gender segregation contributes to labour shortages by hindering efficient matching of labour supply and demand, and by shaping supply of certain skills in ways that make suboptimal use of women's and men's talents. A substantial part of gender segregation can often be traced back to gendered participation in certain education paths. Increasing participation of women in relevant educational fields offers an opportunity to mitigate future labour shortages, including in fast-growing jobs, such as ICT, that are relevant for the twin transition.

Migrants residing in the EU have lower labour market participation, hindering their potential to contribute to tackling labour shortages. They are more often employed in occupations already facing persistent labour shortages or projected to experience strong labour shortages in the future in the EU. This is particularly the case for lower-skilled shortage occupations. However, the lack of skills in the host country language(s), difficulties in recognising their formal qualifications obtained abroad, care responsibilities, and discrimination present significant obstacles to migrants in getting a (suitable) job. This leads to lower labour market participation rates and dampens their potential to mitigate existing and future labour shortages, particularly in higher-skilled occupations.

Working conditions might explain the persistence of labour shortages in certain sectors and occupations, but are not the primary driver in others. A number of sectors facing persistent labour shortages record lower median gross hourly earnings, higher job strain, and higher shares of non-standard employment, which can be associated with desired job flexibility, but also lower job security and elevated risk of precariousness than permanent employment. Similarly, some occupations characterised by persistent labour shortages report higher job strain and difficulties in making ends meet. By contrast, high-skilled sectors and occupations, such as ICT professionals, stand out as being better remunerated and having lower job strain, highlighting the need for different types of measures to tackle their shortages.

Policy actions can play a key role in mitigating persistent and future labour shortages. These include supporting labour market matching through upskilling and reskilling, including in the context of changing skills needs in light of the green and digital transitions, increasing labour market participation through provision of effective employment and social services, reforms of tax-benefit systems, attracting and integrating foreign talent into the EU labour market, and improving working conditions, including with the help of social partners. Chapter 3 presents an overview of some selected policy actions that could help to address persistent labour shortages.