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## **2013 Green Economy Jobs Report – Industry and Survey Approaches**



**Employment  
Security  
Department**  
WASHINGTON STATE

# 2013 Green Economy Jobs Report – Industry and Survey Approaches

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Washington State Employment Security Department  
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## Executive summary

This report presents two ways of analyzing green jobs, and provides a transition from broad-based research dependent upon employer surveys to a more targeted, industry-based approach. This new approach allows for more comparable information over time while requiring fewer private and public resources to conduct.

The survey approach has produced valuable information on perceptions of green jobs among employers, and has helped to capture green jobs that are not reflected in the industry approach. However, by nature of the survey approach, it has proven difficult to track the numbers of green jobs over time. In asking employers whether they have employees whose primary focus falls under one of the four core areas of the green economy definition, we are not asking about doing specific functions (e.g., driving a bus, producing solar panels) but rather about the impact of their work (e.g., increasing energy efficiency, producing renewable energy). That question can be difficult to answer, and is likely influenced by changes in technology, markets, perceptions and other forces.

### Two approaches

This report presents results of these two approaches:

- Analysis of employment and gross business income for specific industries within the economy, defined within Washington as the “clean technology” sector; and
- Responses to a survey of a large sample of Washington employers in industries across the state economy, using a broad definition of the green economy as rooted in the development and use of products and services that promote environmental protection or clean energy.

### Green employment

The differences between the two approaches do not allow for direct comparisons of their results. However, the two approaches resulted in similar green job totals. Using the industry-based approach, average employment of private and public sector clean technology employers in 2013 totaled 58,736. Using the survey approach deployed in 2013, green jobs totaled an estimated 56,762 across all industries.

### Green jobs by industry

Using the industry-based approach, specific industries within the clean technology sector with the largest employment numbers were bus and other motor vehicle transit systems, electric power distribution and remediation services.

Using the survey approach, industry sectors with the largest numbers of green jobs in 2013 were construction, administrative and support and waste management and remediation services and professional, scientific and technical services.

### Green jobs by occupation

Using the industry-based approach, the specific clean technology occupations with the largest employment numbers were bus drivers, school or special client, construction laborers, and refuse and recyclable material collectors.

Using the survey approach, occupations with the largest numbers of green jobs were heating, air conditioning and refrigeration mechanics and installers, heavy and tractor-trailer truck drivers, and janitors and cleaners, except maids and housekeeping cleaners.

### **Education and training required by green jobs**

Using the industry-based approach, we were able to analyze entry-level education requirements for the top 25 clean technology occupations. Over half of employment in those top 25 clean technology occupations require only a high school education, and nearly one-third require short-term on-the-job training.

Using the survey approach, we were able to analyze employers' educational requirements for their green jobs. An estimated 38 percent of green jobs required either an apprenticeship or a certificate/license, and one-third required only a high school diploma.

### **Wages and benefits in the green economy**

Using the industry-based approach, we were able to analyze average wages by both industry and the top 25 clean technology occupations. The overall average annual wage for the clean technology sector was \$61,138. For the top 25 clean technology occupations, the average annual wage was \$50,312.

Using the survey approach, we were also able to analyze hourly wages by both industry and occupation. The overall average hourly wage for all industries was \$24.52, which would be an annual wage of \$51,001 at full-time employment. The average hourly wage rate paid for the top 25 green occupations was \$19.08, which would be an annual wage of \$39,686 at full-time employment.

# Introduction

## Background

This report was conducted in accordance with the statutory requirement that the Employment Security Department (ESD) conduct labor market research on the green economy (RCW 50.12.320, 43.330.310). The report consists of two basic research approaches:

1. An analysis of information on employers in the clean technology industry, which includes much of the business activity commonly considered green, including alternative energy generation and distribution, public transportation, and hazardous waste collection and treatment.
2. A survey of Washington state employers focused on the green economy, broadly defined as the development and use of products and services that promote environmental protection or clean energy.

## Industry approach

As part of the state's Results Washington efforts, initiated in 2013, seven industry sectors have been identified as having the capacity to grow and generate additional, quality jobs and serve as magnets for further development. The basic approach here is categorizing employers by their primary business activity, without allowing for overlap across the seven sectors. Clean technology, which is one of those identified sectors, includes much of the business activity commonly considered "green," including alternative energy generation and distribution, public transportation, and hazardous waste collection and treatment.

Using this approach, some industries with employers that reported green jobs through the survey are not included. However, employers in those same industries may be included in one of the remaining six targeted Results Washington industry sectors. For example, specific industries within agriculture, forestry, fishing and hunting, manufacturing, and transportation and warehousing are included in the agriculture targeted sector. Specific industries within manufacturing, wholesale trade, retail trade, information, professional, scientific and technical services and educational services are included in the information and communication technologies targeted sector.

Using this approach, both employment and gross business income can easily be measured for the clean technology sector based on information provided by employers to the Employment Security and Revenue departments as part of their regular tax filings. This requires no additional time or effort from employers, and can be consistently tracked over time.

## Survey approach

Research began in 2008 with the first iteration of the Washington state green jobs report, which was the first state agency-led survey of its kind in the nation.<sup>1</sup> To determine the appropriate definitions and scope of the research consistent with legislative requirements, researchers did extensive literature review, consulted with industry, labor and other experts and solicited information and ideas from members of the state's Evergreen Jobs Leadership Team.

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<sup>1</sup> "2008 Washington State Green Economy Jobs," Labor Market and Economic Analysis, Employment Security Department, January 2009.

The research team identified the green economy as rooted in the development and use of products and services that promote environmental protection or clean energy, composed of industries and businesses engaged in four core areas:

- Increasing energy efficiency.
- Producing renewable energy.
- Preventing and reducing environmental pollution.
- Providing mitigation or cleanup of environmental pollution.

This foundational definition formed the basis for the surveys of employers ESD conducted in 2008, 2009, 2011 and 2013. The 2008 and 2009 samples included only businesses within industries presumed to be green, but the scope was expanded to all industries for the 2011 and 2013 surveys. It is worth noting that several states and research studies have also used the Washington state concepts completely or in part.<sup>2</sup>

Over the course of these surveys, we have observed employers adding work responsibilities and activities identified as green to existing jobs rather than creating new, “green” jobs. However, by nature of the survey approach, it has proven difficult to track the numbers of green jobs over time. In asking employers whether they have employees whose primary focus falls under one of the four core areas of the green economy definition, we are not asking about doing specific functions (e.g., driving a bus, producing solar panels) but rather about the impact of their work (e.g., increasing energy efficiency, producing renewable energy). That question is difficult to answer, and is likely influenced by changes in technology, markets and other forces.

The questionnaire used for the 2013 survey was revised from the questionnaire used in 2011, but otherwise the sampling, survey and estimating processes remained the same from 2011 to 2013.<sup>3</sup>

Changes to the survey questionnaire in 2013 fell into two categories. First, employers were no longer required to choose which of the four core areas was a specific job’s primary focus. This was an attempt to ease the burden on employers responding to the survey. The question that captured the total number of green jobs for each job title – the data element used to estimate the total number of green jobs – did not change conceptually so that results could be compared.

Second, questions were modified or added to the questionnaire to ensure the information collected covered each of the components of the statutory study mandate. An important addition to the questionnaire was a question on the average hourly wage rate paid for each green job title. This provided a direct measure of the average hourly wage rate and eliminated the need to rely on secondary sources for wage rate data, such as the Occupational Employment Statistics (OES) database, as was necessary for the 2008, 2009 and 2011 reports. This did increase the amount of information asked of employers, which may have discouraged some employers from responding to the survey or reporting any green jobs.

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<sup>2</sup>See “Measurement and Analysis of Employment in the Green Economy: Workforce Information Council Green Jobs Study Group Final Report,” Workforce Information Council Green Jobs Study Group, October 1, 2009. This document draws on Washington’s 2008 study to define green jobs. That green job conceptual design has been used or cited in many of the state-level studies listed in *Appendix Figure A4-1*.

<sup>3</sup>“2011 Green-Economy Jobs Report,” Labor Market and Economic Analysis, Employment Security Department, June 2012.

From June 1, 2013, through August 31, 2013, 21,000 firms were surveyed. The survey yielded 12,537 employer responses, for a 59.7 percent response rate. Of those 12,537 employers, 924 employers, 7.4 percent, reported having green jobs. For the 2011 survey, 21,374 employers were surveyed and yielded 14,298 employer responses. Of these, 2,411 employers reported having green jobs. Thus, in 2011, 16.9 percent of the responding employers reported having green jobs, more than twice as many as in 2013. The reason for the substantial reduction in reported green jobs is unclear. Contributing factors could include the changes to the questionnaire as well as changes in perceptions amongst employers regarding green jobs.

Thus, while the survey approach produces valuable information on perceptions of green jobs among employers in any given year, and helps to capture green jobs that would not be reflected in the industry approach, results may vary significantly from survey to survey without corresponding variations in overall employment levels.

See *Appendix 1* for more information about the study design and how the survey was conducted and *Appendix 3* for the complete survey form.

## **Legislative requirements**

State law (RCW 50.12.320, 43.330.310) requires the Employment Security Department to conduct labor market research to analyze:

- The current labor market and projected job growth in the green economy.
- The current and projected recruitment and skill requirements of green economy employers.
- The wage and benefits ranges of jobs within green economy industries.
- The education and training requirements of workers in green economy industries.

The Employment Security Department must also:

- Propose which industries should be considered high-demand green industries.
- Identify occupations that are part of career pathways to middle- and high-wage occupations.
- Conduct an analysis of occupations in the forest products industry.



# Chapter One: Green economy jobs – results of the industry approach

The findings in this section of the report are based upon information provided by employers to the Employment Security and Revenue departments as part of their regular tax filings.

Information was analyzed and aggregated for those employers whose primary business activity fell within the “clean technology” industry. As one of seven industries identified as part of Results Washington efforts, clean technology was defined to include much of the business activity commonly considered “green,” including alternative energy generation and distribution, public transportation, and hazardous waste collection and treatment.

In 2013, clean technology employment averaged 58,736, of which 64.7 percent was in the private sector. These employment numbers represented 1.6 percent of total private-sector employment and 4.0 percent of total public-sector employment. Over time, employment levels have remained stable, but beat growth in total state employment. Clean technology employment increased by 2.9 percent from 57,073 in 2007 compared to an increase of 1.2 percent in total employment over this same period.

In 2013, clean technology gross business income totaled \$16.8 billion. These numbers represented 2.5 percent of total gross business income in the state for that same year. Over time, clean technology’s total gross business income has increased, but less than total state gross business income. Clean technology increased by 7.8 percent from \$15.6 billion in 2007 compared to an increase of 12.3 percent in total gross business income over this same period.

## Clean technology employment by industry

*Figure 1-1* gives the distribution of employment across the 39 detailed industry classifications within clean technology, including both public and private jobs. To protect the confidentiality of employers, employment information was not provided for 10 of the detailed industry classifications.

The top three were as follows:

- Bus and other motor vehicle transit systems had the highest employment numbers, accounting for 15.8 percent of clean technology jobs in the state.
- Electric power distribution had the second highest employment numbers, accounting for 11.5 percent of clean technology jobs.
- Remediation services had the third highest employment numbers, accounting for 9.5 percent of clean technology jobs.

**Figure 1-1. Public and private sector clean technology jobs by industry**  
Washington state, 2013

Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages

NAICS	Industry	Total employment	Percent of clean technology employment
221111	Hydroelectric power generation	1,648	2.8%
221114	Solar electric power generation	*	*
221115	Wind electric power generation	*	*
221116	Geothermal electric power generation	0	0.0%
221117	Biomass electric power generation	*	*
221118	Other electric power generation	*	*
221121	Electric bulk power transmission and control	1,827	3.1%
221122	Electric power distribution	6,759	11.5%
221320	Sewage treatment facilities	844	1.4%
237110	Water and sewer line and related structures construction	3,374	5.7%
237130	Power and communication line and related structures construction	3,497	6.0%
333611	Turbine and turbine generator set units	80	0.1%
335311	Power, distribution and specialty transformer manufacturing	298	0.5%
335313	Switchgear and switchboard apparatus manufacturing	155	0.3%
335911	Storage battery manufacturing	36	0.1%
423930	Recyclable material merchant wholesalers	1,903	3.2%
485111	Mixed mode transit systems	*	*
485112	Commuter rail systems	0	0.0%
485113	Bus and other motor vehicle transit systems	9,268	15.8%
485119	Other urban transit systems	*	*
485210	Interurban and rural bus transportation	*	*
485410	School and employee bus transportation	2,230	3.8%
485510	Charter bus industry	983	1.7%
485991	Special needs transportation	1,870	3.2%
485999	All other ground passenger transportation	810	1.4%
541620	Environmental consulting services	2,445	4.2%
562111	Solid waste collection	2,718	4.6%
562112	Hazardous waste collection	*	*
562119	Other waste collection	*	*
562211	Hazardous waste treatment and disposal	*	*
562212	Solid waste landfill	1,509	2.6%
562213	Solid waste combustors and incinerators	0	0.0%
562219	Other nonhazardous waste disposal	586	1.0%
562910	Remediation services	5,603	9.5%
562920	Materials recovery facilities	655	1.1%

NAICS	Industry	Total employment	Percent of clean technology employment
562991	Septic tank and related services	706	1.2%
562998	Miscellaneous waste management services	651	1.1%
813312	Environment, conservation and wildlife organizations	2,171	3.7%
924110	Administration of air and water resource and solid waste management programs	2,353	4.0%
	<b>Total</b>	<b>58,736</b>	<b>100.0%</b>

\*Data could not be published to protect confidentiality.

Clean technology employment totaled 58,736 across 39 detailed industries, led by bus and other motor vehicle transit systems with employment of 9,268.

### Public sector clean technology employment by industry

Figure 1-2 focuses on the subset of clean technology employment in the public sector. The public sector accounted for 35.3 percent of clean technology employment, with 20,758 jobs, and 4.0 percent of total public-sector employment. As with total clean technology employment, bus and other motor vehicle transit systems led with 41.1 percent of public sector clean technology employment, with 9,241 jobs.

**Figure 1-2.** Public sector clean technology jobs by industry

Washington state, 2013

Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages

NAICS	Industry	Total public sector employment	Percent of public sector clean technology employment
221111	Hydroelectric power generation	1,565	7.0%
221114	Solar electric power generation	*	*
221115	Wind electric power generation	*	*
221116	Geothermal electric power generation	*	*
221117	Biomass electric power generation	*	*
221118	Other electric power generation	*	*
221121	Electric bulk power transmission and control	1,702	7.6%
221122	Electric power distribution	4,682	20.8%
221320	Sewage treatment facilities	723	3.2%
237110	Water and sewer line and related structures construction	*	*
237130	Power and communication line and related structures construction	*	*
333611	Turbine and turbine generator set units	*	*
335311	Power, distribution, and specialty transformer manufacturing	*	*
335313	Switchgear and switchboard apparatus manufacturing	*	*
335911	Storage battery manufacturing	*	*
423930	Recyclable material merchant wholesalers	*	*
485111	Mixed mode transit systems	*	*

NAICS	Industry	Total public sector employment	Percent of public sector clean technology employment
485112	Commuter rail systems	*	*
485113	Bus and other motor vehicle transit systems	9,241	41.1%
485119	Other urban transit systems	*	*
485210	Interurban and rural bus transportation	*	*
485410	School and employee bus transportation	*	*
485510	Charter bus industry	*	*
485991	Special needs transportation	*	*
485999	All other ground passenger transportation	*	*
541620	Environmental consulting services	*	*
562111	Solid waste collection	*	*
562112	Hazardous waste collection	*	*
562119	Other waste collection	*	*
562211	Hazardous waste treatment and disposal	*	*
562212	Solid waste landfill	*	*
562213	Solid waste combustors and incinerators	*	*
562219	Other nonhazardous waste disposal	*	*
562910	Remediation services	*	*
562920	Materials recovery facilities	*	*
562991	Septic tank and related services	*	*
562998	Miscellaneous waste management services	*	*
813312	Environment, conservation and wildlife organizations	45	0.2%
924110	Administration of air and water resource and solid waste management programs	2,353	10.5%
	<b>Total</b>	<b>20,758</b>	<b>100.0%</b>

\*Data could not be published to protect confidentiality.

*The public sector provided 20,758 clean technology jobs, over one-third of total clean technology jobs.*

## Clean technology employment by occupation

While information on employment is available by industries, comparable information is not available by occupations. The Occupational Employment Statistics survey, which ESD conducts in partnership with the U.S. Bureau of Labor Statistics, provides a basis for staffing patterns which can be used to convert employment by industry to employment by occupation.

These staffing patterns are limited in their application to public-sector employment, so we can only identify occupations that correspond to the clean technology industries dominated by private-sector employers. The staffing patterns also do not include industry classifications at the same level of detail as the clean technology definitions, so we could not identify occupations that correspond to all of the detailed clean technology classifications.

Figure 1-3 displays the top 25 clean technology occupations in the state. These top 25 occupations totaled 18,721 jobs and comprised 31.9 percent of the total number of clean technology employment in the state. The top three occupations were as follows:

- Bus drivers, school or special client, was the leading occupation, accounting for 2,513 clean technology jobs at 4.3 percent of the total.
- Construction laborers accounted for 1,787 clean technology jobs at 3.0 percent of the total.
- Refuse and recyclable material collectors accounted for 1,614 clean technology jobs at 2.7 percent of the total.

**Figure 1-3.** Top 25 clean technology jobs by occupation  
Washington state, 2013

Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

SOC	Occupation	Total employment	Percent of clean technology employment
53-3022	Bus drivers, school or special client	2,513	4.3%
47-2061	Construction laborers	1,787	3.0%
53-7081	Refuse and recyclable material collectors	1,614	2.7%
53-3041	Taxi drivers and chauffeurs	1,411	2.4%
53-3032	Heavy and tractor-trailer truck drivers	1,357	2.3%
47-2073	Operating engineers and other construction equipment operators	1,178	2.0%
53-7062	Laborers and freight, stock and material movers, hand	864	1.5%
53-3021	Bus drivers, transit and intercity	847	1.4%
47-4041	Hazardous materials removal workers	809	1.4%
47-1011	First-line supervisors of construction trades and extraction workers	659	1.1%
49-9051	Electrical power-line installers and repairers	639	1.1%
11-1021	General and operations managers	614	1.0%
47-4071	Septic tank servicers and sewer pipe cleaners	506	0.9%
43-3031	Bookkeeping, accounting and auditing clerks	455	0.8%
43-9061	Office clerks, general	403	0.7%
49-9052	Telecommunications line installers and repairers	400	0.7%
11-9021	Construction managers	381	0.6%
53-1031	First-line spvrs. of transportation and material-moving machine and vehicle oprs.	322	0.5%
49-3031	Bus and truck mechanics and diesel engine specialists	319	0.5%
43-6014	Secretaries and administrative assistants, except legal, medical and executive	313	0.5%
43-5032	Dispatchers, except police, fire and ambulance	285	0.5%
47-2152	Plumbers, pipefitters and steamfitters	268	0.5%
19-4051	Nuclear technicians	263	0.4%
53-7051	Industrial truck and tractor operators	259	0.4%
19-2041	Environmental scientists and specialists, including health	254	0.4%
	<b>Total</b>	<b>18,721</b>	<b>31.9%</b>

*The top 25 clean technology occupations accounted for 31.9 percent of total clean technology jobs in the state.*

Figure 1-4 displays clean technology employment by major occupational group. The top three major occupational groups were as follows:

- Transportation and material moving occupations were the leading occupational group, accounting for 9,750 clean technology jobs at 16.6 percent of the total.
- Construction and extraction occupations accounted for 6,232 clean technology jobs at 10.6 percent of the total.
- Office and administrative support occupations accounted for 2,493 clean technology jobs at 4.2 percent of the total.

**Figure 1-4.** Clean technology jobs by major occupational group

Washington state, 2013

Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

SOC	Major occupational group	Total Employment	Percent of clean technology employment
11-0000	Management	1,837	3.1%
13-0000	Business and financial operations	815	1.4%
15-0000	Computer and mathematical	211	0.4%
17-0000	Architecture and engineering	1,180	2.0%
19-0000	Life, physical and social science	887	1.5%
21-0000	Community and social service	*	*
23-0000	Legal	11	0.0%
25-0000	Education, training and library	*	*
27-0000	Arts, design, entertainment, sports and media	32	0.1%
29-0000	Healthcare practitioners and technical	224	0.4%
31-0000	Healthcare support	*	*
33-0000	Protective service	132	0.2%
35-0000	Food preparation and serving-related	*	*
37-0000	Building and grounds cleaning and maintenance	216	0.4%
39-0000	Personal care and service	*	*
41-0000	Sales and related	279	0.5%
43-0000	Office and administrative support	2,493	4.2%
45-0000	Farming, fishing and forestry	*	*
47-0000	Construction and extraction	6,232	10.6%
49-0000	Installation, maintenance and repair	2,303	3.9%
51-0000	Production	532	0.9%
53-0000	Transportation and material moving	9,750	16.6%
	Unknown	31,589	53.8%
	<b>Total</b>	<b>58,736</b>	<b>100.0%</b>

\*Data could not be published to protect confidentiality.

*The transportation and material moving occupational group led clean technology jobs with 9,750, followed by the construction and extraction occupational group with 6,232.*

## Clean technology gross business income

Figure 1-5 gives the distribution of gross business income across the 39 detailed industry classifications within clean technology. To protect the confidentiality of employers, gross business income information was not provided for three of the detailed industry classifications.

The top three were as follows:

- Electric power distribution had the highest gross business income at \$6.2 billion, accounting for 36.8 percent of the total.
- Hydroelectric power generation had the second highest gross business income at \$1.4 billion, accounting for 8.5 percent of the total.
- Recyclable material merchant wholesalers had the third highest gross business income at \$1.3 billion, accounting for 7.5 percent of the total.

Figure 1-5. Clean technology gross business income by industry

Washington state, 2013

Source: Employment Security Department/LMPA; Department of Revenue

NAICS	Industry	Total gross business income	Percent of clean technology gross business income
221111	Hydroelectric power generation	\$1,431,895,670	8.5%
221114	Solar electric power generation	\$1,081,993	0.0%
221115	Wind electric power generation	\$124,595,862	0.7%
221116	Geothermal electric power generation	\$0	0.0%
221117	Biomass electric power generation	*	*
221118	Other electric power generation	\$102,133,228	0.6%
221121	Electric bulk power transmission and control	\$1,060,034,738	6.3%
221122	Electric power distribution	\$6,185,730,201	36.8%
221320	Sewage treatment facilities	\$1,033,899,395	6.2%
237110	Water and sewer line and related structures construction	\$623,659,149	3.7%
237130	Power and communication line and related structures construction	\$713,642,305	4.2%
333611	Turbine and turbine generator set units	\$23,160,766	0.1%
335311	Power, distribution, and specialty transformer manufacturing	\$145,353,553	0.9%
335313	Switchgear and switchboard apparatus manufacturing	\$38,305,678	0.2%
335911	Storage battery manufacturing	*	*
423930	Recyclable material merchant wholesalers	\$1,264,262,505	7.5%
485111	Mixed mode transit systems	\$76,009,613	0.5%
485112	Commuter rail systems	\$5,322,009	0.0%
485113	Bus and other motor vehicle transit systems	\$20,924,442	0.1%
485119	Other urban transit systems	*	*
485210	Interurban and rural bus transportation	\$38,576,652	0.2%
485410	School and employee bus transportation	\$60,391,771	0.4%
485510	Charter bus industry	\$34,345,323	0.2%
485991	Special needs transportation	\$24,829,765	0.1%

NAICS	Industry	Total gross business income	Percent of clean technology gross business income
485999	All other ground passenger transportation	\$158,285,444	0.9%
541620	Environmental consulting services	\$264,675,722	1.6%
562111	Solid waste collection	\$663,244,671	3.9%
562112	Hazardous waste collection	\$96,302,254	0.6%
562119	Other waste collection	\$565,585,767	3.4%
562211	Hazardous waste treatment and disposal	\$265,379,534	1.6%
562212	Solid waste landfill	\$107,067,167	0.6%
562213	Solid waste combustors and incinerators	\$33,501,884	0.2%
562219	Other nonhazardous waste disposal	\$369,119,476	2.2%
562910	Remediation services	\$549,609,891	3.3%
562920	Materials recovery facilities	\$32,803,105	0.2%
562991	Septic tank and related services	\$92,632,537	0.6%
562998	Miscellaneous waste management services	\$525,186,059	3.1%
813312	Environment, conservation and wildlife organizations	\$21,376,952	0.1%
924110	Administration of air and water resource and solid waste management programs	\$21,151,528	0.1%
	<b>Total</b>	<b>\$16,810,652,245</b>	<b>100.0%</b>

\*Data could not be published to protect confidentiality.

*Clean technology gross business income totaled \$16.8 billion across 39 detailed industries, led by electric power distribution with \$6.2 billion.*

## Clean technology employment and gross business income over time

### Employment

Figure 1-6 tracks clean technology employment from 2007 through 2013 by detailed industry classifications. Overall, employment numbers remained stable, increasing 1,663 or 2.9 percent, over the period. Electric power distribution saw the greatest increase in employment, with an increase of 2,295 or 51.4 percent. The turbine and turbine generator set units industry saw the greatest percentage increase, at 1233.3 percent, increasing by 74 jobs from six in 2007.

Water and sewer line and related structures construction saw the greatest decrease in employment, losing 2,086 jobs or 38.2 percent. Other waste collection saw the greatest percentage decrease, at 61.0 percent, decreasing by 150 jobs.

**Figure 1-6. Comparison of clean technology jobs by industry**

Washington state, 2007 through 2013

Source: Employment Security Department/LMPA, U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages

NAICS	Industry	Total clean technology employment							Change from 2007 through 2013	Percent change from 2007 through 2013
		2007	2008	2009	2010	2011	2012	2013		
221111	Hydroelectric power generation	1,818	1,851	1,706	1,688	1,682	1,660	1,648	-170	-9.4%
221114	Solar electric power generation	*	*	*	*	24	21	22	22	*
221115	Wind electric power generation	*	*	*	*	113	112	98	98	*
221116	Geothermal electric power generation	*	*	*	*	*	*	*	*	*
221117	Biomass electric power generation	*	*	*	*	*	*	*	*	*
221118	Other electric power generation	*	*	*	*	36	40	45	45	*
22121	Electric bulk power transmission and control	3,417	3,463	3,621	1,834	1,840	1,825	1,827	-1,590	-46.5%
22122	Electric power distribution	4,464	4,644	4,986	6,737	6,646	6,687	6,759	2,295	51.4%
221320	Sewage treatment facilities	802	773	795	809	816	822	844	42	5.2%
237110	Water and sewer line and related structures construction	5,460	4,789	3,716	3,392	3,133	3,162	3,374	-2,086	-38.2%
237130	Power and communications line and related structures construction	2,998	2,837	2,735	2,554	2,642	3,039	3,497	499	16.6%
333611	Turbine and turbine generator set units	6	46	55	54	57	65	80	74	1233.3%
335311	Power, distribution and specialty transformer manufacturing	103	91	69	77	219	261	298	195	189.3%
335313	Switchgear and switchboard apparatus manufacturing	151	136	147	124	132	130	155	4	2.6%
335911	Storage battery manufacturing	91	87	60	40	38	36	36	-55	-60.4%
423930	Recyclable material merchant wholesalers	1,572	1,716	1,443	1,617	1,742	1,898	1,903	331	21.1%
485111	Mixed mode transit systems	496	528	533	518	513	523	524	28	5.6%
485112	Commuter rail systems	*	*	*	*	*	*	*	*	*
485113	Bus and other motor vehicle transit systems	9,085	9,272	9,341	9,256	9,196	9,260	9,268	183	2.0%
485119	Other urban transit systems	31	32	28	27	25	27	28	-3	-9.7%
485210	Interurban and rural bus transportation	892	962	999	1,081	1,097	1,120	1,084	192	21.5%
485410	School and employee bus transportation	2,138	2,298	2,275	2,157	2,143	2,149	2,230	92	4.3%
485510	Charter bus industry	1,012	1,086	977	909	899	902	983	-29	-2.9%
485991	Special needs transportation	1,386	1,475	1,692	1,787	1,865	1,844	1,870	484	34.9%
485999	All other ground passenger transportation	592	597	585	669	805	812	810	218	36.8%
541620	Environmental consulting services	2,124	2,253	2,289	2,407	2,533	2,497	2,445	321	15.1%
562111	Solid waste collection	2,106	2,218	2,302	2,225	2,457	2,385	2,718	612	29.1%

		Total clean technology employment								
NAICS	Industry	2007	2008	2009	2010	2011	2012	2013	Change from 2007 through 2013	Percent change from 2007 through 2013
562112	Hazardous waste collection	18	24	9	5	5	6	8	-10	-55.6%
562119	Other waste collection	246	229	147	124	123	102	96	-150	-61.0%
562211	Hazardous waste treatment and disposal	1,371	1,456	1,551	1,918	1,967	1,780	1,851	480	35.0%
562212	Solid waste landfill	1,824	1,779	1,752	1,768	1,673	1,483	1,509	-315	-17.3%
562213	Solid waste combustors and incinerators	*	*	*	*	*	*	*	*	*
562219	Other nonhazardous waste disposal	502	507	466	552	561	592	586	84	16.7%
562910	Remediation services	6,861	7,080	7,240	7,901	7,406	6,016	5,603	-1,258	-18.3%
562920	Materials recovery facilities	232	359	462	487	588	680	655	423	182.3%
562991	Septic tank and related services	743	783	741	687	641	664	706	-37	-5.0%
562998	Miscellaneous waste management services	510	548	553	537	576	586	651	141	27.6%
813312	Environment, conservation and wildlife organizations	1,589	1,765	1,854	1,943	2,057	2,108	2,171	582	36.6%
924110	Administration of air and water resource and solid waste management programs	2,433	2,438	2,402	2,385	2,374	2,374	2,353	-80	-3.3%
	<b>Total</b>	<b>57,073</b>	<b>58,122</b>	<b>57,532</b>	<b>58,269</b>	<b>58,625</b>	<b>57,670</b>	<b>58,736</b>	<b>1,663</b>	<b>2.9%</b>

\*Data could not be published to protect confidentiality.

*Total clean technology employment grew by 2.9 percent from 2007 to 2013 levels.*

### Gross business income

Figure 1-7 tracks clean technology gross business income from 2007 through 2013 by detailed industry classifications. Overall, gross business income increased by 7.8 percent, or \$1.2 billion. As with employment, electric power distribution saw the greatest increase in gross business income, with an increase of \$758.5 million or 14.0 percent. The power, distribution and specialty transformer manufacturing industry saw the greatest percentage increase, at 1688.1 percent, increasing by \$137.2 million from 2007 levels.

The hazardous waste treatment and disposal industry saw the greatest decrease in gross business income, losing \$533.6 million or 66.8 percent. The materials recovery facilities industry saw the greatest percentage decrease, at 91.3 percent, decreasing by \$345.5 million.

**Figure 1-7. Comparison of clean technology gross business income by industry, in millions**  
 Washington state, 2007 through 2013  
 Source: Department of Revenue

		Total clean technology gross business income								
NAICS	Industry	2007	2008	2009	2010	2011	2012	2013	Change from 2007 through 2013	Percent change from 2007 through 2013
221111	Hydroelectric power generation	\$1,163.5	\$1,228.3	\$1,235.5	\$1,191.0	\$1,258.9	\$1,380.1	\$1,431.9	\$268.4	23.1%
221114	Solar electric power generation	*	*	*	*	*	*	\$1.1	\$1.1	*
221115	Wind electric power generation	*	*	*	*	*	\$108.5	\$124.6	\$124.6	*
221116	Geothermal electric power generation	*	*	*	*	*	*	*	*	*
221117	Biomass electric power generation	*	*	*	*	*	*	*	*	*
221118	Other electric power generation	*	*	*	*	*	\$79.0	\$102.1	\$102.1	*
221121	Electric bulk power transmission and control	\$894.1	\$880.3	*	\$928.7	\$990.9	\$1,023.8	\$1,060.0	\$166.0	18.6%
221122	Electric power distribution	\$5,427.2	\$5,574.4	\$5,699.0	\$5,432.3	\$5,835.7	\$5,832.2	\$6,185.7	\$758.5	14.0%
221320	Sewage treatment facilities	\$756.2	\$772.2	\$829.1	\$851.0	\$902.5	\$963.1	\$1,033.9	\$277.7	36.7%
237110	Water and sewer line and related structures construction	\$765.1	\$653.0	\$511.1	\$480.8	\$583.7	\$565.0	\$623.7	-\$141.4	-18.5%
237130	Power and comm. line and related structures construction	\$1,020.3	\$1,057.2	\$890.9	\$790.1	\$783.4	\$793.7	\$713.6	-\$306.6	-30.1%
333611	Turbine and turbine generator set units	\$10.7	\$17.8	\$16.8	\$27.1	\$21.0	\$22.5	\$23.2	\$12.5	116.8%
335311	Power, distribution, and specialty transformer manuf.	\$8.1	\$6.7	\$7.3	\$8.3	\$9.2	\$117.7	\$145.4	\$137.2	1688.1%
335313	Switchgear and switchboard apparatus manufacturing	\$11.3	\$10.9	\$12.3	\$16.2	\$17.6	\$12.1	\$38.3	\$27.0	238.2%
335911	Storage battery manufacturing	*	*	*	*	*	*	*	*	*
423930	Recyclable material merchant wholesalers	\$1,261.5	\$1,455.8	\$1,148.9	\$1,570.2	\$1,364.8	\$1,355.7	\$1,264.3	\$2.7	0.2%
485111	Mixed mode transit systems	\$37.7	\$45.2	\$47.4	\$57.3	\$63.6	\$71.8	\$76.0	\$38.3	101.7%
485112	Commuter rail systems	\$4.2	\$4.3	\$4.9	\$3.7	\$4.0	\$4.7	\$5.3	\$1.1	26.8%
485113	Bus and other motor vehicle transit systems	\$87.8	\$104.5	\$133.2	\$147.0	\$164.1	\$19.1	\$20.9	-\$66.8	-76.2%
485119	Other urban transit systems	*	*	*	*	*	*	*	*	*
485210	Interurban and rural bus transportation	\$37.5	\$43.8	\$41.3	\$47.4	\$51.3	\$45.3	\$38.6	\$1.1	2.9%
485410	School and employee bus transportation	\$73.3	\$71.5	\$55.1	\$55.3	\$55.9	\$59.7	\$60.4	-\$12.9	-17.6%
485510	Charter bus industry	\$29.3	\$37.2	\$41.0	\$42.1	\$42.1	\$37.2	\$34.3	\$5.1	17.3%
485991	Special needs transportation	\$19.0	\$21.3	\$22.9	\$21.0	\$25.3	\$24.3	\$24.8	\$5.9	30.8%
485999	All other ground passenger transportation	\$93.7	\$93.0	\$136.5	\$164.6	\$181.7	\$166.0	\$158.3	\$64.6	68.9%
541620	Environmental consulting services	\$80.2	\$102.3	\$147.7	\$252.0	\$276.2	\$253.6	\$264.7	\$184.5	230.1%
562111	Solid waste collection	\$609.8	\$590.4	\$508.1	\$531.7	\$544.3	\$604.6	\$663.2	\$53.4	8.8%
562112	Hazardous waste collection	\$44.4	\$38.9	\$39.1	\$39.7	\$83.0	\$102.9	\$96.3	\$51.9	116.9%
562119	Other waste collection	\$256.4	\$311.0	\$423.8	\$441.6	\$461.7	\$526.9	\$565.6	\$309.2	120.6%
562211	Hazardous waste treatment and disposal	\$799.0	\$767.3	\$391.0	\$244.3	\$250.9	\$270.3	\$265.4	-\$533.6	-66.8%

Total clean technology gross business income										
NAICS	Industry	2007	2008	2009	2010	2011	2012	2013	Change from 2007 through 2013	Percent change from 2007 through 2013
562212	Solid waste landfill	\$191.9	\$177.0	\$100.6	\$104.5	\$105.0	\$103.2	\$107.1	-\$84.8	-44.2%
562213	Solid waste combustors and incinerators	\$27.4	\$27.7	\$18.6	\$22.4	\$39.2	\$39.1	\$33.5	\$6.1	22.4%
562219	Other nonhazardous waste disposal	\$328.4	\$339.3	\$304.1	\$329.6	\$338.9	\$360.1	\$369.1	\$40.7	12.4%
562910	Remediation services	\$431.3	\$495.2	\$519.4	\$600.5	\$686.4	\$615.1	\$549.6	\$118.3	27.4%
562920	Materials recovery facilities	\$378.3	\$238.5	\$17.9	\$31.8	\$33.5	\$29.1	\$32.8	-\$345.5	-91.3%
562991	Septic tank and related svcs.	\$75.5	\$79.6	\$76.9	\$82.0	\$83.6	\$85.7	\$92.6	\$17.1	22.6%
562998	Miscellaneous waste management services	\$82.0	\$98.8	\$429.2	\$614.6	\$593.1	\$528.2	\$525.2	\$443.1	540.2%
813312	Environment, conservation and wildlife organizations	\$15.9	\$19.1	\$18.3	\$21.0	\$23.6	\$20.4	\$21.4	\$5.5	34.7%
924110	Administration of air and water resource and solid waste management programs	\$3.7	\$4.6	\$6.4	\$10.1	\$10.4	\$10.7	\$21.2	\$17.5	474.4%
	<b>Total</b>	<b>\$15,600.9</b>	<b>\$15,859.6</b>	<b>\$15,155.0</b>	<b>\$15,528.5</b>	<b>\$16,426.9</b>	<b>\$16,357.1</b>	<b>\$16,810.7</b>	<b>\$1,209.7</b>	<b>7.8%</b>

\*Data could not be published to protect confidentiality.

Total clean technology gross business income increased by 7.8 percent from 2007 to 2013 levels.

## Clean technology employment projections by industry and occupation

ESD produces employment projections by industry and occupation. Using the detailed clean technology industry classifications and corresponding major occupational groups, we can provide projections for clean technology employment.

Figure 1-8 provides five-year projections for clean technology employment by industry. Employment projections are not developed for industry classifications at the same level of detail as the clean technology definitions, so we could not project employment changes for all of the detailed clean technology classifications. Across clean technology industries, overall employment is projected to grow by 4,975 jobs, or 9.5 percent, from 2013 to 2018 levels. The environmental consulting services industry is projected to grow at the highest rate, at 36.6 percent, and to add the most jobs at 895 total.

Figure 1-8. Projected future clean technology jobs by industry  
Washington state, 2013 through 2018  
Source: Employment Security Department/LMPA

NAICS	Industry	Projected change in clean technology employment 2013 through 2018	Projected percent change in clean technology employment 2013 through 2018
221111	Hydroelectric power generation	-32	-1.9%
221114	Solar electric power generation	*	*
221115	Wind electric power generation	*	*
221116	Geothermal electric power generation	*	*

NAICS	Industry	Projected change in clean technology employment 2013 through 2018	Projected percent change in clean technology employment 2013 through 2018
221117	Biomass electric power generation	*	*
221118	Other electric power generation	*	*
221121	Electric bulk power transmission and control	-35	-1.9%
221122	Electric power distribution	-130	-1.9%
221320	Sewage treatment facilities	57	6.8%
237110	Water and sewer line and related structures construction	526	15.6%
237130	Power and comm. line and related structures construction	545	15.6%
333611	Turbine and turbine generator set units	7	8.8%
335311	Power, distribution, and specialty transformer manuf.	58	19.5%
335313	Switchgear and switchboard apparatus manufacturing	30	19.4%
335911	Storage battery manufacturing	6	16.7%
423930	Recyclable material merchant wholesalers	186	9.8%
485111	Mixed mode transit systems	*	*
485112	Commuter rail systems	*	*
485113	Bus and other motor vehicle transit systems	337	3.6%
485119	Other urban transit systems	*	*
485210	Interurban and rural bus transportation	*	*
485410	School and employee bus transportation	300	13.5%
485510	Charter bus industry	68	6.9%
485991	Special needs transportation	246	13.2%
485999	All other ground passenger transportation	107	13.2%
541620	Environmental consulting services	895	36.6%
562111	Solid waste collection	391	14.4%
562112	Hazardous waste collection	*	*
562119	Other waste collection	*	*
562211	Hazardous waste treatment and disposal	*	*
562212	Solid waste landfill	151	10.0%
562213	Solid waste combustors and incinerators	*	*
562219	Other nonhazardous waste disposal	59	10.1%
562910	Remediation services	664	11.9%
562920	Materials recovery facilities	78	11.9%
562991	Septic tank and related services	84	11.9%
562998	Miscellaneous waste management services	77	11.8%
813312	Environment, conservation and wildlife organizations	300	13.8%
924110	Admin. of air and water resource and solid waste mgmt. progs.	*	*
	<b>Overall projected change</b>	<b>4,975</b>	<b>9.5%</b>

\*Projections were not available for this detailed industry classification.

*Across clean technology industries, overall employment is projected to grow by 4,975 jobs, or 9.5 percent, from 2013 to 2018 levels.*

Figure 1-9 provides five-year projections for clean technology employment by occupation. Across all identifiable major clean technology occupational groups, overall employment is projected to grow by 3,238, or 11.9 percent, from 2013 to 2018 levels. Construction and extraction occupations are projected to grow at the highest rate, at 22.3 percent, and to add the most jobs at 1,389.

**Figure 1-9. Projected future clean technology jobs by major occupational group**  
Washington state, 2013 through 2018  
Source: Employment Security Department/LMPA

SOC	Major occupational group	Projected change in clean technology employment 2013 through 2018	Projected percent change in clean technology employment 2013 through 2018
11-0000	Management	204	11.1%
13-0000	Business and financial operations	85	10.4%
15-0000	Computer and mathematical	37	17.6%
17-0000	Architecture and engineering	56	4.7%
19-0000	Life, physical and social science	73	8.2%
21-0000	Community and social services	*	*
23-0000	Legal	*	*
25-0000	Education, training and library	*	*
27-0000	Arts, design, entertainment, sports and media	*	*
29-0000	Healthcare practitioners and technical	25	11.2%
31-0000	Healthcare support	*	*
33-0000	Protective services	10	7.6%
35-0000	Food preparation and serving-related	*	*
37-0000	Building and grounds cleaning and maintenance	23	10.7%
39-0000	Personal care and service	*	*
41-0000	Sales and related	25	9.0%
43-0000	Office and administrative support	226	9.1%
45-0000	Farming, fishing and forestry	*	*
47-0000	Construction and extraction	1,389	22.3%
49-0000	Installation, maintenance and repair	193	8.4%
51-0000	Production	34	6.4%
53-0000	Transportation and material moving	852	8.7%
**	<b>Overall projected change</b>	<b>3,238</b>	<b>11.9%</b>

\*Projections were not available for this occupational group.

\*\*Occupational estimates were not calculated for employment in clean technology industries which accounted for fewer than 80 percent of total industry employment at the 4-digit NAICS level.

*Across major clean technology occupational groups, overall employment is projected to grow by 3,238 jobs, or 11.9 percent, from 2013 to 2018 levels.*

## Educational levels for clean technology occupations

For the top 25 clean technology occupations, we were able to identify the typical level of education that most workers need upon entry to the occupation. However, additional training, experience, licenses or credentials may be required and may vary by employer.

*Figure 1-10* breaks out employment in the top 25 occupations by five basic education levels. Over half require only a high school education upon entry, while nearly one-third require short-term on-the-job training.

**Figure 1-10.** Educational requirements for top 25 clean technology jobs

Washington state, 2013

Source: Employment Security Department/LMPA; Bureau of Labor Statistics, Occupational Handbook; O-Net OnLine

Educational requirement	Percent of clean technology employment
High school only	51.7%
Short-term on-the-job training	33.0%
AA or AAS degree	1.4%
BA or BS degree	6.7%
Postsecondary non-degree award	7.2%

*Over half of clean technology employment requires only a high school education upon entry, while nearly one-third requires short-term on-the-job training.*

## Clean technology wage rates by industry and occupation

Using the detailed clean technology industry classifications and corresponding occupations, we can provide average wage rates by industry and occupation.

*Figure 1-11* shows average annual wage rates for clean technology by specific industry classification. The overall average annual wage for the clean technology sector was \$61,138. The electric bulk power transmission and control industry had the highest average annual wages at \$109,743. The school and employee bus transportation industry had the lowest at \$23,322.

**Figure 1-11.** Average annual wage rates for clean technology jobs by industry

Washington state, 2013

Source: Employment Security Department/LMPA; Bureau of Labor Statistics, Quarterly Census of Employment and Wages

NAICS	Industry	Average annual wage rate
221111	Hydroelectric power generation	\$86,728
221114	Solar electric power generation	*
221115	Wind electric power generation	\$84,947
221116	Geothermal electric power generation	*
221117	Biomass electric power generation	*
221118	Other electric power generation	*
221121	Electric bulk power transmission and control	\$109,743
221122	Electric power distribution	\$92,321
221320	Sewage treatment facilities	\$61,692
237110	Water and sewer line and related structures construction	\$60,130
237130	Power and communication line and related structures construction	\$69,742

NAICS	Industry	Average annual wage rate
333611	Turbine and turbine generator set units	\$73,947
335311	Power, distribution, and specialty transformer manufacturing	\$70,640
335313	Switchgear and switchboard apparatus manufacturing	\$57,267
335911	Storage battery manufacturing	\$44,241
423930	Recyclable material merchant wholesalers	\$45,648
485111	Mixed mode transit systems	*
485112	Commuter rail systems	*
485113	Bus and other motor vehicle transit systems	\$56,027
485119	Other urban transit systems	*
485210	Interurban and rural bus transportation	\$41,596
485410	School and employee bus transportation	\$23,322
485510	Charter bus industry	\$29,238
485991	Special needs transportation	\$31,483
485999	All other ground passenger transportation	\$24,024
541620	Environmental consulting services	\$71,766
562111	Solid waste collection	\$52,281
562112	Hazardous waste collection	*
562119	Other waste collection	*
562211	Hazardous waste treatment and disposal	*
562212	Solid waste landfill	\$63,401
562213	Solid waste combustors and incinerators	*
562219	Other nonhazardous waste disposal	\$55,695
562910	Remediation services	\$86,971
562920	Materials recovery facilities	\$39,501
562991	Septic tank and related services	\$41,942
562998	Miscellaneous waste management services	\$51,145
813312	Environment, conservation and wildlife organizations	\$40,928
924110	Administration of air and water resource and solid waste management programs	\$68,019
	<b>Average</b>	<b>\$61,138</b>

\*Data could not be published to protect confidentiality.

*The overall average annual wage for the clean technology sector was \$61,138.*

Figure 1-12 shows average annual wage rates for the top 25 clean technology occupations. The overall average was \$50,312. General and operations managers had the highest average annual wages at \$121,903. Taxi drivers and chauffeurs had the lowest at \$29,000.

**Figure 1-12.** Average annual wage rates for top 25 clean technology occupations

Washington state, 2013

Source: Employment Security Department/LMPA; Bureau of Labor Statistics, Occupational Employment Statistics

SOC	Occupation	Average annual wage rate
11-1021	General and operations managers	\$121,903
11-9021	Construction managers	\$98,320
19-2041	Environmental scientists and specialists, including health	\$76,360
19-4051	Nuclear technicians	\$83,080
43-3031	Bookkeeping, accounting, and auditing clerks	\$40,940
43-5032	Dispatchers, except police, fire, and ambulance	\$45,190
43-6014	Secretaries and administrative assistants, except legal, medical, and executive	\$38,540
43-9061	Office clerks, general	\$32,460
47-1011	First-line supervisors of construction trades and extraction workers	\$75,700
47-2061	Construction laborers	\$43,450
47-2073	Operating engineers and other construction equipment operators	\$58,290
47-2152	Plumbers, pipefitters, and steamfitters	\$64,340
47-4041	Hazardous materials removal workers	\$50,040
47-4071	Septic tank servicers and sewer pipe cleaners	\$40,990
49-3031	Bus and truck mechanics and diesel engine specialists	\$53,570
49-9051	Electrical power-line installers and repairers	\$83,040
49-9052	Telecommunications line installers and repairers	\$55,270
53-1031	First-line supervisors of transportation and material-moving machine and vehicle oprs.	\$65,370
53-3021	Bus drivers, transit and intercity	\$47,820
53-3022	Bus drivers, school or special client	\$35,080
53-3032	Heavy and tractor-trailer truck drivers	\$44,070
53-3041	Taxi drivers and chauffeurs	\$29,000
53-7051	Industrial truck and tractor operators	\$40,700
53-7062	Laborers and freight, stock, and material movers, hand	\$30,800
53-7081	Refuse and recyclable material collectors	\$48,500
	<b>Average</b>	<b>\$50,312</b>

*The overall average annual wage for the top 25 clean technology occupations was \$50,312.*

## Skills and certifications for clean technology occupations

Based on an analysis of online job postings, we were able to identify the top skills and certifications that employers are seeking for the top clean technology occupations. We isolated the top 20 skills and certifications, respectively, from employers' online job postings for the top 25 clean technology occupations. Note that this analysis was limited by the skills and certifications that employers chose to specify in their job postings.

Figure 1-13 identifies the top 20 desired skills for the top 25 clean technology occupations. Accounts payable and accounts receivable skills were the most desired skills, of those specified by employers in their job postings.

**Figure 1-13.** Top 20 clean technology desired occupational skills  
Washington state, 2015  
Source: Employment Security Department/LMPA; WANTED Analytics

Desired skills	Percent of desired skills
Accounts payable	16.9%
Accounts receivable	10.7%
Quality assurance	9.3%
Quality control	8.5%
Freight forwarding	8.0%
Preventive maintenance	5.8%
Preventative maintenance inspections	5.0%
Structured query language	4.7%
General ledger Software	4.5%
Intuit QuickBooks	3.9%
Bilingual	3.2%
Electrical systems	3.1%
Accounting software	2.7%
Bills of lading	2.6%
Equipment maintenance	2.5%
Work order	1.9%
Customer relationship management	1.8%
User experience design	1.8%
Lean manufacturing	1.6%
Filing system	1.5%
<b>Total</b>	<b>100.0%</b>

*Accounts payable and accounts receivable skills were the most desired skills identified in employers' clean technology job postings.*

Figure 1-14 identifies the top 20 desired certifications for the top 25 clean technology occupations. By far, commercial driver's license was the most desired certification, of those specified by employers in their job postings.

**Figure 1-14.** Top 20 clean technology desired occupational certifications  
Washington state, 2015  
Source: Employment Security Department/LMPA; WANTED Analytics

Desired certification	Percent of desired certifications
Commercial driver's license	45.5%
Driver's license	17.9%
HAZMAT	12.1%
Occupational Safety & Health Administration certification	4.2%
DOT medical card	3.4%
Class A commercial driver's license	3.3%
Tanker and hazmat endorsement	2.2%
Certified purchasing manager	2.2%
First aid certification	1.3%
Class B commercial driver's license	1.2%
Material handling equipment	1.2%
Forklift certification	1.2%
General contractor	1.1%
Automotive service excellence	0.8%
Project management professional	0.8%
International Federation of Technical Analysts	0.3%
Certified international property specialist	0.3%
EPA certification	0.3%
Hazardous waste operations and emergency response	0.3%
Health Insurance Portability and Accountability Act - HIPAA	0.3%
<b>Total</b>	<b>100.0%</b>

*Commercial driver's license was by far the most desired certification identified in employers' clean technology job postings.*



## Chapter Two: Green economy jobs – results of the survey approach

The findings in this section of the report are self-reported survey data from a scientific sample of the population of Washington employers in calendar year 2013. These data generated statistical estimates of green jobs for the entire state economy. The 2013 survey found an estimated 56,762 green jobs in the Washington economy, of which 92 percent were in the private sector. The total estimate of green jobs represented 2.0 percent of private-sector employment and 0.9 percent of public-sector employment.

To date, green job studies in Washington and across the nation have not identified any new industries and few new occupations that are uniquely “green,” such as wind turbine technician or solar panel designer. For the most part, employers are adding work responsibilities and activities identified as green to existing jobs. Employers appear to be “greening” jobs through their products and services and through the work practices they require of employees.

### 2011 and 2013 survey results

The 2013 statewide estimate of 56,762 green jobs contrasts with the 2011 estimate of 120,305 green jobs. Thus, employers reported 52.8 percent fewer green jobs in 2013 than they did in 2011. However, the green job estimates for 2013 and 2011 *both* fall in the range of estimated green jobs of five other states, which, like Washington state, had a labor force of between three and four million workers.<sup>4</sup>

The reason for the substantial difference in reported green jobs is unclear. Contributing factors could include the changes to the questionnaire as well as changes in perceptions amongst employers regarding green jobs. The questionnaire used for the 2013 survey was revised from the questionnaire used in 2011, but otherwise the sampling, survey and estimating processes remained the same from 2011 to 2013.

Changes to the survey questionnaire in 2013 included no longer requiring employers to choose which of the four core areas was a specific job’s primary focus, as well as modifications and additions to the questionnaire to ensure the information collected covered each of the components of the statutory study mandate. This did increase the amount of information asked of employers, which may have discouraged some employers from responding to the survey or reporting any green jobs.

We looked further at the responses of employers who responded in both 2011 and 2013. About 1,200 employers responded to both surveys and they reported nearly 5,000 green jobs in 2013, in contrast to nearly 40,000 in 2011. One possible reason for the change in the estimated number of green jobs is that the increased amount of information asked of employers discouraged them from reporting any green jobs. Another possible reason is that cultural perceptions about green jobs may have influenced these employers’ interpretation of the green jobs definition and whether they had any jobs that fell within it.

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<sup>4</sup>The states and their green job counts are: Arizona with 30,716, Indiana with 46,879, Massachusetts with 79,994, Missouri with 131,103 and Tennessee with 43,804. *Appendix 5* provides further detail on other states’ studies.

## Green jobs by industry

Employers were classified into industries based on the North American Industry Classification System (NAICS).<sup>5</sup> *Figure 2-1* gives the distribution of green jobs across industry sectors. These results include both public and private green jobs.

The top five industry sectors were as follows:

- Construction was the leading sector, accounting for more than one-quarter of green jobs in the state and an estimated 7.2 percent of covered employment in this sector.
- Professional, scientific and technical services accounted for 14.1 percent of all green jobs and an estimated 3.8 percent of covered employment in this sector.
- Administrative and support and waste management services accounted for 11.8 percent of all green jobs and an estimated 4.9 percent of covered employment in this sector.
- Other services (except public administration) accounted for 9.2 percent of all green jobs and an estimated 4.0 percent of covered employment in this sector.
- Transportation and warehousing accounted for 6.3 percent of all green jobs and an estimated 4.4 percent of covered employment in this sector.

At the other end of the spectrum, the following industry sectors had the fewest green jobs, in descending order: agriculture, forestry, fishing and hunting; real estate and rental and leasing; healthcare and social assistance; utilities; and educational services.

**Figure 2-1. Estimated green jobs by industry**  
Washington state, 2013  
Source: Employment Security Department/LMPA

NAICS	Industry	Total green employment	Percent of green employment	Estimated percent of covered employment <sup>1</sup>
11	Agriculture, forestry, fishing and hunting	1,282	2.3%	0.9%
21	Mining, quarrying and oil and gas extraction	*	*	*
22	Utilities <sup>2</sup>	513	0.9%	3.8%
23	Construction	15,013	26.5%	7.2%
31-33	Manufacturing	3,589	6.3%	1.7%
42	Wholesale trade	3,185	5.6%	2.5%
44-45	Retail trade	3,528	6.2%	1.4%
48-49	Transportation and warehousing <sup>2</sup>	3,593	6.3%	4.4%
51	Information	*	*	*
52	Finance and insurance	*	*	*
53	Real estate and rental and leasing	820	1.4%	1.3%
54	Professional, scientific and technical services	7,984	14.1%	3.8%
55	Management of companies and enterprises	*	*	*
56	Administrative and support and waste management services	6,720	11.8%	4.9%

<sup>5</sup>The U.S. Bureau of Labor Statistics, other federal agencies and most state employment agencies use NAICS for industry-based research and reporting.

NAICS	Industry	Total green employment	Percent of green employment	Estimated percent of covered employment <sup>1</sup>
61	Educational services <sup>2</sup>	128	0.2%	0.1%
62	Healthcare and social assistance	663	1.2%	0.3%
71	Arts, entertainment and recreation	*	*	*
72	Accommodation and food services	1,486	2.6%	0.6%
81	Other services (except public administration)	5,194	9.2%	4.0%
92	Public administration	2,108	3.7%	1.4%
	<b>Total</b>	<b>56,762</b>	<b>100.0%</b>	<b>2.0%</b>

<sup>1</sup>Shares were estimated based on survey design. For more detail, see *Appendix 2*.

<sup>2</sup>These sectors contain some public sector jobs.

\*Data could not be published to protect confidentiality.

*The three sectors of construction, professional, scientific and technical services and administrative and support and waste management services accounted for 29,717 green jobs, or 52.4 percent of all green jobs in the state.*

### Public sector green jobs by industry

*Figure 2-2* focuses on the subset of green jobs in the public sector. The public sector had an estimated 4,414 green jobs statewide, representing 7.8 percent of all green jobs statewide and 1.0 percent of total public-sector employment. Public administration provided nearly half of all public sector green jobs, 47.8 percent, while transportation and warehousing provided an additional 31.9 percent.

**Figure 2-2. Public sector green jobs by industry**  
Washington state, 2013

Source: Employment Security Department/LMPA

NAICS	Industry	Total public sector green employment	Percent of public sector green employment
22	Utilities	424	9.6%
23	Construction	*	*
48-49	Transportation and warehousing	1,406	31.9%
56	Administrative and support and waste management and remediation services	*	*
61	Educational services	82	1.9%
62	Healthcare and social assistance	*	*
71	Arts, entertainment and recreation	*	*
92	Public administration	2,108	47.8%
	<b>Total</b>	<b>4,414</b>	<b>100.0%</b>

\*Data could not be published to protect confidentiality.

*The public sector provided 7.8 percent of green jobs statewide. Of these, public administration provided nearly half of those green jobs.*

## Green jobs by occupation

For this survey, every job title was coded based on the Standard Occupational Classification (SOC) system.<sup>6</sup> *Figure 2-3* displays the top 25 green occupations in the state.

These top 25 occupations totaled 32,895 jobs and comprised 58.0 percent of the total number of green jobs in the state.<sup>7</sup> The top five occupations were as follows:

- Heating, air conditioning and refrigeration mechanics and installers was the leading occupation, accounting for 3,148 green jobs at 5.6 percent.
- Heavy and tractor-trailer truck drivers accounted for 2,597 green jobs at 4.6 percent.
- Janitors and cleaners, except maids and housekeeping cleaners, accounted for 2,442 green jobs at 4.3 percent.
- Construction laborers accounted for 2,199 green jobs at 3.9 percent.
- Automotive service technicians and mechanics accounted for 2,157 green jobs at 3.8 percent.

At the other end of the spectrum, the following occupations had the fewest green jobs, in descending order: construction managers; farmworkers and laborers, crop, nursery and greenhouse; operating engineers and other construction equipment operators; cashiers; and insulation workers, floor, ceiling and wall.

**Figure 2-3. Top 25 green jobs by occupation**

Washington state, 2013

Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

SOC	Occupation	Total green employment	Percent of green employment
49-9021	Heating, air conditioning and refrigeration mechanics and installers	3,148	5.6%
53-3032	Heavy and tractor-trailer truck drivers	2,597	4.6%
37-2011	Janitors and cleaners, except maids and housekeeping cleaners	2,442	4.3%
47-2061	Construction laborers	2,199	3.9%
49-3023	Automotive service technicians and mechanics	2,157	3.8%
47-2111	Electricians	1,956	3.5%
53-3021	Bus drivers, transit and intercity	1,638	2.9%
17-2051	Civil engineers	1,418	2.5%
41-2031	Retail salespersons	1,353	2.4%
17-1011	Architects, except landscape and naval	1,222	2.2%
37-3011	Landscaping and groundskeeping workers	1,194	2.1%
47-2121	Glaziers	1,049	1.9%
19-2041	Environmental scientists and specialists, including health	1,049	1.9%
47-2031	Carpenters	962	1.7%
13-1199	Business operations specialists, all other	945	1.7%

<sup>6</sup>The U.S. Bureau of Labor Statistics, other federal agencies and most state employment agencies also use SOC codes for occupation-based research and reporting.

<sup>7</sup>Shares of total covered employment by occupation are not available. *Appendix 4* provides a complete list of green jobs by occupation, including average hourly wage rates.

SOC	Occupation	Total green employment	Percent of green employment
47-4041	Hazardous materials removal workers	879	1.6%
51-9199	Production workers, all other	822	1.5%
47-2152	Plumbers, pipefitters and steamfitters	801	1.4%
41-4012	Sales reps., wholesale and manufacturing, except technical and scientific products	783	1.4%
53-7081	Refuse and recyclable material collectors	764	1.4%
11-9021	Construction managers	754	1.3%
45-2092	Farmworkers and laborers, crop, nursery and greenhouse	736	1.3%
47-2073	Operating engineers and other construction equipment operators	714	1.3%
41-2011	Cashiers	688	1.2%
47-2131	Insulation workers, floor, ceiling and wall	625	1.1%
	<b>Total</b>	<b>32,895</b>	<b>58.0%</b>

*The top 25 green occupations comprised 58.0 percent of total green jobs in the state.*

## 2011 and 2013 survey results by industry and occupation

### 2011 and 2013 by industry

Figure 2-4 provides the 2011 and 2013 statewide estimates of green jobs by industry sector. For most industry sectors, the survey results were lower for 2013 than for 2011. Using 2011 estimations as a reference, one sector showed a positive difference, accommodation and food services. The largest percentage negative difference was in the estimated results for educational services, which were 96.0 percent lower than the estimated 2011 value.

These differences support the observed trend described in the 2011 green jobs report that, for the most part, employers continue to add work responsibilities and activities identified as “green” to existing jobs. The continuous “greening” of existing jobs makes it difficult to differentiate a “green job” from an existing job that has been subtly greened. In the absence of decreases in overall employment in the state, it certainly seems that perceptions, rather than real decreases in employment, played a significant role in employers’ differing responses to the 2011 and 2013 surveys.

**Figure 2-4. 2011 and 2013 survey results by industry**  
 Washington state, 2011 and 2013  
 Source: Employment Security Department/LMPA

NAICS	Industry	Estimates of green employment based on 2011 survey	Estimates of green employment based on 2013 survey	Difference in estimations using 2011 as base	Percent difference
11	Agriculture, forestry, fishing and hunting	12,008	1,282	-10,725	-89.3%
22	Utilities	1,450	513	-937	-64.6%
23	Construction	29,864	15,013	-14,851	-49.7%
31-33	Manufacturing	11,309	3,589	-7,721	-68.3%
42	Wholesale trade	5,949	3,185	-2,764	-46.5%
44-45	Retail trade	3,960	3,528	-432	-10.9%
48-49	Transportation and warehousing	6,277	3,593	-2,684	-42.8%
51	Information	360	*	*	*
52	Finance and insurance	1,405	*	*	*
53	Real estate and rental and leasing	1,364	820	-544	-39.9%
54	Professional, scientific and technical services	11,704	7,984	-3,720	-31.8%
55	Management of companies and enterprises	*	*	*	*
56	Administrative and support and waste management	12,542	6,720	-5,822	-46.4%
61	Educational services	3,185	128	-3,057	-96.0%
62	Healthcare and social assistance	3,626	663	-2,964	-81.7%
71	Arts, entertainment and recreation	324	*	*	*
72	Accommodation and food services	606	1,486	880	145.0%
81	Other services (except public administration)	6,749	5,194	-1,555	-23.0%
92	Public administration	7,416	2,108	-5,308	-71.6%
	<b>Total</b>	<b>120,304</b>	<b>56,762</b>	<b>-63,542</b>	<b>-52.8%</b>

\*Data could not be published to protect confidentiality.

*Survey estimates for most industry sectors were lower for 2013 than for 2011.*

### 2011 and 2013 by occupation

Figure 2-5 shows the same relatively large differences in estimated green jobs resulting from the two surveys, but by major occupational group. For most occupational groups, the 2013 survey results were lower than 2011, but three were higher. Food preparation and serving-related occupations were higher by 214.9 percent, arts, design, entertainment, sports and media occupations were higher by 27.8 percent and building and grounds cleaning and maintenance were higher by 16.1 percent. The greatest percentage negative difference was in farming, fishing and forestry occupations (92.0 percent), but education, training and library occupations was a very close second (91.8 percent).

Once again, in the absence of decreases in overall employment in the state, it certainly seems that perceptions, rather than real decreases in employment, played a significant role in employers' differing responses to the 2011 and 2013 surveys.

**Figure 2-5. 2011 and 2013 survey results by major occupational group**  
 Washington state, 2011 and 2013

Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

SOC	Major occupational group	Estimates of green employment based on 2011 survey	Estimates of green employment based on 2013 survey	Difference in estimations using 2011 as base	Percent difference
11-0000	Management	7,128	2,403	-4,725	-66.3%
13-0000	Business and financial operations	3,348	1,425	-1,923	-57.4%
15-0000	Computer and mathematical	771	715	-56	-7.3%
17-0000	Architecture and engineering	13,109	5,126	-7,983	-60.9%
19-0000	Life, physical and social science	3,239	2,604	-635	-19.6%
21-0000	Community and social service	1,677	*	*	*
23-0000	Legal	112	89	-23	-20.5%
25-0000	Education, training and library	1,005	82	-923	-91.8%
27-0000	Arts, design, entertainment, sports and media	471	602	131	27.8%
29-0000	Healthcare practitioners and technical	745	*	*	*
31-0000	Healthcare support	618	*	*	*
33-0000	Protective service	1,471	*	*	*
35-0000	Food preparation and serving-related	309	973	664	214.9%
37-0000	Building and grounds cleaning and maintenance	3,980	4,621	641	16.1%
39-0000	Personal care and service	1,493	*	*	*
41-0000	Sales and related	5,863	3,816	-2,047	-34.9%
43-0000	Office and administrative support	3,883	1,201	-2,682	-69.1%
45-0000	Farming, fishing and forestry	12,265	978	-11,287	-92.0%
47-0000	Construction and extraction	23,573	12,012	-11,561	-49.0%
49-0000	Installation, maintenance and repair	11,236	6,793	-4,443	-39.5%
51-0000	Production	10,894	4,501	-6,393	-58.7%
53-0000	Transportation and material moving	13,114	7,516	-5,598	-42.7%
	<b>Total</b>	<b>120,304</b>	<b>56,762</b>	<b>-63,542</b>	<b>-52.8%</b>

\*Data could not be published to protect confidentiality.

*Similar to the industry sectors, survey results for most occupational groups were lower for 2013 than for 2011.*

## Expected growth of green jobs

For each green job occupation identified, the survey asked employers how many green jobs they expected to have two years in the future. The information collected provided some insight into employers' future green jobs employment, but does not directly translate into a precise forecast of future employment in green jobs.

Employers who responded to this future-looking question expected an average increase of 19.5 percent in their green jobs over the next two years. (See *Figure 2-6*.)

Employers expected the greatest increase in computer and mathematical occupations, with an estimated growth of 109.2 percent from fall 2013 to fall 2015. Additional occupational groups where high growth was expected were business and financial operations (62.3 percent), management (58.1 percent) and architecture and engineering (35.2 percent).

Employers expected growth rates of less than 10 percent in farming, fishing and forestry (6.7 percent) and transportation and material moving (2.3 percent). Employers expected a decline in sales and related occupations of 17.1 percent.

**Figure 2-6.** Expected future green jobs by major occupational group, fall 2015  
Washington state, 2013  
Source: Employment Security Department/LMPA

SOC	Major occupational group	Expected change in green employment for fall 2015
11-0000	Management	58.1%
13-0000	Business and financial operations	62.3%
15-0000	Computer and mathematical	109.2%
17-0000	Architecture and engineering	35.2%
19-0000	Life, physical and social science	12.6%
27-0000	Arts, design, entertainment, sports and media	12.2%
35-0000	Food preparation and serving-related	25.9%
37-0000	Building and grounds cleaning and maintenance	27.4%
41-0000	Sales and related	-17.4%
43-0000	Office and administrative support	13.8%
45-0000	Farming, fishing and forestry	6.7%
47-0000	Construction and extraction	28.1%
49-0000	Installation, maintenance and repair	16.3%
51-0000	Production	17.5%
53-0000	Transportation and material moving	2.3%
	<b>Average growth rate</b>	<b>19.5%</b>

*At 109.2 percent, employers expected the highest green job growth in computer and mathematical occupations from 2013 to 2015.*

## Educational, experience and skill requirements in the green economy

For each green job, the survey asked employers for information on the job's educational, experience and skill requirements.

### Educational requirements for green jobs

The educational requirements for the reported green jobs are shown in *Figure 2-7*. An educational requirement of high school only was most common, reported for 32.5 percent of green jobs. An apprenticeship was required for 15.9 percent of the green jobs. Employers reported that 22.0 percent of green jobs required a certificate, license or similar credential to perform their green job functions. Postsecondary education was required for 21.9 percent of the green jobs, a combination of 2.8 percent requiring an associate degree, 15.0 percent requiring a bachelor's degree and 4.1 percent requiring a post-graduate degree.

**Figure 2-7.** Educational requirements for green jobs  
Washington state, 2013  
Source: Employment Security Department/LMPA

Educational requirement	Percent of green employment
High school only	32.5%
Apprenticeship only	15.9%
Certificate, license, etc. only	22.0%
AA or AAS degree	2.8%
BA or BS degree	15.0%
Post-graduate or professional degree	4.1%
Not identified	7.6%

*Almost one-third of the reported green jobs required only a high school education.*

### Experience requirements for green jobs

As shown in *Figure 2-8*, almost one-half, 46.8 percent, of the reported green jobs required no experience. Only one-quarter of the green jobs required as much as one to two years of experience. Three to five years of experience were required in about one out of six green jobs. Only 7.2 percent of the reported green jobs required over five years of experience, one out of every 14 green jobs.

**Figure 2-8.** Experience requirements for green jobs  
Washington state, 2013  
Source: Employment Security Department/LMPA

Experience requirement	Percent of green employment
None	46.9%
1 to 2 years	25.0%
3 to 5 years	17.2%
More than 5 years	7.2%
Not identified	3.6%

*Nearly half of reported green jobs required no experience.*

### Skill requirements for green jobs

Figure 2-9 reports the skill requirements for a given green job compared to the same job title that is non-green. For a given job title, employers reported that the skills of a green job and a non-green job were identical for 35.1 percent of the reported job titles. For another 42.3 percent of the green jobs, the skills required were mostly the same as those for the non-green job of the same job title. In only 12.9 percent of the job titles reported, the skills were mostly different when comparing green and non-green jobs. Finally, the surveyed employers reported that green skills and non-green skills for the same job title were entirely different for only 2.6 percent of their green jobs.

In summary, there was little skill difference between green jobs and non-green jobs. Overall, green jobs were not unique in terms of their skill requirements compared to non-green jobs.

**Figure 2-9.** Comparative skill requirements for green jobs

Washington state, 2013

Source: Employment Security Department/LMPA

Skill requirements compared to non-green counterparts	Percent of green employment
Skills are identical	35.1%
Skills are mostly the same	42.3%
Skills are mostly different	12.9%
Skills are entirely different	2.6%
Not identified	7.0%

*Overall, green jobs were not unique in terms of their skill requirements compared to non-green jobs.*

### Wage rates and benefits compensation in the green economy

A major improvement of the 2013 survey questionnaire was asking employers about average hourly wage rates and benefits for each green job title. Previous survey questionnaires did not ask employers to report this information, so non-green-specific occupational employment statistics were relied upon to provide that information.

#### Average hourly green job wage rates by industry

Figure 2-10 shows the green job's average hourly wage rate by industry sector. Green jobs in the information industry sector were paid the highest average hourly wage rate of \$46.98 per hour. Green jobs in the professional, scientific and technical services industry sector were paid an average hourly wage rate of \$40.45 per hour. Green jobs in all other sectors were paid an average hourly wage rate of less than \$40.00 per hour.

Green jobs in the arts, entertainment and recreation industry sector were paid an average hourly wage rate of \$10.30 per hour. Green jobs in two other sectors were also paid, on average, less than \$13.00 per hour: retail trade (\$12.73) and accommodation and food services (\$12.12).

Thus, the green job in the information sector was paid almost four times more per hour than the green job in the arts, entertainment and recreation industry sector. This finding is consistent with the results of the Quarterly Census of Employment and Wages (QCEW) for all jobs, green and

non-green, in these two sectors. The results of QCEW show that a job in the information sector in 2013 was paid, on average, over four times more than a job in the arts, entertainment and recreation industry sector.<sup>8</sup>

**Figure 2-10.** Average hourly wage rates for green jobs by industry  
Washington state, 2013  
Source: Employment Security Department/LMPA

NAICS	Industry	Average hourly wage rate
11	Agriculture, forestry, fishing and hunting	\$15.97
22	Utilities	\$34.26
23	Construction	\$26.62
31-33	Manufacturing	\$19.45
42	Wholesale trade	\$22.74
44-45	Retail trade	\$12.73
48-49	Transportation and warehousing	\$19.55
51	Information	\$46.98
53	Real estate and rental and leasing	\$15.83
54	Professional, scientific and technical services	\$40.45
56	Administrative and support and waste management and remediation services	\$17.27
61	Educational services	\$35.73
62	Healthcare and social assistance	\$39.26
71	Arts, entertainment and recreation	\$10.30
72	Accommodation and food services	\$12.12
81	Other services (except public administration)	\$17.49
92	Public administration	\$33.33
	<b>Average for all industries</b>	<b>\$24.52</b>

*While the average hourly wage rate for all green jobs was \$24.52 per hour, there was a large difference between the highest, information at \$46.98, to the lowest, arts, entertainment and recreation at \$10.30, by industry sector.*

<sup>8</sup>Statewide in 2013, the annual average weekly wage for the information industry sector was \$2,602. In arts, entertainment and recreation it was \$534. U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, Data file Q52744.

### Average hourly green job wage rates by occupation

Figure 2-11 displays the average hourly wage rates paid to green jobs in the top 25 occupations. Topping the list is civil engineers that were paid an average hourly wage of \$45.77. The remaining occupations were paid, on average, less than \$40.00 per hour.

Of the top 25 occupations, those that were paid an average hourly wage rate less than \$13.00, were retail salespersons (\$11.69), farmworkers and laborers, crop, nursery and greenhouse (\$11.02) and cashiers (\$9.46).

**Figure 2-11.** Average hourly wage rates for top 25 green job occupations  
Washington state, 2013

Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

SOC	Occupation	Average hourly wage rate
17-2051	Civil engineers	\$45.77
17-1011	Architects, except landscape and naval	\$37.59
11-9021	Construction managers	\$36.75
19-2041	Environmental scientists and specialists, including health	\$36.47
13-1199	Business operations specialists, all other	\$30.48
47-2111	Electricians	\$29.64
41-4012	Sales reps., wholesale and manufacturing, exc. tech. and scientific products	\$29.06
47-2152	Plumbers, pipefitters and steamfitters	\$28.43
47-2073	Operating engineers and other construction equipment operators	\$27.18
47-2121	Glaziers	\$25.38
49-9021	Heating, air conditioning and refrigeration mechanics and installers	\$24.73
47-4041	Hazardous materials removal workers	\$22.38
53-3021	Bus drivers, transit and intercity	\$22.31
47-2031	Carpenters	\$22.18
49-3023	Automotive service technicians and mechanics	\$20.27
51-9199	Production workers, all other	\$17.02
47-2061	Construction laborers	\$16.82
53-3032	Heavy and tractor-trailer truck drivers	\$16.13
37-2011	Janitors and cleaners, except maids and housekeeping	\$15.73
53-7081	Refuse and recyclable material collectors	\$15.41
47-2131	Insulation workers, floor, ceiling and wall	\$15.33
37-3011	Landscaping and groundskeeping workers	\$13.75
41-2031	Retail salespersons	\$11.69
45-2092	Farmworkers and laborers, crop, nursery and greenhouse	\$11.02
41-2011	Cashiers	\$9.46
	<b>Average for top 25 occupations</b>	<b>\$19.08</b>

*The range of average hourly wage rates paid to the top 25 green job occupations was very wide, from a high of \$45.77 per hour for civil engineers to just \$9.46 for cashiers.*

### Average hourly wage rate by educational requirement

The average hourly wage rate among green jobs by educational requirement suggests that the average hourly wage rate increases when the educational requirements increase (*Figure 2-12*).

Green jobs that required a high school education were paid an average hourly wage rate of \$17.73. Green jobs that required an apprenticeship were paid, on average, \$18.81 per hour, \$1.08 more per hour than green jobs that required a high school education.

Relative to the green job that required a high school education, a green job that required an associate degree resulted in a wage rate increase of \$14.17 more per hour. A green job that required a bachelor's degree paid an average hourly wage rate of \$37.50 per hour. Finally, a green job that required a post-graduate or professional degree paid an average hourly wage rate of \$56.57.

**Figure 2- 12.** Average hourly wage rates for green jobs by educational requirement

Washington state, 2013

Source: Employment Security Department/LMPA

Educational requirement	Average hourly wage rate
High school only	\$17.73
Apprenticeship only	\$18.81
Certificate, license, etc. only	\$23.72
AA or AAS degree	\$31.90
BA or BS degree	\$37.50
Post-graduate or professional degree	\$56.57

*Green jobs with higher educational and training requirements were paid much higher average hourly wage rates.*

### Average hourly wage rate by experience requirement

Employers reported a wide range of required experience for workers to be employed in their green jobs. As the data show in *Figure 2-13*, green jobs requiring more experience were paid much higher average hourly earnings. The green job that required no experience was paid an average hourly wage rate of \$18.67. In sharp contrast, the worker who was required to bring more than five years' experience to the green job was paid an average hourly wage rate of \$43.57 per hour.

**Figure 2-13.** Average hourly wage rates for green jobs by years of required experience

Washington state, 2013

Source: Employment Security Department/LMPA

Experience requirement	Average hourly wage rate
None	\$18.67
1 to 2 years	\$24.45
3 to 5 years	\$32.56
More than 5 years	\$43.57

*Green jobs that required more experience were paid higher average hourly wage rates.*

### Average hourly wage rate for a given green job by comparative skill difference

Figure 2-14 shows the variation in average hourly wage rates for green jobs by similarity of their skill requirements to the same, but non-green, jobs. When skills were identical, the green worker in a given job and the non-green worker in that same job earned an average hourly wage rate of \$21.56. In contrast, for a given job title, when the skills of the green job worker were entirely different from the skills of the non-green worker in the same job, the green job worker earned an average hourly wage rate of \$35.60. The more different the green skills were for a given job, the higher average hourly wage rate.

Figure 2-14. Average hourly wage rates for green jobs by comparative skill level  
Washington state, 2013

Source: Employment Security Department/LMPA

Skill requirements compared to non-green counterparts	Average hourly wage rate
Skills are identical	\$21.56
Skills are mostly the same	\$25.57
Skills are mostly different	\$27.83
Skills are entirely different	\$35.60

*The more different the skill level of a green job, the higher the average hourly wage rate.*

### Benefits paid by green economy employers

Benefits paid in green jobs varied by industry. However, results did not meet publication standards for many of the industry sectors. Overall, 74.5 percent of green jobs offered medical benefits, 77.9 percent offered paid leave and 59.6 percent offered retirement benefits. These numbers are consistent with results of the 2013 Employee Benefits Survey Report.<sup>9</sup>

### Industry certification by core area

Many industries offered industry certifications to employers related to the four core areas that define green economic activities. The percent of employers who reported certifications in one or more of the core areas is given in Figure 2-15. It is notable that of those firms certified in any of the four core areas, only 8.5 percent of these firms were certified in the core area of producing renewable energy. Certifications to prevent and reduce environmental pollution, at 34.2 percent, represented the largest certified core area.

Although the data showed that certification levels varied by industry sector, the results of the analysis did not meet publication standards to present the estimated percent of employers with certification.

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<sup>9</sup>“2013 Employee Benefits Survey Report,” Labor Market and Economic Analysis, Employment Security Department, March 2014.

**Figure 2-15.** Employers with green job certifications, licenses and related credentials in any of the four green core areas Washington state, 2013

Source: Employment Security Department/LMPA

Core area	Percent of employers with certification
Increasing energy efficiency	25.7%
Producing renewable energy	8.5%
Preventing and reducing environmental pollution	34.2%
Providing mitigation or cleanup of environmental pollution	19.6%

*Certifications were highest in the core area of preventing and reducing environmental pollution.*

### Regional distribution of green jobs

Estimates of the regional distribution of green jobs are presented in *Figure 2-16*. The Seattle-King County workforce development area (WDA) is the largest labor market area among the workforce development areas and accounted for the largest number of green jobs (20,133, 35.5%). The combined Snohomish County, Seattle-King County and Pierce County WDAs accounted for 51.4 percent of all green jobs. See *Appendix 7* for a map of Washington’s workforce development areas.

The estimates of the regional distribution of green jobs do not include green jobs of employers who reported for their entire group of establishments in the state. These employers accounted for 3,664 green jobs, 6.5 percent of the statewide total. *Figure 2-16* groups them separately.

**Figure 2-16.** Regional distribution of green jobs

Washington state, 2013

Source: Employment Security Department/LMPA

Workforce development area	Total green employment	Percent of green employment
Seattle-King County	20,133	35.5%
Northwest Washington	5,256	9.3%
Snohomish County	4,736	8.3%
Pierce County	4,294	7.6%
Pacific Mountain	4,161	7.3%
Southwest Washington	3,016	5.3%
Spokane	2,972	5.2%
Olympic Consortium	2,871	5.1%
Benton-Franklin	2,084	3.7%
North Central Washington	1,502	2.6%
Eastern Washington	1,039	1.8%
South Central Washington	1,033	1.8%
WDA could not be determined	3,664	6.5%
<b>Total</b>	<b>56,762</b>	<b>100.0%</b>

*The large labor market of the Seattle-King County WDA accounted for 35.5 percent of all green jobs.*

## **The forest products industry**

State law (RCW 43.330.310) requires the Employment Security Department to conduct labor market research to determine key growth factors and employment projections in the forest products industry and define the education and skill standards required for current and emerging green jobs in the forest products industry.

The forest products industry accounted for an estimated 570 of the state's green jobs, paying an average hourly wage of \$20.07. Two sub-industries, logging and sawmills, evenly split 85 percent of these jobs. Data limitations prevented detailed analysis of growth, employment projections and educational and skill requirements of green jobs in the forest products industry.

# Appendices

## Appendix 1. Study design

The purpose of the Washington state 2013 green jobs study is to identify jobs that produced goods or provided services supporting any of the following four green core areas: increasing energy efficiency; producing renewable energy; preventing and reducing environmental pollution; and providing mitigation or cleanup of environmental pollution. The study established baseline measures that provided statistically reliable estimates of the number of green jobs in Washington state based on a survey of employers.

This study measured only those jobs directly related to the core areas as identified and self-reported by employers. The study did not include jobs in secondary or indirect jobs, such as secretaries working in green job establishments. By using the conservative approach of including only direct green jobs, the total effect of green industries and green jobs in the economy was understated.

The 2013 survey was conducted from June 1, 2013, through August 31, 2013. The questionnaire used for the 2013 survey was revised from the questionnaire used in 2011, but otherwise the sampling, survey and estimating processes remained the same from 2011 to 2013.<sup>10</sup>

### Sample Design

The survey is a scientific stratified sample drawn by using the method of probability of selection proportional to size (PPS) without replacement. The official source for this sample is the Enhanced Quarterly Unemployment Insurance (EQUI) file for third-quarter 2012. The EQUI file contains all employment covered by the unemployment insurance system for Washington state. Private and public sector employers (except private households) with positive employment in third quarter 2012 were included. Only master (primary) accounts were used and consequently individual locations were removed (e.g., the various stores – establishments – of McDonald's or Starbucks).

The universe includes 142,080 employers covered by unemployment insurance, of which 1,915 employers are public-sector employers. The total sample of 21,000 employers was stratified into two strata: presumed green and all others. Presumed green employers are those included in the industries identified in the 2009 green jobs study.<sup>11</sup>

The distribution of sample sizes presented in *Figure A1-1* were defined based on the assumption of a certainty proportion of three, for presumed green, to four, for all others. Thus, the assumption yielded a sample size of 8,350 units (firms) for all others – about 10 percent of the population size of all other firms and 12,650 units for presumed green firms – about 24 percent of the population size of firms presumed to be green.

*Figure A1-1* also shows the stratum response rates. The response rates were calculated using valid responses. Valid responses were those that showed no contradiction among item responses and were used to calculate at least one estimation.

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<sup>10</sup>“2011 Green-Economy Jobs Report,” Labor Market and Economic Analysis, Employment Security Department, June 2012.

<sup>11</sup>“2009 Washington State Green Economy Jobs,” Labor Market and Economic Analysis, Employment Security Department, March 2010.

**Figure A1-1. Employer sample size and response rates**  
 Washington state, 2013  
 Source: Employment Security Department/LMPA

Stratum	Population of firms in the universe	Firms included in the sample	Valid responses	Response rate
Presumed green industries	55,078	12,650	7,521	59.5%
All other industries	87,002	8,350	5,016	60.1%
<b>Total</b>	<b>142,080</b>	<b>21,000</b>	<b>12,537</b>	<b>59.7%</b>

The total employment referenced in this report is the employment of the sample weighted to reflect the total population from which it was drawn. The estimated shares in total employment were based on weights adjusted by strata. Consequently, except for strata, multiplying these weights by total covered employment would not produce the universe for the domains used in the tables (for industries and areas). See *Appendix 2* for more information.

**Publishing standards**

For an estimate to be publishable, it had to pass three criteria:

- The number of respondents in any given cell had to be at least four.
- The coefficient of variation had to be less than 50 percent.
- The lower limit of the 95 percent confidence interval had to be greater than zero.

## Appendix 2. Technical notes

### Sample selection

SAS software was used for sample selection and estimations.

The sample was stratified by two strata: presumed green and all others. The size of each primary sampling unit (PSU) was defined by the average total covered employment in third-quarter 2012. Once firm employment size was determined, for each stratum the default selection method was used – the probability of selection proportional to size (PPS) without replacement. This method is more complex than selection with replacement, but provides the ability to produce estimations that are more accurate. Under the PPS method of sample selection without replacement, the probability of selection for each unit is equal to:

$$\text{(Unit size) x (number of units in sample) / total sample size.}$$

A “certainty” option was applied by an iteration, which provided a smooth transition of probabilities from sample units with a certainty of selection to the selection of those firms with the next largest firm size.

The certainties were defined as the result of statistical iteration. As a result, presumed green firms that employed 40 or more workers were selected with certainty and all other firms with an employment size of 160 or more workers were selected with certainty.

To avoid extreme weights for small units a MINSIZE option was applied, which interpreted each sampling unit of size less than MINSIZE as equal the MINSIZE value to establish the probability of selection. MINSIZE for presumed green jobs was defined as 5, which limited the maximum initial weight to about 8. For all others, the MINSIZE was defined as 7, which limited the maximum initial weight to about 23.

### Weighting adjustments

To account for missing values due to non-responses and invalid responses, each stratum was assumed to have the same distribution as the respondents in the primary sample unit (PSU) with valid responses. Primary weights were adjusted for missing values based on this assumption and the final weights used for the population estimates were then calculated.

### Estimations

All estimates of variance (except for median wage rates) were produced using the DOMAIN statement SURVEYMEANS procedure (PROCSURVEYMEANS) in SAS described as follows:

“The DOMAIN statement requests analysis for domains (subpopulations) in addition to analysis for the entire study population. The DOMAIN statement names the variables that identify domains, which are called domain variables.

It is common practice to compute statistics for domains. The formation of these domains might be unrelated to the sample design. Therefore, the sample sizes for the domains are random variables. Use a DOMAIN statement to incorporate this variability into the variance estimation.”<sup>12</sup>

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<sup>12</sup>SAS/STAT 9.22 *User's Guide*, SAS Institute Inc., Cary, 2010.

The estimated shares in total employment were based on weights adjusted by strata. Except for the strata, multiplying these weights by total covered employment would not produce the same universe for the domains used in the figures (e.g., industries and workforce development areas).

Consequently, for each industry sector and workforce development area (WDA), multiplying the initial universe (Enhanced Quarterly Unemployment Insurance) by the estimated percent of green jobs in total covered employment cannot produce the number of estimated green jobs.

**Figure A2-1. Green jobs shares by stratum**  
 Washington state, 2013  
 Source: Employment Security Department/LMPA

Stratum	Total green employment	Estimated percent of covered employment
Presumed green industries	35,866	3.2%
All other industries	20,896	1.2%
<b>Total</b>	<b>56,762</b>	<b>2.0%</b>

# WASHINGTON STATE 2013 GREEN JOBS SURVEY 1

Washington State  
Employment Security Department  
Labor Market and Economic Analysis



## ABOUT THE SURVEY

Washington has long been a leader in environmental stewardship, climate protection, the development of renewable energy and energy efficiency. Washington state has established goals to grow business sectors and jobs that support environmental protection and clean energy.

The Employment Security Department is conducting this survey to determine the number of jobs that directly support environmental protection and clean energy goals. We are surveying firms about production of any goods or services that support any of the following four core areas:

1. Increasing energy efficiency
2. Producing renewable energy
3. Preventing and reducing environmental pollution
4. Providing mitigation or cleanup of environmental pollution

Please direct this survey to your Operations Manager or Human Resources Department. Include information about all your locations in Washington state. All information

collected is confidential and will not be provided to any other entity; it is used for statistical research purposes only. Survey results are presented in aggregate form so that no individual response can be identified.

If you or any of your staff have worked in any of these four core areas as their primary job function within the **past three months**, fill out both sections below and continue to page two. If not, please fill out both sections below and return using the following options.

## OPTIONS FOR RESPONDING TO THE SURVEY

- Enclosed postage-paid envelope
- Fax both sides to 866-406-2449
- Contact us at 888-346-3807

In order to use your information, please respond within 15 days. Your prompt response is appreciated and reduces follow-up costs.

## Please report for all Washington state business locations

How many employees do you currently have in Washington state? \_\_\_\_\_

Number of employees who are full time: \_\_\_\_\_

Number of employees who are part time: \_\_\_\_\_

Do you provide goods or services in any of the four core areas? Yes  No

If 'Yes,' please complete page one and two and return survey.

If 'No,' complete page one and return survey.

## Contact person

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Telephone: \_\_\_\_\_

Date: \_\_\_\_\_

Thank you for your participation.

*The Employment Security Department is an equal-opportunity employer and provider of programs and services. Auxiliary aids and services are available upon request to people with disabilities. Washington Relay Service: 800-833-6384*

# WASHINGTON STATE 2013 GREEN JOBS SURVEY 2

Please enter information for the past three months' business activities only.

## SECTION 1: Green occupation(s)/job title(s)

Please identify the green occupation(s)/ job title(s) among your employees over the past three months, excluding consultants, outside contractors, vendors and others not considered employees.	How many workers did you employ in this green job title? # _____	What was the average <b>hourly wage rate</b> for this green job title, before taxes and deductions? \$ _____ per hour	What were your <b>educational requirements</b> for this green job title? (Please select only the most important response.) 1. Apprenticeship only 2. Certificate, license, etc. only 3. High school only 4. AA or AAS degree 5. BA or BS degree 6. Post-graduate or professional degree	Did you <b>require experience</b> in this green job title? 1. None 2. 1 to 2 years 3. 3 to 5 years 4. More than 5 years	Overall, <b>how different were the skills of employees</b> in this green job title compared to other employees with the same job titles but who were not working in one of the four green "core areas"? (Please select only one response.) 1. Skills are identical 2. Skills are mostly the same 3. Skills are mostly different 4. Skills are entirely different	How many <b>employees</b> are you expecting to have employed in this green job title <b>two years from today</b> ? # _____
<b>Job title: Example</b> <i>Civil Engineer</i>  What does the worker make or do? <i>Green Construction - Pollution Control Systems</i>	2	\$42.11	6	3	2	3
<b>Job title:</b>  What does the worker make or do?						
<b>Job title:</b>  What does the worker make or do?						
<b>Job title:</b>  What does the worker make or do?						
<b>Job title:</b>  What does the worker make or do?						

## SECTION 2: Benefits

Did your organization offer any of the following benefits to your employees?	Medical insurance	Retirement plans – defined benefit and/or defined contribution	Paid leave – sick, vacation, holiday or other undesignated leave
	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

## SECTION 3: Industry certification

Does your organization have any special industry certifications that relate to any of the following four core areas?	Increasing energy efficiency	Producing renewable energy	Preventing and reducing environmental pollution	Providing mitigation or cleanup of environmental pollution
	Yes <input type="checkbox"/> No <input type="checkbox"/>			

If more space is needed, please contact us for another copy or make a photocopy of this page.

Washington State Employment Security Department, Labor Market and Economic Analysis; PO Box 9046 Olympia, WA 98507-9046  
 Phone: 888-346-3807; Fax: 866-406-2449; Email: wagreen@esd.wa.gov

## Appendix 4. Detailed occupational estimates

Figure A4-1 lists the number of green jobs by occupation. This list does not offer a complete set of the occupations reported by employers as green jobs. For reasons of sample size or uncertainty, estimations may be judged too imprecise to be used in extrapolations to the entire state economy. Throughout the report, estimates were suppressed if they are based on fewer than four survey respondents, contain the value of zero within a 95% confidence interval, or have a coefficient of variation greater than 0.5.

**Figure A4-1.** Detailed Standard Occupational Classification codes, job counts and average hourly wage rates of green occupations

Washington state, 2013

Source: Employment Security Department/LMPA; U.S. Bureau of Labor Statistics, Occupational Employment Statistics

SOC	Occupation	Total green employment	Average hourly wage rate
11-3011	Administrative services managers	108	\$39.81
11-3031	Financial managers	25	\$48.37
11-3051	Industrial production managers	90	\$38.99
11-9021	Construction managers	754	\$36.75
11-9041	Architectural and engineering managers	176	\$50.93
11-9121	Natural sciences managers	91	\$52.91
11-9199	Managers, all other	196	\$39.38
11-1011	Chief executives	316	\$61.49
11-1021	General and operations managers	97	\$54.28
13-1041	Compliance officers	106	\$29.02
13-1051	Cost estimators	196	\$37.63
13-1199	Business operations specialists, all other	945	\$30.48
15-1133	Software developers, systems software	315	\$55.81
17-1011	Architects, except landscape and naval	1,222	\$37.59
17-1012	Landscape architects	85	\$33.48
17-2051	Civil engineers	1,418	\$45.77
17-2071	Electrical engineers	274	\$41.49
17-2081	Environmental engineers	387	\$42.01
17-2141	Mechanical engineers	335	\$44.19
17-2199	Engineers, all other	600	\$39.76
17-3029	Engineering technicians, except drafters, all other	151	\$31.96
19-2041	Environmental scientists and specialists, including health	1,049	\$36.47
19-2042	Geoscientists, except hydrologists and geographers	219	\$33.72
19-3051	Urban and regional planners	134	\$39.81
19-4091	Environmental science and protection technicians, including health	372	\$22.02
23-1011	Lawyers	68	*
25-3099	Teachers and instructors, all other	34	\$17.75
27-1021	Commercial and industrial designers	493	\$29.60
29-9011	Occupational health and safety specialists	13	\$27.30

SOC	Occupation	Total green employment	Average hourly wage rate
37-1012	First-line sprvrs. of landscaping, lawn svc., and groundskeeping workers	141	\$27.57
37-2011	Janitors and cleaners, except maids and housekeeping cleaners	2,442	\$15.73
37-2012	Maids and housekeeping cleaners	393	\$12.61
37-3011	Landscaping and groundskeeping workers	1,194	\$13.75
41-2011	Cashiers	688	\$9.46
41-2031	Retail salespersons	1,353	\$11.69
41-3099	Sales representatives, services, all other	157	\$30.76
41-4012	Sales reps., wholesale and manuf., except technical and scientific	783	\$29.06
43-1011	First-line supervisors of office and administrative support workers	199	\$18.28
43-6014	Secretaries and admin. assistants, except legal, medical, and executive	265	\$25.69
45-2092	Farmworkers and laborers, crop, nursery, and greenhouse	736	\$11.02
45-2093	Farmworkers, farm, ranch, and aquacultural animals	125	\$11.56
47-1011	First-line supervisors of construction trades and extraction workers	575	\$36.01
47-2031	Carpenters	962	\$22.18
47-2061	Construction laborers	2,199	\$16.82
47-2073	Operating engineers and other construction equipment operators	714	\$27.18
47-2111	Electricians	1,956	\$29.64
47-2121	Glaziers	1,049	\$25.38
47-2131	Insulation workers, floor, ceiling, and wall	625	\$15.33
47-2152	Plumbers, pipefitters, and steamfitters	801	\$28.43
47-2181	Roofers	558	\$16.58
47-4011	Construction and building inspectors	66	\$27.12
47-4041	Hazardous materials removal workers	879	\$22.38
47-4099	Construction and related workers, all other	154	\$27.12
49-3023	Automotive service technicians and mechanics	2,157	\$20.27
49-3031	Bus and truck mechanics and diesel engine specialists	188	\$23.73
49-9021	Heating, air conditioning and refrigeration mechanics and installers	3,148	\$24.73
49-9041	Industrial machinery mechanics	173	\$20.54
49-9043	Maintenance workers, machinery	116	\$23.27
49-9071	Maintenance and repair workers, general	480	\$16.43
51-2022	Electrical and electronic equipment assemblers	353	\$15.01
51-8031	Water and wastewater treatment plant and system operators	247	\$26.25
51-8099	Plant and system operators, all other	225	\$18.26
51-9199	Production workers, all other	822	\$17.02
53-1021	First-line supervisors of helpers, laborers, and material movers, hand	121	\$19.98
53-3021	Bus drivers, transit and intercity	1,638	\$22.31
53-3032	Heavy and tractor-trailer truck drivers	2,597	\$16.13
53-7061	Cleaners of vehicles and equipment	571	\$12.27
53-7062	Laborers and freight, stock, and material movers, hand	474	\$16.31
53-7081	Refuse and recyclable material collectors	764	\$15.41

\*Data could not be published to protect confidentiality.

## Appendix 5. Existing research on the green economy

There is a substantial amount of research on the green economy. Studies that estimated green economy employment are the research most relevant to this report. Two nonprofit organizations, two federal agencies, 36 states and the District of Columbia have conducted or commissioned such research. The definitions of green jobs in these studies were generally similar to Washington state's definition, though some studies included jobs in environmental compliance, education and training and public awareness – jobs not measured in the Washington state studies.

Many of the state-level studies were funded by Labor Market Information Improvement Grants under the American Recovery and Reinvestment Act of 2009 (ARRA). Few have been updated or repeated. The U.S. Bureau of Labor Statistics began an annual study in 2011 to measure green jobs nationwide, but the study was discontinued after two years.

The studies differed by method and scope. Some focused on the private sector exclusively, while others examined both the private and public sectors. Some gathered data from employer surveys, while others employed industry statistics. A handful focused exclusively on jobs in the energy industry.

Despite these differences in method, the key findings of the studies were remarkably similar. Excluding extreme outliers, the studies estimated that green jobs account for 1.3 percent to 5.2 percent of total state or other area employment, with an average estimate of 2.9 percent.<sup>13</sup> Washington state's estimate for 2011 was toward the upper end of this range; the 2013 estimate of 2.0 percent was nearer the average found in other studies. *Figures A5-1, A5-2 and A5-3* summarize the existing studies as of their most recent update. Full source information for these studies is provided in *Appendix 6*.

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<sup>13</sup>The standard deviation is 1.1. Excluded from this calculation are Pew Charitable Trusts, (nationwide, 0.5 percent), Florida (0.6 percent) and Rhode Island (two estimates: 0.3 percent and 10.7 percent).

**Figure A5-1. Selected studies of the green economy: state reports based on surveys of employers**  
 United States, 2009 through 2013  
 Source: Employment Security Department/LMPA

State	Publication year	Number of employers	Sectors included	Estimated green employment	Green employment (percent of employment)
Arizona	2011	5,234	Private	30,716	1.3%
California	2010	15,185	Private and public	432,840	3.4%
Colorado	2011	7,841	N/A	61,239	2.8%
Delaware	2011	711	Private	16,250	4.2%
Florida	2010	N/A	N/A	42,422	0.6%
Hawai'i	2010	4,008	Private	11,145	2.4%
Idaho	2010	3,904	Private	17,059	3.0%
Illinois*	N/A	20,342	Private and public	115,208	2.1%
Indiana	2011	N/A	Private and public	46,879	1.7%
Iowa	N/A	6,868	Private and public	N/A	4.6%
Kansas	N/A	3,088	Private	46,427	3.4%
Louisiana	2011	5,177	Private and public	30,205	1.6%
Maryland, DC, Virginia	2011	9,892	Private and public	236,000	3.0%
Massachusetts	2013	1,090	Private	79,994	1.9%
Michigan	2009	6,434	Private	109,067	3.4%
Mississippi	N/A	3,181	Private and public	17,360	1.6%
Missouri	N/A	2,537	Private and public	131,103	N/A
Montana	N/A	3997	Private and public	N/A	4.5%
Nebraska	N/A	5,808	Private and public	30,725	3.3%
New York	N/A	8,000	Private	180,000	N/A
Ohio	N/A	7,623	Private	56,785	1.3%
Oregon	2012	3,577	Public and private	43,148	2.7%
Pennsylvania*	2010	14,619	Public and private	183,029	3.4%
South Carolina	2011	498	Public and private	86,700	4.3%
South Dakota	N/A	3,879	Public and private	N/A	3.8%
Tennessee	2011	N/A	Public and private	43,804	1.5%
Utah	N/A	5,385	Public and private	N/A	1.7%
Washington	2012	14,298	Public and private	120,305	4.3%
Wyoming	N/A	407	Public and private	N/A	5.2%

\*Note that Washington state's LMPA conducted the survey research for these two states under contract.

**Figure A5-2.** Selected studies of the green economy: state reports based on industry statistics  
 United States, 2009 through 2012  
 Source: Employment Security Department/LMPA

State	Publication year	Number of employers	Sectors included	Estimated green employment	Green employment (percent of employment)
Connecticut	2012	N/A	Private and public	39,207	N/A
Maine	2010	N/A	Private and public	N/A	N/A
New Hampshire	2009	N/A	Private and public	N/A	N/A
New Jersey	2009	N/A	Private	191,888	N/A
Rhode Island <sup>1</sup>	2010	N/A	Private and public	1,553	0.3%
Rhode Island <sup>2</sup>	2010	N/A	Private and public	64,420	10.7%

<sup>1</sup>Using the Pew Charitable Trusts' green jobs definition. See "The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America," The Pew Charitable Trusts, 2009.

<sup>2</sup>Using the O\*NET green jobs definition. See "Greening of the World of Work: Implications for O\*NET-SOC and New and Emerging Occupations," Erich C. Dierdorff, Jennifer J. Norton, Donald W. Drewes, Christina M. Kroustalis, David Rivkin and Phil Lewis, National Center for O\*NET Development, Raleigh, North Carolina, 2009.

**Figure A5-3.** Selected studies of the green economy: nationwide reports  
 United States, 2009 through 2013  
 Source: Employment Security Department/LMPA

State	Publication year	Number of employers	Sectors included	Estimated green employment	Green employment (percent of employment)
Brookings Institution	N/A	N/A	Private	N/A	N/A
U.S. Bureau of Labor Statistics	2013	120,000	Private and public	3,401,279	2.6%
Pew Charitable Trusts	2009	N/A	Private	770,000	0.5%
U.S. Commerce Department	2010	N/A	Private	1,800,000	1.5%

## Appendix 6. Bibliography of green job reports

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**California:** “California's Green Economy: Summary of Survey Results,” Labor Market Information Division, California Employment Development Department, 2010.

**Colorado:** “Interim Report on Green Jobs in the Colorado Economy,” Colorado Department of Labor and Employment, 2011.

**Delaware:** “Energy, the Environment and Delaware Jobs: Defining and Describing Green Businesses,” Daniel T. Brown and Edward C. Ratledge, 2011.

**Florida:** “Green Jobs Survey Report: State of Florida,” Florida Agency for Workforce Innovation, 2010.

**Hawai'i:** “Hawai'i's Green Workforce: A Baseline Assessment,” Research & Statistics Office, Hawai'i Department of Labor and Industrial Relations, 2010.

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**Kansas:** “2009 Kansas Green Jobs Report,” Kansas Department of Labor, No date.

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**Maryland, DC, Virginia:** “Green Data for a Growing Green Economy: Green Jobs in the District of Columbia, Maryland and Virginia,” Mid-Atlantic Regional Collaborative, 2011.

**Massachusetts:** “Massachusetts Clean Energy Industry Report 2013,” BW Research Partnership, 2013.

**Michigan:** “Michigan Green Jobs Report 2009: Occupations & Employment in the New Green Economy,” Michigan Department of Energy, Labor & Economic Growth, Bureau of Labor Market Information & Strategic Initiatives, 2009.

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**Missouri:** “The Missouri Green Jobs Report, Missouri Economic Research & Information Center,” Missouri Department of Economic Development, No date.

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**Ohio:** “Green Jobs in Ohio: Findings from the Ohio Green Jobs Survey,” Ohio Department of Job and Family Services, No date.

**Oregon:** “The Greening of Oregon's Workforce: Jobs, Wages and Training,” WorkSource Oregon Employment Department, 2012.

**Pennsylvania:** “The Pennsylvania Green Jobs Survey Report,” Pennsylvania Department of Labor & Industry, 2010.

**South Carolina:** “South Carolina's Green Economy: Businesses, Jobs and their Impact,” John D. Mittelstaedt, Ellen W. Saltzman and Robert T. Carey, prepared for the South Carolina Department of Commerce, 2011.

**Tennessee:** “Tennessee's Green Jobs Report,” Dawn Kilpatrick, Matthew Milam and Martha Wettemann, Labor Market Information Section, Employment Security Division, Tennessee Department of Labor and Workforce Development, 2011.

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**Maine:** “Counting Green Jobs in Maine,” Center for Workforce Research and Information, Maine Department of Labor, 2010.

**New Hampshire:** “Green Economy: The Current Status of Green Jobs in New Hampshire,” New Hampshire Employment Security, 2009.

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**Rhode Island:** “Understanding the Green Economy in Rhode Island,” Center for Labor Market Studies, Northeastern University, 2010.

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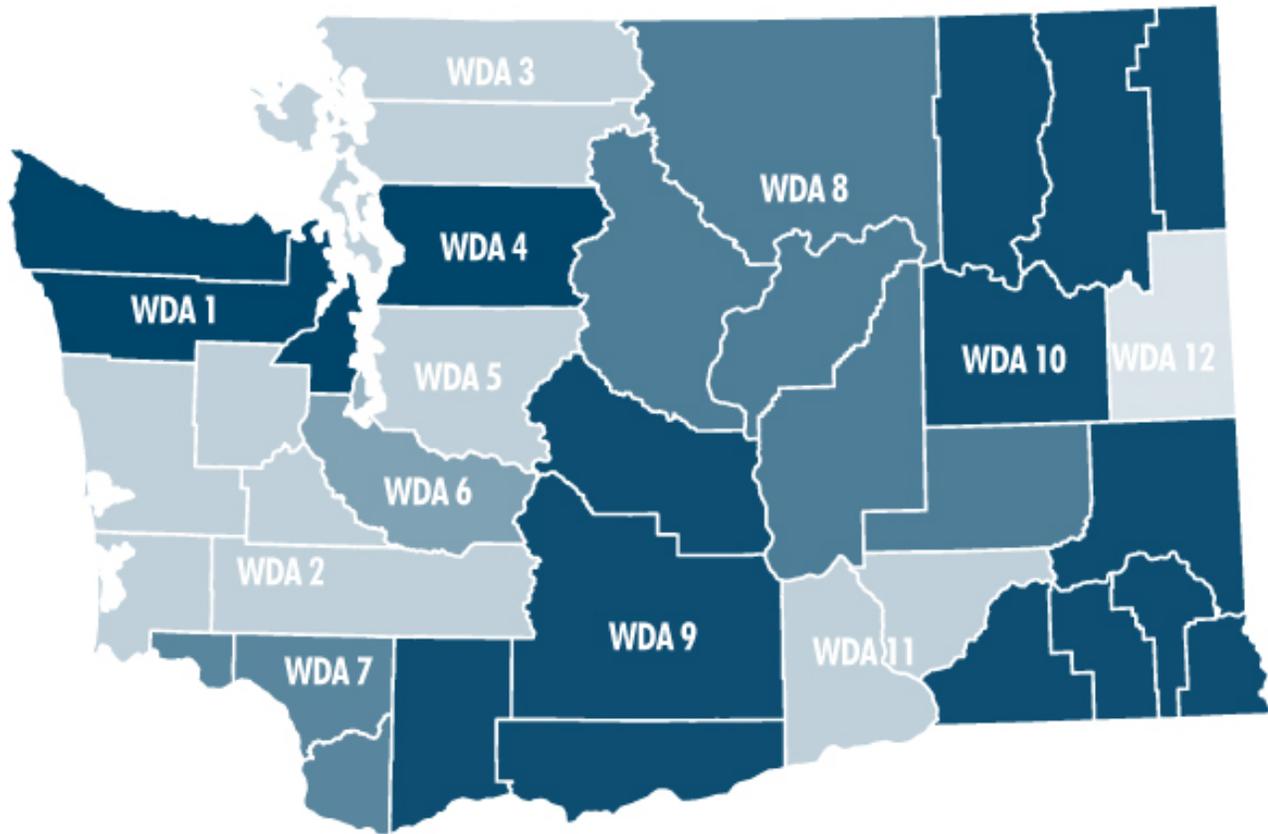
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**U.S. Commerce Department:** “Measuring the Green Economy,” Economics and Statistics Administration, United States Department of Commerce, No date.

## Appendix 7. Map of Washington's workforce development areas



WDA 1 – Olympic Consortium: Clallam, Jefferson and Kitsap counties

WDA 2 – Pacific Mountain: Grays Harbor, Lewis, Mason, Pacific and Thurston counties

WDA 3 – Northwest Washington: Island, San Juan, Skagit and Whatcom counties

WDA 4 – Snohomish County

WDA 5 – Seattle-King County

WDA 6 – Pierce County

WDA 7 – Southwest Washington: Clark, Cowlitz and Wahkiakum counties

WDA 8 – North Central Washington/Columbia Basis: Adams, Chelan, Douglas, Grant and Okanogan counties

WDA 9 – South Central: Klickitat, Kittitas, Skamania and Yakima counties

WDA 10 – Eastern Washington: Asotin, Columbia, Ferry, Garfield, Lincoln, Pend Orielle, Stevens, Walla Walla and Whitman counties

WDA 11 – Benton-Franklin

WDA 12 – Spokane County