The Green Economy: An Overview of Green Industries and Green Occupations

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"Building a robust clean energy sector is how we will create the jobs of the future, jobs that pay well and can't be outsourced."

President Barack Obama, January 2010

"Green industries are both an important part of our immediate economic recovery and a permanent component of a successful 21st century economy."

Secretary of Labor Hilda Solis, September 2011

Global warning and climate change are the clarion calls for reducing carbon emissions and the use of fossil fuels. Heeding that call requires the development of new technologies and renewable energy sources, as well as the conservation of natural resources. One of the keys to fostering a greener economy is the adeptness of the U.S. workforce. New industries, production processes, and technologies imply challenges—as well as opportunities—for American workers. U.S. Department of Labor Secretary Hilda Solis has made it a priority to ensure that the U.S. workforce is ready to partake in the green economy and prosper.

This paper utilizes data on green jobs from the Bureau of Labor Statistics (BLS) to gain a more robust understanding of the green economy from a labor market perspective. Those data, coupled with other BLS labor market information, reveal that green jobs are scattered throughout the economy, accessible to workers with all levels of education, expected to grow rapidly in the future, and include jobs that pay relatively well and are relatively safe.

BLS's Green Jobs Initiative

Background on Green Jobs Surveys

In response to the growing emphasis on "green jobs," in 2010 Congress directed BLS to initiate an effort to develop employment data for industry sectors that produce green goods and services. Accordingly, BLS has developed green job definitions and is responsible for tracking green job trends over time. Their intent is to develop information on the number of jobs related to the production of green goods and services; the industrial, occupational, and geographic distribution of the jobs; and the wages of workers in these jobs.

BLS has used two classification systems to define green job industries and occupations: the North American Industry Classification System (NAICS) and the Standard Occupational Classification (SOC). These classification systems are the standards by which BLS collects data and categorizes green jobs.

Because the pre-existing NAICS and SOC do not specifically identify a distinct group of green industries or occupations, BLS established the annual Green Goods and Services (GGS) survey to identify establishments that produce green goods and services, determine the associated jobs

within each industry, and pinpoint their geographical concentrations.¹ The first GGS survey, conducted under the BLS Quarterly Census of Employment and Wages (QCEW) program, was released in March 2012 and provided annual average data for 2010.²

In order to estimate green job employment and wages by detailed occupations, BLS linked data from the GGS survey to the employment and wage information from the Occupational Employment Statistics (OES) establishment survey. The first Occupational Employment and Wages in Green Goods and Services (GGS-OCC) report presented employment and wage information for November 2011 and highlighted those establishments that received all of their revenue from green goods and services.³ This information was released in September 2012.

Definition of Green Jobs

After reviewing a wide range of studies, BLS determined that green jobs are jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources.

BLS identified 333 industries—or 28 percent of nearly 1,200 detailed NAICS industries—that potentially produce green goods and services, covering all private establishments in these industries, as well as federal, state, and local government entities. The establishments surveyed fall into one or more of the following five groups that together comprise what BLS refers to as "production of green goods and services":

- Production of energy from renewable sources, including wind, hydropower, and solar.
- Products and services that improve energy efficiency, including energy efficient appliances, buildings, and vehicles, as well as Smart Grid technologies.
- Products and services that reduce pollution and greenhouse gas emissions, remove pollutants or hazardous waste, and recycle waste materials or wastewater.
- Products and services that conserve natural resources, including organic agriculture and sustainable forestry.
- Products and services that enforce environmental regulations, promote public awareness, and provide green technology education and training.

BLS counted as green jobs only those associated with the production of green goods and services within these establishments, excluding the jobs at these establishments that are not green. The green employment was parsed out by using the percent of an establishment's revenue that was generated from the sale of green goods or services. Therefore, no single industry is labeled "green"; rather, "green jobs" are estimated to exist in different proportions in different industry sectors.

Industry Concentration of Green Jobs

¹ The Green Goods and Services survey is an establishment survey, employment information reflects the number of jobs within green industries.

² U.S. Department of Labor, Bureau of Labor Statistics, *Employment in Green Goods and Services-2010*, USDL-12-0495, March 22, 2012.

³ U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Employment and Wages in Green Goods and Services – November 2011*, USDL-12-1941, September 28, 2012.

Given that framework, BLS reported that 3.1 million jobs in the United States were associated with the production of green goods and services, or 2.4 percent of total employment. The private sector accounted for 2.3 million or 72.5 percent of green jobs, while the public sector had 860,300 green jobs.

Most green jobs, however, were not only in industries that are typically associated with the green economy – such as organic farming and solar power generation – but rather spread throughout every sector of the traditional economy. (See Table 1) Although the top-20 detailed industries with the most green jobs accounted for two-thirds of all green jobs, that list represented nine different major sectors, ranging from transportation and construction to waste services and professional, scientific, and technical consulting services.

			GGS Employment		
NAICS Code	Industry	Level	Percent of Industry's Employment	Percent of Total Green Jobs Employment	
	Total, all industries	3,129,112	2.4	100.0	
	Total private	2,268,824	2,1	72.5	
11,21	Natural resources and mining	65,050	3.6	2.1	
22	Utilities	65,664	11.9	2.1	
23	Construction	372,077	6.8	11.9	
31-33	Manufacturing	461,847	4.0	14.8	
42,44-45	Trade	202,370	1.0	6.5	
48-49	Transportation and warehousing	245,057	6.2	7.8	
51	Information	37,163	1.4	1.2	
52,53	Financial activities	190	0.0	0.0	
54	Professional, scientific, and technical services	349,024	4.7	11.2	
55	Management of companies and enterprises	34,711	1,9	1.3	
56	Administrative and waste services	319,915	4.3	10.2	
61,62	Education and health services	37,069	0,2	1.7	
71,72	Leisure and hospitality	22,510	0,2	0.7	
81	Other services, except public administration	56,174	1,3	1.8	
	Total public	860,289	4.0	27.5	
	Federal government	156,707	5,3	5.0	
	State government	227,103	4.9	7.3	
	Local government	476,479	3.4	15.2	

Of the 860,300 public sector green jobs in 2010, local government had the largest portion of green employment with 476,500 jobs. Almost half of green employment at the local government level was found in the transportation and warehousing sector, including operators of mass transit systems. State governments had 227,100 green jobs, mostly in the public administration sector enforcing environmental regulations and administrating environmental programs. Reflecting the

same prevalence of public administration jobs, green employment in the federal government amounted to 156,700 in 2010.

Manufacturing, the industry sector with the greatest number of private sector green jobs, accounted for 461,847 green jobs in 2010 – representing 4 percent of all manufacturing jobs and 15 percent of all green jobs. Although jobs are spread throughout this large sector, examples of prominent green manufactured goods include iron and steel production from recycled inputs; eco-friendly paper products; airconditioning and refrigeration equipment that meet specific efficiency standards; energy-efficient household appliances, windows, and doors; turbines for wind energy production; hybrid cars and parts; and pollution mitigation equipment.

Following manufacturing, construction had 372,077 green jobs, comprising almost 7 percent of construction employment. Green job-related activities include the construction of plants that produce energy from renewable sources, as well as weatherization and retrofitting projects that reduce household energy consumption.

The professional, scientific, and technical services sector accounted for 349,024 green jobs in 2010 or 11 percent of all green jobs. Architectural and engineering services, which design and develop energy efficient buildings and machines, was the largest detailed 4-digit NAICS industry in the green economy with 172,738 green jobs. (See Table 2) Three other industries within that sector are major sources of green jobs: (1) management and technical consulting services, which offer hazards materials inspection services and advice on addressing environmental contamination from pollutants; (2) computer systems design, designing smart-grid technologies; and (3) scientific research and development services, on new or improved products or processes that affect the environment. Together, these four industries were responsible for one out of every seven private sector green jobs.

NAICS Code	Industry Title	GGS Employment	Percent of Industry's Employmen
5413	Architectural and engineering services	172,738	13
4854	School and employee bus transportation	160,896	88
	Building equipment contractors	160,112	9
5621	Waste collection	116,293	83
4533	Used merchandise stores	106,865	85
4239	Miscellaneous durable goods merchant wholesalers	95,505	34
5629	Remediation and other waste management services	91,078	75
5622	Waste treatment and disposal	77,517	81
5416	Management and technical consulting services	71,225	7
5415	Computer systems design and related services	54,741	3
2362	Nonresidential building construction	49,405	7
2211	Electric power generation	44,151	13
3311	Iron and steel mill and ferroalloy manufacturing	43,658	50
5417	Scientific research and development services	41,214	6
2381	Building foundation and exterior contractors	40,917	ϵ
3334	Ventilation, heating, AC, and commercial refrigeration equipment manufacturing	40,835	32
2383	Building finishing contractors	37,744	9
6110	Educational services	37,069	1
5511	Management of companies and enterprises	34,711	1
5617	Services to buildings and dwellings	34,491	2

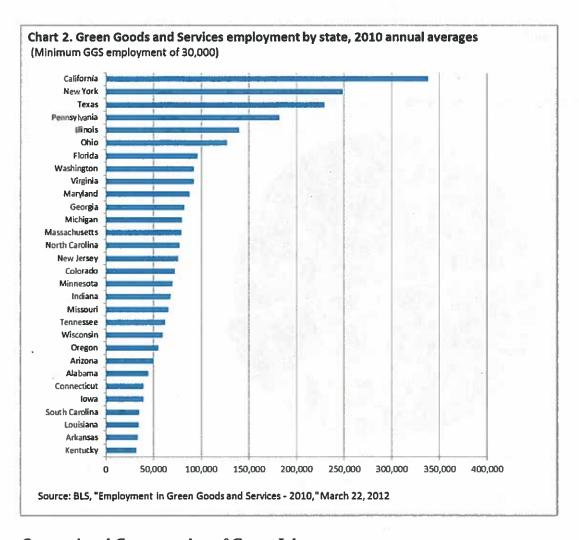
The administrative and waste services sector, which provides waste collection, treatment, and disposal services, was also a major source of green jobs – accounting for 319,900 green jobs or 10 percent of the green economy.

Reflecting the early stage of alternative energy source development, the utilities industry accounted for 65,700 green jobs, or 2 percent of green employment. Among the industries involved in private sector electric power generation, which had 44,151 green jobs, nuclear power had the largest number with 35,800 green jobs, while hydroelectric power generation only had 3,700 green jobs. The third electric power generation industry (labeled "other electric power generation"), which includes electricity generated from biomass, sunlight, wind, and other renewable sources, had 4,700 green jobs. Within this industry, electricity generated from wind had the highest employment with 2,200 jobs, followed by biomass with 1,100 jobs, geothermal with 600 jobs, and solar with 400 jobs.

Geographic Concentration of Green Jobs

While California had the most green jobs – 338,400 in 2010, accounting for 2.3 percent of all jobs in that state – Vermont, with 12,884 green jobs, had the highest percentage of green jobs at 4.4 percent. (See Chart 2)

Six states had more than 100,000 green jobs in 2010. California was followed by New York (248,500), Texas (229,700), Pennsylvania (182,200), Illinois (139,800), and Ohio (126,900).



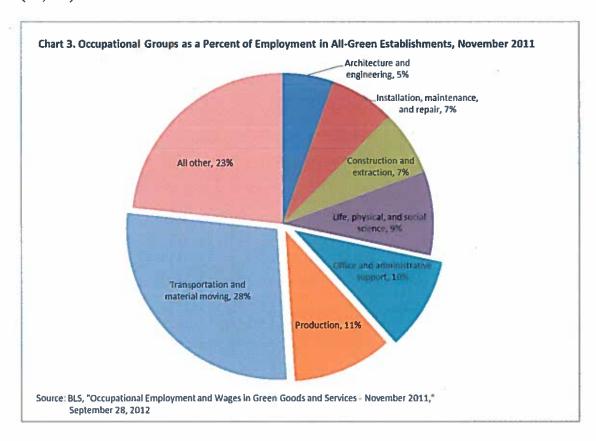
Occupational Concentration of Green Jobs

In November 2011, of the 3.1 million green jobs, 1.9 million were in establishments that receive all of their revenue from the production of green goods or services. Almost half of the employment in these all-green establishments was concentrated in three occupational groups: transportation and material moving; production; and office and administrative support. Within these all-green establishments, the transportation and material moving occupational group accounted for more than a quarter of the employment (539,470 jobs). (See Chart 3) Five of the six largest detailed occupations in all-green establishments were in this group, including school or special client bus drivers (174,450), transit and intercity bus drivers (111,760), and refuse and recyclable materials collectors (56,930). (See Table 3)

The second most significant occupational group-production-accounted for 208,180 jobs. Prominent occupations within this group include team assemblers (29,350); water and wastewater treatment plant and system operators (26,260); first-line supervisors of production and operating workers (17,980); and inspectors, testers, sorters, samplers, and weighers (14,130).

Other large occupations in all-green establishments included forest and conservation technicians (56,620), general operations managers (32,030), secretaries and administrative assistants, except

legal, medical, and executive (30,470), and bus and truck mechanics and diesel engine specialists (29,570).



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SOC code	Оссирайол ййе	GGS-OCC Employment	Total All Occupations Percent Change, 2010-20	Annual GGS-OCC median wage	Typical education needed for entry	Typical on-the-Job training to attain competency	Required work experience in related occupation	Total Fatal Injuries	otal Fatal Fatal Injuries Injury Rate
	ĀII Occupations	1,949,520	14.3	\$40,050		7		4609	3.5
53-3022	Bus Drivers, School or Special Client	174,180	12.0	=	High school diploma or equivalent	Moderate-term on-the- job training	None	8.0	•
53-3021	Bus Drivers, Transit and Intercity	111,760	14.8		High school diploma or equivalent	Moderate-term on-the- job training	None	10.0	m •
53-7081	Refuse and Recyclable Material Collectors	56,930	20.2	\$33,370	Less than high school	Short-term on-the-job training	None	34.0	41.2
19-4093	Forest and Conservation Technicians	56,620	-1.0	\$37,540	Associate's degree	None	None	3.0	•
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	54,890	15.4		Less than high school	Short-term on-the-job training	None	93.0	6.1
53-3032	Heavy and Tractor-Trailer Truck Drivers	39,060	20.6		High school diploma or equivalent	Short-term on-the-job training	1 to 5 years	656.0	24.0
11-1021	General and Operations Managers	32,030	4.6	\$103,730	Associate's degree	None	1 to 5 years	12.0	
	Secretaries and Administrative Assistants,					Short-term on-the-job			
43-6014	Except Legal, Medical, and Executive	30,470	5.8	\$34,370	High school diploma or equivalent	training	None	.4.0	F
40 3034	Bus and Truck Mechanics and Diesel Engine	50.00	-		بالمدين موجود مسمول والماليس بليم بالمالية	Long-term on-the-job	, ,	1	, u
49-3031	Specialists	0/5/27	14.	AS, thu	High school diploma or equivalent	training	None	18.0	ų
51-2092	Team Assemblers	29,350	S, Z,	\$27,840	High school diploma or equivalent	Moderate-term on-the- job training	None	-	
43-9061	Office Clerks, General	29,090	16.6	\$28,760	High school diploma or equivalent	Short-term on-the-job training	None	12.0	= II '
41-2031	Retail Salespersons	27,650	16.6		Less than high school	Short-term on-the-job training	None	22.0	0.8
51-8031	Water and Wastewater Treatment Plant and System Operators	26.260	11.6		High school diploma or equivalent	Long-term on-the-job training	None	9.0	
				-		Moderate-term on-the-			
49-9071	Maintenance and Repair Workers, General	25,700	11.0	\$42,060	High school diploma or equivalent	lob training	None	67.0	16.0
19-2041	Environmental Scientists and Specialists, Including Health	25,540	18.7	\$70,380	Bachelor's degree	None	None	The first of the f	•
13-1199	Business Operations Specialists, All Other	22,720	11.6	010,072	High school diploma or equivalent	Long-term on-the-job training	Less than 1 year		1
37-3011	Landscaping and Groundskeeping Workers	22,560	20.9	\$25,410	Less than high school	Short-term on-the-job training	None	97.0	1
47-4041	Hazardous Materials Removal Workers	21,980	23.1	\$38,590	High school diploma or equivalent	Moderate-term on-the- job training	None		1
41-2011	Cashiers	20,900	7.4	\$19,020	Less than high school	Short-term on-the-job training	None	36.0	1.6
43-3031	Bookkeeping, Accounting, and Auditing Clerks	18,040	13.6	===	536,990 High school diploma or equivalent	Moderate-term on-the- job training	None	Ш	,

Sources: 815, "Occupational Employment and Wages in Green Goods and Services - November 2011," September 28, 2012; "Employment Projections 2010-2020," February 1, 2012; "Occupational Employment and Wages in Green Goods and Services - November 2011," September 2011," September 19, 2012 Note: Dashes indicate no data reported or data that do not meet the publication threshold (15 or more reported latal work injuries in 2011 and 40 million or more work hours).

Education Needed for Entry into Green Occupations

Table 3 lists the 20 largest occupations in all-green establishments, representing almost 40 percent of the jobs. Coupling GSS-OCC data with BLS data on educational requirements reveals that most of these larger green occupations are accessible to workers with relatively low educational attainment. For instance, 17 of the 20 largest green occupations typically need a high school diploma or less for entry into the occupation, moderate-term on-the-job training, and no prior work experience in a related occupation. Environmental scientists and specialists, forest and conservation technicians, and general and operations managers are three exceptions.

As far as the educational requirements for all green occupation, almost half of green occupations require only a high school diploma; a quarter need a bachelor's degree; 12 percent require a non-degree postsecondary award, some college, or an Associate's degree; and only about 5 percent need a master's, doctoral, or professional degree.

In terms of additional training, more than one-third of green occupations require no on-the-job training, while over half entail short- to moderate-term on-the-job training to attain competency in that occupation. Further, 85 percent of green occupations require no prior work experience in a related occupation, while only 11 percent require 1 to 5 years.

Most green jobs that do not require occupation-specific on-the-job training or prior work experience typically need a bachelor's degree. Prominent green jobs that fall within this category include several engineering and scientific occupations such as environmental, civil, and nuclear engineers, as well as conservation, environmental, biological scientists.

Conversely, most green jobs that require a high school diploma need to be augmented with moderate-term on-the-job training – defined as 1 to 12 months of combined on-the-job experience and informal training. Prominent green jobs that fall within this category include bus drivers, team assemblers, locomotive engineers, hazardous materials removal workers, and welders, cutters, solderers, and brazers.

Growth Prospects of Green Jobs by Occupation

In order to assess the growth prospects of green jobs, GGS-OCC data were paired with BLS data on expected employment growth over the next decade.⁴ According to the most recent set of BLS projections, total employment in the United States will grow by 18.9 million jobs over the 2010-2020 period, from 143.1 million to 163.5 million. The expected growth rate of 14.4 percent reverses the 2.2 percent decline that occurred during the 2000-2010 period, in which 3.2 million jobs were lost.

For occupations in general, lower levels of required education usually mean slower rates of growth.⁵ For example, BLS projects that occupations needing a high school diploma will grow

⁴ U.S. Department of Labor, Bureau of Labor Statistics, *Employment Projections - 2010-20*, USDL-12-0160, February 1, 2012.

⁵ U.S. Department of Labor, Bureau of Labor Statistics, *Table 9. Employment and total job openings by education, work experience, and on-the-job training category, 2010 and projected 2020.* http://www.bls.gov/news.release/ecopro.t09.htm

by only 12.2 percent over the 2010-2020 period, while occupations that typically need a master's degree will grow by 21.7 percent. However, this is not the case with green jobs. Many of the largest green job occupations that are accessible to workers with low educational attainment are expected to grow faster than the average for all occupations (+14.3 percent). (See Table 3) Leading the way are relatively low-skilled hazardous materials removal workers (+23.1 percent), landscape and groundskeeping workers (+20.9 percent), heavy and tractor-trailer truck drivers (+20.6 percent), and refuse and recyclable material collectors (+20.2 percent). The demand for cleaner electric generation facilities, the emphasis on recycling, and general population, income, and economic growth will drive these occupations.

Median Wages of Green Occupations

Although the majority of green occupations are accessible to workers with lower educational attainment, most nonetheless pay relatively well. The median annual wage for all green occupations was \$40,050 in 2010, 16.2 percent above the \$34,460 median wage for all occupations in the economy. (See Table 4) Further, most green occupational groups pay a higher wage compared to the median for all jobs within each occupational group. Among production occupations, for example, the median annual wage for green jobs was \$35,230, 14.9 percent greater than for all production occupations. This category is characterized by substantial wage differentials among machinists, semiconductor processors, production worker helpers, and nuclear power reactor operators. Construction and extraction occupations commanded a 4.8 percent premium, with stronger wages seen by green construction laborers, electricians, and construction equipment operators.

The 20 largest detailed green occupations each pays well above the minimum wage, currently at \$15,080 per year, while most pay almost double the poverty threshold of \$23,021 for a family of four. Water and wastewater treatment plant and system operators with an annual median wage of \$42,980 and hazardous materials removal workers with an annual mean wage of \$38,590 are two examples of well-paying green occupations that only require a high school diploma for entry, moderate-term on-the-job training, and no prior work experience.

⁶ U.S. Department of Commerce, Census Bureau, *Poverty Thresholds*, *2011*. http://www.census.gov/hhes/www/poverty/

			Annual median wage		Difference	
SOC code Occupation Group		GSS-OCC Employment ¹	Green Job Occupations ¹	All Occupations ²	Percent	Numeric
00-0000	Total, All Occupations	1,949,520	\$40,050	\$34,460	16.2%	\$5,590
11-0000	Management Occupations	95,360	\$100,990	\$92,880	8.7%	\$8,110
13-0000	Business and Financial Operations Occupations	83,740	\$67,860	\$61,700	10.0%	\$6,160
15-0000	Computer and Mathematical Occupations	25,540	\$76,170	\$75,080	1.5%	\$1,090
17-0000	Architecture and Engineering Occupations	105,670	\$76,120	\$72,070	5.6%	\$4,050
19-0000	Life, Physical, and Social Science Occupations	174,930	\$51,860	\$59,330	-12.6%	-\$7,470
21-0000	Community and Social Service Occupations	3,030	\$44,060	\$39,880	10.5%	\$4,180
23-0000	Legal Occupations	6,670	\$120,870	\$75,420	60.3%	\$45,450
25-0000	Education, Training, and Library Occupations	13,090	\$49,020	\$45,060	6.4%	\$2,960
27-0000	Arts, Design, Entertainment, Sports, and Media Occupations	22,200	\$44,700	\$43,640	2.4%	\$1,060
29-0000	Healthcare Practitioners and Technical Occupations	7,900	\$61,920	\$59,570	3.9%	\$2,350
31-0000	Healthcare Support Occupations	70	\$33,720	\$25,140	34.1%	\$8,580
33-0000	Protective Service Occupations Food Preparation and Serving Related	26,320	\$39,880	\$36,740	8.5%	\$3,140
35-0000	Occupations	2,160	\$22,530	\$18,900	19.2%	\$3,630
37-0000	Building and Grounds Cleaning and Maintenance Occupations	35,620	\$27,210	\$22,620	20.3%	\$4,590
39-0000	Personal Care and Service Occupations	18,780	\$21,680	\$20,730	4.6%	\$950
41-0000	Sales and Related Occupations	84,560	\$23,310	\$24,840	-6.2%	-\$1,530
43-0000	Office and Administrative Support Occupations	194,440	\$34,960	\$31,250	11.9%	\$3,710
45-0000	Farming, Fishing, and Forestry Occupations	29,260	\$21,860	\$19,460	12.3%	\$2,400
47-0000	Construction and Extraction Occupations	137,060	\$41,740	\$39,820	4.8%	\$1,920
49-0000	Installation, Maintenance, and Repair Occupations	135,470	\$47,220	\$40,600	16.3%	\$6,620
51-0000	Production Occupations	208,180	\$35,230	\$30,670	14.9%	\$4,560
53-0000	Transportation and Material Moving Occupations	539,470	\$32,840	\$28,760	14.2%	\$4,080

¹ BLS, Occupational Employment and Wages in Green Goods and Services, November 2011.

How Safe Are Green Occupations?

BLS's Injuries, Illnesses, and Fatalities (IIF) program provides annual information on work-related injuries, illnesses, and fatal injuries and how these statistics vary by incident, industry, geography, occupation, and other characteristics. In 2011, 4,609 fatal work injuries occurred in the United States at a rate of 3.5 per 100,000 workers. Fatality rates for most of the largest green job occupations were either lower than the national average or below the threshold that is required for disclosure. Notable exceptions, however, are refuse and recycling materials collectors with a fatality rate of 41.2, ranking this occupation as the fourth most dangerous in the United States; heavy and tractor-trailer truck drivers with a 24.0 fatality rate; and general maintenance and repair workers with a 16.0 fatality rate. (See Table 3)

OPPORTUNITIES FOR GOOD GREEN JOBS.

The potential benefits of fostering a green economy extend well beyond curtailing global warming and climate change. A green economy also provides many good jobs in diverse and

² BLS, Occupational Employment Statistics Survey, May 2011.

growing sectors that pay well and are relatively safe. The American workforce is poised to take advantage of new opportunities that are inherent in the green economy.

Green jobs are scattered throughout every sector of the economy – from manufacturing, construction, and utilities to waste services, consulting services, transportation, and government. Jobs in these sectors include a number of good jobs, such as architects and engineers, electricians and carpenters, transit bus drivers, and environmental regulators. Green jobs are also accessible to workers with all levels of education, such as assemblers at factories, hazardous material removal workers, and transit bus drivers requiring only a high school diploma for entry and moderate term on-the-job training. In addition, many green jobs are relatively safe and pay comparatively well – commanding a substantial wage premium that is well above the minimum wage. Fortunately, green jobs are among the jobs expected to grow in the future as many of the largest green job occupations are projected to grow faster than the average for all occupations.

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