Falling Behind

How Skills Shortages Threaten Future Jobs

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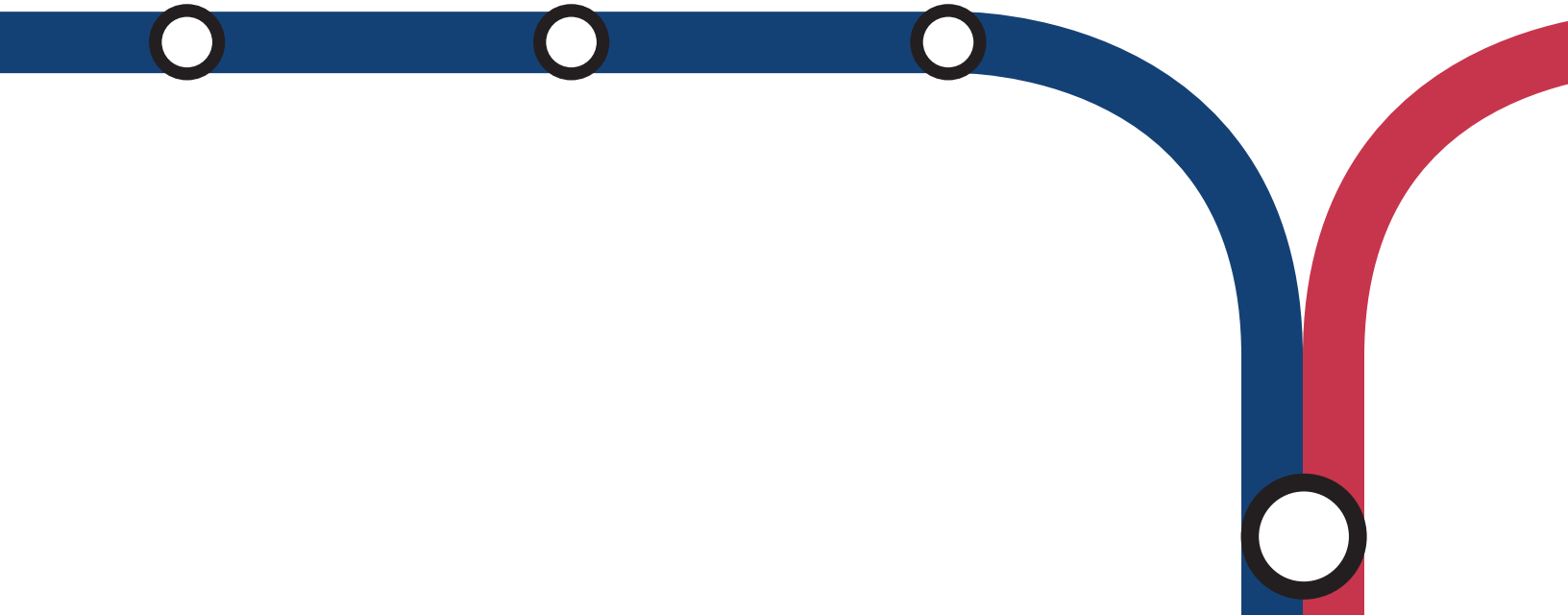

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Introduction

The US is facing a skills shortage brought on by an aging population approaching retirement and a shortfall in the number of young workers with the educational attainment needed to meet labor-market demands. From 2024 through 2032, 18.4 million experienced workers (ages 55–64) with postsecondary education are expected to retire, far outpacing the 13.8 million younger workers (currently ages 16–24) who will enter the labor market with equivalent postsecondary educational qualifications. Compounding the problem, the economy is expected to add 685,000 new jobs requiring at least some postsecondary education and training, further widening the gap between the demand for and the supply of qualified workers. In total, from 2024 through 2032, the US economy will need 5.25 million more workers with education and training beyond high school, 4.5 million of whom will need at least a bachelor's degree.[1] Without massive and immediate increases in educational attainment, 171 occupations will face skills shortages through 2032.[2]

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Skills shortages could be an opportunity for millions of workers, including many from low-income households and marginalized racial/ethnic groups, to gain better access to economic opportunity. But we are running out of time to create the educational and training programs necessary to reach these potential workers and convey the skills they need to succeed—and meanwhile, the economy is missing out on their talents. Every year, more than 500,000 students from the top half of the high school class do not go on to complete a college credential, whether they never enroll in college or enroll and don't complete.[3] In addition, approximately 36.8 million American workers have started postsecondary education but never completed a credential.[4] These workers are poised to help fill skills gaps by finishing the credentials that would allow them to reach their full potential.

Further complicating the issue, the skills crisis is emerging at a time of profound skepticism about the value of postsecondary education. Growing student loan debt is one factor driving this skepticism, and the large number of college students who never finished a degree has played an outsized role in the massive increase in student loan debt.[5] Meanwhile, high unemployment rates among recent college graduates are generating speculation that a slow economy combined with growing adoption of artificial intelligence may be tamping down the demand for workers with college degrees.[6]

All things considered, the public reassessment of higher education threatens to undermine the potential for policy and practice to address skills shortages. Denying the value of postsecondary education isn't the answer, as pursuing a college degree or obtaining some postsecondary training remains one of the few viable ways future workers can acquire the qualifications necessary for future

1 Georgetown University Center on Education and the Workforce analysis of data from the US Census Bureau and Bureau of Labor Statistics, Current Population Survey (CPS), 1992–2023; US Census Bureau, American Community Survey (ACS), 2019–23; and US Bureau of Labor Statistics, *Employment Projections,* 2023. Values in this paragraph may not sum to totals due to rounding.
2 The occupations with expected shortages are listed in Appendix E.
3 Georgetown University Center on Education and the Workforce, *The Forgotten 500,000 College-Ready Students*, 2018.
4 Berg et al., *Some College, No Credential,* 2024.
5 Itzkowitz, "The College Completion Crisis Fuels the Student Debt Crisis," 2024.
6 Thompson, "Something Alarming Is Happening to the Job Market," 2025.

jobs. Furthermore, shifting to skills-based hiring alone won't solve the challenge, as postsecondary education and training are still the primary pathways to develop the advanced skills needed to sustain a thriving economy.

To overcome the skills crisis and repair the pathways from education to work, we need aggressive workforce, education, and training policy—and dedicated resources. Under ideal circumstances, the US would invest in policies aimed at enhancing enrollment and completion in college and training programs, especially for workers who have a high school diploma or less.

In addition, we could use technology to alleviate some projected skills shortages. Technology could increase worker productivity by providing scalable training and educational opportunities through online platforms; it could also supplement human labor by increasing workplace productivity through careful use of automation, artificial intelligence, and advanced robotics. For this to happen, however, we need a concerted effort to ensure that the use of technology enhances rather than replaces human work.

In this report, we explore what is causing the skills shortage, and we detail how the shortage of workers with education and training beyond high school will play out between 2024 and 2032. We look at nine specific occupations that will be particularly affected: accountants, attorneys, construction workers, doctors, engineers, managers, nurses, teachers, and truck drivers. We also examine potential strategies to address the impending skills shortage and mitigate its impact on the US economy. These include making education more affordable, offering alternative credential pathways, encouraging partnerships between postsecondary institutions and employers, and using technology to improve worker productivity.

These changes can make a meaningful difference in resolving the skills shortage through 2032. But if we don't act now, the gap will keep growing between what people are learning and the skills that jobs require, leaving many workers unprepared for the future of work. If that happens, the skills shortage could undermine the US's ability to remain competitive in the world economy.[7]

7 Revell, "US Has a Shortage of Manufacturing Workers and It Threatens Global Competitiveness," 2024.

How We Calculate Projected Skills Shortages

This report estimates anticipated skills shortages in the national economy and in specific occupational groups based on (1) the flow of workers into and out of the labor market and (2) the growing labor-market demand for workers with specific levels of educational attainment. Our analysis focuses on the following questions:

- ***Where*** are skills shortages expected within the American economy?
- ***How many*** more workers with a high school diploma or less, a middle-skills education, or a bachelor's degree or higher will be needed to fill these skills shortages?

To answer these questions, we compared the number of workers at each level of education who are poised to exit the labor market from 2024 through 2032 (workers currently ages 55–64) with the number of workers poised to enter the labor market through the same year (people currently ages 16–24). We also factored in the role of job growth by including data on the increase in net new jobs through 2032, with the understanding that new job opportunities can further exacerbate skills shortages if there aren't enough qualified individuals to fill these jobs. We then made the following assumptions:

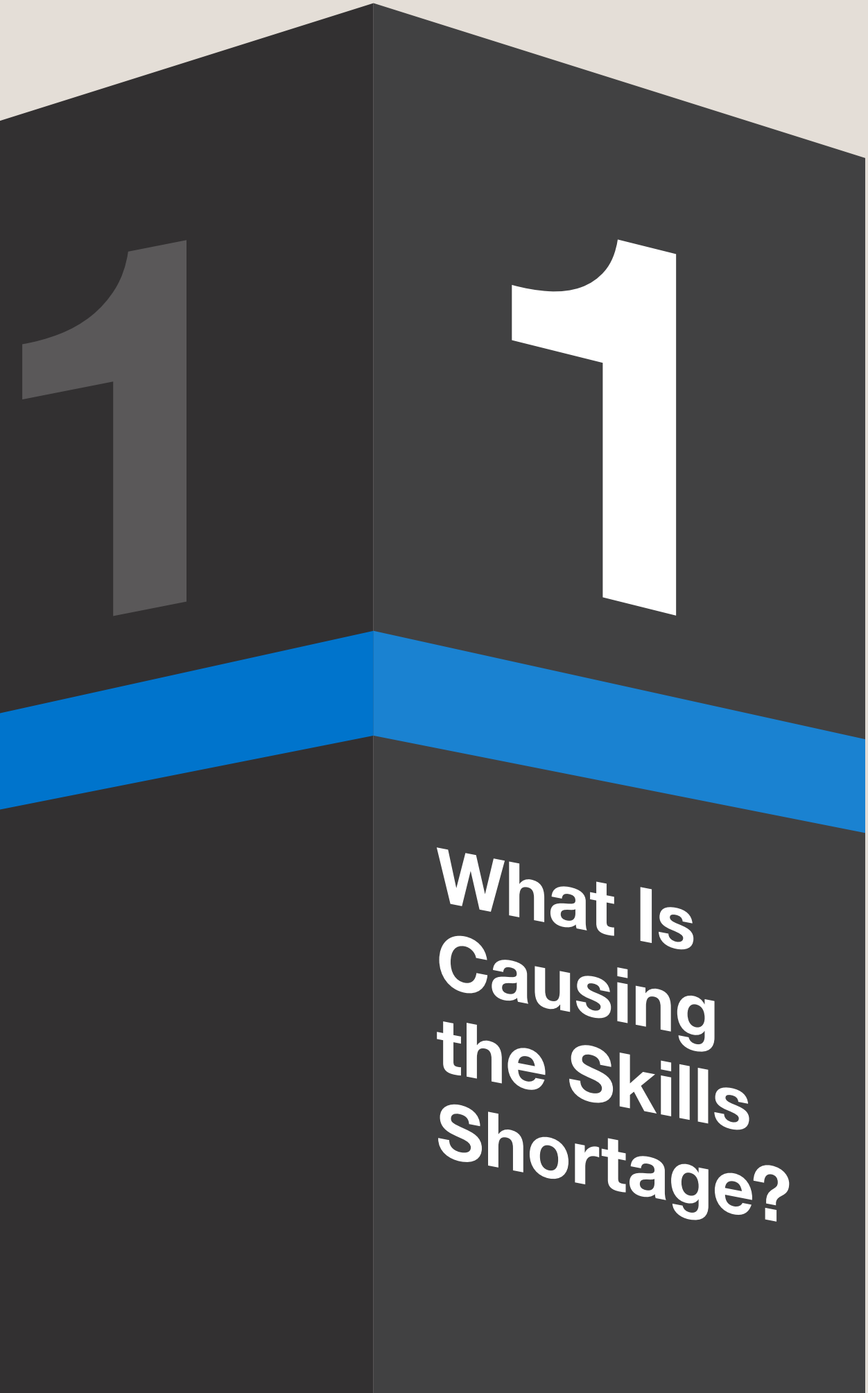
- The educational attainment and occupational distribution of the youngest cohort of workers will mirror that of the next oldest cohort (workers currently ages 25–34).
- The entering cohort will participate in the workforce at the same rate as the next oldest cohort. (We assume fixed labor-force participation rates.)
- The youngest workers will enter jobs vacated by the next oldest cohort, who will move into jobs vacated by the cohorts above them in a stepwise fashion.

We adjusted our analysis to account for the changing demand for skills in the labor market by examining changes in the level of educational attainment that employers expect from workers. We also adjusted the analysis to account for both upskilling within occupations (which has shifted employers toward hiring workers with higher levels of educational attainment) and growth (or reductions) in the number of jobs within occupations.

We followed a consistent and transparent methodological approach to estimate workforce shortages across the economy. Our estimates of skills shortages may differ from those of groups making similar occupational forecasts because the assumptions and data sources used by those groups may vary from study to study.[8]

For a more detailed description of our methodological approach, see Appendix A.

8 For example, some studies use online job postings as estimates of job demand, while others assume all job openings published by the US Department of Labor are shortages. Other studies count jobs that have been filled as skills shortages if the workers who fill them do not possess industry-specific credentials.



What Is Causing the Skills Shortage?

Part 1.
What Is Causing the Skills Shortage?

The skills shortage has been looming for decades. The baby boom generation, the largest demographic cohort born in US history, was bound to leave a chasm in its wake as it left the labor force. As baby boomers retire in increasing numbers, they are taking with them a combination of education, skills, and experience accumulated over decades of working. Younger workers are entering the labor market with higher levels of educational attainment than departing older workers, but because the younger cohort is smaller than the older cohort, there are fewer younger workers with postsecondary credentials than retiring older workers. The overall result is a shortage of workers with the postsecondary credentials we associate with in-demand skills. The cohort of younger workers is hard-pressed to match the education and skills, and certainly cannot match the experience, of those who are leaving the labor force.[9]

Overall, we project that from 2024 through 2032, the United States will see a skills shortage of 5.25 million workers with at least some college education, divided into the following educational categories:

As baby boomers retire in increasing numbers, they are taking with them a combination of education, skills, and experience.

- 4.5 million workers with a bachelor's degree or higher, and
- 750,000 workers with middle skills, including those with an associate's degree, a postsecondary vocational certificate, or some college but no degree.

At the same time, we will see a surplus of

- 131,000 workers with a high school diploma or less.

9 Because our estimates based on educational attainment do not account for differences in work experience, they may underestimate the true magnitude of the skills shortage. However, our approach assumes that workers vacating the labor force are replaced in their roles by the next most qualified workers—those with similar education and experience—whose roles are likewise filled in a stepwise fashion by the next most qualified. This approach assumes that the job openings appear at the bottom of the career ladder.

Labor Shortages and Skills Shortages

Labor shortages and skills shortages are closely connected. A **labor shortage** occurs when "the quantity of workers demanded exceeds the supply available and willing to work at the prevailing wage and working conditions at a particular place and point in time."[10] This can arise due to demographic shifts, such as a declining working-age population, increased retirement rates, or reduced participation in the workforce. It can also be influenced by factors such as migration patterns, when low levels of immigration or high levels of emigration result in fewer available workers. A labor shortage may result in difficulty filling positions across a range of sectors and a variety of education levels, leading to increased competition for workers and potential disruptions in business operations.

A **skills shortage** is a "shortfall in the aggregate supply of a certain skill or set of skills broadly sought by employers."[11] In a skills shortage, the supply of workers possessing the specific skills, qualifications, or expertise required by employers is insufficient to meet demand. Such shortages typically arise in industries or sectors that require specialized knowledge, advanced technical abilities, or certifications that are not readily available within the existing workforce. Declining labor-force participation and rising retirements among workers with in-demand skills also contribute to skills shortages.

Skills shortages often emerge due to advancements in technology, evolving industry standards, or failure of the education and training systems to equip individuals with the degrees they need. When skills shortages occur, employers struggle to fill positions that require particular skills, representing misalignment between the qualifications of job seekers and the needs of employers. With a skills shortage, even if sufficient numbers of workers are available, employers may struggle to find individuals with the precise qualifications necessary to meet their needs.

While both labor shortages and skills shortages influence the dynamics of the US labor market, this report focuses exclusively on skills shortages. As we discuss, the projected shortages are concentrated among workers who have attained education and training beyond the high school level.

10 Barnow et al., *Occupational Labor Shortages*, 2013.
11 Donovan et al., *Skills Gaps*, 2022.

The skills shortage results from a set of complex intertwining factors.

The extent to which the workforce can meet the demand for skills is shaped by educational attainment within the population (and subpopulations) and the ability of the education system to meet emerging needs for credentialing, upskilling, and retraining. The factors contributing to the skills shortage include the following:

- too few young Americans attaining postsecondary credentials to replace the educated exiting retirees;
- growing educational demand from employers that outstrips the educational attainment of potential workers;[12]
- uneven improvements in K–12 graduation rates and declining academic preparation for college;
- declines in college enrollment[13] and low completion rates for the fastest-growing population groups;[14]
- declining labor-force participation rates among workers at all levels of educational attainment;[15]
- a decline in immigration, with the likelihood of further restrictions that will limit the availability of skilled foreign-born workers;[16] and
- uncertainty over whether generative artificial intelligence (AI) will ease or worsen existing skills shortages.

In this section, we describe how the factors listed above may be contributing to the skills shortage.

Fewer young Americans with postsecondary attainment than older educated Americans exiting the workforce

Older workers contribute valuable experience, skills, and expertise that benefit their organizations through direct work as well as mentorship and skills transfer. When they leave the labor force, these workers take with them not only institutional knowledge but also specialized skills that are difficult to replace—especially in the short term.

From 2024 to 2032, we expect 18.4 million workers with postsecondary education to retire from the labor market.[17] This exodus of educated retirees is likely to be challenging for employers, given the smaller size of incoming cohorts: We expect 13.8 million workers with postsecondary education to enter the labor market during the same period. The shrinking number of workers with postsecondary education reflects an overall demographic shift. As others have reported, the country is facing a "demographic cliff," with the number of high school graduates expected to decline by 10 percent over roughly the next decade (from a high of 3.9 million graduates in 2025 to 3.5 million by 2037).[18]

While there are fewer total workers in the incoming cohort, these workers have higher overall levels of educational attainment than the departing cohort. The public high school graduation rate reached 87 percent in 2021–22, up from 80 percent as recently as 2011–12.[19] In 2024, combined undergraduate and graduate student enrollment levels were up by 4.5 percent over 2019 levels.[20] The six-year college completion rate for the fall 2018 cohort was 61.1 percent, the highest in 12 years.[21] But there are

12 Carnevale et al., *Help Wanted*, 2010. See, in particular, Appendix 4.
13 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics,* Table 303.25, 2021.
14 US Department of Education, National Center for Education Statistics, "Indicator 23: Postsecondary Graduation Rates," 2019.
15 Krueger, "Where Have All the Workers Gone?," 2017.
16 Duzhak, "The Role of Immigration in U.S. Labor Market Tightness," 2023.
17 We use age 65 as a proxy for retirement age in this report. There is no official retirement age in the US, but the average retirement age in 2024 was 65 for men and 63 for women. Center for Retirement Research at Boston College, "Average Retirement Age for Men and Women, 1962–2024," n.d. The age of eligibility to receive full Social Security benefits has gradually increased. It was 65 for decades, but is now 67 for those born in 1960 or later. US Social Security Administration, "Retirement Age Calculator," n.d.
18 Bransberger et al., *Knocking at the College Door*, 2020.
19 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics*, Table 219.46, 2023.
20 National Student Clearinghouse Research Center, *Current Term Enrollment Estimates: Fall 2024,* 2025.
21 National Student Clearinghouse Research Center, *Yearly Progress and Completion,* 2024.

signs that growth in enrollment and completion is beginning to falter. At the postsecondary level, the total number of undergraduate completers increased by a modest 0.6 percent in 2023 compared with the previous year, the first rise in three years. In addition, the numbers of both associate's degrees and bachelor's degrees awarded declined, with associate's degree awards dropping by 0.9 percent and bachelor's degree awards declining by 1.3 percent compared with the previous year.[22] Thus, the rise in overall completions was due to increases in the number of undergraduate certificates conferred. These data reveal concerning trends in postsecondary attainment.

The convergence of these trends—an exodus of educated retirees that outpaces the influx of younger workers with postsecondary education—threatens to exacerbate existing skills gaps.

Growing demand from employers for higher educational attainment among workers

While demographic shifts and educational attainment patterns are primary contributors to the skills shortage, changes in demand by occupation are also a factor. These changes reflect trends in occupational growth as well as trends in upskilling.

Occupational growth encompasses the combined effects of job growth and replacement growth, with job growth referring to the creation of new roles driven by industry expansion, technological advancements, and shifts in economic demand, and replacement growth reflecting the need to fill positions vacated by workers retiring or transitioning to new occupations. About one-third of the overall increase in educational requirements comes from shifts in economic growth toward industries and occupations that tend to require more education.

The other two-thirds of the increase comes from rising skill requirements within existing occupational categories—a phenomenon known as "upskilling."[23]

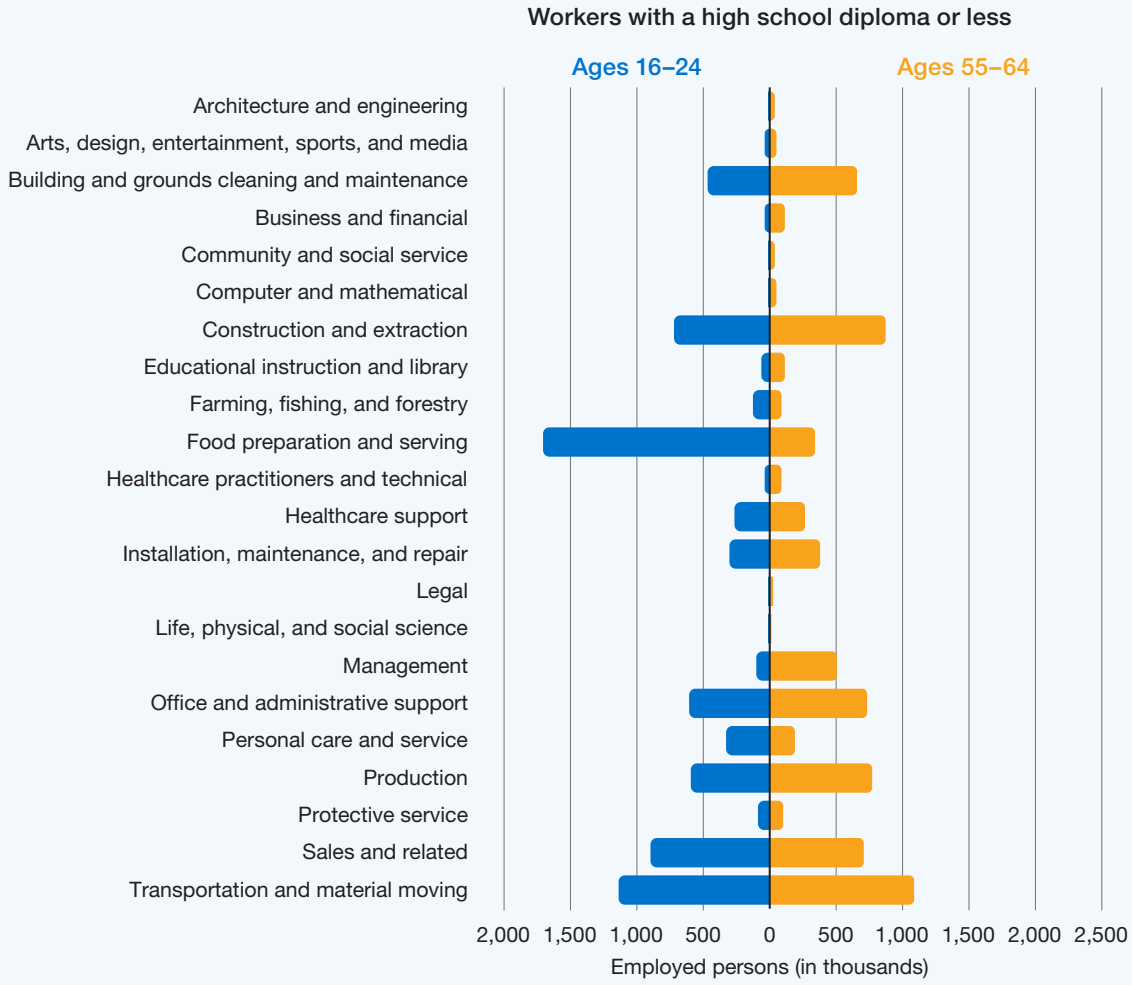
We anticipate that upskilling, and with it the demand for higher levels of education, will continue to grow, intensifying longstanding trends: In the early 1980s, the American economy featured more jobs for workers with less than a high school education than for college graduates—only 32 percent of jobs required any postsecondary education and training beyond high school in 1983. By 2022, that share had climbed to 68 percent. We project that 72 percent of jobs in 2031 will require at least some postsecondary education and/or training.[24]

In the figures below, we examine projected skills shortages within a variety of occupations at three broad levels of educational attainment: a high school diploma or less, middle skills (those with some college or an associate's degree but without a bachelor's degree), and a bachelor's degree or higher.

The demand for workers with a high school diploma or less has diminished as the labor market increasingly prioritizes roles that require higher levels of skill and specialized knowledge. And yet, the number of workers ages 16–24 expected to enter the workforce with a high school diploma as their highest level of attainment is larger than the number of similarly qualified workers ages 55–64 leaving the workforce. Occupations that are seeing a net gain in the number of workers with a high school diploma as their highest level of attainment include management, building and grounds cleaning and maintenance, and production occupations (Figure 1). However, some occupations have higher concentrations of 55-to-64-year-olds with a high school diploma than others. The high concentration of older workers is particularly concerning in occupations such as construction and extraction where the loss of experienced workers creates significant knowledge gaps. Transportation and material moving is another occupation facing similar challenges. Without targeted workforce development initiatives, these shortages could lead to productivity declines and economic disruptions.

22 National Student Clearinghouse Research Center, *Undergraduate Degree Earners,* 2025.
23 Carnevale et al., *Help Wanted*, 2010. See, in particular, Appendix 4.
24 Carnevale et al., *After Everything,* 2023.

Figure 1. Among workers with a high school diploma or less, there are far more older workers than younger workers in occupations such as construction and extraction.

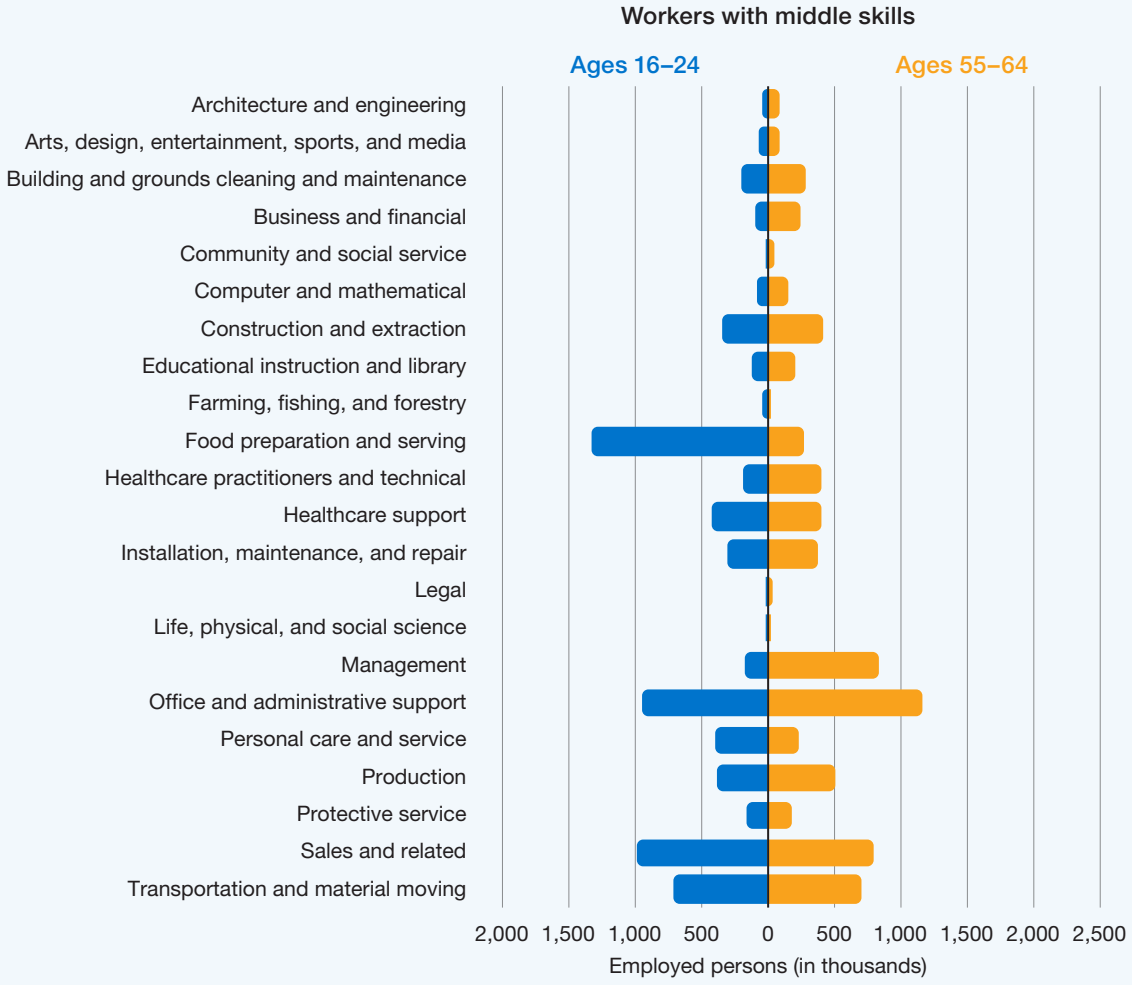


Source: Georgetown University Center on Education and the Workforce analysis of data from the US Bureau of Labor Statistics and the US Census Bureau, American Community Survey, 2022.

Note: We applied the educational attainment and occupational distribution of workers currently ages 25–34 to workers ages 16–24 to estimate the expected attainment and occupation of these younger workers as they enter the labor force.

At the middle-skills level,[25] there is an insufficient supply of younger workers to replace the older workers anticipated to retire from occupations such as office and administrative support and healthcare practitioners and technical occupations (Figure 2).

Figure 2. Among workers with middle skills, older workers outnumber younger workers in many occupations, including office and administrative support occupations and healthcare practitioners and technical occupations.



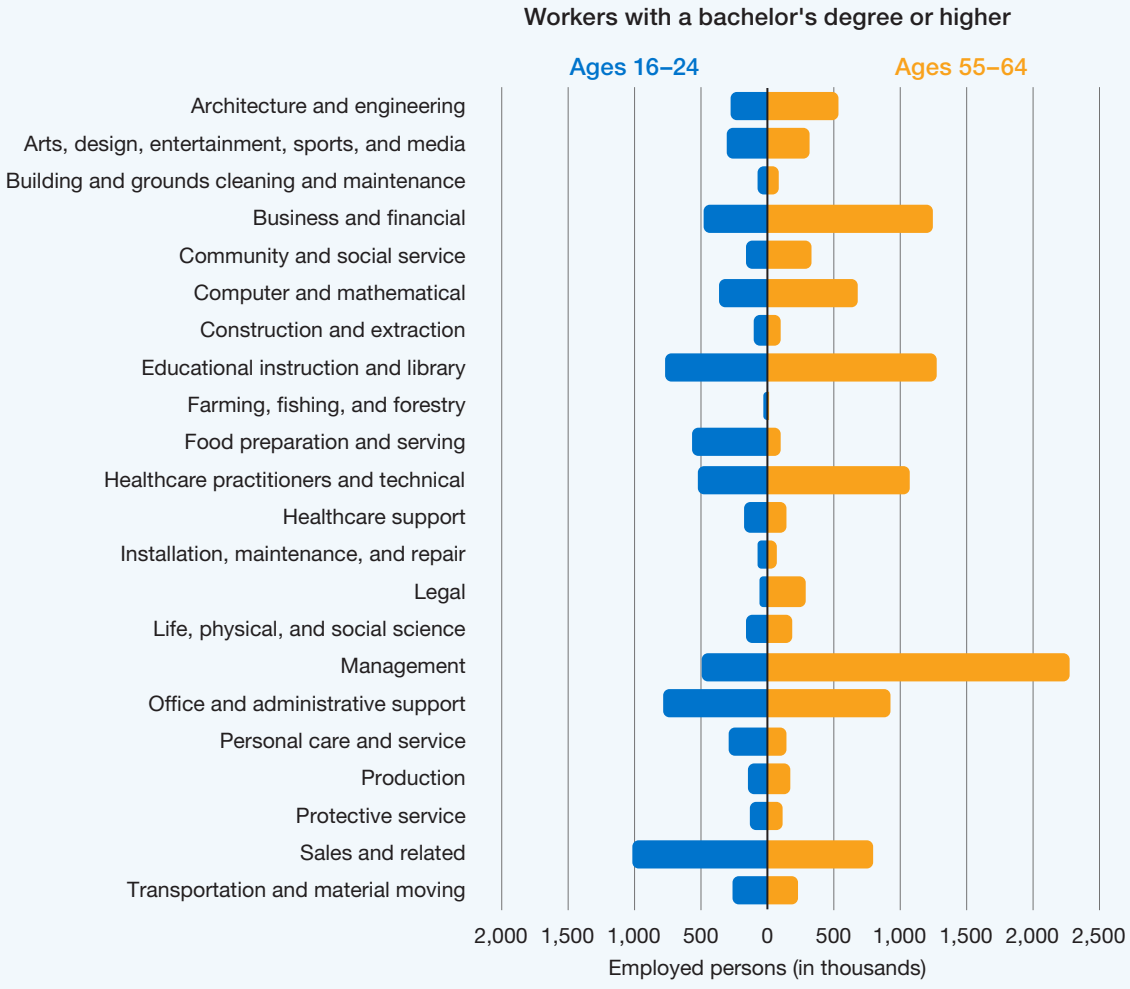
Source: Georgetown University Center on Education and the Workforce analysis of data from the US Bureau of Labor Statistics and the US Census Bureau, American Community Survey, 2022.

Note: We applied the educational attainment and occupational distribution of workers currently ages 25–34 to workers ages 16–24 to estimate the expected attainment and occupation of these younger workers as they enter the labor force.

25 Middle-skills workers are those with a higher educational attainment than a high school diploma but less than a bachelor's degree. This category includes people with an associate's degree, a certificate, or some college credits but no postsecondary credential.

Among workers with a bachelor's degree or higher, the cohort ages 16–24 is significantly smaller than the cohort ages 55–64. This demographic disparity suggests an insufficient number of younger workers to replace those expected to retire—especially from careers in management, business and financial, educational instruction and library, and healthcare practitioners and technical occupations (Figure 3).

Figure 3. Older workers with a bachelor's degree or higher outnumber younger workers with equivalent educational attainment in many occupations, including management, business and financial, educational instruction and library, and healthcare practitioners and technical occupations.



Source: Georgetown University Center on Education and the Workforce analysis of data from the US Bureau of Labor Statistics and the US Census Bureau, American Community Survey, 2022.

Note: We applied the educational attainment and occupational distribution of workers currently ages 25–34 to workers ages 16–24 to estimate the expected attainment and occupation of these younger workers as they enter the labor force.

Uneven improvements in K–12 graduation rates and declining academic preparation for college

As noted above, high school graduation rates have been increasing rapidly.[26] However, there are reasons to be concerned about students' educational preparation. Within cohorts, there are notable gaps in high school graduation rates by race/ethnicity and sex. In 2022, the high school graduation rate was 94 percent for Asian/Pacific Islander students and 90 percent for white students, but was much lower for students of other races/ethnicities: 83 percent for Hispanic/Latino students, 81 percent for Black/African American students, and 74 percent for American Indian/Alaska Native students.[27] In 2023, the high school graduation rate was 85 percent for young men and 90 percent for young women.[28]

Even as graduation rates are on the rise, K–12 academic performance is slipping. For example, American students' scores on the Trends in International Mathematics and Science Study have fallen precipitously in recent years. Math scores for fourth graders in 2023 were similar to those in 1995, when the test was first given, despite decades-long efforts in the US to raise standards and increase school choice. The results showed that US fourth graders scored just above the average of all countries in math, with scores similar to those of students from Hungary and Portugal.[29] Only 39 percent of US students who took the SAT met or exceeded college readiness benchmarks on both the writing and math sections of the test,[30] suggesting that too many high school graduates are unprepared for the academic rigor of four-year degree programs.

High school graduation gaps and inadequate preparation for postsecondary education have significant implications for skills shortages down the road. Most young people will need to do more than just complete high school. They will also need at least some postsecondary education and training to acquire the skills necessary for many jobs in the labor force, especially given the projected surplus of workers with only a high school diploma and the rising demand for workers with education and training beyond high school. Young men of all races/ethnicities lag behind young women in graduating high school and completing postsecondary credentials. While many young men with a high school diploma or less can potentially find jobs in the blue-collar economy, their chances of reaching the middle class are lower without postsecondary education and training.[31]

Declining college enrollment and low completion rates among the fastest-growing population groups

For decades, it was easy to find new college graduates to fill the shoes of retiring workers. College enrollment rose continuously for 40 years, starting in 1970, when 8.6 million students were enrolled in US colleges, until 2010, when 21 million students were enrolled—a rate of growth that was more than 5.5 times the rate of population growth for 18-to-24-year-olds over a similar time period.[32,33] But that trend has changed, influenced by factors that include rising tuition, the impact of the COVID-19 pandemic, and changing perceptions of the value of a college education.[34] College enrollment declined for 11 consecutive years after

26 While high school graduation rates have improved, the shrinking youth cohort means fewer total graduates. The total number of high school graduates is projected to drop from 3.9 million in 2025 to 3.5 million in 2037 despite higher completion rates. Bransberger et al., *Knocking at the College Door*, 2020.
27 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics*, Table 219.46, 2023.
28 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics*, Table 219.40, 2024.
29 Goldstein, "U.S. Students Posted Dire Math Declines on an International Test," 2024.
30 College Board, "SAT Participation Continues to Grow as the SAT Suite Successfully Completes Its Transition to Digital Testing," 2024. The college readiness benchmarks are scores at or above 480 on the reading and writing portion and at or above 530 on the math portion of the SAT. Students who score at those levels have a 75 percent chance of earning at least a C in first-semester college-level courses. College Board, "SAT Suite of Assessments: Benchmarks," n.d.
31 Carnevale et al., *Three Educational Pathways to Good Jobs*, 2018.
32 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics,* Table 303.25, 2021.
33 Georgetown University Center on Education and the Workforce analysis of data from the US Census Bureau, *2023 National Population Projections Tables*, Table 2, 2023.
34 Meyer, "The Case for College," 2023.

2010, dropping to 18.7 million in fall 2021.[35] The US Department of Education projects another reversal of this trend, with college enrollment expected to increase by 8.4 percent from 2021 to 2031.[36] But even if total enrollment reaches 20.2 million in 2031 as projected, it will still be lower than it was in 2010.[37]

There are serious gaps in college enrollment and completion by race/ethnicity. About 74 percent of Asian/Asian American students and 64 percent of white students graduate within six years of entering a bachelor's degree program, but completion rates are far lower for Hispanic/Latino students (54 percent) and Black/African American students (40 percent).[38] In the near future, colleges will face an important challenge: The racial/ethnic groups that historically have had the highest college completion rates are the same groups experiencing declining enrollments, and the racial/ethnic groups that historically have had among the lowest completion rates are the ones experiencing rising enrollments. By 2030, college enrollment is expected to increase by just 3 percent for white students while decreasing by 7 percent for Asian/Pacific Islander students.[39] The largest increases in postsecondary enrollment through 2030 are expected among Hispanic/Latino students (21 percent) and Black/African American students (19 percent).[40]

College graduation rates on the whole have been rising, but primarily because the most prepared students from higher–socioeconomic status backgrounds are the ones most likely to enroll in college.[41] The number of bachelor's degrees conferred increased by 19 percent from 2010–11 to 2019–20.[42] As more students from groups with historically lower completion rates enter college—including students from lower–socioeconomic status backgrounds and historically underrepresented racial/ethnic groups—educators will need to grapple with new challenges related to student preparedness and support in order to increase graduation rates and narrow the skills gap.

Enrollment and completion gaps among racial/ethnic groups present a historic opportunity: We can simultaneously address the skills shortage while more fully extending workforce opportunities to members of underrepresented racial/ethnic groups who historically have not had access to them.

Declining labor-force participation rates that are more pronounced for workers with lower levels of educational attainment

Higher labor-force participation rates can help address skills shortages because when more individuals participate in the workforce, employers have a broader pool of talent to draw from.[43] However, because labor-force participation rates are lower among workers with lower levels of educational attainment, policies to boost participation will help address skills shortages only if they are targeted toward workers with higher levels of attainment, or if they include substantial education and training resources for upskilling—or both.

The US economy is not currently enjoying the benefits of high labor-force participation. In fact, the US labor-force participation rate (LFPR)—the percentage of working-age individuals who are either employed or actively seeking employment—has been declining since 2000, when it peaked at 67.3 percent.[44] The rate dropped as low as 60.1 percent in the midst of the COVID-19-induced recession, although it has rebounded slightly, hovering between 62 percent and 63 percent since the beginning of 2022.[45]

35 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics*, Table 303.25, 2021.
36 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics*, Table 303.10, 2023.
37 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics*, Table 303.10, 2023.
38 US Department of Education, National Center for Education Statistics, "Indicator 23: Postsecondary Graduation Rates," 2019.
39 These projections, reported by the US Department of Education's National Center for Education Statistics, are based on historical data that cannot be disaggregated to provide separate estimates for Asian/Asian American and Pacific Islander students. Irwin et al., *Projections of Education Statistics to 2030*, 2024.
40 Irwin et al., *Projections of Education Statistics to 2030*, 2024.
41 Reber and Smith, "College Enrollment Gaps," 2023.
42 Irwin et al., *Projections of Education Statistics to 2030*, 2024.
43 Donovan et al., *Skills Gaps*, 2022.
44 Krueger, "Where Have All the Workers Gone?," 2017.
45 US Bureau of Labor Statistics, "Civilian Labor Force Participation Rate," 2024.

Table 1. For both younger and older cohorts of Americans, postsecondary education is associated with higher rates of labor-force participation.

Ages	Labor-force participation rate, by highest level of educational attainment		
	High school or less	Middle skills (some college or an associate's degree)	Bachelor's degree or higher
16–24	77%	84%	89%
55–64	59%	66%	76%

Source: Georgetown University Center on Education and the Workforce analysis of data from the US Census Bureau and the US Bureau of Labor Statistics, Current Population Survey (CPS), 2024.

Among younger Americans, those with a bachelor's degree or higher participate in the labor force at significantly higher rates than their peers with a high school diploma or less, reflecting better access to stable jobs among more-educated workers. Similarly, older adults with higher education levels are more likely to remain in or reenter the workforce, often due to greater opportunities for workers with their credentials and stronger financial incentives to delay retirement. By contrast, in both cohorts, individuals with lower levels of educational attainment face more limited job opportunities. This pattern underscores how education not only shapes opportunity for younger workers but can also extend opportunity for those in later life stages (Table 1).

It will not be easy to draw people who left the labor market back into it. Efforts to increase labor-force participation should focus on attracting workers to the jobs that offer the most opportunity and show the greatest need.

Increasingly restrictive immigration policies

Immigration will undoubtedly continue to be a politically contentious subject. While the immigration debate often centers on those who enter the country illegally or outstay the terms of their visas, trends in legally sanctioned immigration have a substantial influence on the population and the labor force. In 2024, 14.3 percent of the US population was foreign born, up from 4.7 percent in 1970.[46] Thirty-five percent of foreign-born adults over the age of 25 have a bachelor's degree or higher.[47]

US immigration policies could help alleviate skills shortages if they allowed the entry of more highly skilled workers. The H-1B visa program, which allows companies to hire highly skilled foreign workers, is capped at 85,000 visas per year—far below what businesses actually need.[48] Big tech companies like Amazon, Microsoft, and Google rely on these workers to fill critical roles, but increasingly burdensome restrictions and long wait times have made hiring much more difficult. Because of this, many companies struggle to find enough qualified professionals to fill a growing number of positions.[49]

Jobs for highly skilled workers are not the only ones affected by immigration restrictions, however. Immigration policies have made it harder to fill essential roles in industries like agriculture and disaster recovery. Immigrants make up a large portion of skilled disaster-restoration workers, who are crucial for rebuilding after hurricanes, wildfires, and other natural disasters.[50] Experts point out that strict immigration policies are already leaving communities without enough workers to rebuild efficiently.[51]

46 Moslimani and Passel, "What the Data Says about Immigrants in the U.S.," 2024.
47 US Census Bureau, Table S0501, 2022.
48 Certain US institutions are exempt from the annual H-1B visa cap, meaning they can sponsor H-1B workers at any time of year without being subject to the 85,000 annual cap. As a result, in fiscal year 2023, the US Department of State issued approximately 386,000 H-1B visas globally. US Department of State, *Nonimmigrant Visa Issuances by Nationality and Visa Class: Fiscal Year 2023*, 2024; Dixit and Nicoll, "From Amazon to Pinterest," 2025.
49 Fottrell, "America's Job Market Is Eerily Similar to the 1990s Dot-Com Bubble," 2025.
50 Lakhani, "No Rebuilding without Them," 2025.
51 Lakhani, "No Rebuilding without Them," 2025.

The increasing use of generative artificial intelligence

The adoption of generative artificial intelligence (AI) has been swift. In August 2024, 39.4 percent of US residents ages 18–64 reported that they had used generative AI at least once. About 23 percent of employed survey respondents said they had used generative AI at work at least once in the previous week. While generative AI is used most often in occupations related to management, business, and computers, it is also used regularly in blue-collar occupations.[52]

The rapid implementation of AI is creating paradoxical challenges for the workforce that could simultaneously exacerbate and alleviate skills shortages. While AI can facilitate the automation of certain routine cognitive tasks, it also generates new demands for advanced technical and adaptive skills.[53] Occupations requiring mid-level analytical and writing skills face particular disruption, potentially creating gaps in talent pipelines by moving or removing the traditional stepping stones that allow workers to advance from entry-level to higher-level skills.[54] This technological displacement echoes earlier patterns of displacements caused by automation, although it is unfolding at a faster pace and affecting different segments of the labor market.[55]

Several interconnected factors are driving the skills shortages associated with AI adoption. First, education systems globally are struggling to update curricula at the speed of technological innovation, particularly in fields heavily affected by AI.[56] Second, the geographic concentration of AI-intensive jobs in tech hubs exacerbates regional shortages.[57] Third, AI-augmented work increasingly demands hybrid skill sets—combining technical expertise with creative problem-solving and emotional intelligence—that are difficult to cultivate rapidly or at scale.[58] These dynamics are particularly evident in fields like healthcare diagnostics, legal services, and software engineering, where AI tools are transforming rather than simply replacing human roles.[59]

Despite these disruptions, the overall impact of AI on employment remains uncertain. Credible studies forecast outcomes ranging from modest job growth to significant job losses.[60] Over the long term, AI is likely to generate some employment gains alongside painful dislocations for many workers. Ultimately, the balance will depend on the actual pace of AI innovation and the capacity of the workforce to adapt accordingly. Addressing the challenges presented by AI will require coordinated policy action and institutional reforms, which we discuss further in Part 3 of this report.

In summary, the skills shortage arises from a combination of complex and intertwining factors. Key drivers include the rapid retirement of baby boomers, the smaller incoming worker cohort, shortfalls in college preparedness, lagging postsecondary attainment rates among the fastest-growing population groups, low labor-force participation rates, and new restrictions on immigration. Separately, these are all significant issues. When combined, as they are in the modern American economy, these issues suggest the need for different policy approaches at many levels.

52 Bick et al., "The Rapid Adoption of Generative AI," 2024.
53 Brynjolfsson et al., "Generative AI at Work," 2023.
54 Autor et al., *The Work of the Future*, 2019.
55 Acemoglu and Restrepo, "Tasks, Automation, and the Rise in U.S. Wage Inequality," 2022.
56 Autor et al., *The Work of the Future,* 2019.
57 Muro and Liu, "The Geography of AI," 2021.
58 World Economic Forum, *The Future of Jobs Report 2023,* 2023.
59 Davenport and Mittal, "How Generative AI Is Changing Creative Work," 2022.
60 According to one McKinsey study, estimates range from 400 million to 800 million jobs lost due to AI and automation by 2030; Manyika et al., *Jobs Lost, Jobs Gained,* 2017. Another report estimates 92 million jobs lost globally, with 170 million new jobs created, resulting in a net gain of 78 million jobs; World Economic Forum, *The Future of Jobs Report 2025*, 2025. Yet another report warns that AI could affect up to 40 percent of jobs globally, potentially resulting in productivity growth alongside job losses; United Nations Conference on Trade and Development, *Technology and Innovation Report 2025*, 2025.

2

What Kinds of Occupations Will Be Particularly Affected by the Skills Shortage?

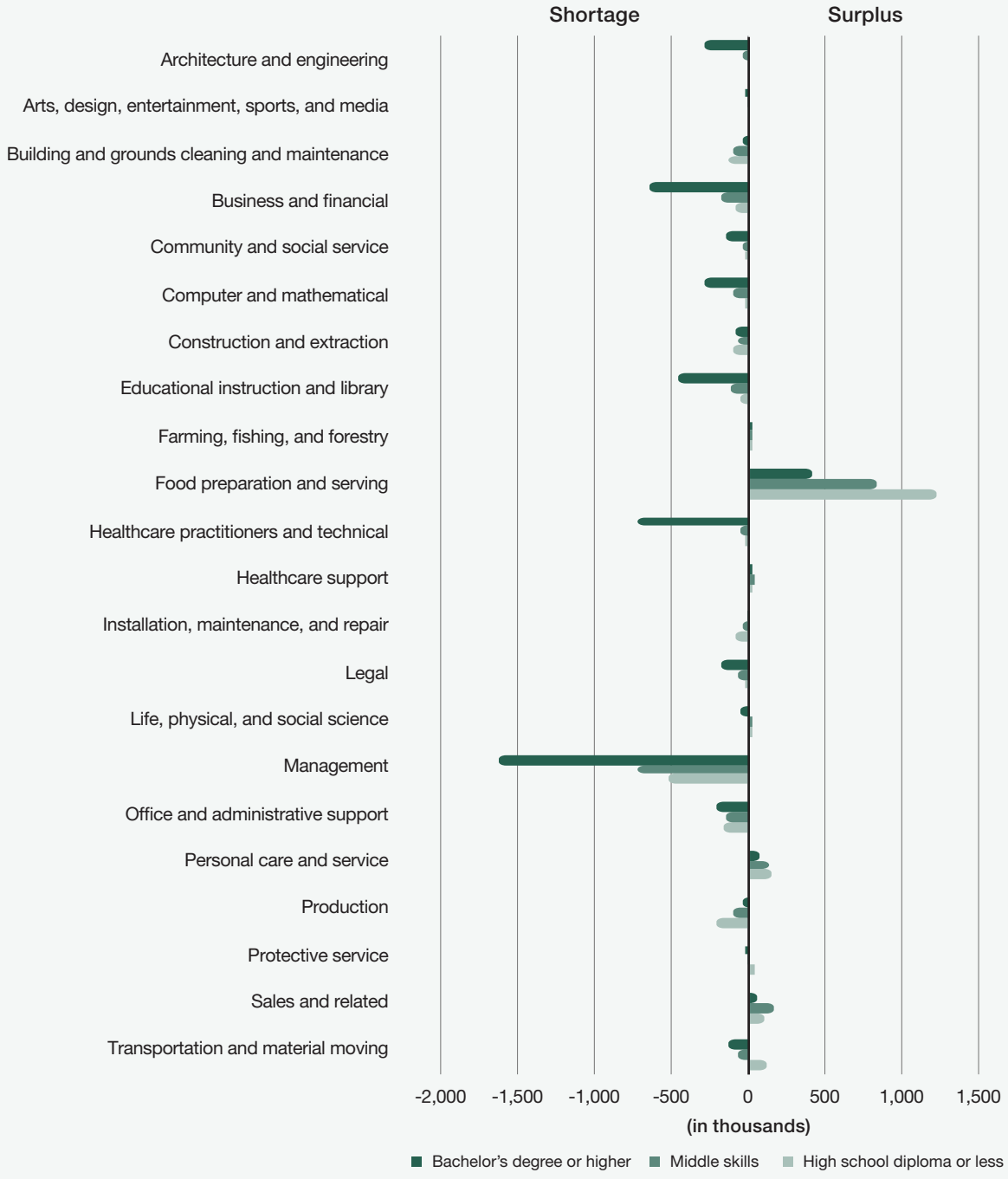
Part 2.
What Kinds of Occupations Will Be Particularly Affected by the Skills Shortage?

Some occupations are much more likely to experience skills shortages than others. We forecast that there will be shortages in 171 of the 561 individual occupations that we analyzed.[61] The largest shortfall of workers with at least a bachelor's degree by far will be in management occupations, particularly in management jobs. The largest shortfall of workers with some college or an associate's degree will also be in management occupations, such as mid-level managers in the transportation, storage, and distribution industry. However, there will also be significant shortfalls of middle-skills workers in blue-collar occupations. For workers with a high school diploma or less, the most significant shortages will be in managerial positions, while there will be a surplus of high school–educated workers in food preparation occupations (Figure 4).

We forecast that there will be shortages in 171 of the 561 individual occupations that we analyzed.

61 We consolidated 867 occupations identified by the US Bureau of Labor Statistics into 561 occupations, based on categories found in the US Census Bureau's Current Population Survey (CPS). We do not include occupations for which projected shortages are fewer than 10,000 workers. The US Bureau of Labor Statistics further consolidates occupations into broad occupational groups. For a breakdown of projected skills shortages by level of educational attainment for each occupational group, see Appendix B. For a breakdown of projected skills shortages for each occupational group by age and level of educational attainment, see Appendix C.

Figure 4. Through 2032, the largest projected shortfall of workers at all levels of educational attainment will be in management occupations.



Source: Georgetown University Center on Education and the Workforce forecast using data from the US Census Bureau and Bureau of Labor Statistics, Current Population Survey (CPS); US Census Bureau, American Community Survey (ACS); and US Bureau of Labor Statistics, Employment Projections, 2023.

In this section, we highlight nine occupational categories[62] that warrant discussion because of the size of the expected shortfalls, the prominence of the occupations, the social and economic needs they fill, or the larger trends they represent.[63] We break these occupations into two groups: those that primarily require workers with a bachelor's degree and above and those that primarily require workers with less education than a bachelor's degree.

Selected occupations that primarily require workers with at least a bachelor's degree will have the following worker shortages through 2032:

- **Managers** 2.9 million
- **Engineers** 210,000
- **Teachers** 611,000
- **Attorneys** 203,000
- **Nurses** 362,000
- **Physicians** 189,000
- **Accountants and auditors** 226,000

Selected occupations that primarily require workers with less education than a bachelor's degree will have the following worker shortages through 2032:

- **Driver/sales workers and truck drivers** 402,000
- **Construction workers** 200,000

62 Each of these occupational categories combines several occupations as defined by the US Bureau of Labor Statistics. For example, the "teachers" category includes elementary and middle school teachers, secondary school teachers, postsecondary teachers, education and childcare administrators, and librarians and media collections specialists. In addition, we moved construction managers to the management group from the construction workers group and education administrators to the management group from the teaching occupations group.

63 Our estimates of shortages for some occupations differ from estimates in some studies conducted by industry or professional groups and other organizations due to different assumptions regarding the age distribution, time frames, data sources, and other methodological parameters. Our analysis follows a systematic and transparent approach to estimating workforce shortages across all occupations.

Shortages are expected in several critical occupations that primarily require workers with a bachelor's degree or higher.

Managers

No occupational group has a larger projected shortage than managers.[64] This projected shortage (2.9 million through 2032) is concerning because managers play a crucial role in leading teams, driving business growth, and ensuring organizational success. A lack of skilled managers can have a detrimental impact on an organization's ability to effectively navigate challenges, implement strategies, and achieve goals.

There is no single path or credential that leads to management jobs. That said, 82 percent of managers have more than a high school diploma, and 56 percent of managers have a bachelor's degree or higher. Most organizations promote workers to management positions from within the company based on job performance and perceived ability to take on more responsibility, and many managers perform work that is similar to that of the people they supervise.[65] In some respects, the many routes to this occupation may make management shortages difficult to fill; on the other hand, management jobs are generally attractive to candidates because they typically offer higher compensation than other jobs and can come with additional perks, such as flexible working arrangements, professional development opportunities, and wellness programs.

Teachers

The teacher shortage is a pressing concern that has plagued the education system for years. It is a multifaceted problem that has far-reaching consequences for educational quality and the overall well-being of the education system. Our forecast—a shortfall of 611,000 teachers through 2032—covers shortages in many areas of the teaching profession, including elementary and middle school teachers, secondary school teachers, postsecondary teachers, special education teachers, and instructors and teaching assistants.[66] We project a surplus of preschool and kindergarten teachers and tutors.

Teacher shortages were greatly exacerbated by the COVID-19 pandemic, with teacher turnover rates hitting a historic high of 14 percent during the 2021–22 academic year.[67] From January 2020 to February 2022, the number of educators working in public schools fell by approximately 600,000.[68] According to a survey conducted by the National Education Association (NEA) in early 2022, 55 percent of educators said the pandemic had made them more likely to retire or leave the profession earlier than they had planned.[69]

Indeed, from 2020 through 2022, teachers who were quitting accounted for the largest group of those leaving the profession (compared with layoffs/discharges and other separations, including retirements).[70] This may be partially explained by the fact that teaching remains a comparatively young profession, with relatively few workers nearing retirement age for the profession as a whole. Only about 8 percent of all K–12 teachers in the US are at least 60 years old, compared with about 16 percent of all US workers. Forty-eight percent of postsecondary teachers, however, are at least

64 In this report, managers are classified by the broad Standard Occupational Classification (SOC) major group used by the US Bureau of Labor Statistics, with a few adjustments: We include construction managers, transportation managers, education administrators, and architectural and engineering managers; we exclude chief executives, legal workers, and finance workers.
65 Strohl et al., *The Future of Good Jobs*, 2024.
66 We exclude education administrators from this group.
67 Nguyen et al., "Teacher Shortages in the United States," n.d.
68 Walker, "Survey," 2022.
69 GBAO Strategies, "Poll Results," 2022.
70 National Education Association, *Elevating the Education Professions*, 2022.

60 years old. About 56 percent of all public school teachers are in their 30s and 40s, compared with 49 percent of all US workers.[71]

The supply of new teachers was an issue even before the pandemic. Between 2009 and 2019, enrollment in teacher preparation programs declined by 35 percent.[72] The NEA says that job openings for teachers started to outpace hires in 2017.[73] Surveys suggest that the decline in engagement and employment in teaching professions could be due to concerns about compensation and working conditions. On average, US teachers earn 23.5 percent less than other college-educated workers, a gap larger than those seen in other industrialized countries.[74]

On average, US teachers earn 23.5 percent less than other college-educated workers, a gap larger than those seen in other industrialized countries.

Nurses

We project shortages of 362,000 nurses[75] and 42,000 licensed practical nurses (LPNs)[76] through 2032, which would have far-reaching implications for the healthcare system. Although many experts predict that the nursing shortage may vary by geography and specialization, any shortage in this occupation is concerning, especially since the demand for nurses has increased dramatically in the post-pandemic years.[77]

Demographic factors are contributing to the nursing shortfall. The median age of registered nurses rose from 41.9 in 2000[78] to 46 in 2022;[79] in total, more than 1 million nurses are expected to retire by 2030.[80] The current shortage started well before the pandemic, in 1998, making this the longest-lasting nursing shortage in US history.[81] Staffing improved as younger nurses entered the profession after the 2001 and 2008 recessions, but shortages still remain.

The nursing shortage has many causes, including high turnover rates in nursing jobs, lingering burnout from the COVID-19 pandemic, and limited opportunities to grow the nursing labor force through employment-based immigration. On the supply side, enrollment in nursing programs has slowed since the pandemic, and the programs themselves are not growing because of an insufficient number of faculty members.[82] Teaching faculty may be in short supply due to salaries that are far lower than nurses can make in the field. Median earnings at a nursing school for a professor with a master's degree are about $94,000, compared with median earnings of $129,000 for advanced practice registered nurses.[83]

Accountants and auditors

We project a shortage of 226,000 accountants and auditors through 2032. Accounting jobs are

71 Schaeffer, "Key Facts about Public School Teachers in the U.S.," 2024.
72 Will, "Fewer People Are Getting Teacher Degrees," 2022.
73 National Education Association, *Elevating the Education Professions*, 2022.
74 National Education Association, *Elevating the Education Professions*, 2022.
75 Nurses with shortages include nurse practitioners and registered nurses (RNs) only.
76 Because LPNs and RNs have very different levels of education, we choose to list them separately in this analysis. LPNs typically complete a shorter, practical nursing program (12 to 18 months); RNs undergo more extensive training, earning either an Associate Degree in Nursing (ADN) or a Bachelor of Science in Nursing (BSN).
77 American Association of Colleges of Nursing, "Fact Sheet: Nursing Shortage," 2024.
78 Hamilton, "The Nursing Shortage," 2022.
79 Smiley et al., "The 2022 National Nursing Workforce Survey," 2023.
80 Hamilton, "The Nursing Shortage," 2022.
81 Hamilton, "The Nursing Shortage," 2022.
82 American Association of Colleges of Nursing, "Fact Sheet: Nursing Shortage," 2024.
83 American Association of Colleges of Nursing, "Fact Sheet: Nursing Faculty Shortage," 2024.

plentiful, but they are going unfilled because of an aging labor force and the qualifications required for the job. Additionally, it is highly likely that a number of potential workers are choosing closely related fields that pay more.

The number of accountants has dropped from 2 million in 2019 to 1.6 million in 2023.[84] This is despite the fact that, as of February 2025, accountant job postings on Indeed are up 24 percentage points from a prepandemic baseline,[85] while all job postings are up just 10 percentage points from the same February 2020 baseline.[86]

The supply of accounting graduates and candidates for the Uniform Certified Public Accountant Examination (CPA Exam) is drying up. The CPA Exam was administered to just over 48,000 first-time candidates in 2016, but that number dropped to around 32,200 in 2021.[87] The number of bachelor's degrees awarded in the field was down 2.8 percent over the same period, and the number of master's degrees was down 8.4 percent.[88] Downward trends in supply are especially concerning given that the current workforce is aging: Approximately 75 percent of current members of the American Institute of Certified Public Accountants (AICPA) are at retirement age and likely to leave the workforce within the next few years.[89]

One common reason that fewer students are entering the field is the educational requirements for becoming a CPA. Students must complete 150 credit hours of coursework, equivalent to an extra year of full-time education beyond the credit hours needed for a typical bachelor's degree.[90] The additional investment of time and money does not pay off immediately. Moreover, entry-level positions in accounting may be less attractive than those in finance and other business-related fields, which often pay more.[91] While accounting jobs can offer reasonably good earnings, they do not necessarily pay well enough to offset the price of admission to the field, and earnings may be stagnating as firms choose to invest in technology instead of hiring more accounting staff.[92] Students considering entering the field are also worried about job security. The availability of software like TurboTax and QuickBooks may encourage students to select related fields, such as finance, where the risk of automation is less obvious.[93]

Engineers

We anticipate a shortage of 210,000 engineers through 2032. While legislation like the CHIPS and Science Act of 2022 aimed to bolster the engineering workforce, the lack of young people with a background and interest in the profession may hinder the effectiveness of this and similar initiatives.[94] Even among students who do pursue engineering, the most popular areas of specialization do not align with labor-market needs. Undergraduates disproportionately major in aerospace, chemical, materials, and mechanical engineering, while shortages are expected in civil, electrical, industrial, and software engineering.[95] Engineers are critical to the success of the national economy because they drive innovation, technological advancements, and infrastructure development—key factors in economic growth and global competitiveness. Engineers design and improve everything from transportation systems and energy grids to medical devices and advanced manufacturing processes, ensuring that industries remain efficient and resilient.

84 Constantz, "There Are 340,000 Fewer Accountants, and Companies Are Paying the Price," 2024.
85 Federal Reserve Bank of St. Louis, "Accounting Job Postings on Indeed in the United States," 2025.
86 Federal Reserve Bank of St. Louis, "Job Postings on Indeed in the United States," 2025.
87 Burke and Polimeni, "The Accounting Profession Is in Crisis," 2023.
88 Burke and Polimeni, "The Accounting Profession Is in Crisis," 2023.
89 Burke and Polimeni, "The Accounting Profession Is in Crisis," 2023.
90 Burke and Polimeni, "The Accounting Profession Is in Crisis," 2023.
91 Burke and Polimeni, "The Accounting Profession Is in Crisis," 2023.
92 Friedman et al., "Technological Investment and Accounting," 2025.
93 Gordon, "Technology's Hidden Role in the Accountant Shortage," 2024.
94 Kodey et al., "The US Needs More Engineers. What's the Solution?," 2023.
95 Kodey et al., "The US Needs More Engineers. What's the Solution?," 2023.

A survey by the American Council of Engineering Companies (ACEC) found that 89 percent of engineering firms had at least one job opening, with a median of at least five open positions.[96] A report on the survey, written in the first quarter of 2024, notes that "in the past three months, over half of firms (51 percent) continue to turn down work due to workforce shortages."[97] In 2023, ACEC leaders wrote a letter to the Biden administration calling for the expansion of both STEM education and visa limits so more qualified foreign-born engineering workers could enter the US workforce. Those strategies, the organization said, could address engineering worker shortages in both the short and longer terms.[98]

Attorneys

We project that there will be a shortage of 203,000 attorneys through 2032. The American Bar Association (ABA) reports that the attorney shortage is due, in part, to the fact that the nation's existing population of lawyers is generally older than the rest of the workforce. Thirteen percent of lawyers are 65 or older, while only 7 percent of all US workers are 65 or older.[99]

In the coming years, attorney shortages may be particularly acute in rural areas. These areas already have fewer attorneys per resident; almost 1,300 US counties have less than one attorney per 1,000 residents.[100] Additionally, in some states, rural attorneys may skew even older than the profession's average: A study of the profession in Kansas found that the median age of attorneys in rural areas was 54, compared with a median age of 40 for attorneys in urban areas, meaning that upcoming retirements will affect the state's rural regions sooner than its urban ones.[101]

Shortages are expected to be more pronounced within certain law specialties as well. In some areas, such as immigration law, this is due to increased demand. The court backlog of immigration cases tripled from 2019 to 2023, and the supply of lawyers hasn't kept up; in September 2019, 65 percent of cases in immigration court had legal representation, compared with only 30 percent of cases in December 2023.[102]

In other specialties, shortages are likely due to lower potential earnings. For example, the ABA forecasts an increasing shortage of civil legal aid attorneys, both nationally and regionally, attributing the shortage to low earnings and uneven funding of legal aid organizations.[103] Even after working in legal aid for 11–15 years, lawyers make a median salary of $78,500 per year, less than half the median salary for all lawyers nationwide.[104] The comparatively low salaries are especially concerning given the high cost of attending law school.[105]

Physicians

We project a shortfall of 189,000 physicians through 2032.[106] Some medical specialties will have larger or more pronounced shortages than others; generally, shortages will be larger in primary care than in non–primary care.[107] However, surpluses are expected in a few areas, including critical care, emergency medicine, general pediatric primary care, and pulmonology.[108]

The Association of American Medical Colleges (AAMC) cites multiple reasons for the projected

96 ACEC (American Council of Engineering Companies) Research Institute, *Engineering Business Sentiment 2024 Q1*, 2024.
97 ACEC (American Council of Engineering Companies) Research Institute, *Engineering Business Sentiment 2024 Q1*, 2024.
98 American Council of Engineering Companies, "ACEC Calls for Action on Engineering Shortage," 2023.
99 American Bar Association, *ABA Profile of the Legal Profession 2024*, 2024.
100 American Bar Association, *ABA Profile of the Legal Profession 2020*, 2020.
101 Searles, *Kansas Attorney Data Profile*, 2022.
102 Transactional Records Access Clearinghouse, "Too Few Immigration Attorneys," 2024.
103 Sloan, "Civil Legal Aid Attorneys in Short Supply, ABA Report Finds," 2023.
104 Reynolds, "Civil Legal Aid Lawyers Are Often the Last Line of Defense," 2024.
105 Strohl et al., *A Law Degree Is No Sure Thing*, 2024.
106 Physicians with shortages include optometrists, radiologists, and other physicians.
107 Dall et al., *The Complexities of Physician Supply and Demand*, 2024.
108 Dall et al., *The Complexities of Physician Supply and Demand*, 2024.

shortages, including the aging physician workforce. AAMC expects more than one-third of active physicians to retire by 2034.[109] At the same time, the country's aging population will likely need more healthcare than the younger population.[110] Other studies predict that the physician shortage will vary by region, with the South and the West experiencing the largest shortages and the Northeast experiencing a surplus.[111] The physician shortage would be even greater if members of underrepresented racial/ethnic groups, uninsured individuals, and rural residents were to receive as much healthcare as the rest of the population.[112]

Shortages are expected in some key occupations that primarily don't require a bachelor's degree.

Driver/sales workers and truck drivers

The driver/sales workers and truck drivers field encompasses various driving jobs. We include local delivery drivers who may also have sales responsibilities and drivers who operate a small truck or van as "drivers/sales workers," and we define "truck drivers" as drivers of heavy-duty vehicles and tractor-trailers.[113] We project a shortage of just over 402,000 driver/sales workers and truck drivers through 2032, driven largely by an insufficient number of workers entering the field. There are nearly three times as many workers ages 55–64 as workers ages 18–24 in these occupations today.

Industry sources have reported shortages of commercial drivers in recent years. In 2018, industry analysis found that only one truck was available for every 12 loads in need of transportation—the lowest truck-to-load ratio since 2005.[114] And yet, there is a surplus of qualified potential workers. More than 10 million Americans held a commercial driver's license (CDL) in 2019, while the US had only 3.7 million trucks requiring a CDL to drive.[115]

In 2018, industry analysis found that only one truck was available for every 12 loads in need of transportation—the lowest truck-to-load ratio since 2005.

So, while many Americans are qualified to take truck driving jobs, many workers do not want them. Turnover rates among truck drivers are extremely high, averaging 95 percent per year,[116] with more pronounced shortages in certain types of jobs. Long-haul trucking (operating beyond a 150-mile radius from home) has much higher turnover rates than short-haul trucking and local delivery services; similarly, large truckload carriers (those transporting large quantities of single commodities) have higher turnover rates than carriers of smaller loads.[117] Additionally, women are severely underrepresented, accounting for only 7 percent of the driver workforce.[118] Inconsistencies regarding just how many workers are available and how many we need across different parts of the industry may be contributing to conflicting narratives about driver shortages.

109 Dall et al., *The Complexities of Physician Supply and Demand*, 2024.
110 Dall et al., *The Complexities of Physician Supply and Demand*, 2024.
111 Zhang et al., "Physician Workforce in the United States of America," 2020.
112 Dall et al., *The Complexities of Physician Supply and Demand*, 2024.
113 US Bureau of Labor Statistics, "2018 Standard Occupational Classification System," n.d.
114 Raphelson, "Trucking Industry Struggles with Growing Driver Shortage," 2018.
115 Goodman, "The Real Reason America Doesn't Have Enough Truck Drivers," 2022.
116 Goodman, "The Real Reason America Doesn't Have Enough Truck Drivers," 2022.
117 Woods, "Why Driving Big Rig Trucks Is a Job Fewer Americans Dream about Doing," 2022.
118 American Trucking Associations, *Driver Shortage Update 2021*, 2021.

Truck driving jobs may be hard to fill because the occupation involves many financial challenges: Drivers typically are not paid for time spent waiting while goods are being loaded or unloaded, and some are responsible for their own fuel costs.[119] Some are hired as independent contractors, and if they leave before the end of their contracts, they can be charged for training they received.[120]

Construction workers

We project that there will be a shortage of 200,000 construction workers through 2032.[121] As in other occupations, construction workers are reaching retirement age without sufficient numbers of younger workers poised to enter their roles. Almost one in four construction workers is older than 55, and younger workers are not entering the skilled trades quickly enough to fill the spaces vacated as a result of upcoming retirements.[122] Associated Builders and Contractors, a leading trade group, reports that new construction workers are far more plentiful in entry-level positions such as construction laborers than they are in some skilled occupations such as carpentry.[123] Workers in entry-level jobs need training and upskilling to fill the skilled roles currently held by older workers. For example, there will be a shortage of 170,000 construction managers through 2032, compared with a surplus of 88,000 construction laborers. With adequate training and experience, these laborers could conceivably fill manager positions at some point in their careers.

About 93 percent of construction firms have reported recent difficulties in hiring qualified workers.[124] Construction firms are expected to lose 22 percent to 28 percent of their management and executive employees to retirement from 2023–27, an increase over expectations reported in a 2015 survey (which predicted that 8 percent to 16 percent of workers would retire over a five-year period).[125] Firms could attract more talent by creating and promoting a more inclusive culture that welcomes women and members of marginalized racial/ethnic groups.[126] However, some factors that might make construction jobs less appealing to younger workers—such as inflexible hours and the inability to work remotely—are inherent to the nature of the work itself and unlikely to change.[127]

119 Woods, "Why Driving Big Rig Trucks Is a Job Fewer Americans Dream about Doing," 2022.
120 Woods, "Why Driving Big Rig Trucks Is a Job Fewer Americans Dream about Doing," 2022.
121 Construction workers include construction and building workers, heavy equipment and machinery operators, construction supervisors, and construction inspectors. We exclude construction managers from this group.
122 Associated Builders and Contractors, "Construction Workforce Shortage Tops Half a Million in 2023, Says ABC," 2023.
123 Associated Builders and Contractors, "Construction Workforce Shortage Tops Half a Million in 2023, Says ABC," 2023.
124 Appelman et al., *2023 FMI Talent Study*, 2023.
125 Appelman et al., *2023 FMI Talent Study*, 2023.
126 Appelman et al., *2023 FMI Talent Study*, 2023.
127 Appelman et al., *2023 FMI Talent Study*, 2023.


3
3
What Can We
Do to Help
Resolve Skills
Shortages?

Part 3.
What Can We Do to Help Resolve Skills Shortages?

Historically, the government and employers have invested in a variety of strategies to increase the availability of skills in the labor force. These have included enticing people who are not working back into the labor force; encouraging immigration; lowering the barriers to jobs for incoming workers; investing in technological advances that increase productivity; and, most importantly, providing the education and training people need to fill available jobs.

Improving the skills profile of the workforce will require a combination of approaches. We can start by giving additional education and training to the 131,000 workers with no more than a high school diploma who we anticipate will represent a skills surplus from 2024 through 2032. But there are not enough workers with a high school diploma or less to fill the gaps we project, even if they all gained higher levels of educational attainment. In this section, we describe strategies that, by themselves and in combination, are key to solving the skills shortage.

Increase the labor-force participation rate.

If the country could bring the labor-force participation rate (LFPR) back to its 2000 historic high of 67.3 percent and keep the unemployment rate at 4.1 percent (as it was in 2000),[128] the workforce would increase by 12 million workers—more than double the number needed to fill the shortages we project through 2032. However, simply increasing the LFPR would not solve the skills shortage. These 12 million potential workers would likely need more education and training to provide the skills employers are seeking, as 52 percent would not have any education or training beyond high school. Workers reentering the labor market after time away may also need to upskill to meet new job requirements and familiarize themselves with new technologies. Thus, policymakers and advocates would have to make substantial investments in education and training to ensure that workers' education levels and their specific skills align with the needs of the economy.

128 Krueger, "Where Have All the Workers Gone?," 2017.

Workers reentering the labor market after time away may also need to upskill to meet new job requirements and familiarize themselves with new technologies.

That said, increasing labor-force participation would be a strong start, and we could incrementally improve the LFPR through a combination of strategies.[129] For example, subsidized childcare policies could significantly boost female labor-force participation.[130] Better wages, benefits, and career opportunities can attract discouraged workers,[131] while phased retirement options and workplace accommodations can encourage older workers to extend their employment.[132] Additionally, targeted efforts to engage discouraged workers, combined with technological advancements like remote work and online training, can significantly boost the LFPR, fostering economic growth and workforce resilience.[133]

Address persistent attainment gaps by race/ethnicity and socioeconomic status.

A significant amount of talent currently goes untapped, especially among young people from marginalized racial/ethnic and socioeconomic groups, with disparities in opportunity and access throughout K–12 contributing to lower high school graduation rates and inadequate college preparation.[134] It is imperative to implement targeted policies and allocate sufficient resources to support the educational progression of all the students currently enrolled in our schools.[135] Such efforts are essential to mitigating the growth of skills shortages and ensuring a more equitable and skilled future workforce.

White people will make up less than half of the total US population by 2042,[136] but the transition to a majority-minority population has already occurred among American youth.[137] Between fall 2012 and fall 2022, the share of white students in US public elementary and secondary schools dropped from 51 percent to 44 percent.[138] In fall 2022, Hispanic/Latino students made up 29 percent of enrollment in public schools; Black/African American students made up 15 percent; and Asian/Asian American students and students of two or more races each made up 5 percent of enrollment.[139]

Regrettably, high school graduation rates[140] for Hispanic/Latino and Black/African American students have historically fallen short of those for white and Asian/Asian American students. Thus,

129 Gitis, "A Menu of Options to Grow the Labor Force," 2017.
130 Gurrentz, "Measuring Impact of Child Care Subsidies on Working Moms," 2021.
131 Halim et al., "Increasing Female Labor Force Participation," 2023.
132 Heisler and Bandow, "Retaining and Engaging Older Workers," 2018.
133 Aksoy et al., "Working from Home Around the World," 2022.
134 Carnevale et al., *Born to Win, Schooled to Lose*, 2019.
135 Southern Education Foundation, *A New Majority*, 2015.
136 Maxwell, "U.S. School Enrollment Hits Majority-Minority Milestone," 2014.
137 See Appendix D for a detailed projection of the changes in the racial/ethnic makeup of the US population through 2050.
138 US Department of Education, National Center for Education Statistics, "Racial/Ethnic Enrollment in Public Schools," 2024.
139 US Department of Education, National Center for Education Statistics, "Racial/Ethnic Enrollment in Public Schools," 2024. The remainder of students were American Indian/Alaska Native or Pacific Islander.
140 As of the 2021–22 school year, the US average adjusted cohort graduation rate (ACGR) for public high school students was 87 percent, with variations by race/ethnicity. The ACGR was 94 percent for Asian/Pacific Islander students, 90 percent for white students, 83 percent for Hispanic/Latino students, and 81 percent for Black/African American students. US Department of Education, National Center for Education Statistics, "High School Graduation Rates," 2024.

as the K–12 student body becomes more racially/ethnically diverse, educators will need to face the challenge of raising graduation rates among these student groups to ensure that the student body as a whole is prepared for success after high school.

A disproportionate share of children in the US also come from families in the lower reaches of the income distribution: 38 percent of all children in the nation are from low-income families (defined as those with incomes that are below twice the federal poverty threshold), according to the National Center for Children in Poverty.[141] The Southern Education Foundation found that in 2013, for the first time, the majority of public school students nationwide were eligible for free or reduced-price lunches. That share had been less than 32 percent in 1989.[142]

Like children in marginalized racial/ethnic groups, children from lower-income families also tend to have lower levels of postsecondary attainment. About 51 percent of students from families in the bottom quintile of socioeconomic status enroll in college within 18 months of completing high school, compared with 89 percent of students from the top quintile.[143] Completion rates are also much higher for children from families with higher earnings: 77.5 percent of children from families with incomes of $115,001 or higher completed a postsecondary credential within eight years of completing high school, compared with 49.4 percent of children from families with incomes of $35,000 or less.[144]

In the long term, closing college completion rate disparities by race/ethnicity and family income will help prepare a new generation to fill the skills gap.[145] The evolving demographics of high school students highlight the need for fresh thinking to ensure that this next generation is successful. Standardized education models often overlook the unique needs of underrepresented students, resulting in disengagement, lower academic achievement, and higher dropout rates.[146] A culturally sensitive approach is crucial for boosting high school graduation rates for all students, because it recognizes and responds to the diverse backgrounds, experiences, and challenges faced by students from various racial/ethnic and socioeconomic groups.[147] Schools can use culturally responsive teaching to create an inclusive learning environment where students see their identities and experiences reflected in the curriculum, strengthening their sense of belonging and enhancing their motivation to succeed.[148]

In the long term, closing college completion rate disparities by race/ethnicity and family income will help prepare a new generation to fill the skills gap.

Study the expansion of skills-based hiring.

Skills-based hiring emphasizes the selection of job candidates based on their demonstrated abilities and competencies rather than their formal qualifications, such as degrees or years of experience. It has gained traction in recent years as a combination of labor-market shifts, technological advancements, and a growing emphasis on diversity and inclusion has led more employers to

141 Koball et al., *Basic Facts about Low-Income Children*, 2021.
142 Suitts, *A New Majority Research Bulletin*, 2015.
143 Reber and Smith, "College Enrollment Gaps," 2023.
144 US Department of Education, *High School Longitudinal Study of 2009 (HSLS:09)*, 2024.
145 Rabe and Jensen, "Exploring the Racial and Ethnic Diversity of Various Age Groups," 2023.
146 Whitcomb and Singh, "Underrepresented Minority Students Receive Lower Grades and Have Higher Rates of Attrition across STEM Disciplines," 2021.
147 Aronson and Laughter, "The Theory and Practice of Culturally Relevant Education," 2016.
148 Butler-Barnes et al., "Promoting Resilience among African American Girls," 2018.

reconsider whether degrees alone are sufficient to demonstrate the competencies necessary to be considered for a job, or whether skills and experience could substitute for formal credentials.

For many years, entry-level educational attainment requirements for jobs have often been higher than the observed education distribution of workers who actually hold the jobs.[149] Thus, educational attainment requirements might block experienced workers from jobs they are entirely capable of doing. Skills-based hiring offers a chance for these workers to obtain more opportunities. Advocates estimate that millions of workers could benefit from skills-based hiring.[150]

However, it is unclear whether and to what degree skills-based hiring will address the skills shortages we have identified. A study by Harvard Business School and the Burning Glass Institute revealed that, although companies like Bank of America and Amazon removed degree requirements from job postings, their actual hiring practices still favored college graduates. Specifically, fewer than 1 in 700 hires in the past year were non-college graduates, indicating a significant gap between policy changes and implementation.[151]

We project skills shortages at both the bachelor's degree and above and middle-skills educational levels. If skills-based hiring enabled some middle-skills workers to take jobs that normally require workers with at least a bachelor's degree, it could help address shortages at the bachelor's degree level but would exacerbate the shortage of workers with middle skills.[152] In fact, as skills-based hiring enables workers to move into higher-wage, degree-optional jobs, the positions they leave behind risk becoming even harder to staff. If new workers do not receive adequate training to backfill these vacancies, skills shortages could deepen as a result.

Skills-based hiring can widen access and increase mobility for groups historically excluded from career ladders, thus helping address the skills shortage. But it must be coupled with other strategies, including reskilling workers who need to update their abilities. Ideally, employers would work with workforce development boards, community colleges, and community-based organizations to build reskilling pipelines for both vacated and emerging roles. Hiring managers should seek a balance between the growing need for the higher-level skills developed through education and training at the bachelor's and graduate degree levels and the growing understanding that these degrees are not the only ways to gain these skills. By identifying transferable skills among job applicants, employers could help lower the costs of education and training associated with reskilling.

Use technology to increase productivity.

Productivity-enhancing technologies, such as robots, hold promise as tools to lessen skills shortages by reducing the number of workers required to complete specific tasks. Japan's ability to maintain economic growth with an aging population is one example of how the use of productivity-enhancing technology can be a successful strategy.[153] The Japanese government recognized that the nation's demographic shift would force it to boost productivity through innovations like robotics, not only to close the labor-force gap but also to address the healthcare and nursing needs of the aging population. Generative artificial intelligence (AI) is just one technology that can increase productivity—with the potential downside that it may disrupt the labor market by automating or replicating job tasks that have historically been completed by humans.

149 For example, in 2015, 67 percent of job listings for production supervisors required a college degree, even though only 16 percent of production supervisors had a college degree. Fuller and Raman, *Dismissed by Degrees*, 2017.
150 Opportunity@Work, "Who Are STARs?," n.d.
151 Sigelman et al., *Skills-Based Hiring,* 2024.
152 Sigelman et al., *Skills-Based Hiring*, 2024.
153 "An Ageing Country Shows Others How to Manage," *The Economist*, 2021.

Among the possible positive outcomes is that generative AI could increase efficiency by automating repetitive tasks, thereby allowing humans to focus on more complex and strategic responsibilities.

Generative AI could have both positive and negative effects, depending on the specific context. Among the possible positive outcomes is that generative AI could increase efficiency by automating repetitive tasks, thereby allowing humans to focus on more complex and strategic responsibilities. It could also increase creativity by supporting a broad range of novel ideas and designs that can help humans work more quickly and productively. If used wisely, generative AI can thereby complement the work of humans and lead to productivity gains and cost savings even with fewer workers. Such has been the case with earlier generations of technological advancement at manufacturing facilities in Germany, Japan, and South Korea, which allowed these nations to increase productivity even though their populations are aging even faster than that of the US.[154]

The adoption of generative AI could similarly enable workers with minimal training to contribute more effectively—but it could also intensify the need for education and training if work done by humans becomes less routine and more complex. In fact, generative AI could be a blessing for some industries and a curse for others: It could help address skills shortages in some occupations but worsen shortages in other occupations. How quickly its impact will be felt in the labor force is unclear. Nobel Prize–winning economist Daron Acemoglu thinks the impact will be quite modest: no more than a 0.66 percent increase in total productivity over 10 years.[155] He suggests that AI's "true impact won't be felt until the mid-2030s."[156]

Despite its promise, however, generative AI could also have a devastating impact on workers. Employers who see worker salaries as an unnecessary cost would likely respond to improvements in generative AI by eliminating jobs.[157] In contrast, employers who see their workers as valuable company assets can use AI to ensure that workers have better information, to increase workers' productivity, and to assist in worker training.[158] While the US is unlikely to see sweeping legislation on the scale of the AI Act adopted by the European Union, it may experience increasing pressure for some regulation of AI.[159]

It is not possible to say definitively what impact generative AI will have on the workforce. The skills shortages we project in this report are based on historical trends that reflect current technology; substantial technological and economic changes could lead to different scenarios. Until there is solid empirical information about the impact of new technology, no one can know how AI or any other technological development will transform the labor force. But, in any scenario, we expect workers with higher levels of education and training to maintain an edge, as long as they are prepared to employ technologies like AI to automate routine tasks so they can focus on higher-level issues.

154 Acemoglu, "America Is Sleepwalking into an Economic Storm," 2024.
155 Acemoglu's estimate is specifically focused on factor productivity, which measures how efficiently an economy uses inputs like labor and capital to produce goods and services. He says that, above and beyond just adding more labor and capital, innovation in AI will improve productivity only slightly. Acemoglu, "The Simple Macroeconomics of AI," 2024.
156 Acemoglu, "America Is Sleepwalking into an Economic Storm," 2024.
157 Acemoglu and Johnson, "Choosing AI's Impact on the Future of Work," 2023.
158 Acemoglu and Johnson, "Choosing AI's Impact on the Future of Work," 2023.
159 Whyman, "AI Regulation Is Coming," 2023.

Use the immigration system to increase the supply of skills.

Immigrants hold all kinds of jobs across the US economy. While some immigrant workers fill low-paying jobs requiring manual labor in the agriculture, blue-collar, and food services industries, many highly skilled immigrant workers fill complex high-paying jobs, particularly in the technology sector. Recent slowdowns in immigration have resulted in a loss of talented workers who could help resolve the skills shortage. The Federal Reserve Bank of San Francisco found that if immigration had continued at its pre-2017 pace,[160] the US would have had an additional 2 million foreign-born workers by the end of 2021.[161] Of those immigrants, nearly half would have been college-educated.[162] In addition, declines in immigration could result in long-term losses in entrepreneurship, since foreign-born workers are three times more likely to start a new business in the US than people born in this country.[163]

Declines in immigration could result in long-term losses in entrepreneurship, since foreign-born workers are three times more likely to start a new business in the US than people born in this country.

Slowdowns in immigration will have long-term impacts on the US workforce. If the US severely curtails immigration, the skills shortage will likely grow. One way to close the skills shortage is to make it easier for skilled workers to come to the US. Expanding visa programs like the H-1B program[164] and the EB-2 program[165] would help companies hire more highly skilled workers, especially in science and technology. The US could also create a system that prioritizes immigrants with in-demand skills, similar to what Canada and Australia do.[166] The current political environment makes it unlikely that we will see policies to accelerate immigration, which may leave the US behind in attracting top talent from around the world.

160 Growth in the foreign-born population fell to 0.45 percent in 2018 and 2019, and there was virtually no growth in 2020. Duzhak, "The Role of Immigration in U.S. Labor Market Tightness," 2023.
161 Duzhak, "The Role of Immigration in U.S. Labor Market Tightness," 2023.
162 Peri and Zaiour, "Labor Shortages and the Immigration Shortfall," 2022.
163 Azoulay et al., "Immigration and Entrepreneurship in the United States," 2022.
164 The H-1B visa allows US employers to temporarily hire foreign workers in specialty occupations that require at least a bachelor's degree or the equivalent, with a maximum initial duration of three years, extendable to six years, subject to an annual cap.
165 The EB-2 is a US immigrant visa category for foreign workers with advanced degrees or exceptional abilities in specific fields that allows these workers to apply for permanent residency.
166 Gibson, "A Point System Has Helped Canada and Australia Evaluate Potential Immigrants," 2021.

4

Conclusion

Part 4. Conclusion

If the skills shortage continues, it could hobble the American economy for years to come. The large number of workers likely to exit the workforce as they reach retirement age, especially those with higher levels of educational attainment, far exceeds the smaller number of people entering the workforce. The resulting skills shortage could tamp down productivity and economic competitiveness while exacerbating training costs.

We must take proactive steps to attract and retain younger workers in the specific occupations facing shortages. The most direct way to address this challenge is by investing in training and development programs to upskill the existing workforce and prepare young people to become the workforce of the future. It is particularly important that we increase training and educational opportunities for members of underrepresented and marginalized racial/ethnic groups. Members of these groups represent a growing share of the US population, but they historically have had lower levels of educational attainment than white Americans.

By providing employees with the opportunity to acquire new skills and enhance their capabilities, businesses can ensure a steady supply of skilled workers who can meet their current and future needs. Partnerships among businesses, educational institutions, and industry associations to develop specialized training programs can help bridge the gap between the demand for skilled workers and the available supply.

The US increasingly has relied on immigrants to build its workforce in recent decades. Immigrants are particularly important for filling technical positions requiring high levels of skill: They make up more than half of all STEM workers with PhDs in the US, and they are especially prevalent in software programming and other computer-related jobs.[167] But there is tremendous political pressure to decrease immigration to the US.

If immigration is restrained for the foreseeable future, employers will need to explore other avenues for recruiting new workforce talent. At the same time, the country will need to invest in education and training, as well as other policies and programs aimed at increasing the labor-force participation rate. For example, expanding access to affordable childcare and elder care could allow more individuals to work and allow those who are currently only able to work part-time to increase their hours.[168] Likewise, improving the affordability of preventive and behavioral healthcare would make it easier for workers with related healthcare responsibilities to remain in the labor force.[169]

Tight labor markets can also lead to opportunities to increase employment among members of

167 Belsie, "Immigrants Play a Key Role in STEM Fields," 2016.
168 Coffey, "Providing Affordable, Accessible, and High-Quality Child Care," 2024; Schochet, *The Child Care Crisis Is Keeping Women Out of the Workforce,* 2019.
169 Dawes et al., "The Projected Costs and Economic Impact of Mental Health Inequities in the United States," 2024.

underrepresented racial/ethnic groups.[170] Recent improvements in the employment prospects for Black/African American workers demonstrate this point. Black/African American workers have traditionally had lower employment levels and less job security than their white counterparts. But as older white workers have retired and shortages have persisted, many Black/African American workers have been able to move into opportunities that eluded previous generations.[171] Historically, however, many post-recession employment booms have been short-lived, as the last hired often become the first fired when the labor market cools. It is therefore too soon to suggest that these trends are permanent, especially since we do not see commensurate gains in educational attainment for Black/African American workers.[172]

Another potential solution to skills shortages is to invest in vocational and technical education programs that can train individuals for careers in blue-collar industries. By promoting these programs and raising awareness about available blue-collar opportunities, policymakers, employers, and educators can encourage more individuals to pursue careers in these fields. Additionally, policymakers can provide incentives for companies to hire and train blue-collar workers, such as tax breaks or subsidies for apprenticeship programs. These actions can help bridge the gap between supply and demand in the labor market and ensure a sustainable future for blue-collar workers. However, the potential impact of these actions is constrained by the relatively modest projected shortfalls of middle-skills workers. To achieve meaningful results, investments in vocational and technical education must be combined with the development of robust career pathways that enable workers to transition into bachelor's degree–level positions.

Of course, the ultimate impact of technology on these shortages remains an open question. Technological advances, particularly generative artificial intelligence (AI), are rapidly transforming the workforce and people's personal lives.[173] Generative AI holds promise for potentially unlocking gains in productivity, leading to large economic upticks and the creation of new jobs. At the same time, productivity-enhancing technology can reduce the demand for skilled workers.[174] More specifically, integrated training platforms with user-friendly interfaces can reduce the skill barrier to operating complex machinery, allowing workers to quickly learn to manage automated systems. On the whole, though, it is unlikely that an increased use of AI and other technologies will fully resolve the large skills shortages we predict through 2032, in part because some occupations are more open to AI than others.[175]

To best manage the promise and pitfalls of these emerging technologies, the US government should take a measured approach that balances innovation, evaluation, and regulation. Without appropriate guardrails, AI has the potential to undermine human well-being rather than complement human work. We urge policymakers to account for both AI's risks and its benefits when developing public policy.

In the face of a potential crisis fueled by the skills shortage, action across the government, businesses, education and training providers, and workers themselves will be necessary to maintain American competitiveness and economic might. Without such action, American workers will be unprepared for the future of work, and the American economy will be unable to keep pace with foreign competitors.

170 Wilson, "Tight Labor Markets Are Essential to Reducing Racial Disparities and within the Purview of the Fed's Dual Mandate," 2024.
171 Campo-Flores, "America's Role Reversal," 2024.
172 Böheim et al., "The Impact of Health and Education on Labor Force Participation in Aging Societies," 2023.
173 Somers, "How Generative AI Can Boost Highly Skilled Workers' Productivity," 2023.
174 Milmo, "What International AI Safety Report Says on Jobs, Climate, Cyberwar and More," 2025.
175 Gmyrek et al., "Generative AI and Jobs," 2025.

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Appendix A. Methodology and Data Sources

This report projects national skills shortages by occupation based on anticipated retirements among the aging workforce and educational attainment rates that are insufficient to meet the demand for skilled labor. Collectively, these dynamics are likely to exacerbate challenges in aligning workforce supply with the evolving needs of employers.

We began by measuring the size of two population groups: 16-to-24-years-olds and 55-to-64-year-olds. For the purposes of modeling the future workforce, we assumed that over an eight-year period starting in 2024 and ending in 2032, the 55-to-64-year-olds will leave the labor force, while the 16-to-24-year-olds will enter it. We consider the population of workers and potential workers to consist of five broad age groups: 16–24, 25–44, 45–54, 55–64, and 65–70.

While comparing the sizes of the 16-to-24-year-old and 55-to-64-year-old cohorts, we also assumed that new job entrants move through the workforce sequentially. Evidence supports the notion that openings created by retirements or job departures are typically filled by individuals from the immediately younger age cohort.[1] We expect job openings to be filled in a stepwise progression, wherein qualified workers from younger age cohorts gradually replace those retiring from older cohorts. For instance, we anticipate that workers ages 55 to 64 will be replaced upon retirement by those currently ages 45 to 54, who will, in turn, be succeeded by workers ages 35 to 44, and so forth.

Additionally, we categorized educational attainment in three levels: a high school diploma or less; middle skills (some college, an associate's degree, a postsecondary vocational certificate, or a certification); and a bachelor's degree or higher. We used educational attainment as a proxy for skills, since possession of a credential is often a prerequisite by which employers determine whether a potential worker is qualified for a job. We also assume that individuals hold only one job.

We measured skills shortages by asking whether there are enough people entering the workforce to account for projected retirements. We then projected educational requirements by occupation. By comparing the size and skill composition of incoming cohorts (new entrants) with those of outgoing cohorts (retiring or transitioning workers), we assessed whether there will be skills shortages or surpluses in each occupation. Since individuals ages 16 to 24 have not yet completed their education, we assigned them the educational attainment level corresponding to the next oldest age group, ages 25 to 34. Furthermore, we assumed that the future occupational distribution

1 Lovett and Cole, "An Empirical Study on Job Differentiation and Tenure," 2003.

of the incoming cohort will mirror that of the next oldest age group. By comparing these new workers with the exiting cohort—whose educational attainment levels are assumed to remain stable as they retire—we further refined our analysis to identify occupational skills shortages. Additionally, we assumed that labor-force participation remains constant within age cohorts.

The analysis also accounts for occupational growth. Even if the incoming and outgoing workforce cohorts are equal in size and education levels, differences in job growth rates across occupations can generate skills shortages. We obtained job growth within occupations from the US Bureau of Labor Statistics' projections of occupational openings using a methodology applied in the Georgetown University Center on Education and the Workforce's 2023 report *After Everything: Projections of Jobs, Education, and Training Requirements through 2031*. Finally, using net new occupational openings and controlling for the average rate of job creation per year, we calculated the net difference between incoming and outgoing workers by education level and occupation to account for projected job growth by education level. For each occupation, we assume that the percentage of net new jobs available to 16-to-24-year-olds matches the percentage of all jobs currently held by this age group.

This method results in a comprehensive list of occupational shortages and surpluses, factoring in the relative sizes of the incoming (ages 16 to 24) and outgoing (ages 55 to 64) workforce cohorts, along with expected occupational growth. Our approach provides insights into the alignment—or misalignment—between the supply of skilled labor and the evolving demands of the labor market, highlighting occupations at greater risk of experiencing workforce imbalances.

In general, we provide detail at the six-digit Standard Occupational Classification (SOC) code level in the appendix and collapse to a more aggregated two-digit SOC code level for the body of the report, with specific adjustments:

- Construction managers are included in construction occupations instead of managerial occupations.
- Education and childcare administrators are included in education occupations instead of general management roles.

Our data sources for this analysis included the following:

- The US Bureau of Labor Statistics' data on employment by age and detailed occupation, base year 2024. We used these data to compare the number of young workers with the number of aging workers by occupation.
- The US Bureau of Labor Statistics' occupational openings data (estimates of occupational demand), 2024. To project openings, the US Bureau of Labor Statistics (BLS) estimates the fraction of separations that occur when workers permanently leave an occupation or the workforce, as opposed to the fraction of separations that occur when workers move to other job locations or get a promotion. This estimate of openings does not count people who change jobs but stay in the same occupational group. The BLS website includes a technical description of the regression analysis and assumptions the agency used to estimate permanent labor-force exits and job movement.[2]
- The US Census Bureau's Current Population Survey (CPS) estimates of educational demand within occupations. We forecast the educational distribution within each occupation from 2022 through 2032 with CPS data using an exponential smoothing process.
- The US Census Bureau's American Community Survey (ACS). We used the ACS to gather detailed information on educational attainment across occupations and within selected age cohorts.

2 US Bureau of Labor Statistics, "Employment Projections: Calculation," 2024.

There are numerous studies that examine shortages on an occupation-by-occupation basis, but they rarely focus on the skills driving these shortages. In contrast, our approach relies on the generalized and systematic method discussed above. The projected shortages in our analysis may differ in magnitude from those of other studies, largely because each relies on different assumptions such as age distributions, time frames, and data sources.

For example, some studies make subjective assumptions regarding the participation rate of younger workers or the age at which retirees permanently leave the labor force. Others rely on job vacancy surveys, which capture temporarily unfilled positions and general job turnover, or churn. This can significantly overstate true labor-market growth. Indeed, in December 2024, there were approximately 7.6 million job openings, yet the economy only added 2.2 million new jobs in the entire year of 2024.[3]

Our methodology takes a more controlled approach by focusing on economic growth while comparing workforce exits (retirees) with new entrants. In the future, we may refine our estimates by incorporating more occupation-specific data. However, we maintain that any such refinements must align with our core principle: the difference between workforce entries and exits and their educational attainment levels serves as the fundamental starting point for estimating future skill shortages.

3 US Bureau of Labor Statistics, "Job Openings and Labor Turnover Summary–2024 M12 Results," 2025.

Appendix B.
Skills Shortages and Surpluses by Occupational Group and Educational Attainment Level

Table B1. Projected shortages (negative values) and surpluses (positive values) by education level and occupational group through 2032

	High school diploma or less	Middle skills	Bachelor's degree or higher
Architecture and engineering	-16,000	-37,000	-285,000
Arts, design, entertainment, sports, and media	-7,000	-14,000	-31,000
Building and grounds cleaning and maintenance	-140,000	-104,000	-49,000
Business and financial operations	-90,000	-190,000	-655,000
Community and social service	-23,000	-43,000	-150,000
Computer and mathematical	-28,000	-100,000	-293,000
Construction and extraction	-108,000	-68,000	-88,000
Educational instruction and library	-65,000	-123,000	-457,000
Farming, fishing, and forestry	4,000	12,000	20,000
Food preparation and serving related	1,219,000	832,000	408,000
Healthcare practitioners and technical	-20,000	-58,000	-735,000
Healthcare support	23,000	35,000	9,000

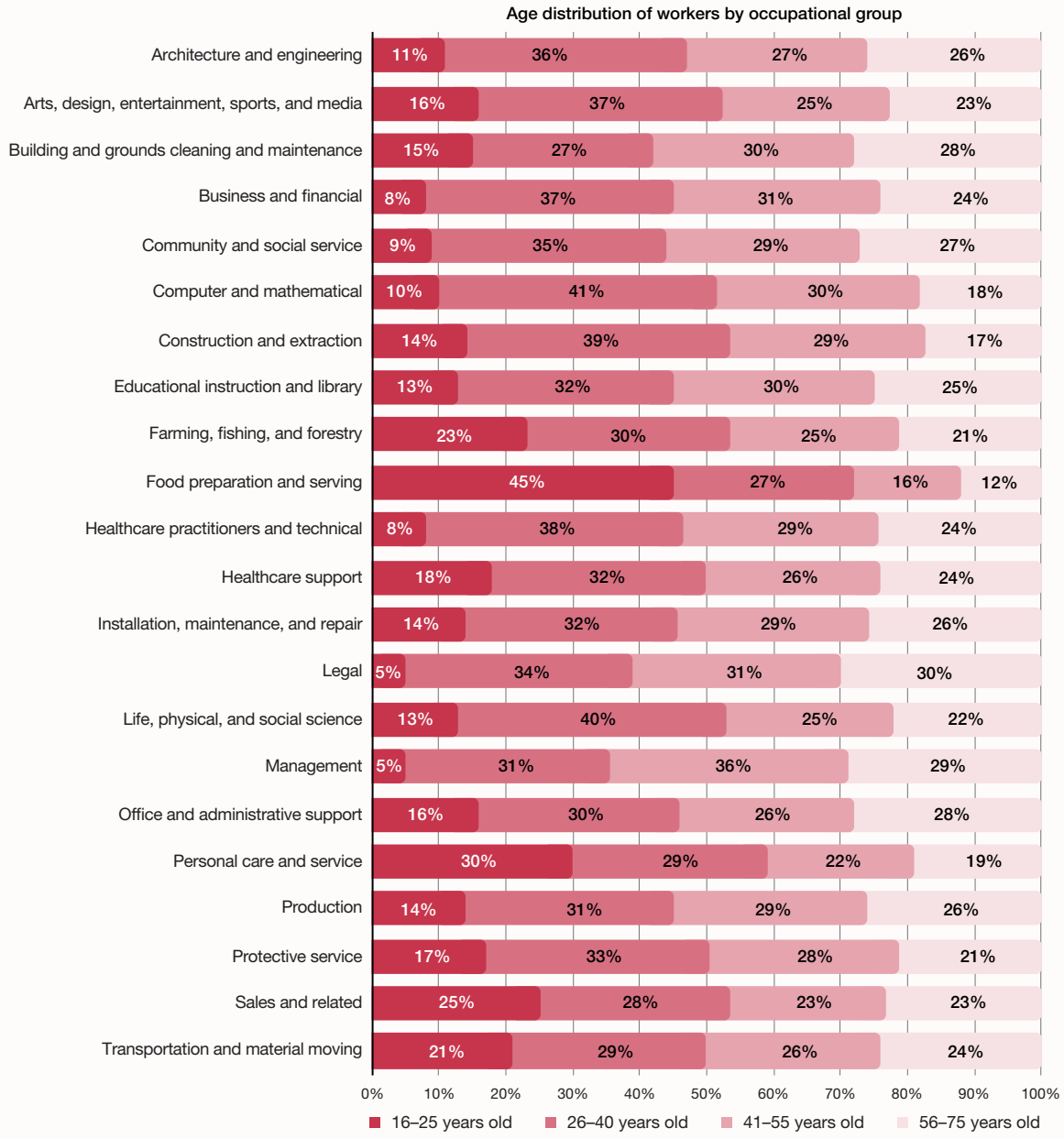
	High school diploma or less	Middle skills	Bachelor's degree or higher
Installation, maintenance, and repair	-82,000	-45,000	-11,000
Legal	-26,000	-66,000	-184,000
Life, physical, and social science	3,000	7,000	-61,000
Management	-525,000	-736,000	-1,637,000
Office and administrative support	-168,000	-151,000	-213,000
Personal care and services	145,000	126,000	65,000
Production	-206,000	-108,000	-39,000
Protective service	29,000	-8,000	-20,000
Sales and related	91,000	168,000	47,000
Transportation and material moving	120,000	-73,000	-129,000
TOTAL	131,000	-746,000	-4,488,000

Source: Georgetown University Center on Education and the Workforce forecast using data from the US Census Bureau and Bureau of Labor Statistics, Current Population Survey (CPS), 2023; the US Census Bureau, American Community Survey (ACS), 2023; and the US Bureau of Labor Statistics, Employment Projections, Table 1.10, 2023.

Note: Values may not sum to totals due to rounding. Middle skills includes associate's degrees and some college, no degree. We categorized individual occupations into 22 occupational groups. An occupational group consists of a set of related occupations classified under the US Bureau of Labor Statistics' Standard Occupational Classification (SOC) system.

Appendix C.
Age and Educational Distributions within Occupational Groups

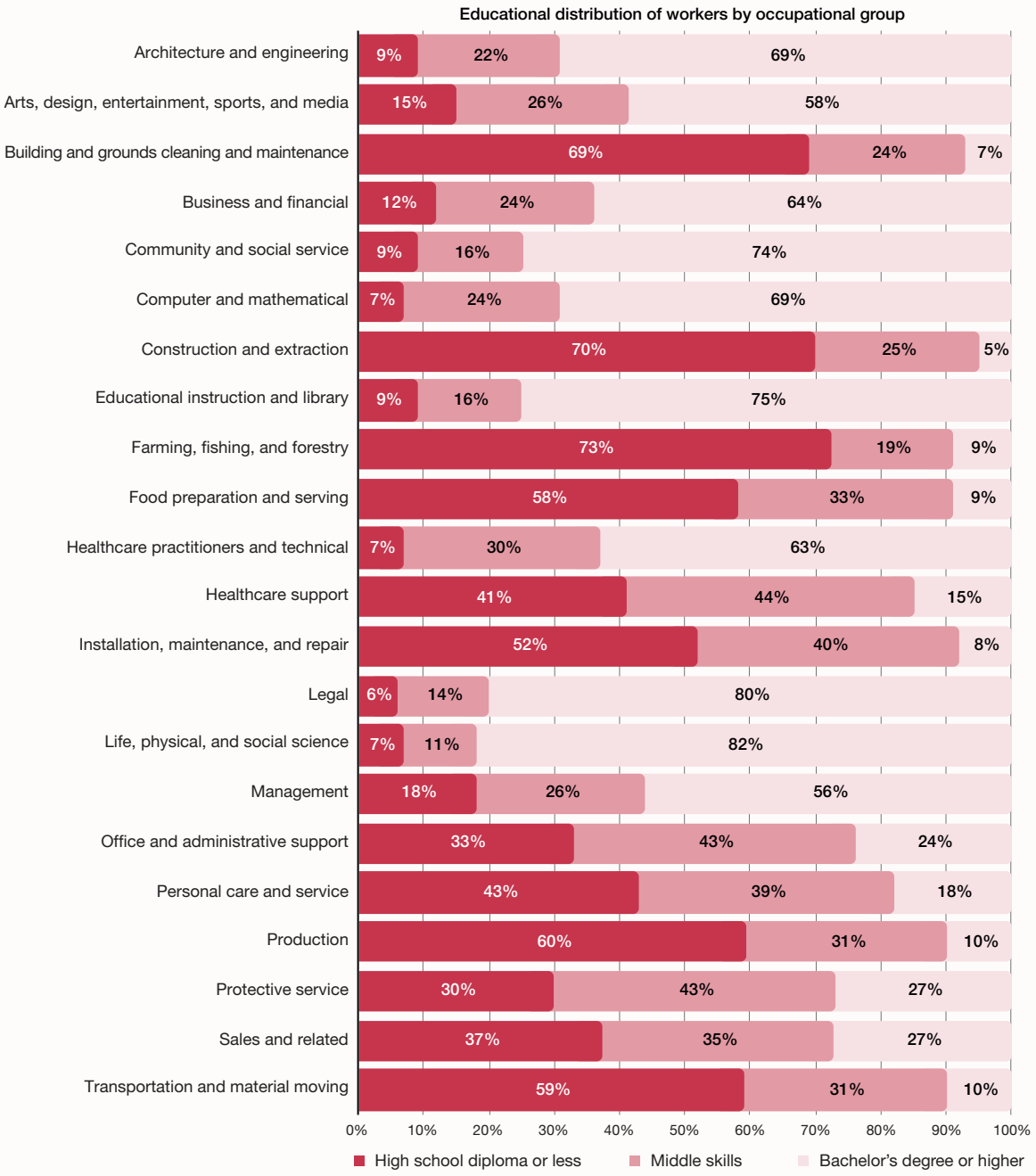
Figure C1. Worker distribution by age within occupational groups



Source: Georgetown University Center on Education and the Workforce analysis of data from the US Census Bureau, American Community Survey (ACS), 2023.

Note: Values may not sum to 100 percent due to rounding.

Figure C2. Worker distribution by education level within occupational groups

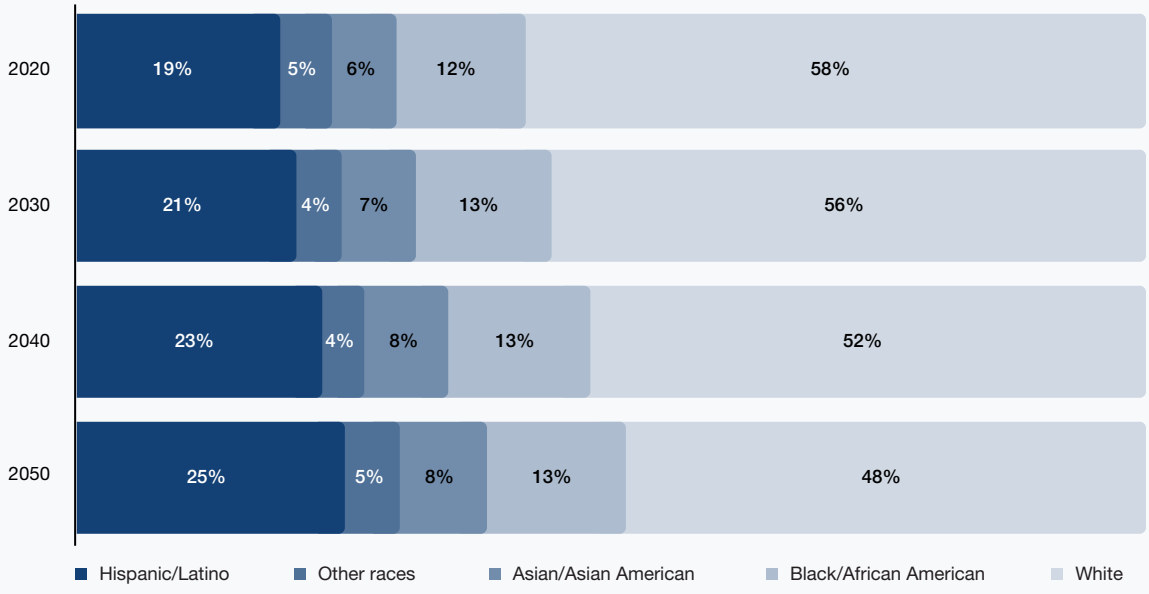


Source: Georgetown University Center on Education and the Workforce analysis of data from the US Census Bureau, American Community Survey (ACS), 2023.

Note: Values may not sum to 100 percent due to rounding. Middle skills includes associate's degrees and some college, no degree.

Appendix D.
Past and Projected Population Shares by Race/Ethnicity

Figure D1. Past and projected population shares by race/ethnicity



Source: Georgetown University Center on Education and the Workforce analysis of data from the US Census Bureau, 2023 National Population Projections Tables: Main Series, 2023.

Note: Values may not sum to 100 percent due to rounding.

Appendix E.
Skills Shortages by Occupation and Educational Attainment Level

Table E1. Projected shortages (negative values) and surpluses (positive values) by education level and occupation through 2032 for occupations with net shortages

Architecture and engineering	High school diploma or less	Middle skills	Bachelor's degree or higher
Aerospace engineers	*	-800	-19,700
Architects, except landscape and naval	-500	-900	-24,300
Architectural and engineering managers	-1,100	-3,100	-35,900
Civil engineers	-900	-2,400	-33,300
Electrical and electronics engineers	-1,100	-3,500	-36,300
Engineers, all other	-1,000	-4,400	-55,900
Mechanical engineers	-1,300	-2,500	-35,000
Other engineering technologists and technicians, except drafters	-8,700	-15,500	-13,300

Arts, design, entertainment, sports, and media	High school diploma or less	Middle skills	Bachelor's degree or higher
Artists and related workers	-5,400	-6,700	-8,300
Editors	-200	-1,100	-20,200
Interior designers	-2,600	-4,200	-3,700
Musicians and singers	-3,100	-3,500	-3,800
Other designers	-2,900	-5,500	-24,800
Technical writers	-600	-1,000	-9,200
Writers and authors	-500	-1,800	-15,600
Building and grounds cleaning and maintenance	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
First-line supervisors of housekeeping and janitorial workers	-35,300	-17,900	-5,000
First-line supervisors of landscaping, lawn service, and groundskeeping workers	-30,100	-8,400	-1,400
Janitors and building cleaners	-50,400	-29,800	-10,300
Maids and housekeeping cleaners	-46,700	-57,400	-36,300
Business and financial operations	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Accountants and auditors	-22,400	-54,800	-149,000
Business operations specialists, all other	-3,400	-4,900	-41,000
Buyers and purchasing agents, farm products; wholesale and retail buyers, except farm products; purchasing agents, except wholesale, retail, and farm products	-6,700	-7,300	-30,700
Claims adjusters, appraisers, examiners, and investigators	-2,500	-4,000	-14,000
Compensation, benefits, and job analysis specialists	-300	-800	-10,000
Compliance officers	-6,700	-17,000	-27,500
Cost estimators	-1,300	-3,100	-12,400
Credit counselors and loan officers	-1,600	-3,700	-37,900
Management analysts	-7,200	-14,300	-89,500
Other financial specialists	-2,100	-3,500	-12,800
Personal financial advisors	-1,800	-3,000	-60,600

Project management specialists	-15,800	-35,300	-53,900
Property appraisers and assessors	-600	-1,300	-23,000
Training and development specialists	-300	-800	-9,700
Community and social service	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Clergy	-10,000	-23,100	-42,100
Directors, religious activities and education	-800	-3,200	-12,100
Social workers, all other	-6,900	-11,200	-47,100
Substance abuse and behavior disorder counselors; mental health counselors	-800	-1,000	-12,100
Computer and mathematical	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Computer network architects	-1,000	-4,200	-7,000
Computer occupations, all other	-11,600	-39,100	-61,600
Computer programmers	-2,900	-10,100	-34,800
Computer support specialists	-2,500	-11,300	-31,100
Computer systems analysts	-2,200	-6,900	-45,500
Database administrators and architects	-2,100	-8,500	-14,000
Information security analysts	-800	-3,400	-9,400
Network and computer systems administrators	-2,200	-8,900	-14,700
Operations research analysts	-500	-1,100	-16,700
Software developers	-1,600	-5,900	-59,500
Construction and extraction	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Carpenters	-14,100	-2,600	-1,400
Carpet, floor, and tile installers and finishers	-6,500	-3,700	-1,300
Construction and building inspectors	-14,700	-9,200	-1,300
Construction equipment operators	-15,800	-5,700	-1,700
First-line supervisors of construction trades and extraction workers	-72,300	-17,700	-13,000
Painters and paperhangers	-11,500	-2,800	-300

Educational instruction and library	High school diploma or less	Middle skills	Bachelor's degree or higher
Elementary and middle school teachers	-9,300	-11,500	-278,500
Librarians and media collections specialists	-2,500	-4,500	-9,400
Other educational instruction and library workers	-4,800	-3,600	-7,000
Other teachers and instructors	-700	-900	-14,200
Postsecondary teachers	*	-57,400	-61,000
Secondary school teachers	-16,100	-28,800	-41,400
Special education teachers	0	-2,000	-33,300
Food preparation and serving related	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Chefs and head cooks	-8,300	-2,300	-1,300
Healthcare practitioners and technical	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Clinical laboratory technologists and technicians	-2,800	-10,300	-5,900
Dental hygienists	-2,600	-6,600	-13,100
Dentists	*	*	-15,900
Licensed practical and licensed vocational nurses	-5,800	-14,300	-22,000
Medical records specialists	-2,600	-30,000	-7,800
Nurse practitioners	*	-7,700	-26,100
Occupational therapists	*	-600	-16,500
Optometrists	0	0	-13,500
Other healthcare practitioners and technical occupations	-2,200	-9,100	-700
Other physicians	0	0	-152,400
Pharmacists	0	0	-26,400
Physical therapists	0	0	-45,400
Physician assistants	0	0	-10,000
Radiologic technologists and technicians	0	0	-23,200
Registered nurses	0	0	-328,100
Respiratory therapists	*	-2,800	-9,800
Speech-language pathologists	*	-1,800	-10,000

Healthcare support	High school diploma or less	Middle skills	Bachelor's degree or higher
Home health aides; personal care aides	-15,500	-48,400	-30,000
Massage therapists	-5,900	-7,800	-1,700
Other healthcare support workers	-900	-4,100	-11,300
Installation, maintenance, and repair	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Computer, automated teller, and office machine repairers	-3,200	-6,000	-1,400
First-line supervisors of mechanics, installers, and repairers	-30,200	-7,900	-2,100
Heavy vehicle and mobile equipment service technicians and mechanics	-8,300	-4,800	-1,400
Industrial and refractory machinery mechanics	-28,800	-24,400	-4,500
Maintenance and repair workers, general	-23,200	-12,600	-2,400
Other installation, maintenance, and repair workers	-4,500	-4,400	-1,400
Legal	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Judges, magistrates, and other judicial workers	*	-6,400	-13,100
Lawyers	*	*	-124,500
Legal support workers, all other	-1,000	-3,100	-8,500
Paralegals and legal assistants	-300	-100	-24,000
Tax examiners and collectors and revenue agents	-1,500	-4,800	-7,800
Title examiners, abstractors, and searchers	-100	-800	-14,800
Life, physical, and social sciences	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Medical scientists	0	0	-13,000
Other psychologists	0	0	-25,200

Management	High school diploma or less	Middle skills	Bachelor's degree or higher
Administrative services managers	-1,400	-2,900	-6,800
Chief executives	-54,300	-103,600	-376,400
Computer and information systems managers	-7,900	-18,100	-96,800
Construction managers**	-51,700	-42,900	-75,400
Education and childcare administrators**	-10,000	-21,900	-126,100
Facilities managers	-5,600	-14,300	-26,600
Farmers, ranchers, and other agricultural managers	-55,000	-48,600	-42,900
Financial managers	-22,300	-68,300	-150,600
General and operations managers	-19,900	-34,800	-49,100
Human resources managers	-2,800	-7,000	-33,800
Human resources workers	-10,300	-18,600	-38,600
Industrial production managers	-9,700	-16,200	-37,100
Lodging managers	-5,200	-10,700	-11,900
Managers, all other	-287,000	-297,900	-397,800
Marketing managers	-800	-1,800	-19,100
Medical and health services managers	-10,700	-36,200	-84,500
Property, real estate, and community association managers	-14,300	-22,700	-122,100
Public relations and fundraising managers	-300	-500	-9,800
Purchasing managers	-4,900	-10,400	-41,100
Sales managers	-11,300	-21,800	-63,000
Social and community service managers	-6,400	-13,900	-49,700
Office and administrative support	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Bill and account collectors	-2,300	-5,300	-5,400
Billing and posting clerks	-39,800	-19,000	-1,400
Bookkeeping, accounting, and auditing clerks	-40,300	-112,500	-36,800
Dispatchers, except police, fire, and ambulance	-2,100	-2,900	-5,000
Door-to-door sales workers, news and street vendors, and related workers	-3,000	-3,100	-5,900

Executive secretaries and executive administrative assistants	-13,000	-18,300	-5,900
File clerks	-2,100	-3,700	-4,500
First-line supervisors of office and administrative support workers	-2,600	-13,300	-168,200
Insurance claims and policy processing clerks	-5,600	-16,800	-13,700
Legal secretaries and administrative assistants	-2,300	-3,700	-6,800
Loan interviewers and clerks	-3,200	-5,400	-4,800
Office and administrative support workers, all other	-8,800	-13,300	-8,800
Payroll and timekeeping clerks	-7,200	-8,500	-5,900
Postal service clerks	-6,200	-6,000	-2,500
Postal service mail carriers	-9,800	-20,700	-10,400
Procurement clerks	-3,000	-5,400	-2,800
Production, planning, and expediting clerks	-9,100	-9,700	-2,500
Secretaries and administrative assistants, except legal, medical, and executive	-123,700	-92,500	-39,600
Personal care and service	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Hairdressers, hairstylists, and cosmetologists	-6,500	-8,400	-10,000
Manicurists and pedicurists	-2,700	-12,900	-9,900
Supervisors of personal care and service workers	-15,800	-10,100	-2,700
Production	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
First-line supervisors of production and operating workers	-58,400	-34,200	-14,500
Inspectors, testers, sorters, samplers, and weighers	-32,600	-23,300	-3,000
Machinists	-29,600	-8,600	-800
Other metal workers and plastic workers	-20,000	-4,700	-1,600
Other production workers	-5,800	-6,800	-4,600
Printing press operators	-4,500	-9,000	-1,400
Sewing machine operators	-14,100	-10,300	-4,700
Stationary engineers and boiler operators	-10,600	-4,000	-400

Protective service	High school diploma or less	Middle skills	Bachelor's degree or higher
Correctional officers and jailers	-3,900	-9,500	-6,700
Detectives and criminal investigators	-2,700	-11,200	-4,800
First-line supervisors of police and detectives	-4,700	-7,500	-7,800
First-line supervisors of security workers	-2,500	-7,900	-1,300
Police officers	-4,200	-12,100	-9,300
Private detectives and investigators	-1,100	-4,600	-10,700
Sales and related	**High school diploma or less**	**Middle skills**	**Bachelor's degree or higher**
Advertising sales agents	-7,900	-4,300	-1,600
First-line supervisors of non-retail sales workers	-32,200	-76,600	-98,300
First-line supervisors of retail sales workers	-25,900	-78,000	-149,600
Insurance sales agents	-14,200	-17,000	-14,200
Real estate brokers and sales agents	-51,600	-55,000	-78,600
Sales representatives of services, except advertising, insurance, financial services, and travel	-2,700	-4,100	-14,600
Sales representatives, wholesale and manufacturing	-31,400	-60,900	-69,800
Securities, commodities, and financial services sales agents	-13,600	-10,000	-1,200
Travel agents	-3,700	-4,100	-2,600

Transportation and material moving	High school diploma or less	Middle skills	Bachelor's degree or higher
Aircraft pilots and flight engineers	-25,200	-8,900	-800
Bus drivers, school	-2,100	-7,100	-35,500
Bus drivers, transit and intercity	-6,700	-36,700	-29,500
Driver/sales workers and truck drivers	-154,000	-168,400	-80,000
Flight attendants	-9,900	-5,100	-1,600
Industrial truck and tractor operators	-6,500	-5,500	-1,900
Motor vehicle operators, all other	-8,000	-11,300	-2,600
Shuttle drivers and chauffeurs	-400	-7,700	-2,900
Supervisors of transportation and material moving workers	-10,400	-3,300	-1,400
Taxi drivers	-35,200	-32,100	-7,100
Transportation, storage, and distribution managers	-18,300	-23,600	-27,500

Source: Georgetown University Center on Education and the Workforce forecast using data from the US Census Bureau and Bureau of Labor Statistics, Current Population Survey (CPS), 2023; the US Census Bureau, American Community Survey (ACS), 2023; and the US Bureau of Labor Statistics, Employment Projections, Table 1.10, 2023.

*Note: * = This occupation is not an exact match with ACS. ** = For this report's analysis, these occupations were included in the management group. Values may not sum to totals due to rounding. Occupations with projected net surpluses and occupations with projected net shortages of fewer than 10,000 workers are not shown. Middle skills includes associate's degrees and some college, no degree.*

Falling Behind: How Skills Shortages Threaten Future Jobs

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