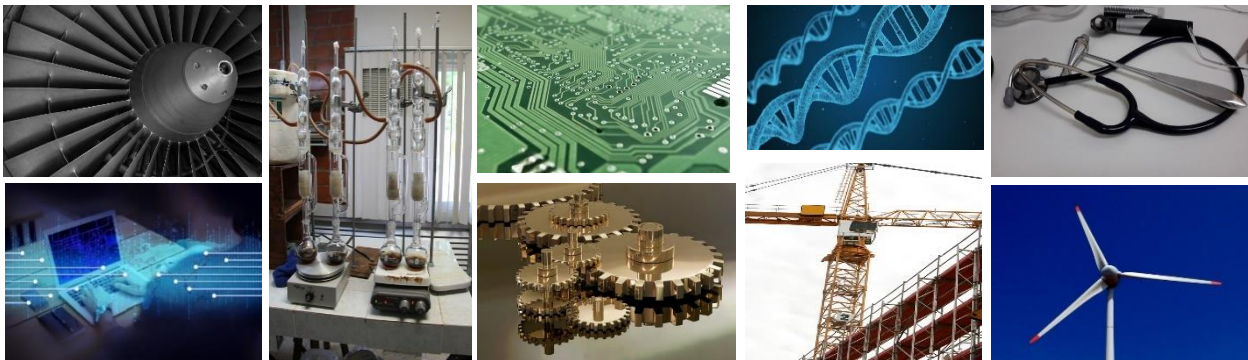


A Skilled and Educated Workforce 2017 Update



An analysis of postsecondary education, workforce preparation, and employer demand in Washington

A Joint Agency Report

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Executive Summary

Reflecting a persistent trend highlighted in previous reports, Washington employment projections for 2020–2025 show strong demand for workers with postsecondary education. Nearly 70 percent of all projected job openings will require at least some education beyond high school, with two-thirds requiring mid-level education or higher. As businesses, industries, and workplaces become increasingly complex, employers need workers with skills and education that allow them to adapt and excel in evolving environments.

Key Results

At the mid-level,* out of 43,000 annual openings, projections show the supply of skilled graduates will fall short by almost 10,000 each year. The largest gaps are in computer and information science, technician, service, and education occupations. Mid-level demand in computer and information science is led by jobs for computer support specialists, software programmers, systems analysts, and web developers. Jobs for technicians are primarily in the fields of biology, life, physical, and social sciences. Teacher assistants, preschool teachers, and library technicians are key occupations driving demand for educators at the mid-level. As seen in previous analyses, demand also remains strong for specific health occupations, led by jobs for registered nurses; nursing, psychiatric, and home health aides; medical and dental assistants; diagnostic-related technologists; dental hygienists; massage therapists; and health practitioner support technicians.

At the baccalaureate level, out of 33,000 annual openings, projections show that the supply of skilled graduates will fall short of meeting this demand by almost 7,000 each year. Overall degree-completions in computer science, engineering, health, and other STEM fields have increased substantially from 2007 to 2017. However, these gains were marked by uneven progress, rising steadily and peaking in 2012, but then followed by successive years of moderate decline. Consistent with previous reports on education and the workforce in Washington, the largest supply and demand gap at the baccalaureate level is in computer science and information technology, with the majority of jobs going to software developers, programmers, and systems analysts. Skilled workers in engineering are also in high demand, particularly in the area of civil engineering. The prominence of these two fields reflects the key role that technology and innovation play in fueling the state's dynamic economic engine. Education is another occupational field at the bachelor's degree level in which demand is currently outpacing the supply of qualified people to fill job openings. Demand is strong across a wide range of occupations: preschool and kindergarten, elementary and middle school, secondary school, and special education teachers.

At the graduate and professional level, the largest gaps are in computer science and health occupations. In the top group, job openings are led by those for software developers, computer programmers, and systems analysts. In the health professions, strong demand is led by projected openings for physicians, surgeons, physical therapists, dentists, and pharmacists, and for advanced practice registered nurses, physical and occupational therapists, and medical technicians.

K-12 education is an emerging high demand field at all education levels—middle, baccalaureate and graduate—driven by pressures for class-size reductions, teachers leaving the profession, and declining teacher program enrollments and completions. The key occupations driving demand for educators at the mid-level include teacher assistants, preschool teachers, and librarians. At the baccalaureate and graduate levels, demand is led by job openings for kindergarten, elementary, middle school, and special education teachers.

* Mid-level includes individuals with at least a year of college but less than a bachelor's degree. The category includes associate degrees, certificates of one year or longer, and apprenticeship completers.

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Background

Purpose of the Report

The purpose of this report is to provide an overview of the current status of workforce preparation in Washington; identify high employer demand occupations, as well as fields in which academic degree production is failing to keep pace with demand; and highlight occupation fields in which students may find expanding employment opportunities. This report focuses on projected workforce needs for the period from 2020 to 2025.

The Washington Student Achievement Council (WSAC) prepares this analysis in collaboration with the State Board for Community and Technical Colleges (SBCTC) and the Workforce Training and Education Coordinating Board (Workforce Board), in accordance with statutory responsibilities specified in RCW 28B.77.080. This 2012 statute directs these agencies, as part of a broader educational needs assessment process, to analyze “the number of forecasted net job openings at each level of higher education and training, and the number of credentials needed to match the forecast of net job openings.”

The report is also used in the state’s broader educational planning. In 2013, WSAC issued its Roadmap report, a ten-year guide for the development of a coordinated, long-term strategy to increase educational attainment in the state. It identified key challenges and priorities the state must address in the development of the plan. Among these key challenges were closing existing workforce skills gaps and meeting the demand for an educated workforce to complement Washington’s modern, dynamic economy.

Similarly, SBCTC and the Workforce Board use the report in their strategic planning, focusing on meeting Washington’s needs for mid-level education. This includes apprenticeships, certificate programs, and associate degrees.

Current Context

National Workforce Trends

The Increasing Importance of Postsecondary Education and Training

Two recent national reports look at a growing trend for the necessity of education beyond high school for career success from different perspectives. One analyzes quantitative education and workforce data of the last several years to show a stark contrast in the relative employment outcomes of workers with varying education levels. The other looks at worker survey data to show how this trend is reflected in respondents’ views on their future employment prospects and the rising necessity for more upskilling and retraining.

Workers with postsecondary education have benefited from advantageous employment opportunities in the economic recovery since 2010, while those with a high school diploma or less have been largely shut out. A recent national study by the Georgetown Center on Education and the Workforce reports that there has been a sharp divide in the way workers have experienced the job market recovery since the Great Recession, depending on their level of education.¹ This trend toward an increasing advantage for those with college education has been apparent for some time, but the contrast revealed in this analysis is surprising. Those with at least some postsecondary education are doing fairly well. The economy has added 11.6 million jobs since the low point of the recession in January of 2010. Ninety-nine percent of those jobs (11.5 million) have gone to workers with at least some college education.

During this same period, however, workers with a high school diploma or less had a very different experience. The huge number of jobs jettisoned over the course of the recession affected this group of workers the hardest. Of the 7.2 million jobs lost in the recession, 5.6 million were jobs for workers with a high school diploma or less. Making a bleak situation even worse, over the past six years, workers at this education level have recovered only one percent of those job losses and saw no growth among well-paying jobs with benefits. From the perspective of many in this position, it's not surprising that it may seem as if no recovery has occurred at all.

Ninety-nine percent of the 11.6 million jobs the national economy has added since the low point of the recession have been filled by workers with at least some college education.

- Georgetown Center on Education and the Workforce

Workers at all education levels lost jobs during the recession, but bachelor's degree holders gained most during the recovery. From January 2010 to January 2016, 4.6 million new jobs were added for this segment of the workforce.

Graduate degree holders have also fared relatively well. During the recession, the economy created 253,000 new jobs for graduate degree holders and added 3.8 million more jobs during the recovery. Since the beginning of the recession in 2007, more than 4 million jobs have been created for highly-skilled workers with graduate degrees. Collectively, workers with bachelor's degrees and those with graduate or professional credentials have secured 73 percent (around 8.4 million) of the 11.6 million jobs gained in the recovery.

Overall, job losses during the Great Recession were more severe for workers with an associate degree, or with some college but no degree. But this group still fared substantially better than those with a high school diploma or less. The Great Recession cost them 1.8 million jobs, but by September 2012 they had recouped those positions and were the beneficiaries of 1.3 million new jobs added as of January 2016—a turnaround of more than 3 million new jobs.

These differential employment opportunities varying by education level have been part of a long-term development, but the Great Recession and its aftermath have only intensified the trend. The future job market heavily favors workers with postsecondary credentials.

A shifting economic landscape, reflecting skill-focused technological and structural change, is beginning to reshape workers' views on the skills and training they need to succeed. A 2016 PEW Research Center survey of U.S. workers highlighted their views on the current state of American jobs and how transformative changes in work environments are affecting them.² The survey was based on telephone interviews with a national sample of over 5,000 adults.

The authors compare the transformation of the modern American workplace that has accompanied the spread of knowledge-based, service-oriented economies to a deep tectonic shift. In this dynamic landscape, workers with specific technical proficiencies are not the only ones gaining advantages. The job market also offers increasing advantages to those with good social, communications, and analytical skills. As a result, many workers are recognizing a new reality—that in order to advance in their careers, they need to make a long-term commitment to retraining and upgrading their skills.

The report highlights the changing fundamental nature of employment in the United States. Using data from the Department of Labor’s O*NET, the authors show that jobs in occupations requiring high social and analytical skills had the highest and fastest rate of growth in recent years.

Most workers in the survey felt that they do not currently have the skills they need to get ahead in their job and believe they will need continuous training and upskilling to advance. Fifty-four percent said it will be essential to get training and develop new skills throughout their work life to keep up with changes in the workplace. The most highly educated workers (63 percent of those with a bachelor’s degree or higher) were more likely to feel the need to keep upgrading their skills throughout their careers. For many in the survey (85 percent), a mixture of soft skills and technical skills was seen as being critical for success in today’s economy.

Many workers are recognizing a new reality—that in order to advance in their careers, they need to make a long-term commitment to retraining and upgrading their skills.

- Georgetown Center on Education and the Workforce

Respondents had mixed views about how well postsecondary education prepares students for the workforce. Many college graduates said that their education had a generally positive impact on their personal and professional development. But with respect to actually preparing students for the workforce, a significant portion expressed reservations. Only 16 percent felt that a college degree prepares students “very well,” while 51 percent said that it prepares them “somewhat well.” Similarly, 58 percent said that a two-year associate degree prepares students very well or somewhat well. Professional and technical certificates were viewed a bit more positively, with 26 percent saying that it prepares students very well and 52 percent saying somewhat well.

Proposed national infrastructure renewal programs could create a temporary boom in middle-skills jobs. There is currently fairly broad agreement among national political leaders that U.S. infrastructure is in serious need of renewal. Both President Trump and Senate Democrats have proposed separate trillion dollar plans to reconstruct the country’s roadways, bridges, and waterworks over a ten-year period. The proposals carry the promise of millions of new jobs created as part of an extensive network of public-private partnerships. So far the plans are thin on details, and it is uncertain when they might rise to an actionable level among congressional priorities. But, given the urgent need, it would be reasonable to expect that infrastructure will be addressed at some point in the near future.

A 2017 analysis of the potential impact of these proposals, conducted by Anthony Carnevale and Nicole Smith of the Georgetown University Center on Education and the Workforce, suggests that 11 million new jobs could be created, with most geared to the low- and middle-skills level.³ These would include those directly related to infrastructure, which would significantly increase jobs areas involving the trades, construction, material moving, and transportation. And it would also impact labor markets downstream from the core infrastructure projects, which would include many jobs in offices and retail services, for example.

Most of the jobs created by recently proposed national infrastructure plans would be temporary and go to workers at the middle-skills level or below.

- Georgetown Center on Education and the Workforce

An infrastructure plan of this size would create jobs at all educational levels. However, most of the jobs created (79 percent) would go to workers with a postsecondary vocational certificate, some college education but no degree, or a high school diploma as their highest educational attainment level. The remaining jobs would go to workers with an associate degree (8 percent) or those with a bachelor's degree or higher (13 percent).

The long-term prospects for most of these positions are slim. Infrastructure jobs would likely expand swiftly as part of a boom and then eventually decline as the projects wind down. The only newly-created jobs that would likely continue for an extended period would be those necessary to maintain, repair, and update the infrastructure. Thus, the revitalization of this segment of the economy and workforce may be short-lived. In the wake of the boom and decline in this segment of the labor market, many of the displaced low- and middle-skills workers who had temporarily thrived in a revived blue-collar economy could still face the familiar challenge of transitioning to jobs in a modern technological service-dominated economy.

The Impact of Automation in the Workplace

Several recent reports have focused on the potential impact of the evolving sophistication and growing use of robotics, artificial intelligence, and automation in the workplace. Advances in robotics, artificial intelligence, and machine learning are ushering in a new age of automation, as machines are beginning to match or outperform human performance in a range of work activities, including ones requiring cognitive capabilities.

One recent report by the McKinsey Global Institute (MGI) analyzed the automation potential of the global economy, the factors determining the pace and extent of workplace adoption, and the potential economic impact.⁴ The authors conducted an analysis of more than 2,000 work activities across 800 occupations and concluded that about half of all the activities people are paid to do in the global economy have the potential to be automated by adapting currently demonstrated technology. While less than five percent of all occupations can be automated entirely using demonstrated technologies, about 60 percent of all occupations involve a significant amount of constituent activities (at least 30 percent) that could be automated.

About half of all the work activities in the current global economy have the potential to be automated by adapting currently demonstrated technology.

- McKinsey Global
Institute

Activities most susceptible to automation involve physical activities in highly structured and predictable environments, as well as the collection and processing of data. In the United States, these activities make up 51 percent of activities in the economy, accounting for almost \$2.7 trillion in wages. These include jobs at the middle-skills level, with many associated with manufacturing, accommodation and food service, and retail trade.

Technical, economic, and social factors will determine the pace and extent of automation. Continued technical progress,—for example, in areas such as natural language processing—is a key factor. Beyond technical feasibility, the cost of technology; competition with labor, including skills and supply and demand dynamics; performance benefits, including and beyond labor cost savings; and social and regulatory acceptance will affect the pace and scope of automation. The study suggests that half of today's work activities could be automated by 2055, but this transition could happen up to 20 years earlier depending on various economic and technological factors.

This projection concurs with another study by two researchers from Oxford University.⁵ The authors show that while automation (or computerization) has been historically confined to routine tasks involving explicit rule-based activities, algorithms for big data and pattern recognition can readily substitute for labor in a wide range of non-routine cognitive tasks. Advanced robots are rapidly gaining enhanced senses and dexterity, allowing them to perform a broader scope of manual tasks, and threatening to impact work in a broad range of industries and occupations. In order to assess how susceptible current jobs are to this evolving automation movement, the authors estimated the probability of computerization for 702 detailed occupations, distinguishing between high, medium, and low-risk occupations.

Workers in transportation and logistics, office and administrative support, and service occupations are highly susceptible to automation and computerization.

- National Bureau of Economic Research

For the near future, high-skill and high-wage occupations will be the least susceptible to automated displacement while low-skill and low-wage jobs will be the most susceptible.

- National Bureau of Economic Research

According to the authors' estimates, around 47 percent of total U.S. jobs are in the high-risk category—those that could be automated over the next decade or two. Their model predicts that most workers in transportation and logistics occupations, together with the bulk of office and administrative support workers, and labor in production occupations, are at risk. A more surprising result was their finding that a substantial share of employment in service occupations, where most U.S. job growth has occurred over the past few decades, are highly susceptible to automation.

In addition, the authors provide evidence that wages and educational attainment exhibit a strong negative relationship with the probability of computerization. For the near future, high-skill and high-wage occupations will be the least susceptible to automated displacement, while low-skill and low-wage jobs will be the most susceptible.

However, while automation is clearly already affecting employment in the United States and is likely to continue to expand in scope, gauging the rate of change is challenging. Two recent complementary analyses by researchers at the National Bureau of Economic Research (NBER) point out the complexities involved in estimating the rate of automation-related worker displacement.⁶ The authors contend that studies like the one conducted by MGI base their projections largely on what is technologically feasible, but they do not do a very good job of accounting for the equilibrium impact of automation on employment and wages. Even if automation technology advances as envisioned, an employer's choice to automate a job would not depend merely on the fact that the technology exists to do it. Their decisions would depend on the costs of substituting machines for labor and how much wages change in response to this threat. In addition, the labor market impacts of new technologies depend not only on where they hit, but also on the adjustment in other parts of the economy. For example, other sectors and occupations might expand to soak up the labor freed from the tasks that are now performed by machines, and productivity improvements due to new machines may even expand employment in affected industries.

As more automation is employed in workplaces, some workers will still need to continue working alongside machines. The authors compare this shift in the labor force to the long-term shift away from agriculture and decreases in manufacturing share of employment in the United States, both of which were accompanied by the creation of new types of work not foreseen at the time. During this transition, policymakers will need to support innovative policies that help workers and institutions adapt to the impact on employment. This will likely include rethinking education and training, income support, and safety nets, as well as transition support for those dislocated. Individuals in the workplace will need to engage more comprehensively with machines as part of their everyday activities, and acquire new skills that will be in demand in the new automation age.

The advance of automation in the workplace will necessitate innovative approaches to education and training and transition support for displaced workers.

- National Bureau of Economic Research

Washington Context

The Advantages and Challenges of a STEM-based Economy

Washington faces challenges related to its dynamic STEM-driven economy. Washington has the advantage of possessing a dynamic economy driven largely by its growing technology sector, with leading companies in fields such as aerospace, electronic commerce, information technology, clean energy, and biomedicine. This expanding technological environment poses special challenges in aligning the state's education and career training system with the workforce needs of its employers. It requires a focus on STEM education to effectively meet workforce demand.

Recent reports by the Washington STEM Education Innovation Alliance highlight these challenges.⁷ Washington is among the elite states in the areas of innovation and research development, has one of the highest proportions of STEM jobs in the nation, and is one of the largest importers of technology degrees as a proportion of the population. But the state also ranks low in the production of degrees in key technology fields, such as computer science and information technology, engineering, health, and other fields associated with science and technology.

Regional analysis reveals a need for more focus on soft skills, college and career guidance, and career-connected learning opportunities. A 2017 report on Washington's regional education and workforce needs, prepared by the Western Interstate Commission on Higher Education in collaboration with the Washington Student Achievement Council, highlighted key issues and concerns across the state.⁸ Using a combination of focus group discussions, employer surveys, and interviews with regional business, education, industry, and community leaders, the authors highlighted some common themes that were heard in all regions.

- **Soft Skills & Communication:** Many graduates seeking employment are lacking soft skills in key areas such as communication, work habits, and interpersonal relations to succeed in the workplace. Business and industry leaders reported that this applies to graduates across the spectrum, from K-12 to postsecondary.

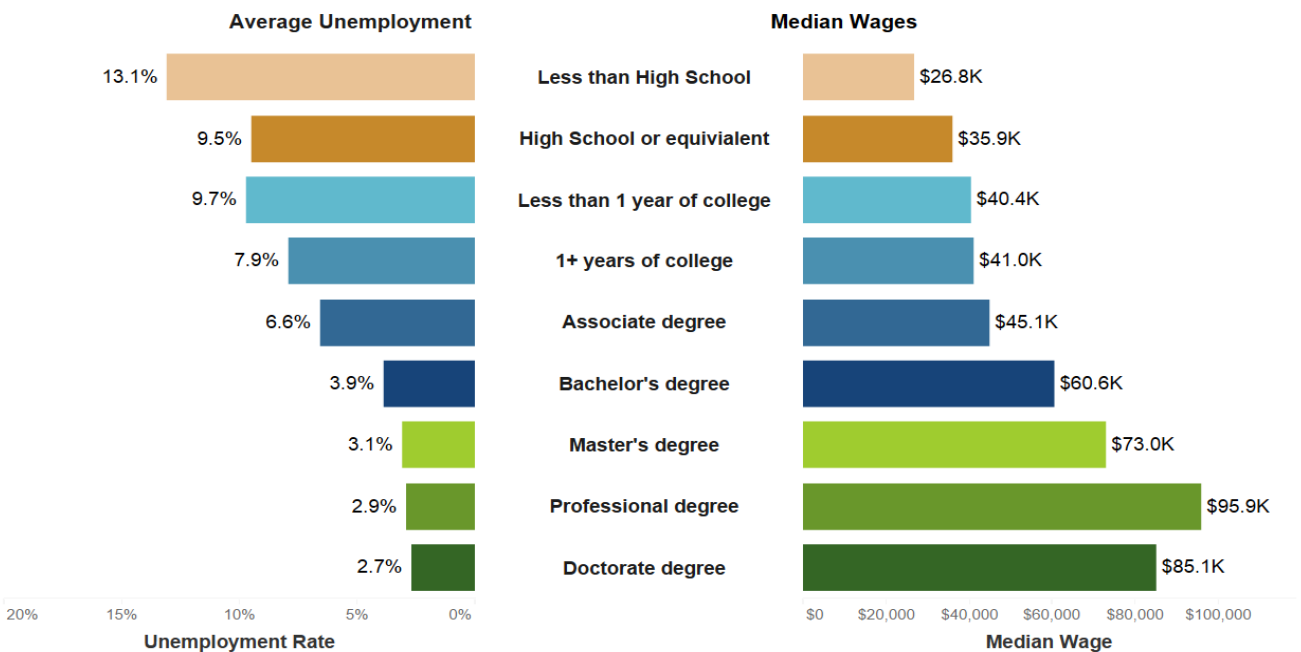
- **Career-Connected Learning:** Both K-12 and postsecondary students need more opportunities for work-based learning. Direct engagement with the workplace, through job shadows, internships, or apprenticeships, gives students the knowledge and experience to make more informed decisions about their future careers and what it will take to succeed.
- **College & Career Guidance:** Many students are not receiving the crucial college and career guidance they need to succeed. More counselors and advisors are needed to help them understand the range of available options and to successfully navigate the postsecondary and career waterways.

Key Indicators of Demand

Education, Wages, and Unemployment

Two important indicators of the demand for educated workers are 1) the effect of educational attainment levels on wages and unemployment rates and 2) the rate of in-migration of educated workers to Washington from other states and nations. In Washington, mirroring national trends, we see a stable and consistent relationship between these indicators and education level. On average, earnings tend to rise and unemployment rates decline with additional years of formal training and education (see Figure 1). The relationship holds when looking at occupation groups as well. We find differences in earnings between occupational groups and within occupational groups by education level.

Figure 1



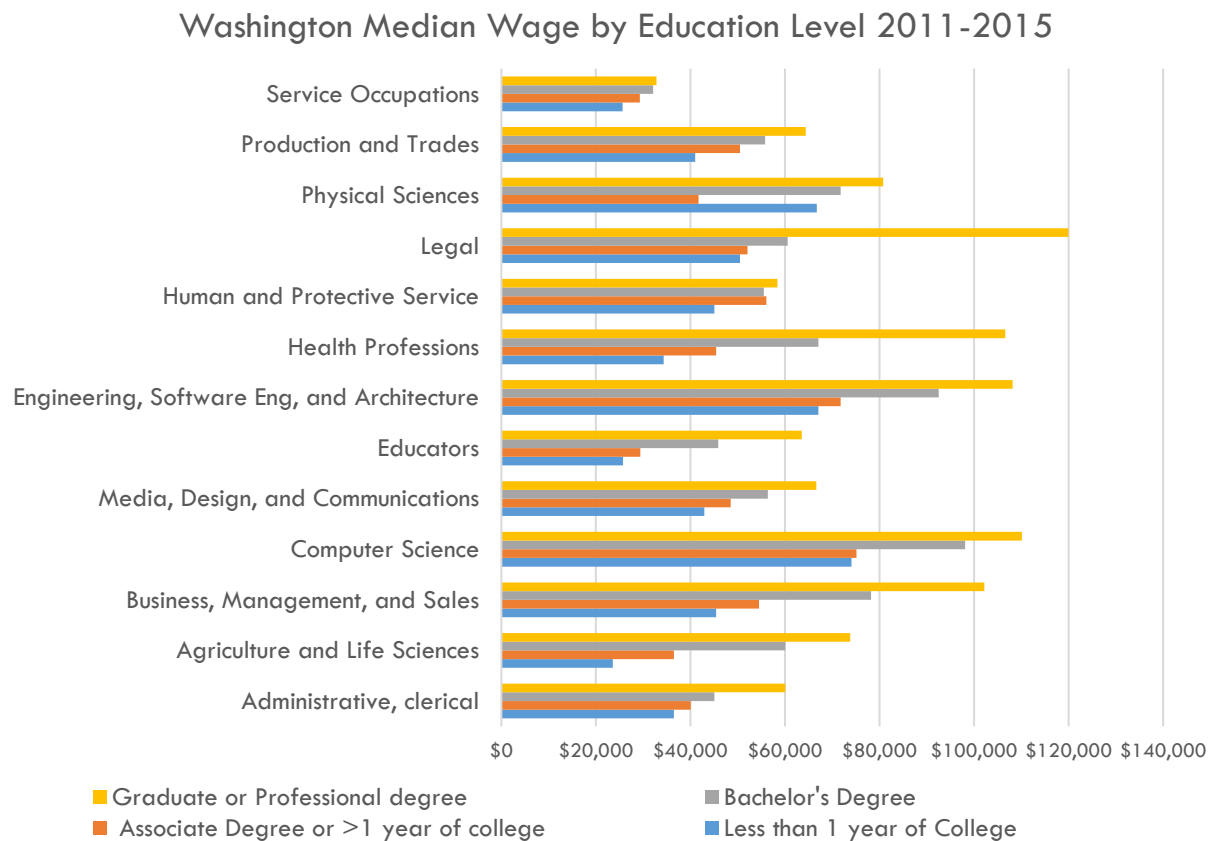
Source: 2011-15 American Community Survey. Wages include civilian employed Washington residents ages 25-44. Unemployed rate reflects civilian labor force for Washington residents age 25-44.

The age span of 25 to 44 was chosen here for two reasons: 1) it covers a set of individuals who are potential long-term participants in the state's workforce, and 2) individuals in this group are at an age when they could see a strong return on investment from further education.

Education, Occupations, and Wages

In most occupational clusters workers experience significant growth in income with additional years of formal training (see Figure 2). For example, in the fields of agriculture and life sciences, median wages escalate from a low for workers with less than a year of college (\$24,000) to holders of an associate degree or one year or more of college (\$37,000) to a bachelor's degree (\$60,000) and to those with graduate or professional degrees (\$74,000). Variation is also seen in the range of wage increases. In some fields, such as the health professions, computer science, and engineering, the wage impact seen at the bachelor's and graduate and professional degree levels is particularly pronounced.

Figure 2

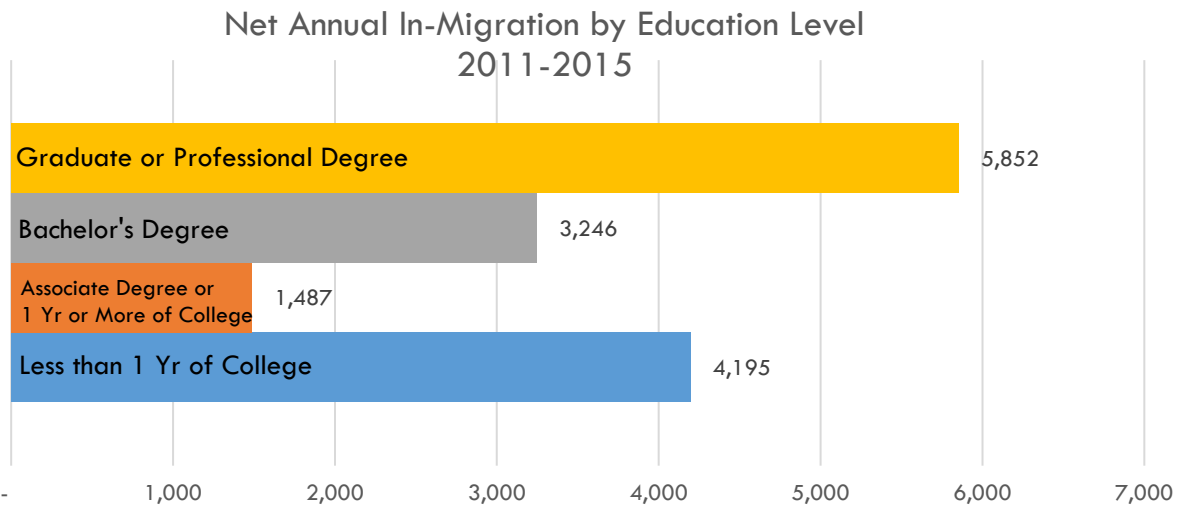


Source: WSAC Staff Analysis of 2011-2015 American Community Survey Data.

Washington's In-Migration Rate

Washington is a state with a growing population, so we should expect a fair amount of in-migration generally. However, Washington relies heavily on workers trained in other states and nations to meet the needs of the economy, particularly at the higher educational levels. Between 2011 and 2015, Washington attracted a net of about 3,200 workers from other states each year at the bachelor's level and over 5,800 at the graduate level (see Figure 3). This figure shows substantial in-migration from just state-to-state exchanges alone, without taking into account international workers. Among all states, Washington ranks fourth in overall net in-migration and third for in-migration of workers with bachelor's degrees and above.⁹ This statistic highlights the challenge that a number of Washington employers are facing in finding qualified skilled workers and reveals that many are hiring those who have been educated in other states to fill openings.

Figure 3



Source: WSAC Staff Analysis of 2011-2015 American Community Survey Data.

These trends help set the context for the analysis of supply and demand of skilled and educated workers in Washington. It should be noted, however, that although in-migration has been a key source of talent in Washington over the last two decades, in-migration counts were not included in the supply analysis for this report.

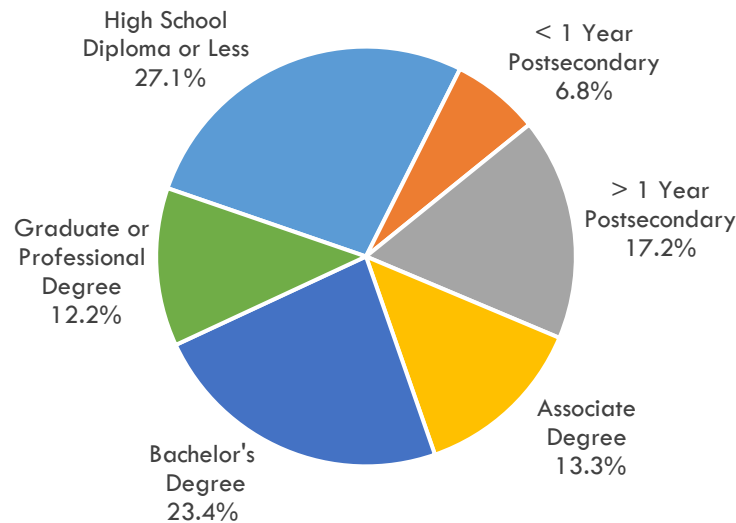
Overall Supply and Demand Outlook by Education Level

Employment projections in the state of Washington for the period of 2020–2025 show strong demand for workers with postsecondary education. The trend toward increasing complexity in the workplace and the need for more skilled and educated workers, as observed in recent national studies, are clearly reflected in Washington’s employment outlook. The vast majority of all job openings (73 percent) will require at least some education beyond high school, with 66 percent requiring at least a year or more of postsecondary training. Thirty-two percent of open positions will call for workers educated at the mid-level. This category includes postsecondary education leading to an apprenticeship, one year or more of postsecondary education, training certification, or an associate degree.

Demand for workers with bachelor’s and graduate degrees is also projected to be strong. More than 35 percent of employment opportunities will be aimed at workers who have bachelor’s degrees or above, with about 23 percent of openings requiring a baccalaureate and 12 percent requiring graduate-level education. The percentage of projected openings for workers with a high school education or less (27 percent) increased slightly since 2015, when it was at 23 percent. But this expansion of lower-skill jobs should be expected with the economic recovery on track and a very low unemployment rate.

Figure 4

Total Projected Job Openings by Education Level 2020-2025



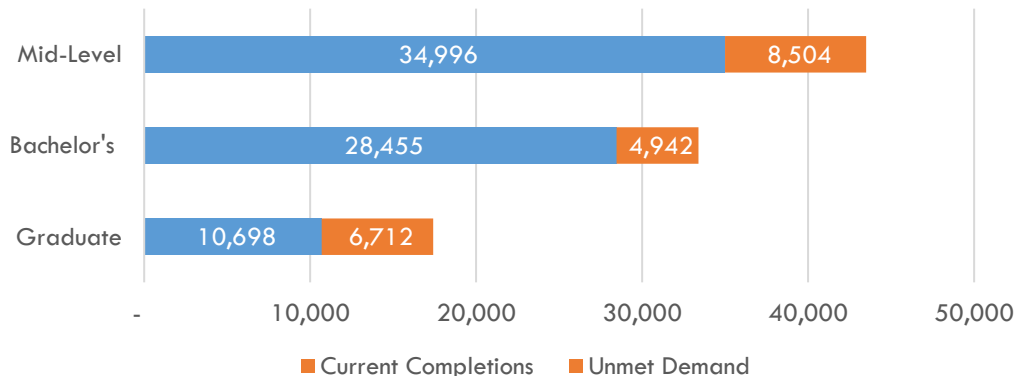
Source: WSAC Analysis of openings in 2017 Washington State Employment Security Department, Long-Term Employment Forecast and Education Levels based on analysis of the 2011-15 American Community Survey.

Overall Workforce Supply and Demand Gaps

To assess how well the state's higher education system is responding to employer workforce needs and how well it is preparing residents to compete for employment opportunities in a broad sense, we analyzed trends at the middle-skills, baccalaureate, and graduate/professional levels. We compared total supply against projected demand for workers trained at those levels. For the years 2020–2025, Figure 5 below shows the estimated current annual supply of workers educated at each level and the additional numbers of workers that will be needed to meet projected employer demand.

Figure 5

Aggregate Workforce Supply and Demand Gaps 2020-2025



Source: WSAC, WTECB, SBCTC joint analysis of 2017 Washington ESD long-term employment forecast; Bureau of Labor Statistics Training levels; IPEDS; 2014 Census PUMS data.

The supply figure was calculated by adjusting the annual number of degrees completed at each level to estimate the number of graduates expected to enter the workforce. See Appendix A for more detail on the analytical methodology.

The largest skills gap is seen at the mid-level. There were nearly 33,000 completers entering the workforce in 2016 with middle-skills education. An additional 10,500 workers will be needed annually to meet the state’s employer workforce needs. This number represents nearly 24 percent of anticipated mid-level demand.

Anticipated supply also falls short of projected workforce demand at the other education levels. At the baccalaureate level, 20 percent of demand is anticipated to be unmet by the number of annual completers entering the workforce. For workers with graduate degrees, the percent of demand unmet by supply is the highest, at nearly 46 percent.

At each education level, there were fewer students completing credential programs on an annual basis than reported in our last update in 2015. This drop in degree production is likely due to the continuing economic recovery and concomitant surge in job openings. During the recession, with fewer job opportunities available, more potential workers enrolled in academic programs, seeking further education and credentials. After the recession, with job opportunities more plentiful, enrollments declined as many potential students entered or reentered the workforce.

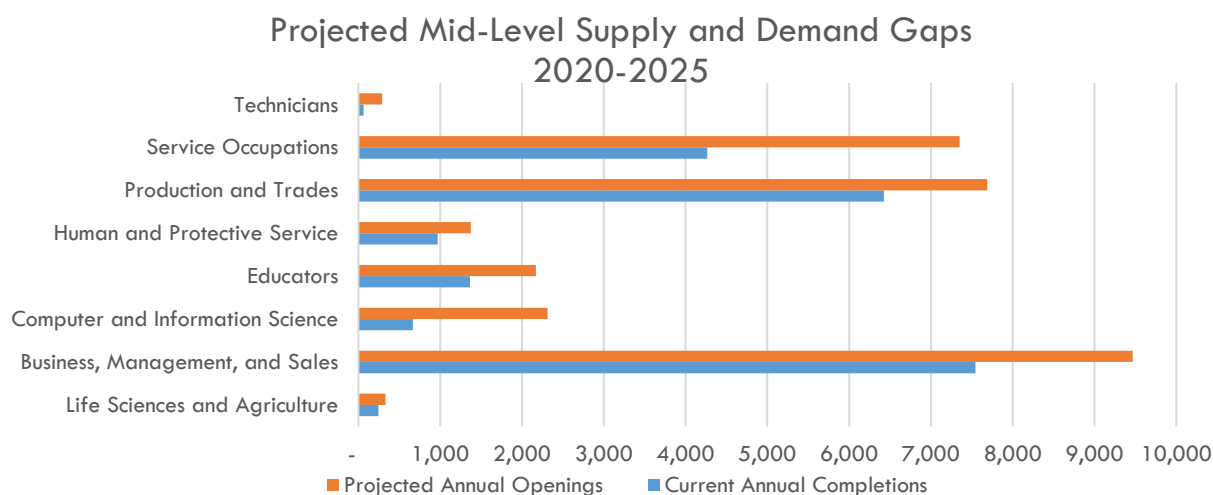
High Employer Demand Fields

At each of the three education levels—middle skills, baccalaureate, and graduate/professional—certain occupational clusters stand out with respect to employer needs. For this analysis, we have defined *high demand* fields as those for which the gap between annual supply and demand is equal to or exceeds 15 percent of the total number of projected annual openings.

The Middle Skills Level

The mid-level supply includes two-year degree graduates. It also includes completers of long-term certificates and apprenticeships from the community and technical colleges and private career schools.

Figure 6



Source: WSAC, WTECB, SBCTC joint analysis of 2017 Washington ESD long-term employment forecast; Bureau of Labor Statistics Training levels; IPEDS; 2016 Census PUMS data.

Major occupational groups for which current supply will not meet projected demand at the mid-level are shown in Figure 6. The largest gaps between supply and demand are seen in computer and information science, technician, service, and education occupations. Mid-level demand in computer and information science is led by jobs for computer support specialists, software programmers, systems analysts, and web developers. Jobs for technicians are primarily in the fields of biology, life, physical and social sciences. Service occupations include a range of management jobs in the culinary and hospitality industries. This year we are also seeing a supply and demand gap in the field of education as well. The key occupations driving demand for educators at the mid-level include teacher assistants, preschool teachers, and library technicians.

Among business, management, and sales occupations, the largest numbers of openings are for general and occupational managers, business operations specialists, and retail salespersons. The production and trades category includes jobs such as auto and diesel mechanics and machine tool technicians. Service occupations include management jobs in both culinary and hospitality industries. Human protective services include firefighters, criminal justice, and law enforcement. Computer science encompasses graduates trained for jobs like database administrators and analysts.

The Health Field at the Mid-Level. Supply and demand gaps are seen in specific health occupations at the middle-skills level. As in previous reports, demand remains strong for registered nurses; nursing, psychiatric, and home health aides; medical and dental assistants; dental hygienists; massage therapists; diagnostic related technologists; and health practitioner support technicians.

The Washington State Health Workforce Sentinel Network reported in 2016 that medical assistants, licensed practical nurses, and registered nurses were among the top occupations for which clinics, hospitals, and nursing facilities experienced exceptionally long vacancy times. Among the key reasons presented for these vacancies were difficulties finding qualified candidates in rural areas. Vacancies were particularly acute in less-populated regions where no schools with degree programs in these health fields are locally available.



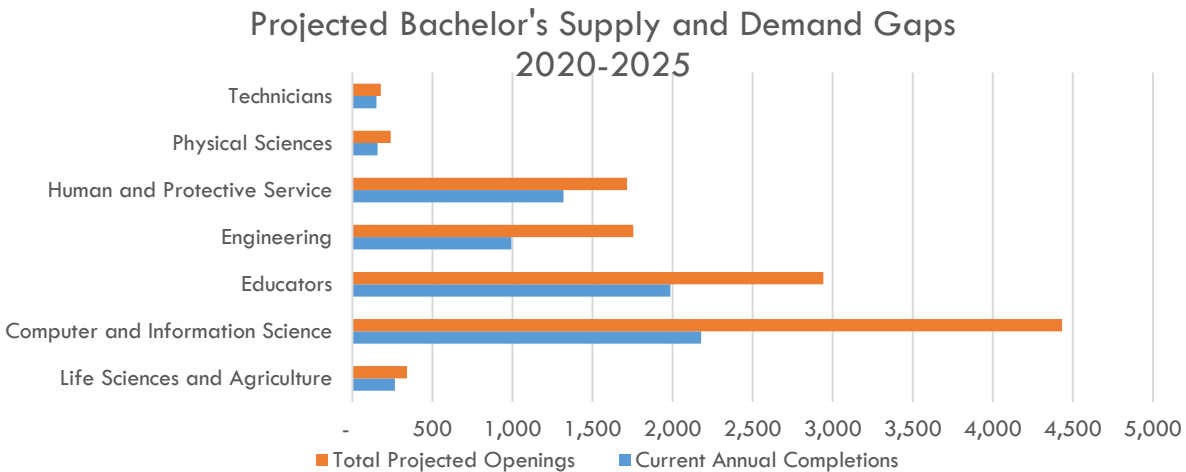
The Baccalaureate Level

Figure 7 shows the major workforce supply and demand gaps at the baccalaureate level. Many of the same occupational clusters highlighted in previous reports also appear in the 2017 analysis.

Key Drivers of Demand

Consistent with previous reports on education and the workforce in Washington, the largest disparities between supply and demand at the baccalaureate level are in computer science and information technology and engineering. This reflects the expanding role that technology and innovation play in fueling the state's dynamic economic engine. Education is another occupational field in which demand is outpacing the supply of qualified people to fill job openings.

Figure 7



Source: WSAC, WTECB, SBCTC joint analysis of 2017 Washington ESD long-term employment forecast; Bureau of Labor Statistics Training levels; IPEDS; 2016 Census PUMS data.

Computer Science. Employer demand for workers with computer science skills at the baccalaureate level is strong across the field. However, skilled-worker needs are especially strong in certain occupations. In the field of computer science, 52 percent of projected openings are for software developers, 12 percent are for computer programmers, and 10 percent are for systems analysts.

Overall, the broad-based need for workers educated and skilled in computer science seen in this data reflects not only the state's innovative economic spirit, but also the extent to which companies are generally incorporating digital technology in the workforce. The deep demand for individuals with software development skills specifically reflects the dynamic nature of Washington's computer and technology industries. Software developers focus on analyzing user needs and designing software to perform a given range of required functions. This field includes systems software developers, who specialize in computer operating systems, and applications software developers, who focus on various applications, such as games, video editors, word processors, and databases. Computer programmers, on the other hand, focus on writing code using the specifications that software developers have designed. The persistent stress on the need for software developers in the state reveals a strong innovative and cutting edge approach in the state's core technology industries.



Engineering. Similarly, demand for engineers is fairly strong across all areas of specialization. But some areas stand out. Twenty-four percent of projected openings are for civil engineers. This, in part, is a reflection of the strong surge in construction the state is currently undergoing, accompanying a sustained upswing in the economic recovery. Rounding out the list of occupations with the highest employer demand at the baccalaureate level are mechanical engineering (16 percent), electrical and electronics engineering (11 percent), industrial engineering (10 percent), and aerospace engineering (9 percent).

Education. Our 2017 analysis is showing a significant gap in the fields of early childhood and K-12 education. Demand is strong across a wide range of occupations: preschool and kindergarten, elementary and middle school, secondary school, and special education teachers.

Human and Protective Services. Another high employer demand occupational cluster is human and protective services. Past reports have consistently shown an imbalance between supply and demand in this field. The projected gap between the supply of skilled workers and industry needs in the human and protective services field is primarily driven by demand in a few key fields. In the top group, 27 percent of forecasted job openings are for counselors, and 24 percent for social workers. Employment growth in this field is primarily driven by increased demand for healthcare and social services. Social workers, for example, help people cope with a wide range of problems. They are employed in a variety of settings, including mental health clinics, schools, child welfare and human service agencies, and hospitals. One group of social workers—clinical social workers—also diagnose and treat mental, behavioral, and emotional issues.

Physical Sciences. Demand in the physical sciences occupational cluster is tied to the strength of Washington’s research and innovation communities. The leading occupations in this field are in environmental and geoscience, chemistry, and materials science. Environmental scientists conduct research to identify, control, or eliminate sources of pollutants or hazards affecting the environment or public health. Geoscientists address critical questions affecting a range of issues, including energy, weather and climate, water and mineral resources. Materials scientists incorporate elements of physics, chemistry, and engineering in cutting-edge research and development in areas such as nanotechnology and composites.

Life Sciences and Agriculture. The majority of projected openings in life sciences and agriculture are for biologists, conservation scientists, and foresters.

The Graduate and Professional Level

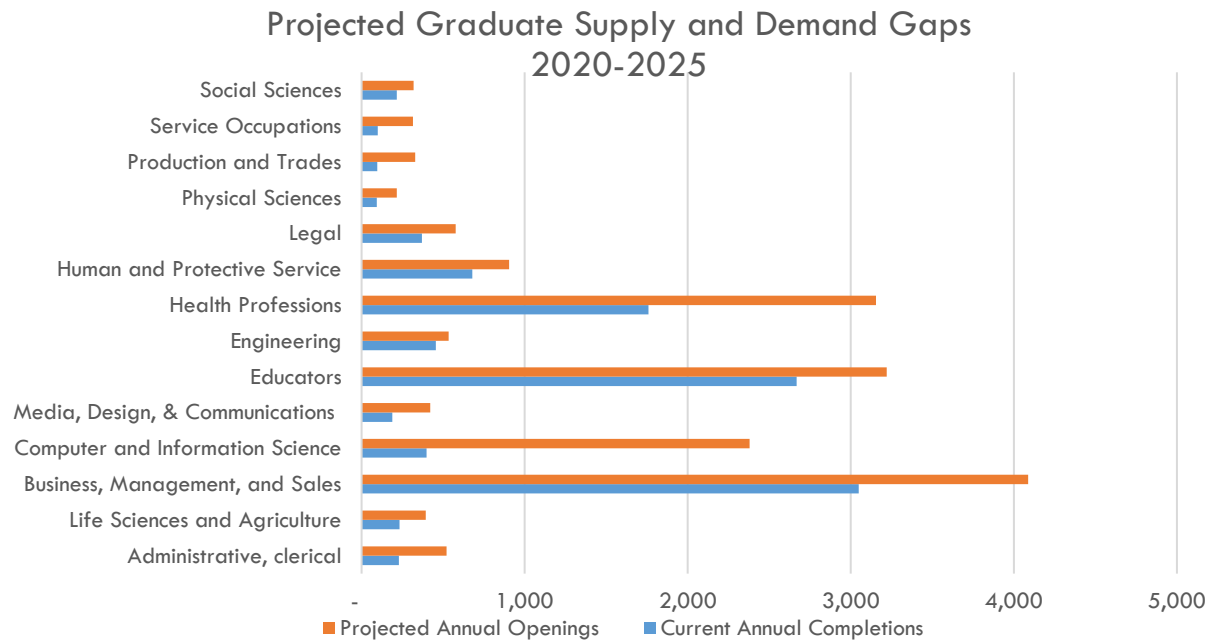
Key Drivers of Demand

The largest supply and demand gaps at the graduate level are in computer science and the health professions (see Figure 8). Other occupational clusters with substantial gaps are education, engineering, physical sciences, life sciences and agriculture, engineering, and human and protective services.

Computer Science. By far, the occupational field showing the largest skills gap at the graduate level is computer and information science. Demand for workers in this field with graduate-level education is strong, with nearly 2,400 openings projected per year through 2025. But each year, fewer than 400 students are completing graduate programs prepared to fill those openings.

Overall, the same occupations that drive demand at the baccalaureate level also lead the field here. At the graduate level, job openings for software developers stand in even higher relief, representing 65 percent of the total. Employment opportunities for computer programmers (ten percent) and computer systems analysts (seven percent) round out the top group. The higher demand for software developers at the graduate level reflects a central hierarchy in the profession. In general, software developers operate at a higher level. They design the fundamental software, and computer programmers write code to their specifications. Given a strong need for individuals in this area, employers tend to prefer those with graduate-level training. However, even though a few specific occupations in the field tend to lead the pack, demand remains strong across the spectrum in computer science.

Figure 8



Source: WSAC, WTECB, SBCTC joint analysis of 2017 Washington ESD long-term employment forecast; Bureau of Labor Statistics Training levels; IPEDS; 2014 Census PUMS data.

Health Professions. Previous analyses in 2013 and 2015 revealed small and diminishing supply and demand gaps for health professions at the baccalaureate level. The 2017 analysis reflects a continuation of this same trend for health professions in general. Current projections suggest that supply and demand is fairly well-aligned overall, but demand for specific occupations like registered nurses remains strong. Fifty-five percent of all projected openings for health professionals with bachelor’s degrees are for registered nurses. However, as shown in previous reports, persistent gaps remain at the graduate level for health professionals. Nearly 20 percent of projected openings are for physicians and surgeons. Other occupations that figure prominently in projected job openings include physical therapists (ten percent), pharmacists (eight percent), and dentists (seven percent).

Registered nurses with graduate degrees and nurse practitioners are also in demand at the graduate level for positions with advanced practice responsibilities. Nurse practitioners are qualified to diagnose medical problems, order treatments, perform advanced procedures, prescribe medications, and make referrals for a wide range of acute and chronic medical conditions within their scope of practice. They perform vital functions that fill an important need for primary medical care as healthcare demand continues to expand in Washington.

A recent report by the University of Washington Center for Health Workforce Studies highlighted supply and demand gaps for physicians in the state, particularly in rural areas.¹⁰ The report noted that Washington’s overall physician supply, on a per capita basis, is generally comparable to national averages. But significant differences in distribution are apparent between urban and rural areas of the state. Rural areas, particularly in the eastern part of the state, are experiencing serious shortages of physicians, in both generalist and specialist fields. Compounding this difficulty is the fact that more than half the physicians in many rural communities are currently age 55 or older, and likely to retire in the near future.

The 2016 Annual Report by the Health Workforce Council emphasizes studies showing that the location where physicians complete their residency is the strongest predictor of where they will choose to practice.¹¹ For this reason, the Council stresses the importance of increasing slots for in-state residencies, with a focus on underserved areas in rural parts of the state.

Business, management, and sales. Projected openings in the business, management, and sales field at the graduate level are highest for management analysts, accountants, and auditors. The gap in this area is likely due in part to currently steady economic growth and a steep rise in business activity after a prolonged period of stagnation and decline during the Great Recession.

Engineering and Related Technology. Demand in the engineering field is led by jobs for civil engineers, driven largely by strong growth in the construction industry in many parts of the state.

Media, Design, and Communications. Demand in the area of media, design, and communications was led by jobs for designers. Graphic designers are a key component of this occupational cluster, using computer software to create visual displays for production design, or to communicate concepts that inspire, inform, and captivate consumers.

Education and the Teacher Shortage

An Emerging High Demand Field at the Baccalaureate and Graduate Levels

Our 2017 analysis shows education as an emerging high demand field, particularly at the baccalaureate and graduate levels. A number of factors are contributing to increased demand for qualified educators, which is currently outpacing teacher preparation in the state.

One factor is pressure to reduce class sizes in response to the Washington State Supreme Court's McCleary decision on public education funding and reform. This decision directed the state to address the implementation plan for K–3 class-size reduction and full-day kindergarten outlined in Substitute House Bill (SHB) 2776. As a result of this decision and related legislation, sharply increased demand for more elementary school teachers is anticipated. Moreover, the decision fostered political pressures for further measures, such as voter-approved Initiative 1351, which reduces class sizes for all grades. So there is anticipation of increased demand for teachers at the middle school and high school levels down the road as well.

Compounding the pressure for more teachers caused by class-size reduction is the difficulty of retaining qualified teachers in some areas of the state. A 2017 study on teacher retention, conducted by the Center for the Study of Teaching and Policy at the University of Washington, concluded that Washington in general is not facing a large wave of teachers leaving the state or the profession.¹² But particular rural areas and some urban districts face challenges in keeping qualified teachers. Adding to this challenge is a downward trend in teacher program enrollment and completions in the state.



The Professional Educator Standards Board (PESB) also produced a report assessing the state's capacity to meet the increased demand for elementary school teachers stemming from SHB 2776 and the McCleary Supreme Court decision.¹³ Washington currently has 21 approved teacher-preparation programs, and about 1,500 students complete programs in teaching at the elementary-school level in a typical year. But only about 60 percent of those completers continue on to be hired in teaching positions in Washington during their first year. It is unknown how many are choosing not to enter the teaching workforce in Washington for some reason, or how many are simply unable to find positions where they are willing to reside.

A 2016 teacher shortage survey conducted jointly by the Office of Superintendent of Public Instruction, the Washington School Personnel Association, and the Association of Washington School Principals highlighted teacher supply and demand gaps confronted by school leaders.¹⁴ Twenty-three percent of principals reported that they are in "crisis mode" as they scramble to hire qualified teachers to fill openings, and 74 percent report that they are in a "struggling but getting by mode." Particular areas of concern are difficulties in: (1) filling vacancies in urban and economically disadvantaged schools and (2) finding qualified teachers in the areas of special education, elementary, math, and science. The survey also reports that there is currently a serious shortage of substitute teachers in the state, with a majority of school leaders describing the situation as a "crisis."

To address the teacher shortage challenge, PESB has recommended a multi-pronged approach. Several strategies could be pursued, including exploring ways to make the teaching profession more attractive, increasing the pipeline through recruitment efforts and scholarships, expanding alternative route programs for teacher certification, and broadening interstate teacher certification reciprocity agreements.

Closing the Gaps

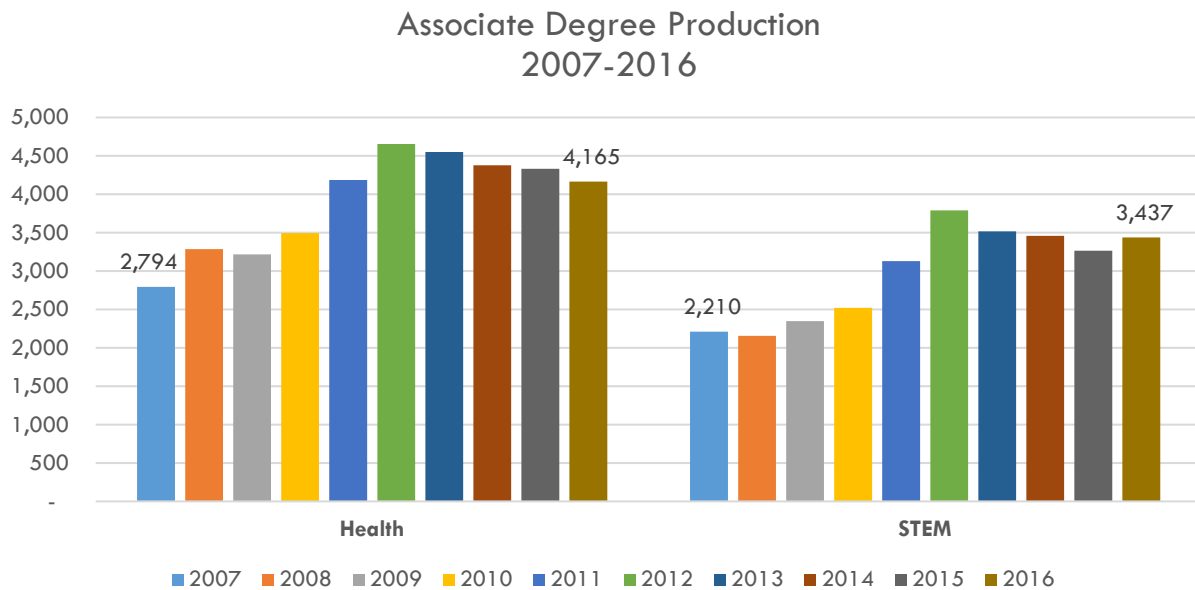
Washington is home to many fine educational institutions that have laid the groundwork for postgraduate success for many students and prepared them for the opportunities and challenges of the state's dynamic economy and innovative employers. But the gaps between supply and demand in key occupational fields demonstrate that there is still room for improvement at all levels. Fortunately, our institutions provide a solid foundation on which further progress can be built.

Over the course of recent years, data indicate that continuous progress has been made in increasing degree and certificate production in high employer demand fields of study. Depending on the field and the educational level, progress in some areas has been more dramatic than others. But in all of these key fields degree production has moved in a positive direction during this time.

Mid-Level

Figure 9 shows mid-level degree and certificate production in the key fields of health, computer science, engineering, and science and mathematics from 2007 to 2016. Over this time period, degree-completions increased fairly steadily through the peak year of 2012, reflecting sharp enrollment increases during the recession years. Enrollments and completions declined gradually in subsequent years, as the economy rebounded and large numbers of people were returning to work. STEM degrees rose slightly in 2016 in response to the strength of employer demand in this field. Current indications show that enrollments are once again on the rise.

Figure 9



Source: Integrated Postsecondary Education Data System (IPEDS).

Despite the moderate downward movement in recent years, the overall trend shows a substantial rise in mid-level degree production. In the health occupations, production grew by nearly 50 percent from 2007 to 2016. Progress in degrees and certificates granted in STEM fields overall also rose significantly, with over 55 percent growth during this same period.

Baccalaureate Level

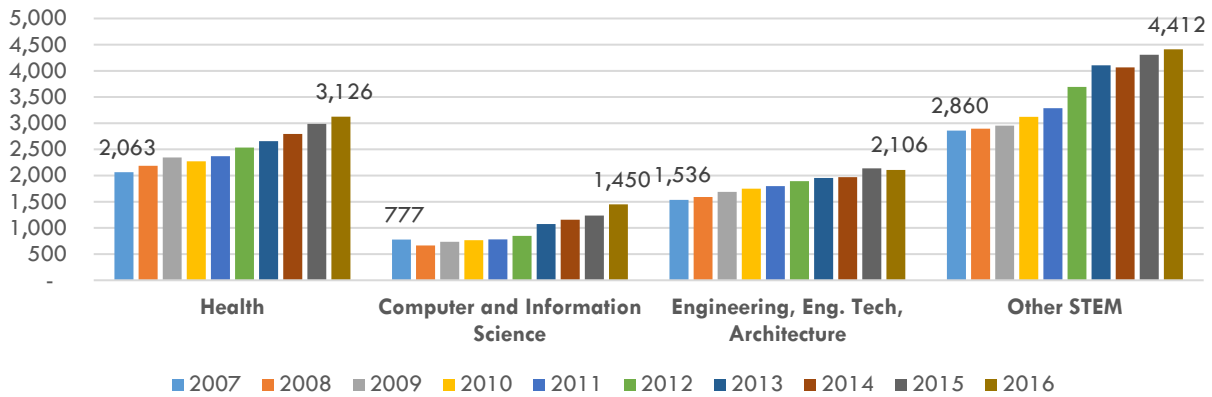
Figure 10 shows the trend at the baccalaureate level. Degree production in health, computer science and information science, engineering and related technology, and other science and mathematics fields increased steadily in recent years. In computer and information science, there has been consistent and substantial growth in degree-completions, increasing by over 85 percent from 2007 to 2016. Degree production also saw gains in the fields of health (over 50 percent) engineering and related technology (37 percent) and other STEM fields (nearly 55 percent) during this period.

Targeted funding for expanding STEM programs at Washington’s public universities included in recent legislative budgets was instrumental in fueling successful gains in degree production. For example, the Legislature’s 2012 budget reallocated over \$9 million in targeted funding for the state’s public universities and colleges to expand enrollments in engineering at the research universities, and to expand enrollments in science, technology, engineering, and mathematics fields at the regional institutions and the Evergreen State College.

In the 2013–15 operating appropriations, increased funding was included to expand enrollments in computer science and engineering at the University of Washington (\$4,459,000 per year), Washington State University (\$2,856,000 per year), and Western Washington University (\$1,497,000 per year). The 2015–17 operating budget provided \$6 million for computer science enrollments at the University of Washington and \$1.6 million for computer science and engineering at Washington State University.

Figure 10

Baccalaureate Degree Production in Health and STEM fields 2007-2016



Source: Integrated Postsecondary Education Data System (IPEDS).

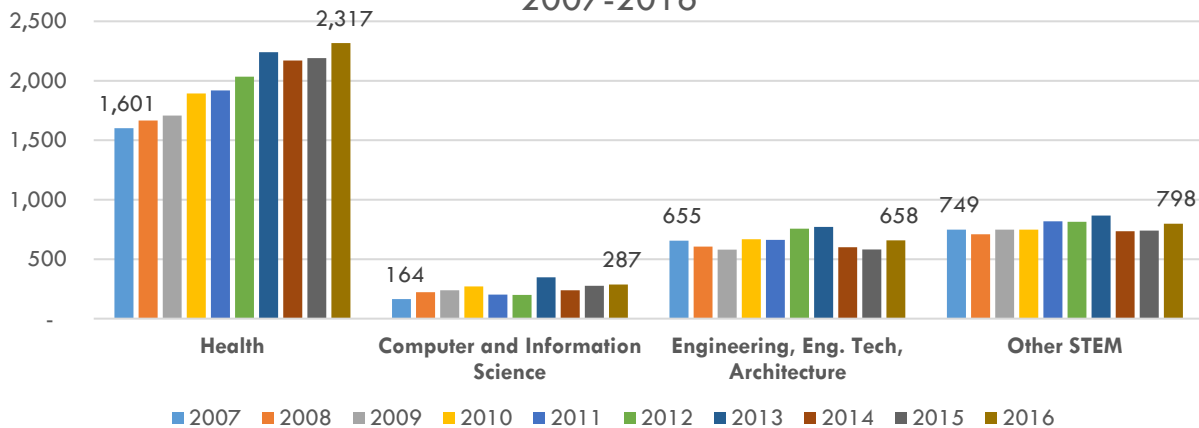
It should be noted, however, that the impact of such expansions tend to take time to develop. With these additional funds, the universities have been adding enrollments gradually over the past few years. Going forward, degree production will begin to increase as students move toward completion of program coursework.

Graduate Level

As shown in Figure 11, at the graduate level, the fastest growth in degree production occurred in the health sciences, with an increase of almost 45 percent from 2007 to 2016. Steady growth occurred in computer and information science as well, with degree-completions increasing by 75 percent. Other STEM fields as a group experienced positive but more modest levels of expansion (six percent). Degree production in engineering and related technology, however, has been relatively flat. Completions in this field rose moderately, peaking in 2012, then declined to the 2007 level by 2016.

Figure 11

Graduate Degree Production in Health and STEM Fields 2007-2016



Source: Integrated Postsecondary Education Data System (IPEDS).

Concluding Observations

Our analysis shows that, despite overall progress during the last decade in increasing numbers of students completing degree programs, the supply of skilled workers is lagging behind rising employer demand in a range of key fields. Gaps are present at all education levels: middle skills, baccalaureate, and graduate.

Some of the largest gaps are in the STEM fields, particularly in the areas of computer science and information technology, engineering, and health. Education is also facing recruitment and retention challenges in high-need fields and hard-to-staff schools and districts.

Over the last several years, degree production in the health care professions has increased, largely due to a coordinated system-wide effort to invest in this field. However, substantial shortages still exist, particularly at the professional level. For example, rural areas, particularly in the eastern part of the state, are experiencing serious shortages of physicians, in both generalist and specialist fields. Adding to this challenge is the fact that many rural physicians in the state right now are 55 years of age or older, and likely to begin retiring in the near future.

Studies have shown that the location where physicians complete their residency is the strongest predictor of where they will choose to practice. For this reason, action may need to be taken to increase slots for in-state residencies, with special attention paid to underserved areas in rural parts of the state. In 2015, in part to respond to this challenge, the Legislature approved a budget that included funding to create a new Washington State University Medical School in Spokane. One of its primary missions will be to focus on training primary care physicians to work in rural and urban underserved areas. The medical school's first class of students began coursework in the fall of 2017. This is an ambitious effort, but it will take several years before the impact of this expansion will be felt in the communities currently experiencing healthcare shortages. Supply and demand for health professionals is likely to continue to warrant careful monitoring in the foreseeable future.

Current data show some progress in increased degree production in the computer science and engineering fields at both the baccalaureate and graduate level. However, the rate of progress in these fields is still lagging behind surging demand. Workers with skills in this area are in demand at all education levels. More expansion will be required to meet the needs of our state's dynamic economy and to provide more Washington residents with vital opportunities to compete for these high-skill, high-wage jobs.

Appendix A: Notes on the Analysis

The conclusions contained in this report were based on two primary measures: 1) workforce supply, estimates of the annual number of graduates entering the workforce by degree level and major field of study, and 2) employer demand, projections of the number of net annual job openings by sector and education level.

Workforce Supply

The analysis of workforce supply was grounded on degree production data from the Integrated Postsecondary Education Data System (IPEDS), which was adjusted to estimate the number of graduates expected to immediately enter the workforce. IPEDS compiles results from annual institutional surveys conducted by the National Center for Education Statistics. These surveys include data on enrollments and degree-completions from every college, university, and technical and vocational institution that participates in federal student financial aid programs. Since not all graduates immediately enter the workforce, these completion figures must be adjusted to account for graduates who opt to continue their postsecondary education or postpone work for other reasons. These modified figures are necessary to arrive at realistic estimates of the number of graduates available to meet employer demand in a given period.

For the mid-level, IPEDS data was supplemented with administrative data from the Workforce Training and Education Coordinating Board. The Workforce Board's data captures degrees and certificates awarded by schools operating in Washington but not reporting credentials in IPEDS for Washington, either because they do not participate in Title IV aid programs or because they are based out of state and report completions in their home state.

Workforce supply was adjusted using data from the 2011–2015 American Community Survey conducted by the U.S. Census Bureau, which includes the percentages of degree holders in this survey reporting that they were 1) enrolled and either unemployed or employed part-time, 2) enlisted in the military, or 3) not in the labor force. The data were used to estimate the percentage of degree-completers that would not immediately be available to enter the workforce. For each degree level, the total number of completions was adjusted downward by the corresponding aggregate percentage.

Employer Demand

Employer demand was estimated using projected job openings from the Employment Security Department's long-term occupational forecast of total openings for 2016–2023, issued in May 2015. These employment outlook projections were matched against estimates of the training and education levels required for various occupational types, based on Washington Student Achievement Council staff analysis of U.S. Census Bureau data, reflecting actual education and training levels of survey respondents in various occupations, and adjusted based on Bureau of Labor Statistics education and training assignments by detailed occupation to establish a minimum training level.

Limitations of the Analysis

A few limitations of this analysis that could affect the gaps reported at each level should be noted. First, the report is not able to fully address the impact of new and emerging industries and occupations, due to restrictions in the methods of the Employment Security Department's long-range forecast. In addition, because of difficulties in obtaining accurate information in this area, the numbers do not reflect any adjustments to account for workers in jobs that may require more or less education than they currently possess.

In addition, because demand is based on openings and supply is based upon program completions, gaps may be understated in fields where a significant number of workers would complete a degree or certificate as a normal part of their ongoing professional development. For example, many practicing teachers will complete a master's degree and would therefore show up in supply; however, in most cases those teachers would not change occupations and therefore would not be available to fill an opening. This is further complicated by the fact that some teachers do receive their initial training at the master's level and are seeking to fill an opening in that occupation. We see similar issues in health care, particularly among practicing nurses who often train at the associate level but then later complete a bachelor's degree, and managers who may complete a Master of Business Administration as part of their professional development for their current occupation.

Finally, the analysis is not intended to fully account for the overall dynamics of the current employment market for recent graduates as the economy recovers in the wake of the Great Recession. Instead, it is based on historical trends and a forward-looking perspective, with demand assessed upon projected future openings compared to current degree production and labor force participation rates.

Appendix B: Mid-Level Gaps – All Occupational Groups

Mid-Level	Completions	Supply	Demand	Gap
Administrative, Clerical	7,490	6,102	5,815	(287)
Life Sciences and Agriculture	301	245	332	87
Business, Management, and Sales	9,261	7,545	9,468	1,923
Computer and Information Science	818	666	2,313	1,647
Media, Design, and Communications	1,138	927	755	(172)
Educators	1,675	1,364	2,170	806
Engineering	874	712	301	(411)
Health Professions	6,409	5,222	5,449	227
Human and Protective Service	1,191	970	1,374	404
Legal	559	456	190	(266)
Physical Sciences	29	23	5	(18)
Production and Trades	7,887	6,425	7,688	1,263
Service Occupations	5,236	4,266	7,350	3,084
Social Sciences	9	8	-	(8)
Technicians	78	63	290	227
Total	42,955	34,996	43,500	8,504

Appendix C: Baccalaureate Gaps – All Occupational Groups

Bachelor's Level	Completions	Supply	Demand	Gap
Administrative, Clerical	3,591	3,058	2,639	(419)
Life Sciences and Agriculture	312	265	341	76
Business, Management, and Sales	11,915	10,146	11,086	940
Computer and Information Science	2,557	2,178	4,433	2,255
Media, Design, and Communications	1,515	1,290	1,479	189
Educators	2,333	1,986	2,942	956
Engineering	1,166	993	1,754	761
Health Professions	3,451	2,939	2,702	(237)
Human and Protective Service	1,549	1,319	1,715	396
Legal	297	253	168	(85)
Physical Sciences	184	157	239	82
Production and Trades	2,149	1,830	1,726	(104)
Service Occupations	2,153	1,834	1,971	137
Social Sciences	68	58	25	(33)
Technicians	176	150	177	27
Total	33,417	28,455	33,397	4,942

Appendix D: Graduate and Professional Gaps – All Occupational Groups

Graduate	Completions	Supply	Demand	Gap
Administrative, Clerical	261	229	521	292
Life Sciences and Agriculture	266	233	393	160
Business, Management, and Sales	3,475	3,049	4,088	1,039
Computer and Information Science	453	398	2,379	1,981
Media, Design, and Communications	214	188	421	233
Educators	3,041	2,668	3,220	552
Engineering	518	455	534	79
Health Professions	2,005	1,759	3,155	1,396
Human and Protective Service	774	679	905	226
Legal	422	370	577	207
Physical Sciences	106	93	216	123
Production and Trades	109	96	329	233
Service Occupations	112	99	315	216
Social Sciences	246	216	319	103
Technicians	189	166	38	(128)
Total	12,192	10,698	17,410	6,712

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