2014 EMPLOYMENT PROJECTIONS

Occupations
Industries
Job openings
Growth rates
Wages by education

Employment Security Department
WASHINGTON STATE

Labor Market and Performance Analysis

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About the employment, industry and occupational projections

Employment projections provide a general outlook for industries and occupations in Washington state. They provide job seekers, policy makers and training providers an idea of how much an industry or occupation is projected to change over time and show the future demand for workers.

On an annual basis, the Employment Security Department produces industry employment projections for two, five and 10 years from a base period. The base period for the two-year (short-term) projections is second-quarter 2013. The base period for the five-year (medium-term) and 10-year (long-term) projections is 2012.

Staffing patterns for each industry are used to convert industry projections into occupational projections.

Industry classifications are based on the North American Industry Classification System (NAICS). However, they have been modified to match the industry definitions used by the U.S. Bureau of Labor Statistics' (BLS) Occupational Employment Statistics (OES) program. These modified industry definitions are called Industry Control Totals (ICT). The Standard Occupational Classification (SOC) system is used to group occupations. Appendix 3 contains frequently asked questions relating to projections. Appendix 4 provides a glossary of terms and shows a table of educational categories used in this report.

Data sets used to develop projections

The following data sets are used to produce projections:

1. Historical employment time series, in this case the U.S. Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW).
2. Employment not covered by the unemployment insurance system from the U.S. Bureau of Labor Statistics' Current Employment Statistics (CES) program.
3. Occupational employment by industries (staffing patterns) based on the OES survey.
4. Independent variables (predictive indicators), which help to project the future direction of the economy, from IHS Global Insight's national forecast.

Use of employment projections

Employment Projections are intended for career development over time, not as the basis for budget or revenue projections, or for immediate corrective actions within the labor market.

Executive summary

This report highlights findings on specific aspects of Washington's employment outlook. In the first section, industry projections, we describe changes in employment by industry from 2012 through 2022. In the next section, occupational projections, we look at:

- Major occupational groups
- Specific occupations
- Employment and wages by educational levels

Detailed information on the projected demand for industry and occupational employment is available in the Employment Projections data files at: https://fortress.wa.gov/esd/employmentdata/reports-publications/occupational-reports/employment-projections.

Key findings

The 10-year average annual growth rate for total nonfarm employment for the 2012 through 2022 period is projected to be 1.62 percent. This is an increase over the 1.47 percent average annual growth rate predicted last year for 2011 through 2021.[1]

Industry projections

- The largest increase by share of employment is projected for the professional and business services sector.
- The largest decreases by share of employment are projected for the state and local government (including education) and manufacturing sectors.

Occupational projections

Major occupational groups

- The largest increases by share of employment are projected for the construction and extraction occupations. During the Great Recession, construction dropped significantly and is now partially regaining ground.
- The largest decrease by share of employment is projected for the farming, fishing and forestry occupations.
- The largest employment shares in 2022 are projected for office and administrative support occupations, sales and related occupations and food preparation and serving related occupations. However, the first two occupational groups are projected to have declining employment shares.

[1] See: "2013 Employment Projections," Washington State Employment Security Department, Labor Market and Economic Analysis, *Figure 2*, page 6.

Specific occupations

- The retail salespersons occupation is projected to have the largest number of average annual total openings.
- Only three of the 20 occupations with the largest numbers of total openings are projected to have a greater number of openings due to growth than to replacement. These occupations are carpenters, software developers, applications and construction laborers. Janitors and cleaners, except maids and housekeeping cleaners, are projected to have an equal number of openings due to growth and replacement.

Employment, wages and education levels

- The most job openings are projected for occupations that require some college (no degree) and a high school diploma or equivalent (50,962 average annual total openings from 2012 through 2022).
- Occupations requiring associate and bachelor's degrees or higher are projected to have the fastest job growth (1.73 percent average annual growth rate from 2012 through 2022).
- Higher wages, on average, are associated with occupations that require higher education.
- Seven of the top 10 occupations, statewide, require a high school diploma, equivalent or less.
- The highest paid occupation within the top 10 occupations is construction manager ($105,470).

2014 industry projections results

Figure 1 presents 2012 estimated employment, 2012 employment shares and 2022 employment shares by industry for Washington state and the nation.

The three industry sectors with the largest increases in employment shares in Washington state are projected to be professional and business services, construction, and health services and social assistance.

The two industry sectors with the largest decreases in employment shares in the state are projected to be state and local government (including education) and manufacturing.

The changes in employment shares for the state and the nation are generally close. The three sectors with the largest increases in employment shares are identical for the state and the nation, but in different order. The same holds true for the four sectors with the largest decreases in employment shares.

Figure 1. Base and projected industry employment
United States and Washington state, 2012 and 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics

NAICS	Industry sector	WA state est. empl. 2012	WA state est. empl. shares 2012	WA state proj. empl. shares 2022	Washington state percentage point change in employment shares 2012 through 2022	Nat'l. est. empl. shares 2012	Nat'l. proj. empl. shares 2022	National percentage point change in employment shares 2012 through 2022
11 and 21	Natural resources and mining*	2,200	0.08%	0.07%	-0.01%	0.60%	0.62%	0.02%
22	Utilities	4,900	0.17%	0.16%	-0.01%	0.41%	0.33%	-0.08%
23	Construction	139,000	4.84%	5.73%	0.89%	4.20%	4.85%	0.65%
31-33	Manufacturing	280,200	9.76%	8.89%	-0.87%	8.87%	7.59%	-1.27%
42	Wholesale trade	124,100	4.32%	4.27%	-0.05%	4.22%	4.10%	-0.12%
44-45	Retail trade	319,300	11.12%	10.77%	-0.36%	11.07%	10.66%	-0.40%
48-49	Trans. and warehousing	87,800	3.06%	2.93%	-0.13%	3.28%	3.17%	-0.12%
51	Information	104,900	3.65%	3.68%	0.02%	1.99%	1.74%	-0.25%
52	Financial activities	143,300	4.99%	4.69%	-0.30%	5.79%	5.70%	-0.09%
54	Professional and bus. svcs.	349,300	12.17%	13.67%	1.50%	13.34%	14.30%	0.96%
61	Education services	50,200	1.75%	1.82%	0.07%	2.49%	2.69%	0.20%
62	Health services and social assist.	335,000	11.67%	12.31%	0.64%	12.63%	14.67%	2.04%
71 and 72	Leisure and hospitality	277,200	9.66%	9.80%	0.15%	10.23%	10.04%	-0.19%
81	Other services	111,100	3.87%	3.60%	-0.27%	4.59%	4.56%	-0.04%
GOV	Federal government	73,100	2.55%	2.16%	-0.39%	2.09%	1.61%	-0.49%
GOV	State and local gov. (incl. educ.)	469,200	16.34%	15.46%	-0.89%	14.21%	13.38%	-0.83%

**Logging is not included in natural resources and mining to match national data.*

The mix of industry employment is projected to stay about the same from 2012 through 2022. The largest growth sectors for the state are projected to be the professional and business services, construction and health services and social assistance sectors.

Historical and projected growth rates

The Great Recession had a negative effect on historical nonfarm-employment growth rates from 2002 through 2012, and all areas of the state were below long-term historical trends. *Figure 2* shows the historical and projected growth rates for the state and Washington's 12 workforce development areas (WDAs).[2]

From 2002 through 2012, the largest difference between historical growth rates and the projected growth rates are in the Seattle-King County WDA. During this same period, nonfarm employment for the area increased by 0.47 percent per year and the average annual employment growth rate in the future is projected to be 1.77 percent.

There are only two areas where projected growth is less than that achieved in the previous 10 years – Benton-Franklin and the Snohomish WDAs.

Figure 2. Historical and projected total employment growth
Washington state and workforce development areas, 1975 through 2012 and 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics

Workforce development area	Historical growth rate 2002 through 2012	Projected growth rate 2012 through 2022	Historical trend growth 1975 through 2012*
1 - Olympic Consortium	0.51%	1.13%	1.73%
2 - Pacific Mountain	0.57%	1.37%	1.50%
3 - Northwest	0.95%	1.79%	2.48%
4 - Snohomish County	2.23%	1.39%	3.12%
5 - Seattle-King County	0.47%	1.77%	1.84%
6 - Pierce County	0.82%	1.64%	1.94%
7 - Southwest Washington	0.98%	1.95%	2.33%
8 - North Central	0.80%	1.49%	2.21%
9 - South Central	0.52%	1.33%	1.18%
10 - Eastern Washington	0.38%	1.23%	1.34%
11 - Benton-Franklin	2.08%	1.42%	2.10%
12 - Spokane	0.62%	1.57%	1.50%
0 - Statewide	**0.82%**	**1.62%**	**1.93%**

*Trend growth is calculated by gathering historical data, plotting the trend line and calculating growth based on this trend line.

The Benton-Franklin and Snohomish WDAs are the only two areas where the projected growth is less than the previous 10 years' growth.

[2] Workforce development areas are regions within Washington state with economic and geographic similarities.

2014 occupational projections results

The occupational projections cover approximately 810 occupations. This publication, however, provides only a summary of the top occupations. For a complete list of occupations and projected employment, see the 2014 Employment Projections data files available at: https://fortress.wa.gov/esd/employmentdata/reports-publications/occupational-reports/employment-projections.

Major occupational groups

Figure 3 shows occupational employment estimates and employment shares at the state and national levels.

At the state level, one occupational group stood out with increases in employment shares from 2012 through 2022. Construction and extraction occupations are projected to increase employment shares from 4.89 percent to 5.52 percent for an increase of 0.63 percent. The next highest increase in shares is projected for computer and mathematical occupations with an increase of 0.24 percentage points.

The largest decreases in employment shares at the state level were in farming, fishing and forestry occupations, with projected decreases of 0.27 percent and in sales and related occupations, with a projected decrease of 0.25 percent.

By 2022, at the state level, the top three occupational groups for shares of employment are projected to be:

1. Office and administrative support occupations (12.57 percent)
2. Sales and related occupations (9.93 percent)
3. Food preparation and serving related occupations (7.30 percent)

By 2022, combined, these three major groups are projected to represent nearly 30 percent of total employment shares for the state.

At the national level, the top three occupational groups projected to have the greatest number of shares by 2022 are the same as the state:

1. Office and administrative support occupations (14.91 percentage points)
2. Sales and related occupations (10.06 percentage points)
3. Food preparation and serving related occupations (8.00 percentage points)

The top five and the bottom seven occupational group shares are the same for the state and the nation, but not in identical order.

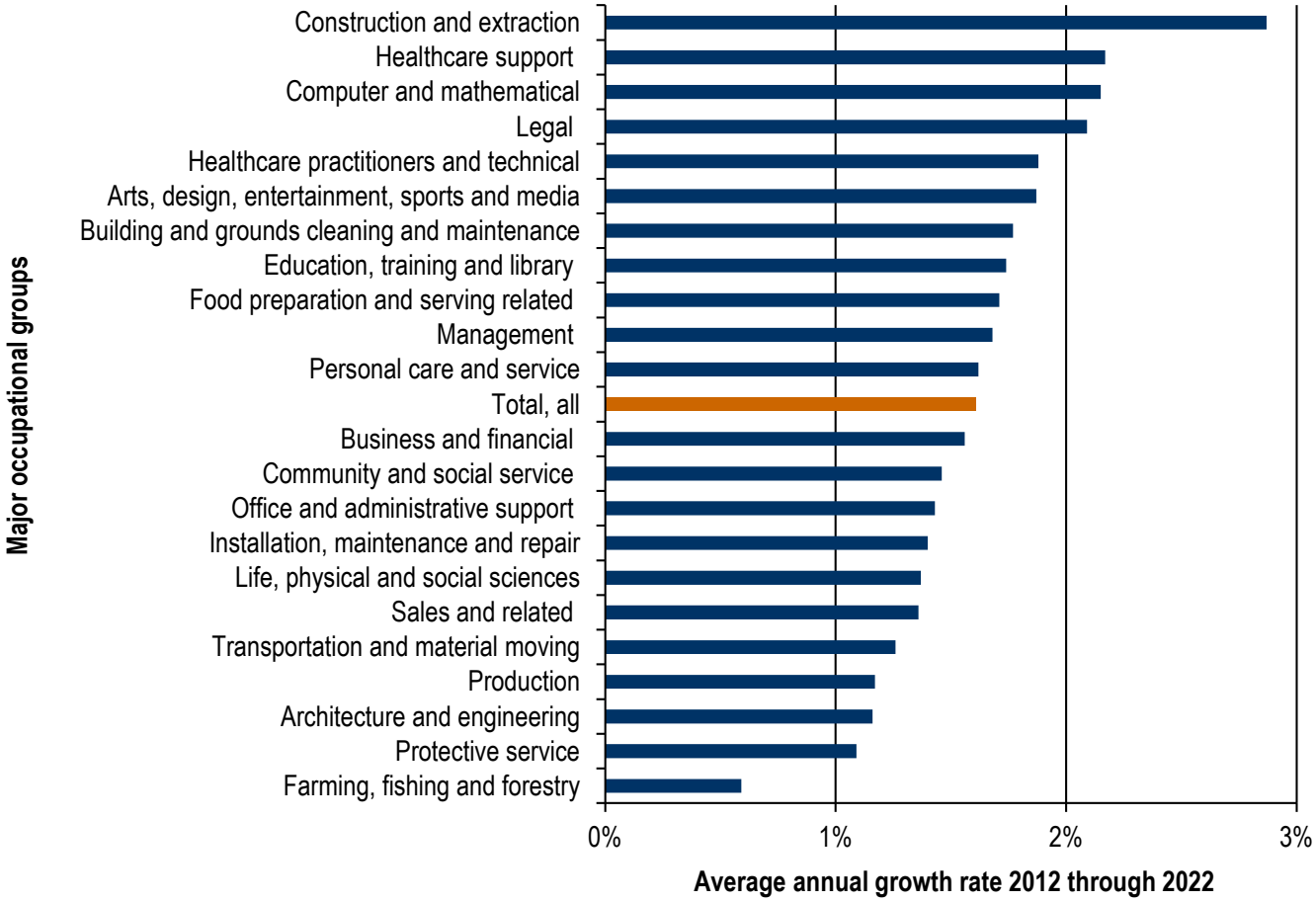
Figure 3. Base and projected occupational employment
Washington state, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics

2-digit SOC	Major occupational group	WA state est. empl. 2012	WA state est. empl. shares 2012	WA state est. empl. shares 2022	Nat'l. est. empl. shares 2012	Nat'l. est. empl. shares 2022	WA state percentage point change in empl. shares 2012 through 2022	National percentage point change in empl. shares 2012 through 2022
11-0000	Management	180,206	5.38%	5.42%	6.10%	5.90%	0.04%	-0.33%
13-0000	Business and financial operations	186,801	5.58%	5.56%	4.93%	5.01%	-0.03%	0.16%
15-0000	Computer and mathematical	147,511	4.41%	4.65%	2.62%	2.80%	0.24%	0.63%
17-0000	Architecture and engineering	80,933	2.42%	2.31%	1.70%	1.65%	-0.11%	-0.32%
19-0000	Life, physical and social sciences	38,120	1.14%	1.11%	0.86%	0.85%	-0.03%	-0.06%
21-0000	Community and social services	55,050	1.64%	1.62%	1.63%	1.73%	-0.02%	0.57%
23-0000	Legal	27,289	0.82%	0.85%	0.86%	0.86%	0.04%	-0.01%
25-0000	Education, training and library	195,510	5.84%	5.92%	6.27%	6.29%	0.08%	0.04%
27-0000	Arts, design, entertain., sports and media	69,053	2.06%	2.12%	1.77%	1.71%	0.05%	-0.34%
29-0000	Healthcare practitioners and technical	162,097	4.84%	4.97%	5.54%	6.08%	0.13%	0.93%
31-0000	Healthcare support	85,136	2.54%	2.69%	2.83%	3.27%	0.15%	1.47%
33-0000	Protective service	59,469	1.78%	1.69%	2.29%	2.23%	-0.09%	-0.26%
35-0000	Food preparation and serving related	241,947	7.23%	7.30%	8.10%	8.00%	0.07%	-0.13%
37-0000	Building and grounds cleaning and maint.	138,351	4.13%	4.20%	3.80%	3.86%	0.07%	0.16%
39-0000	Personal care and service	150,031	4.48%	4.49%	3.70%	4.04%	0.01%	0.88%
41-0000	Sales and related	340,576	10.17%	9.93%	10.39%	10.06%	-0.25%	-0.32%
43-0000	Office and administrative support	427,903	12.78%	12.57%	15.46%	14.91%	-0.22%	-0.36%
45-0000	Farming, fishing and forestry	94,284	2.82%	2.55%	0.65%	0.57%	-0.27%	-1.36%
47-0000	Construction and extraction	163,561	4.89%	5.52%	4.19%	4.59%	0.64%	0.92%
49-0000	Installation, maintenance and repair	121,449	3.63%	3.56%	3.79%	3.76%	-0.07%	-0.10%
51-0000	Production	176,550	5.27%	5.05%	6.15%	5.60%	-0.22%	-0.93%
53-0000	Transportation and material moving	205,379	6.14%	5.93%	6.36%	6.23%	-0.21%	-0.20%

From 2012 through 2022, occupational projections for both the state and nation show that the top three sectors for employment shares will be office and administrative support, sales and related, and food preparation and serving related occupations.

The projected average annual growth rates for the major occupational groups in Washington state are presented in *Figure 4*. Construction and extraction occupations (2.87 percent), healthcare support occupations (2.17 percent) and computer and mathematical occupations (2.15 percent) are projected to grow faster than other occupational groups from 2012 through 2022. In the long term, only one occupational group is projected to fall below a one percent average annual growth rate: farming, fishing and forestry (0.59 percent).

Figure 4. Projected average annual growth rates for major occupational groups
Washington state, 2012 through 2022
Source: Employment Security Department/LMPA



Construction and extraction occupations, healthcare support occupations and computer and mathematical occupations are projected to experience the largest growth rates through 2022 (2.87, 2.17 and 2.15 percent, respectively).

Specific occupations

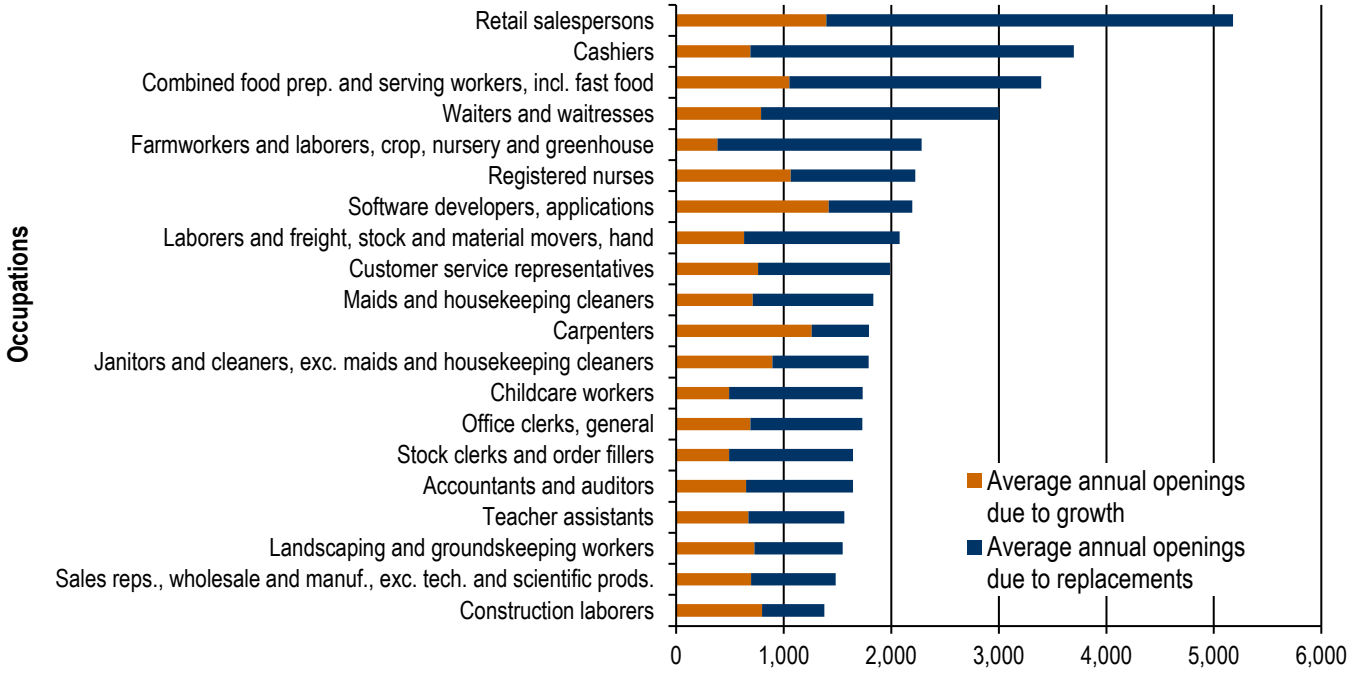
The top 20 specific occupations by total openings are presented in *Figure 5*. At the detailed occupational level (six-digit SOC), the office and administrative support occupation is projected to have the largest number of total openings. Openings can be due to replacement (filling an existing position that is now vacant) or due to growth (a newly created position). On average at the state level, the total number of openings due to replacement is about 1.5 greater than the number of openings due to growth.

The number of openings due to job growth is greater than the number of openings due to replacement in only three of the top 20 occupations:

- Carpenters
- Software developers, applications
- Construction laborers

For janitors and cleaners, except maids and housekeeping cleaners, the number of openings due to growth is equal to the number of openings due to replacement.

Figure 5. Top 20 occupations by average annual total openings
Washington state, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics



The number of openings due to growth is greater than the number of openings due to replacement needs in only three of the top 20 occupations.

Employment, wages and education levels

The U.S. Bureau of Labor Statistics categorizes occupations by educational level to reflect how a worker enters and becomes competent in an occupation. Any scheme will be imperfect since educational and training requirements vary significantly from one job to another, even within an occupation. In addition, some occupations require licensure, which is not covered in BLS' categories.

To make educational levels more representative and somewhat comparable with those used in previous projections reports, we aggregated the eight BLS categories, assigned to the 2010 SOC codes, to just four educational levels. When measured by the four educational levels used in this report, occupations requiring higher educational levels were associated with higher wages. This held true for the state as shown in *Figure 6*.

Figure 6 shows statewide average employment growth and current wages[3] for occupations categorized by BLS-assigned educational levels. Wages are representative of the money earned by the people who work in these occupations, not by the listed educational level.

Only occupations with available wage data were included in these calculations. Through 2022, jobs projected to require an associate degree and postsecondary non-degree award and bachelor's degree or higher will be the fastest growing occupations (at 1.73 percent annually). However, more openings are projected for occupations that require some college (no degree) and a high school diploma or equivalent (50,962 average annual total openings 2012 through 2022).

The largest dollar gain is the transition from occupations requiring an associate degree and postsecondary non-degree award to a bachelor's degree or higher, with an estimated average gain of $32,265 annually. The gain in average wages from occupations requiring some college and high school diploma or equivalent to an associate degree and postsecondary non-degree award is $7,529 and from less than high school to some college and high school diploma or equivalent, the gain is $18,199.

The transition from occupations requiring less than high school to some college (no degree) and high school diploma or equivalent posted the most significant increase in average annual wages, based on percent change (64.05 percent).

Occupations requiring some college (no degree) and high school diploma or equivalent and requiring less than high school represented two-thirds of total estimated 2012 employment.

[3] Wages are not part of the occupational projections. Source data for wages come from the Occupational Employment Statistics (OES) survey and is subject to the restrictions and limitations of the OES survey protocol.

Figure 6. Employment, projected growth, wages and educational levels
Washington state, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Education level	Estimated employment 2012	Average annual growth rate 2012 through 2022	Average annual total openings 2012 through 2021	Average annual wages estimated March 2014*
Bachelor's degree or higher	808,184	1.73%	33,364	$86,406
Associate degree and postsecondary non-degree award	325,066	1.73%	13,120	$54,141
Some college (no degree) and high school diploma or equivalent	1,301,103	1.55%	50,962	$46,612
Less than high school	907,655	1.53%	43,925	$28,412

*Wages were estimated for SOC-coded occupations based on U.S. Bureau of Labor Statistics, Occupational Employment Statistics (OES) definitions, not educational levels.

The fastest employment growth rates in the 2012 through 2022 period are projected for occupations requiring associate degree and post-secondary non-degree award and bachelor's degree or higher (1.73 percent).

Top 10 occupations

From 2012 through 2022, Washington state is projected to have nearly 144,595 average annual job openings. *Figure 7* presents the top 10 occupations in Washington state, based on the average of two criteria:

1. Average annual growth rate.
2. Total number of job openings due to growth and replacement.

Statewide, seven of the top 10 occupations require a high school diploma, equivalent or less. The U.S. Bureau of Labor Statistics' breakout of eight educational categories was used when calculating the top 10 occupations.

Figure 7. Top 10 occupations by growth and openings
Washington state, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2031	Carpenters	H.S. diploma or equivalent	36,638	39,009	4.17%	3.00%	2,160	1,794	$50,000
2	47-2061	Construction laborers	Less than high school	22,744	23,807	4.20%	3.05%	1,531	1,378	$42,056
3	31-9011	Massage therapists	Postsec. non-degree award	9,230	9,627	4.25%	3.99%	494	563	$52,076
4	47-2141	Painters, construction and maintenance	Less than high school	14,479	15,403	3.92%	2.91%	854	739	$42,248
5	47-1011	First-line svprs. of construction trades and extraction wrkrs.	H.S. diploma or equivalent	15,029	15,705	3.88%	2.85%	808	677	$75,521
6	47-2111	Electricians	H.S. diploma or equivalent	14,949	15,334	3.69%	2.82%	862	808	$63,398
7	47-2181	Roofers	Less than high school	5,001	5,485	4.76%	3.41%	388	327	$45,416
8	11-9021	Construction managers	Bachelor's degree	13,217	13,687	3.62%	2.68%	684	645	$105,470
9	13-1051	Cost estimators	Bachelor's degree	5,443	5,684	3.86%	2.98%	399	392	$67,939
10	37-3011	Landscaping and groundskeeping workers	Less than high school	29,103	29,985	3.12%	2.26%	1,719	1,548	$30,643

The highest paid occupation within the top 10 occupations is construction managers ($105,470).

Tables for the top 10 occupations for each WDA are available in *Appendix 2*.

Appendices

Appendix 1. Use and misuse of employment projections

Employment projections provide a general outlook for industries and occupations in Washington state. Occupational projections show how many job openings are projected due to occupational employment growth, decline and replacement needs.[4]

Replacement includes openings created by retirements and separations. It does not include normal turnover as workers go from one employer to another or from one area to another without changing their occupations. Total openings from occupational projections do not represent the total demand, but can be used as an indicator of demand.

Occupational details for employment (with at least 10 jobs) are presented for the state and all workforce development areas in our employment projections data files available online at https://fortress.wa.gov/esd/employmentdata/reports-publications/occupational-reports/employment-projections.

Observed and predicted extremes in employment growth and other indicators, such as fastest-growing occupations and shortage of skills, can be used for placement and short-term training decisions. However, these should be limited for use when developing long-term education programs. There are two main reasons for this limitation:

1. First, with more education targeting occupations with skills shortages, there is a higher probability that this will cause an oversupply in those occupations and skills sets.[5]
2. Second, the general development of transferable skills is much more productive than trying to catch up with a skills shortage.

The U.S. Bureau of Labor Statistics cautions: "The 2010 SOC was designed solely for statistical purposes. Although it is likely that the 2010 SOC also will be used for various non-statistical purposes (e.g., for administrative, regulatory, or taxation functions), the requirements of government agencies or private users that choose to

[4]As we discuss in the technical description in Appendix 3, due to the non-additive formula for calculating total openings, in this round of projections we calculated total openings for aggregated occupations as a total for detailed occupations. As a result, the aggregated level of total openings might not equal the total of growth plus replacement.

[5]Occupational projections are used as a major input for the Occupations in Demand list (also referred to as the Training Benefits list). See https://fortress.wa.gov/esd/employmentdata/reportspublications/occupational-reports/occupations-in-demand.

use the 2010 SOC for non-statistical purposes have played no role in its development, nor will OMB modify the classification to meet the requirements of any non-statistical program.

Consequently, the 2010 SOC is not to be used in any administrative, regulatory, or tax program unless the head of the agency administering that program has first determined that the use of such occupational definitions is appropriate to the implementation of the program's objectives."[6]

Different programs use different SOC coding systems. Combining the employment projections with other data sources generally requires a case-by-case analysis; an understanding of the differences of each program should be clearly explained and properly handled.

Occupations in Demand list

The methodology for determining whether an occupation is "in demand," "not in demand" or "balanced" is based on industry and occupational projections. Specific levels of job growth and job openings are used to designate an occupation as "in demand," "not in demand," or "balanced." For more details and methodology, refer to How we determine demand for occupations.

[6] See: www.bls.gov/soc/soc_2010_user_guide.pdf , pages xxv-xxvi.

Appendix 2. Top 10 occupations by workforce development area

Figure A-2-1. Top 10 occupations by growth and openings
Olympic Consortium, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2061	Construction laborers	Less than high school	1,312	1,338	4.07%	2.73%	84	74	$36,439
2	47-2031	Carpenters	High school diploma or equivalent	2,065	2,155	3.26%	2.08%	99	76	$52,399
3	39-9021	Personal care aides	Less than high school	1,389	1,379	2.75%	2.54%	47	51	$23,108
4	31-9011	Massage therapists	Postsec. non-degree award	516	513	3.36%	3.11%	22	25	$60,163
5	11-9021	Construction managers	Bachelor's degree	500	513	3.64%	2.45%	26	23	$101,642
6	33-9032	Security guards	High school diploma or equivalent	707	843	3.44%	2.15%	42	29	$32,642
7	37-3011	Landscaping and groundskeeping workers	Less than high school	1,338	1,345	2.68%	2.12%	71	69	$32,421
8	29-1141	Registered nurses	Associate's degree	2,005	2,034	2.57%	2.06%	88	89	$75,775
9	47-2181	Roofers	Less than high school	237	235	4.17%	2.69%	15	13	$38,883
10	47-2073	Operating engineers and other construction equip. operators	High school diploma or equivalent	312	317	3.26%	2.57%	18	17	$59,861

Figure A-2-2. Top 10 occupations by growth and openings
Pacific Mountain, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2061	Construction laborers	Less than high school	1,539	1,609	4.11%	3.00%	102	92	$41,746
2	31-9011	Massage therapists	Postsec. non-degree award	731	769	4.58%	3.79%	42	43	$57,452
3	47-2031	Carpenters	High school diploma or equivalent	2,382	2,429	4.06%	2.59%	132	104	$45,509
4	51-7041	Sawing machine setters, operators and tenders, wood	High school diploma or equivalent	539	527	5.81%	2.31%	47	32	$38,261
5	15-1131	Computer programmers	Bachelor's degree	280	328	4.33%	4.14%	23	24	$85,595
6	43-9199	Office and administrative support workers, all other	High school diploma or equivalent	348	405	3.64%	3.50%	27	27	$31,473
7	41-9041	Telemarketers	Less than high school	1,083	983	3.25%	2.50%	56	56	#N/A
8	51-9199	Production workers, all other	High school diploma or equivalent	454	446	3.42%	2.93%	27	29	$25,775
9	53-7062	Laborers and freight, stock and material movers, hand	Less than high school	2,710	2,778	2.86%	2.07%	170	156	$31,715
10	47-2181	Roofers	Less than high school	292	312	4.24%	3.40%	20	19	$31,965

Figure A-2-3. Top 10 occupations by growth and openings
Northwest Washington, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2061	Construction laborers	Less than high school	1,724	1,711	4.29%	3.45%	112	115	$43,384
2	47-2031	Carpenters	High school diploma or equivalent	3,471	3,561	4.19%	3.31%	198	185	$47,877
3	47-2181	Roofers	Less than high school	629	691	5.42%	3.84%	54	45	$45,275
4	47-1011	First-line supervisors of construction trades and extraction workers	High school diploma or equivalent	1,158	1,150	4.26%	3.37%	64	60	$69,470
5	47-2111	Electricians	High school diploma or equivalent	1,108	1,031	4.27%	2.86%	64	61	$61,986
6	11-9021	Construction managers	Bachelor's degree	998	991	4.01%	3.32%	54	58	$97,013
7	47-2141	Painters, construction and maintenance	Less than high school	824	873	4.37%	3.04%	53	44	$37,652
8	47-2073	Operating engineers and other construction equipment operators	High school diploma or equivalent	692	685	3.66%	3.13%	40	43	$58,952
9	27-2022	Coaches and scouts	Bachelor's degree	937	1,004	3.19%	2.94%	64	64	$32,489
10	13-1051	Cost estimators	Bachelor's degree	320	308	4.29%	3.31%	23	25	$60,555

Figure A-2-4. Top 10 occupations by growth and openings
Snohomish County, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	37-3011	Landscaping and groundskeeping workers	Less than high school	3,610	4,123	3.95%	3.55%	272	261	$34,588
2	47-2181	Roofers	Less than high school	1,213	1,350	5.34%	3.43%	104	81	$48,796
3	47-2061	Construction laborers	Less than high school	2,372	2,579	4.27%	2.89%	168	139	$43,871
4	47-2031	Carpenters	High school diploma or equivalent	4,308	4,841	4.16%	2.84%	268	202	$53,538
5	37-2011	Janitors and cleaners, except maids and housekeeping cleaners	Less than high school	4,025	4,391	3.19%	2.84%	218	219	$29,782
6	47-2141	Painters, construction and maintenance	Less than high school	2,515	2,933	3.50%	2.81%	150	125	$40,986
7	11-9021	Construction managers	Bachelor's degree	1,235	1,288	4.03%	2.93%	70	65	$102,167
8	31-9011	Massage therapists	Postsec. non-degree award	1,001	1,109	3.59%	4.02%	49	62	$65,563
9	51-4041	Machinists	High school diploma or equivalent	879	968	3.80%	3.36%	60	59	$46,535
10	47-1011	First-line supervisors of construction trades and extraction workers	High school diploma or equivalent	1,191	1,297	4.08%	2.83%	69	54	$74,226

Figure A-2-5. Top 10 occupations by growth and openings
Seattle-King County, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2031	Carpenters	High school diploma or equivalent	11,676	12,527	4.68%	3.28%	761	619	$53,896
2	47-2061	Construction laborers	Less than high school	6,728	6,991	4.83%	3.34%	496	436	$44,241
4	31-9011	Massage therapists	Postsec. non-degree award	3,477	3,607	4.82%	4.49%	207	239	$50,317
	47-2111	Electricians	High school diploma or equivalent	4,650	4,844	4.48%	3.43%	312	292	$70,356
5	47-2141	Painters, construction and maintenance	Less than high school	4,228	4,470	4.75%	3.45%	287	249	$42,546
6	47-1011	First-line supervisors of construction trades and extraction workers	High school diploma or equivalent	5,080	5,334	4.65%	3.32%	318	262	$81,003
7	41-3099	Sales reps., services, all other	High school diploma or equivalent	8,811	9,128	3.52%	2.82%	574	562	$68,527
8	47-2152	Plumbers, pipefitters and steamfitters	High school diploma or equivalent	3,248	3,382	4.51%	3.47%	200	181	$69,261
9	27-1014	Multimedia artists and animators	Bachelor's degree	4,330	4,501	3.55%	3.06%	273	272	$78,858
10	31-1011	Home health aides	Less than high school	3,271	3,488	3.88%	3.31%	200	199	$28,168

Figure A-2-6. Top 10 occupations by growth and openings
Pierce County, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2031	Carpenters	High school diploma or equivalent	4,506	4,735	4.02%	3.15%	254	230	$46,080
2	47-2061	Construction laborers	Less than high school	2,503	2,627	4.10%	3.20%	166	157	$41,926
3	47-2181	Roofers	Less than high school	1,090	1,163	4.95%	4.03%	85	81	$51,173
4	47-2141	Painters, construction and maintenance	Less than high school	1,708	1,791	4.08%	3.31%	102	97	$44,366
5	47-1011	First-line supervisors of construction trades and extraction workers	High school diploma or equivalent	2,069	2,149	3.95%	3.05%	112	99	$73,440
6	11-9021	Construction managers	Bachelor's degree	1,620	1,671	3.87%	2.97%	88	86	$108,704
7	13-1051	Cost estimators	Bachelor's degree	603	632	4.18%	3.33%	47	47	$66,462
8	31-1011	Home health aides	Less than high school	1,189	1,245	3.98%	2.96%	73	66	$26,827
9	51-9195	Molders, shapers, and casters, except metal and plastic	High school diploma or equivalent	363	376	5.81%	3.42%	34	30	$39,364
10	47-2111	Electricians	High school diploma or equivalent	1,637	1,668	3.51%	2.67%	91	85	$59,357

Figure A-2-7. Top 10 occupations by growth and openings
Southwest Washington, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2111	Electricians	High school diploma or equivalent	1,400	1,376	4.65%	3.95%	91	100	$57,755
2	47-2061	Construction laborers	Less than high school	2,063	2,142	4.21%	3.28%	138	132	$42,429
3	49-9021	Heating, air conditioning, and refrigeration mechanics and installers	Postsec. non-degree award	559	543	4.85%	4.06%	41	46	$48,727
4	13-1051	Cost estimators	Bachelor's degree	518	539	4.54%	3.48%	42	41	$54,200
5	31-9011	Massage therapists	Postsec. non-degree award	546	583	5.02%	3.96%	35	33	$60,625
6	47-2152	Plumbers, pipefitters and steamfitters	High school diploma or equivalent	660	653	4.13%	3.63%	36	39	$52,074
7	47-1011	First-line supervisors of construction trades and extraction workers	High school diploma or equivalent	968	1,024	3.97%	3.06%	54	47	$78,950
8	47-2031	Carpenters	High school diploma or equivalent	2,437	2,622	3.74%	2.71%	133	110	$46,189
9	33-9032	Security guards	High school diploma or equivalent	1,093	1,119	3.77%	2.85%	59	55	$26,162
10	47-2141	Painters, construction and maintenance	Less than high school	887	936	3.83%	2.77%	51	44	$40,335

Figure A-2-8. Top 10 occupations by growth and openings
North Central Washington, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2031	Carpenters	High school diploma or equivalent	1,022	1,143	4.28%	2.82%	65	48	$48,087
2	47-2061	Construction laborers	Less than high school	772	848	3.99%	2.86%	53	45	$36,731
3	51-4121	Welders, cutters, solderers and brazers	High school diploma or equivalent	292	305	5.27%	3.65%	24	22	$43,570
4	51-2031	Engine and other machine assemblers	High school diploma or equivalent	165	192	6.80%	5.16%	17	14	N/A
5	27-2022	Coaches and scouts	Bachelor's degree	558	591	2.75%	2.65%	34	35	$35,593
6	47-2141	Painters, construction and maintenance	Less than high school	312	338	3.63%	2.74%	18	16	$41,628
7	31-9011	Massage therapists	Postsec. non-degree award	178	180	4.35%	4.02%	10	11	$62,042
8	47-2111	Electricians	High school diploma or equivalent	408	482	3.37%	2.36%	25	20	$60,036
9	51-4041	Machinists	High school diploma or equivalent	153	157	4.67%	2.71%	11	9	$41,190
10	51-2092	Team assemblers	High school diploma or equivalent	356	363	3.25%	2.51%	18	16	$24,277

Figure A-2-9. Top 10 occupations by growth and openings
South Central Washington, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2031	Carpenters	High school diploma or equivalent	1,368	1,481	3.42%	2.48%	71	58	$42,284
2	51-4041	Machinists	High school diploma or equivalent	203	215	5.43%	3.34%	17	14	$43,454
3	47-2141	Painters, construction and maintenance	Less than high school	457	467	3.68%	2.52%	25	21	$34,467
4	47-2111	Electricians	High school diploma or equivalent	469	468	3.36%	2.41%	24	23	$55,366
5	51-4121	Welders, cutters, solderers and brazers	High school diploma or equivalent	425	501	3.53%	2.16%	30	22	$38,258
6	33-9032	Security guards	High school diploma or equivalent	488	527	2.99%	2.54%	24	23	$29,186
7	47-2061	Construction laborers	Less than high school	654	710	2.98%	2.23%	37	32	$35,673
8	49-9041	Industrial machinery mechanics	High school diploma or equivalent	339	337	2.92%	2.24%	19	20	$48,326
9	43-6013	Medical secretaries	High school diploma or equivalent	516	514	2.69%	2.32%	20	21	$34,551
10	11-9021	Construction managers	Bachelor's degree	288	321	3.22%	2.40%	15	13	$92,813

Figure A-2-10. Top 10 occupations by growth and openings
Eastern Washington, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	37-1012	First-line supervisors of landscaping, lawn service and groundskeeping workers	High school diploma or equivalent	385	461	4.35%	3.52%	25	21	$46,466
2	47-2111	Electricians	High school diploma or equivalent	364	376	3.78%	2.98%	22	21	$64,847
3	37-3011	Landscaping and groundskeeping workers	Less than high school	849	926	2.87%	2.36%	51	47	$26,175
4	47-2031	Carpenters	High school diploma or equivalent	602	605	2.77%	2.56%	25	26	$47,086
5	51-7041	Sawing machine setters,operators and tenders, wood	High school diploma or equivalent	86	95	7.12%	3.81%	10	7	$35,272
6	51-9061	Inspectors, testers, sorters, samplers and weighers	High school diploma or equivalent	197	202	4.12%	2.53%	13	11	$43,451
7	47-2061	Construction laborers	Less than high school	517	540	2.65%	2.28%	26	26	$32,537
8	51-4041	Machinists	High school diploma or equivalent	92	100	5.36%	3.83%	8	7	$43,725
9	49-9021	Heating, air conditioning, and refrigeration mechanics and installers	Postsec. non-degree award	95	99	4.93%	3.65%	7	7	$43,386
10	13-1111	Management analysts	Bachelor's degree	244	256	3.46%	2.19%	13	11	$82,910

Figure A-2-11. Top 10 occupations by growth and openings
Benton-Franklin, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	31-1011	Home health aides	Less than high school	509	524	3.65%	3.30%	29	31	$22,901
2	37-3011	Landscaping and groundskeeping workers	Less than high school	931	1,023	3.13%	2.73%	59	56	$28,969
3	31-9092	Medical assistants	Postsec. non-degree award	541	559	3.34%	2.97%	28	31	$31,414
4	43-6013	Medical secretaries	High school diploma or equivalent	516	526	3.46%	3.14%	25	26	$36,056
5	47-2061	Construction laborers	Less than high school	1,286	1,315	3.40%	2.16%	74	62	$42,035
6	47-2031	Carpenters	High school diploma or equivalent	1,442	1,485	3.41%	2.16%	71	55	$40,256
7	31-9011	Massage therapists	Postsec. non-degree award	168	172	5.10%	4.94%	10	13	$52,524
8	31-9091	Dental assistants	Postsec. non-degree award	347	351	3.64%	2.86%	20	20	$40,017
9	29-2021	Dental hygienists	Associate's degree	232	235	3.76%	3.11%	14	15	$88,194
10	47-2181	Roofers	Less than high school	238	258	4.92%	2.41%	19	13	$42,554

Figure A-2-12. Top 10 occupations by growth and openings
Spokane County, 2012 through 2022
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

Rank	SOC	Occupational title	Education level	Est. empl. 2012	Est. empl. 2013Q2	Average annual growth rate 2013Q2 through 2015Q2	Average annual growth rate 2012 through 2022	Average annual total openings 2013Q2 through 2015Q2	Average annual total openings 2012 through 2022	Est. average wage March 2014
1	47-2031	Carpenters	High school diploma or equivalent	2,178	2,251	3.39%	2.93%	106	105	$47,510
2	37-3011	Landscaping and groundskeeping workers	Less than high school	1,855	2,043	3.65%	2.48%	129	105	$28,610
3	47-2061	Construction laborers	Less than high school	1,930	1,984	3.35%	2.72%	110	108	$39,500
4	33-9032	Security guards	High school diploma or equivalent	1,309	1,585	2.98%	3.37%	71	76	$28,197
5	31-9011	Massage therapists	Postsec. non-degree award	583	586	4.18%	3.66%	29	33	$50,637
6	47-2211	Sheet metal workers	High school diploma or equivalent	384	394	4.47%	3.43%	26	24	$34,076
7	47-2141	Painters, construction and maintenance	Less than high school	710	789	3.49%	2.99%	40	37	$38,244
8	47-1011	First-line supervisors of construction trades and extraction workers	High school diploma or equivalent	937	968	3.40%	2.84%	45	42	$64,698
9	47-2111	Electricians	High school diploma or equivalent	1,008	1,048	3.10%	2.67%	53	53	$50,274
10	37-3012	Pesticide handlers, sprayers and applicators, vegetation	High school diploma or equivalent	286	333	4.98%	3.26%	26	19	$28,285

Appendix 3. Technical description

Introduction

The Projections Managing Partnership[7] (PMP) methodologies advise forecasters to combine alternative econometric forecasting methods and to choose the best fitting model in order to produce reliable forecasts. The "fit" of a model is based on performance measures for the observed time periods. PMP's advice was followed for the production of state and regional forecasts.

Two major sets of data are required for making a forecast:

1. An employment time series.
2. Independent variables (predictive indicators).

Autoregressive models only use historical employment time series to forecast employment. The more complex models incorporate dependent and independent variables. Structural changes in employment are incorporated in the complex models through independent leading indicators.

Projection accuracy is measured by the variance between predicted and actual observed results (in sample and out of sample). Typically, time series models produce accurate results for industries, areas and occupations when smooth patterns of economic development exist. However, such models cannot reliably predict unexpected changes. No econometric tools exist that can predict structural changes. However, such predictions are highly valued by forecast consumers. Current forecast models are based on the assumption of smooth economic development.

High statistical accuracy may not indicate the achievement of significant results. For example, a one-day-ahead weather forecast which predicts tomorrow's weather will be the same as today has a high measure of statistical reliability, but is of no real value. Predicting significant economic change carries the risk of increasing statistical errors, but raises the value of the prediction for those who plan for future events. Such predictions often require the use of subjective judgment. Subjective judgment can differ significantly between individuals.[8]

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[7] PMP partnership is between (1) the U.S. Department of Labor, Employment and Training Administration (ETA); (2) the U.S. Department of Labor, Bureau of Labor Statistics (BLS); (3) the National Association of State Workforce Agencies (NASWA); and (4) the State Projections Consortium. The PMP operates an integrated, nationwide program of state and local projections.

[8] For example, two individuals observe a car driving well above the speed limit. One of them is thinking that the car will reach its destination faster; the other thinks there is a higher probability that the car will be stopped by a police officer or cause a traffic accident. The same is true for extremely fast growing industries and occupations.

Nonetheless, subjective judgments are often used to adjust initial results. The need for adjustment increases as the level of detail increases.

The main biases in employment projections come from:

- Applying ongoing trends.
- Using opinions or anecdotes rather than data-based expectations.
- Ignoring the possible effects of actions taken by consumers as a result of projection results. For example, assume a scenario in which a forecast states that registered nurses will be in demand. Prospective students and college planners read the nursing forecast. A large influx of nursing students occurs and colleges graduate a large number of registered nurses. With the resulting oversupply of registered nurses in the market, a sizeable number of applicants for nursing jobs find that their skills are no longer in demand.

Projection output is put to multiple uses. Therefore, the application of various methodological treatments to projections is warranted. In some cases, projection results are used for developing fast corrective actions. For example, employment projections used for budget forecasting and contingency budget planning should receive priority attention from forecasters. Employment projections for budgetary planning require the use of adaptive controls. Consequently, forecasts should be updated often to reflect the best and most current data. In such cases, up-to-date data takes priority over long, stable forecasting time periods.

Other consumers use forecasts for career development. Prospective students need forecasts that are stable for medium-range time periods. Frequent updates of forecasts in such cases would be disruptive. In other words, for prospective students, frequently updated forecasts lose practical value.

The compromise between statistical accuracy and the ability to predict sharp economic changes can be achieved by developing a relatively smooth baseline forecast (i.e., what happens if nothing changes) and introducing a few alternative scenarios, which address the possibility of positive and negative shocks. Some well-known forecasting companies, including Global Insight, successfully use such an approach.

Industry projections

The principal source for industry employment projections was a detailed, covered employment time series of four-digit NAICS data for all Washington counties. These data were aggregated to workforce development area (WDA) levels.

The PMP advised analysts to use quarterly data frequencies for short-term projections and annual frequencies for long-term projections. The PMP has the software for producing short- and long-term projections, but no software for producing medium-term projections. We found it to be more effective to combine elements of these two programs and then to supplement them with medium-term projections. It should be noted that medium-term projections are required by Washington state law. We also found that the best results could be achieved by using models with monthly data frequencies. These data frequencies are better suited for incorporating seasonality into the forecasting model.

There are two options for reflecting seasonality:

1. Use an independently adjusted series as an input in the model, or
2. Incorporate seasonal dummy variables as part of the projection model.

In our special study, "Seasonality in Employment Time Series,"[9] we demonstrated that the best model for seasonal adjustment might not be the best autoregressive model for forecasting and vice versa. Consequently, in the majority of cases it is preferable to incorporate seasonal adjustments in the forecasting model, rather than use an independently adjusted series as an input to the model.

Short-term projections have a two-year time horizon from the latest available quarter of covered employment data. For this round of short-term projections, second-quarter 2013 was the latest available data; the target point was second-quarter 2015. For the current round of long-term projections, the latest available data was for 2012 and target point was 2022. The medium-term projection target is the middle point of the long-term horizon. In this case, it is the year 2017.

Due to some differences in noncovered employment (which are used for benchmarking) and the way noneconomic code changes are handled, the base numbers used for projections can be slightly different from those published in the Current Employment Statistics (CES) estimates.

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[9] Available from the Employment Security Department Labor Market Information Center, 800-215-1617.

[10] The Global Insight model uses quarterly frequencies of the data. We interpolate quarterly historical series and forecasts for the national model to monthly frequencies using cubic spline functions (default interpolation model in SAS).

Projection process

The first step was to develop aggregated statewide industry projections. Initial covered employment at the county level was aggregated into 34 industry groups (cells) for nonfarm employment. These groups were used in the Global Insight model and then rolled up to the statewide series.

We used the SAS Time Series Forecasting System as the main tool for industry employment projections. This system includes 42 default autoregression models and can easily be supplemented by other custom-built models, including models with independent variables. The two main independent variables (regressors) used in forecasting were:

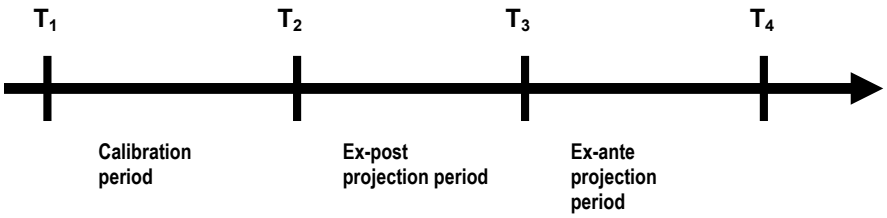
- Industry employment forecasts for the same national industry as the Global Insight model,[10] and
- The forecast of total nonfarm employment for the state (using the SAS Forecasting System and a Global Insight forecast of the national total nonfarm employment).

The selection of the regression model (or multiple models) to add to the forecasting system for each industry was based on standard regression statistics for the parameters. The main choices built into this system were:

- Type of variable transformation (log, logistic, Box-Cox, square root, none).
- Seasonal model (seasonal ARIMA, seasonal difference, seasonal dummy variable, none).
- Trend model (linear, trend curve, first difference, second difference, none).
- Error model (combination of the different orders of autoregression and moving averages).

The custom-built models were added to the default models in the SAS system. The goal of such a custom fit was to build a model that better predicted the future. The main criteria used to select such models were based on different types of prediction errors in and out of the sample (SAS Time Series Forecasting System includes 13 criteria to choose from). We mainly used mean absolute percent error (MAPE) as criteria. The final forecast can often be improved by combining several forecasting models. The SAS forecasting system includes a sophisticated tool for combining such forecasts, which is based on optimization of weights of the selection. The selected models (or combination of the models) were used to produce initial forecasts.

In SAS, the technique called hold-out sample, often referred to as ex-post projections, was used to estimate out-of-sample errors. The main idea behind this approach was to estimate a model on a sample that was shorter than the available observations. Then, we made forecasts and calculated errors for observations that were available, but not included in the sample. The following illustration shows the main idea of this technique:



Ex-post projection tests

T_3 = Base year (for ex-ante projections)

T_4 = Projection year (for ex-ante projections)

T_2 = Base year (for ex-post projection tests)

T_3 = Projection year (for ex-post projection tests)

T_1 = Beginning year of calibration period

The historical data were available for period T_1 - T_3 , but the model was estimated on a shorter interval of T_1 – T_2 and then a forecast was produced for the interval T_2 – T_3. Since we have observed data for this period, we calculated the forecasting errors for the out-of-sample forecasts.

$$MAPE = \frac{1}{T} \sum \left| (P_t - A_t) / A_t * 100 \right|$$

The mean absolute percent error (MAPE) commonly used for error estimations and defined as:

Where:

P_t is the predicted value at time t.

A_t is the actual value at time t.

T is the number of time periods for which the model is tested.

The other useful measure of errors, which reflects the ability of models to pick up variances, is the Theil U-statistic, which is built into the PMP long-term projection software.

$$U = \frac{\left[\frac{1}{T}\sum_{t=2}^{T}(p_t - a_t)^2\right]^{1/2}}{\left[\frac{1}{T}\sum_{t=2}^{T} a_t^2\right]^{1/2}}$$

Where: P_t = Predicted, or Projected Value At Time t

A_t = Actual Value at Time t

$$p_t = \frac{P_t - A_{t-1}}{A_{t-1}}$$

$$a_t = \frac{A_t - A_{t-1}}{A_{t-1}}$$

T = Number of time periods for which projections are developed within the projection horizon.

A lower value of U is desirable. The extreme negative case, which is an eventual death sentence for the model and forecast, is when U>1. It means that a straight-line (i.e., no change) forecast would serve better in terms of reflecting the variance. Even with a possible lower MAPE, such a forecast is worthless.

To meet state employment projections requirements and Occupational Employment Statistic (OES) definitional requirements, we transformed codes from the Global Insight model in order to match them with codes used in state projections. For example, we disaggregated transportation equipment to aerospace and other transportation equipment. State and local government were disaggregated to government education, hospitals and other government. Two industries related to the information sector were disaggregated. Forecasts for these industries were produced mainly by the same means, excluding Global Insight forecasts as regressors.

The selection of projections from different scenarios was based on complex calculations and adjustments. Aggregated statewide employment projections from the Economic and Revenue Forecast Council (ERFC) and the Office of Financial Management (OFM) were used as important guides in this process.

In many cases, this complex process produced the weights used to aggregate the results from the different scenarios. Selected results were then rolled up to create multi-level tables that were somewhat comparable with the Current Employment Statistics (CES) tables.

Adjusted statewide projections were disaggregated down to WDA levels of industry employment projections. This occurred at the same level of industry detail as state forecasts. The main tools used for this step were the regression models, where state forecasts were used as independent variables for the same industries as WDA forecasts. The forecasts also incorporated the effects of special events.

For detailed forecasts, there were limited options for manually evaluating each model and each forecasting result. At the same time, the direct use of model results can produce extreme results. To smooth the results, we used the concept of stability controls for dynamic systems. The variance of historical employment was used to define confidence intervals for projected employment variances. We also sometimes arbitrarily established the upper and lower confidence limits. The intervals represented the lower number between the historical confidence and the established limit.

For each time point, if the projected numbers fell within the used intervals, it stayed. Otherwise, the proper limit was applied. This process was used as the main mechanism for model adjustments. In addition, some other limited manual adjustments may be used. These other limited adjustments are mainly used for targeting the variances between areas.

Finally, the totals of smoothed projections for each industry and/or state totals were adjusted to meet each other.

Industry inputs for occupational employment projections (industry control totals)

The industry inputs for occupational projections are called industry control totals (ICTs). ICTs act as a bridge between industry and occupational projections. To create such inputs, the following steps were followed:

- Forecasts for employment other than nonfarm (e.g., private households, agriculture, forestry and fishing) were developed at the WDA level.

- Industry projections for nonfarm employment were disaggregated according to OES definitions (mainly to the four-digit NAICS level).

Forecasts for private households, agricultural, forestry and fishing employment were based on the covered employment time series and on the same techniques used for aggregated industry projections.

Occupational projections also account for self-employment and unpaid family member workers. However regular historical data does not exist for these worker types. To estimate the base numbers for the year 2012, we used the American Community Survey (ACS) five-year data estimation (2008 through 2012) (see http://www.census.gov/acs/www/).

There is no direct industry forecast for self-employed and unpaid family member workers. The growth of self-employment was defined by national occupational self-employment ratios. These ratios were applied to occupational forecasts. Then, these growth rates were applied to base-year estimations adjusted to ACS totals.

To provide industry input for occupational projections, the industry inputs were disaggregated and then rolled up according to the definitions used in OES surveys. Stability controls and adjustments were important for smoothing the results.

For private employment, ICTs were mainly at the four-digit NAICS level. Both agriculture and educational employment were aggregated separately. Federal government employment, excluding post offices, was a separately aggregated cell. Employment for educational sectors and hospitals were separated from state and local government employment and then combined with private employment for these industries. After education and hospital employment were removed, the remaining employment was dispersed between state and local government.

Due to the combination of private and government employment for education and hospitals, ICTs could not be directly aggregated to conventional industry sectors. In addition, it is not advisable to use them as detailed industry projections due to the very low statistical reliability of forecasts for the detailed industry cells.

The goal of these processes was to provide input for occupational projections.

Occupational estimations and projections

Occupational employment projections result from the conversion of industry employment to occupations. These conversions are based on occupation/industry ratios (i.e., staffing patterns) from the Occupational Employment Statistics (OES) survey conducted by the Labor Market and Performance Analysis (LMPA) office of the Employment Security Department (ESD) in cooperation with the U.S. Bureau of Labor Statistics (BLS). The full OES survey has a three-year cycle. One-third of the survey is completed each year. Occupational estimations and projections are subject to the limitations of the OES survey which include nonfarm employment and agricultural services. Excluded from the survey are noncovered employment, self-employment, unpaid family members, private households and major agricultural employment (except agricultural services).

The sample for the OES survey is designed for metropolitan statistical areas (MSA). From the perspective of statistical accuracy for occupational projections, this level of aggregation is most appropriate. However, for different applications like the Training Benefits Program, we used the WDA aggregation levels for regional details. The direct use of OES staffing patterns for WDAs can create significant bias for a variety of reasons.

For instance, in cases where the OES survey has weak or missing cells for geographic areas, a substituted staffing pattern was used. These substitutions come from other similar in-state areas or from other states. Such imputations can have a significant influence on staffing patterns from the OES survey. In addition, the imputations were based on wage statistics and may not properly reflect employment structures. Direct use of OES staffing patterns can also create significant bias for industries with high shares of noncovered employment, which were not part of the survey (e.g., religious organizations).

For a few industries, a combined staffing pattern was used between areas. This mainly occurred for King County WDA and Snohomish County WDA. This was a necessary step because King and Snohomish counties were combined in the OES survey sample. The national staffing pattern was only used as a last resort. We had to use national staffing patterns for private households.

Some problems, however, were unavoidable and significantly influenced the final occupational estimations and projections. For example, doctors may not be employed by clinics or hospitals, but rather may be employees of independent associations or may be self-employed. For this reason, staffing patterns for medical institutions were bound to be biased.

Occupational projections use the following national inputs:

- Self-employment and unpaid family worker ratios.
- Net replacement rates for each occupation.
- Change factors, which we modify.

Also noteworthy this year was the limited use of some of the results from last year's OES green supplement survey for agriculture industries. The green supplement survey allowed us to create staffing patterns for agriculture, based on weighted sample responses.

Once staffing patterns are developed, the national methodology advises the application of change factors. Change factors are developed nationally. Change factors predict the expected changes in the occupational shares for each industry over time. The reliability of change factors tend to be low because unlike for industry employment, there are no historical time series for occupational employment. With the lack of historical trends upon which to base future expectations, BLS uses researchers' expectations about structural changes for occupations inside industries. Within this BLS process, there is a high degree of subjective judgment. This is especially true since change factors must be developed for each occupation in an industry. Occupational outputs are very sensitive to these change factors. It is very important to evaluate the adequacy of the change factors before use. Incorrect change factors can drastically increase the errors in projections.

Some testing in Washington and Oregon demonstrated that the quality of projections was better without using the full file of change factors. We created change factors for a very limited numbers of cells. This was done where the national historical series and the state historical series were available and consistent with the suggested change factors in the national file. For such cases, we used the most conservative estimation as a change factor.

Introducing change factors in occupational estimations created a difference between staffing patterns for base and projected periods. After applying change factors to each projected staffing pattern, the shares of occupational employment for each industry were readjusted (normalized). The total of occupational shares for all industries in the projected and base staffing pattern should be equal to one.

Multiplying occupational/industry matrices for each time period of industry control totals produced initial occupational employment estimations.

We used national self-employment ratios to produce unadjusted estimations of self-employment. Self-employment estimations for the base periods were adjusted to totals from the ACS and then projected based on growth rates from unadjusted self-employment estimations. Finally, the adjusted and projected estimations of the self-employed were added to initial employment estimations. The results represented the total estimations and projections of occupational employment.

To calculate openings due to replacement for detailed occupations, we applied national net replacement rates to annual employment on a compound basis. Then, average annual openings, due to replacement, were calculated.

Total openings for each detailed occupation are equal to the openings due to replacement and growth, but they cannot be negative. So if the numbers are negative, they are replaced with zero. If a projected decline in occupational employment is greater than the projected replacement, the negative totals are replaced with zeroes. This creates nonadditive results for total openings. In other words, if we apply the same calculations of total openings for aggregated occupations as for detailed occupations, total openings for aggregated levels would be less than total openings for detailed levels.

There is no perfect solution for this problem. Our solution was to aggregate the total openings from the detailed levels. In this way, the aggregated numbers of total openings are equal to the totals for detailed occupations. However, on the aggregate level, the total openings might not be equal to the total of growth plus replacement. The differences were not significant for this round of projections, especially at the state level.

The formal description of occupational projections

Here is a fragment of a hypothetical staffing pattern matrix:

Occupations across rows

SOC	NAICS 1	NAICS 2	NAICS....n
11-1011	0.30	0.20	0.05
15-1143	0.10	0.50	0.10
35-3022	0.05	0.00	0.08
41-2031	0.25	0.08	0.08
47-2031	0.00	0.00	0.10
51-4041	0.30	0.22	0.59
Totals	1.0	1.0	1.0

Industries across columns

Shares of employment estimates across industries by occupation in percentage

Columns sum to 1.0

(100% of industry employment)

The calculations of occupational outputs are based on staffing pattern matrices and ICT vectors.

Let's define:

Indexes:

i = 1,2, …, m - for occupations

j = 1,2, …, n - for industries

Vectors:

known $X = \begin{bmatrix} x_1 \\ . \\ . \\ . \\ . \\ x_n \end{bmatrix}$ – base year ICT vector (without self-employed and unpaid family members)

$\underline{X} = \begin{bmatrix} \underline{x}_1 \\ . \\ . \\ . \\ . \\ \underline{x}_n \end{bmatrix}$ – projected year ICT vector

$S = \begin{bmatrix} s_1 \\ . \\ . \\ . \\ . \\ s_m \end{bmatrix}$ – self-employed and unpaid family members ratios (could be combined or separate)

Unknown

$Y = \begin{bmatrix} y_1 \\ . \\ . \\ . \\ . \\ y_m \end{bmatrix}$ – base year occupation employment

$$\underline{Y} = \begin{bmatrix} y_1 \\ . \\ . \\ . \\ . \\ \underline{y}_m \end{bmatrix}$$ – projected year occupation employment

Matrices:

Known $A = [\, a_{ij} \,]$ i = 1,…,m; j = 1, …,n – base year staffing pattern

$C = [\, c_{ij} \,]$ i = 1,…,m; j = 1, …,n – change factors

Unknown $\underline{A} = [\, a_{ij} \,]$ i = 1,…,m; j = 1, …,n – projected year staffing pattern

The basic calculations

Each column of matrix A should be normalized, so $\sum_j a_{ij} = 1$ for all i = 1, …,n.

$Y = A^*X$ or $y_i = \sum_j a_{ij}^* x_j$ i=1, …,m (1)

$\breve{a}_{ij} = a_{ij} * c_{ij}$ for each i = 1, …,n, j=1,…,m

normalized $\underline{a}_{ij} = \breve{a}_{ij} / \sum_i \breve{a}_{ij}$ for each i = 1, …,n, j=1,…,m (2)

$\underline{Y} = \underline{A}^*\underline{X}$ or $\underline{y}_i = \sum_j \underline{a}_{ij}^* \underline{x}_j$ i=1, …,m (3)

Due to $\sum_j a_{ij} = 1$ and $\sum_j a_{ij} = 1$ we will have $\sum_j x_j = \sum_i y_i$ and $\sum_j x_j = \sum_i y_i$

If base year employment $x_j = 0$ and projected $\underline{x}_j > 0$ we can add the column in projected matrix.

Calculations of self-employment and unpaid family members

The non-adjusted vector of self-employed (m,1) $\Delta = \{\Delta_i\}$ i =1,…, m

for the base year will be:

$\Delta = (S,Y)$ or $\Delta_i = s_i * y_i$, i =1,…, m (4)

If Δ' is a control total

$\Delta(i)a_{dj} = \Delta_i * (\Delta' / \sum_i \Delta_i)$

The same base year adjustment ratios are applied to projected year calculations:

$$\underline{\Delta}(i)a_{dj} = s_i * \underline{y}_i *(\Delta' / \Sigma_i \Delta_i)$$

The final outputs

$$Y(i) \text{ final} = Y(i) + \Delta(i)a_{dj}$$

$$\underline{Y}(i) \text{ final} = \underline{Y}(i) + \underline{\Delta}(i)a_{dj}$$

The final results could be rounded to the integers and this will not create any significant differences between ICT totals and occupational employment totals.

Summplementary calculations of openings due to growth and replacement

To calculate the annual openings due to replacement, the net replacement rates ri should be applied to the annual employment on a compound basis. Let's define annual average growth rates as:

$$g_i = (\underline{Y}(i) \text{ final}/ Y(i) \text{ final})\text{^}(1/T)\text{-}1 \qquad i=1, \ldots,m ,$$

where T – number of projected years.

The annual average openings R_i due to replacement were calculated as:

$$R_i = (\sum_{t=0}^{T-1} r_i * Y^t_i (1+ g_i))^t / T \qquad i=1, \ldots,m ,$$

The average annual openings due to growth

$$OG(i) = (Y(i) \text{ final} - Y(i) \text{ final})/T$$

Finally average annual total openings are:

$$TO(i) = \max(0, (OG(i) + R_i)).$$

The projections software applies replacement rates to the base-year employment. Because of this approach, openings due to replacement are unrelated to projected employment changes.

To illustrate the possible differences between the compound and the base-year calculation of replacement rates, let's suppose we have a base-year occupational employment of 100, an annual growth rate of 20 percent and a replacement rate of 5 percent. The number of average annual opening due to replacement will be 11.6 for the 10-year projection and 5.5 for the two-year projection under the compound approach.

The same number for the base-year calculations will be 5 for any period in spite of significant differences in annual average employment. The ratio of openings due to replacement compared to openings due to growth under the compound approach is equal to the proportion of replacement and growth rates (5/20 = 25 percent) and does not depend on the projection period.

Under the base-year calculations, this ratio will be 22.7 percent for the two-year projections and 10.8 percent for the 10-year projections. Most importantly the replacement rate calculated under the base-year approach is not the average annual rate of openings due to replacement.

BLS used the same approach in the past, but recently changed to applying the replacement rates to the first and last years and then taking averages. This is a significant improvement compared to applying the replacement rates to the base-year only, but is still not quite an accurate approach. This most recent BLS approach assumes a fixed absolute change in employment for the projected period. Our approach assumes a fixed growth rate.

Appendix 4. Frequently asked questions

Q: What are the steps in industry projections?

A: There are two steps to industry projections. The first step is developing aggregated statewide industry projections using the Global Insight model. The second step produces detailed industry projections. The principal data source for industry projections is a detailed covered employment time series of four-digit NAICS data for all Washington counties, specifically, the U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages (QCEW).

Q: Why are the detailed industry projections not comparable with U.S. Bureau of Labor Statistics, Current Employment Statistics (CES) definitions?

A: Industry projections are disaggregated according to U.S. Bureau of Labor Statistics, Occupational Employment Statistics (OES) definitions, which are somewhat different from CES.

Q: What is the source for occupational/industry ratios?

A: The primary source for occupational/industry ratios is the OES survey. However, this survey uses different area designations than the state's workforce development areas (WDAs) and has limited industry coverage (agriculture, non-covered employment, private households and self-employment are excluded) necessitating the use of other staffing patterns as well.

Q: Why can the ratio for industry and occupational projections be different from the OES survey outputs?

A: The ratios can be different from the OES survey outputs due to the reasons stated above and the use of substituted or combined staffing patterns or raw sample.

Q: Why can occupational/industry ratios differ between the base year and projected years?

A: This is due to the use of change factors, which predict changes in the occupational shares for each industry over time.

Q: Why can't projections be benchmarked or verified?

A: There are no administrative records for employment by occupation; therefore, the data cannot be reliably benchmarked or verified by non-survey means.

Q: How are occupational projections used?

A: Occupational projections are the only data source for the statewide and WDA-specific occupational outlook. Projections are also the foundation for developing the Occupations in Demand list, which is used to determine eligibility for a variety of training and support programs, but was created to support the unemployment insurance Training Benefits Program.

Q: How are industry projections used?

A: Industry projections can be used by policy makers, job seekers, job counselors and economic analysts. For any policy decisions, the projections should be supplemented with other available data sources (e.g., unemployment insurance claims, educational data, job announcements, etc.)

Q: Which occupational codes are used?

A: The 2010 Standard Occupational Classification (SOC) system was used for this round of projections.

Q: Can the SOC be used for administrative purposes?

A: According to BLS, the 2010 SOC was designed solely for statistical purposes. To use SOC for administrative programs, the head of an agency considering using SOC must first determine if the use of SOC definitions is appropriate for a program's objectives.

Q: Why don't the occupational totals by WDA equal the state total?

A: The totals are not additive due to the use of local staffing patterns for projections by WDA, which differ from the statewide staffing pattern.

Appendix 5. Glossary of terms

Figure A5-1. Educational categories
Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics

Four aggregated educational categories used for projections		Eight 2010 SOC educational categories	
1	Bachelor's degree or higher	1	Doctoral or professional degree
		2	Master's degree
		3	Bachelor's degree
2	Associate degree and postsecondary non-degree award	4	Associate degree
		5	Postsecondary non-degree award
3	Some college (no degree) and high school diploma or equivalent	6	Some college, no degree
		7	High school diploma or equivalent
4	Less than high school	8	Less than high school

Educational level

The preparation categories for specific occupations are an aggregated version of education clusters from the U.S. Bureau of Labor Statistics. They are estimates of typical preparation levels required for entry-level jobs in an occupation.

Industries

A classification of business establishments based on their specific economic activity.

Job openings due to growth and net replacement

Job openings due to growth and net replacement (calculated on a compound basis) represent the total projected number of openings available for new entrances into the occupation. This does not include openings that result when workers change jobs but stay in the same occupation.

Net replacement

Net replacement includes openings created by retirements and separations. It does not include normal turnover as workers go from one employer to another or from one area to another without changing their occupations.

North American Industry Classification System (NAICS)

North American Industry Classification System (NAICS) is the system used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing and publishing statistical data related to the U.S. business economy. NAICS was developed under the authority of the U.S. Office of Management and Budget.

Occupation

A job or profession, a category of jobs that are similar with respect to the work performed and the skills possessed by the workers.

Occupational projections

Industry projections converted to occupations, based on occupational/industry ratios.

Standard Occupational Codes (SOC)

Standard Occupational Classification (SOC) is the system used by federal statistical agencies in classifying workers into occupational categories for the purpose of collecting, calculating or disseminating data. All workers are classified into one of 840 detailed occupations according to their occupational definition. SOC was developed under the authority of the U.S. Office of Management and Budget.

Total occupational estimations and projections

Total occupational estimations and projections are calculated to describe employment in the base year and future time periods.

Wages

Wages are not based on employment projections, nor are they attached to educational categories. The attached wages come from the U.S. Bureau of Labor Statistics' Occupational Employment Statistic (OES) survey and are subject to the restrictions and limitations of that survey. Agricultural employment (except for agricultural services), self-employment and private households are excluded from the survey. All wage estimations are adjusted as of March 2014, according to OES definitions. Wages are attached to specific workforce development areas based on survey wages from the most closely related metropolitan areas. For more information regarding the OES programs, go to http://www.bls.gov/oes/.