

BLS green jobs overview

Through its green jobs initiative, BLS has developed its green jobs definition and published information on green careers and results from three new data collection activities that measure the number of green jobs that produce green goods and services and the number of jobs related to the use of green technologies and practices

Dixie Sommers

The first decade of this century saw growing attention to issues of renewable energy, energy independence and conservation, and global warming. This interest led to an expectation that a “green economy” would emerge and create associated “green jobs.” Many public officials at all levels of government, as well as business leaders and others, developed plans and programs regarding green jobs, such as Congress passing the Green Jobs Act in 2007.¹ The American Recovery and Reinvestment Act of 2009 contained significant funding for energy projects and green jobs training.²

At the same time, however, little reliable or consistent data were available about the number and types of green jobs, and the data that did exist used a variety of green jobs definitions. To help address this information gap, the Bureau of Labor Statistics (BLS) requested and received funding starting in fiscal year (FY) 2010 for a green jobs initiative.

In its budget request, BLS proposed working with other federal agencies and key organizations to define green jobs and then to produce data about these jobs. BLS proposed to “produce new data measuring employment and wages for businesses whose primary activities can be defined as ‘green’ and produce information on the occupations involved, in whole or in part, in green

economic activities.”³ In addition, BLS proposed to conduct “special employer surveys” to provide information on the occupations and wages paid in green jobs and to develop and disseminate career information related to green jobs.

Since FY 2010, BLS has implemented the green jobs initiative, which resulted in developing the BLS green jobs definition and publishing articles on green careers and results from three new data collection activities: the Green Goods and Services (GGS) survey, GGS occupations (GGS-OCC) data, and Green Technologies and Practices (GTP) survey.

The GGS survey indicated that in 2010, the United States had 3.1 million green goods and services (GGS) jobs. GGS jobs accounted for 2.4 percent of total U.S. wage and salary employment.⁴ The private sector had 2.3 million GGS jobs, and the public sector had 860,000 GGS jobs. Additional results and data for 2011 will be presented in a forthcoming *Monthly Labor Review* article.

GGS-OCC data indicate that establishments that received all their revenue from GGS had about 540,000 transportation and material moving jobs, about 208,000 production jobs, and 194,000 office and administrative support jobs in November 2011. In his article in this issue, Zachary Warren

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discusses GGS-OCC data.

The GTP survey showed that, in August 2011, about three-quarters of business establishments reported using at least one green technology or practice. Approximately 854,700 jobs were held by workers who spent more than half of their time involved in green technologies and practices (GTP). Audrey Watson presents further highlights from the GTP survey in this issue's visual essay.

The Parrott and Wiatrowski article in this issue provides safety and health information for occupations that comprise the largest number of GTP jobs.

The remainder of this overview article describes how BLS developed its green jobs definition and how each of the three data collection activities were designed, tested, and implemented, along with their limitations. The article wraps up by briefly discussing the green career information.

How BLS developed its green jobs definition

The first step in the BLS green jobs initiative was to develop a definition of green jobs. BLS established three criteria for the definition: it must be objective, be measurable, and use standard classifications. An objective definition would avoid policy judgments or advocacy, consistent with the BLS mission as a statistical agency. A measurable definition would work when used in data collection: it would be clear to potential survey respondents and be based on information survey respondents have and are able and willing to report to BLS. Finally, a definition that uses standard classifications would meet Office of Management and Budget statistical standards, as well as permit comparison of the resulting data to other data. The standard classifications used include the North American Industry Classification System (NAICS) and the Standard Occupational Classification (SOC).

The process of defining green jobs began with reviewing the variety of existing definitions found in analytical and survey efforts of several states, private research and industry organizations, other federal agencies, and international organizations. Prior to the FY 2010 budget request, BLS participated with several State Workforce Agencies and the Employment and Training Administration in the Green Jobs Study Group. The Study Group examined the range of existing state green jobs surveys and data projects to understand the issue and the various attempts at measurement, to identify the questions surrounding measuring green jobs, and to develop ideas for providing data and information on green jobs.⁵ Although the primary benefit of the Study Group's work was to the State Workforce Agencies, many of whom were preparing

proposals for green jobs data projects under the American Recovery and Reinvestment Act of 2009, BLS also learned about definition and data collection issues. Green jobs studies already conducted in California, Michigan, Oregon, and Washington were useful examples.⁶

BLS examined green jobs efforts underway by the O*NET Resource Center; Brookings Institution; the U.S. Department of Commerce's Economics and Statistics Administration; the Pew Charitable Trusts; Global Insight, Inc.; and other organizations.⁷ The Environmental Goods and Services Sector Handbook from Eurostat, the statistical agency of the European Union, provided a very helpful conceptual framework for defining environmental impact in economic measurement.⁸ BLS also closely examined the Survey of Environmental Goods and Services conducted by Statistics Canada and consulted with staff from that agency concerning their data collection experience.⁹

During the research process, BLS also consulted with other federal agencies—notably the U.S. Department of Energy, the Environmental Protection Agency, the Economics and Statistics Administration, and the Council on Environmental Quality—to obtain feedback on early definition approaches. Similarly, BLS consulted with several industry groups, especially those representing renewable energy industries.

BLS also reviewed its earlier experience in developing an empirical method to define another special category of jobs of considerable interest to policymakers and other users, namely, "high-tech" jobs. This work was conducted first in the early 1980s and has been updated several times, most recently in 2005.¹⁰ As with green jobs, a number of methods identify high-tech jobs, often resulting in differing lists of high-tech industries. Also as with green jobs, BLS needed a definition that was objective, was measurable, and used standard classifications (measurability was based on use of existing data, because no new data collection was conducted).

In a 2004 interagency seminar on high-tech industries, four factors contributing to the high-tech nature of an industry were identified. These factors related to inputs, outputs (products and services), and production processes: (1) a high proportion of scientists, engineers, and technicians; (2) a high proportion of research and development employment; (3) production of high-tech products; and (4) use of high-tech production methods.¹¹ The output and process factors are similar to the output and process approaches in the BLS green jobs definition, discussed in the subsequent paragraphs.

From the research and examination of existing definitions, BLS found that no standard definition of green

jobs had been widely accepted. Although the topic is of interest across government, academia, and the business community, various studies defined the term differently. A common thread ran through the studies and discussions, however, that green jobs are jobs related to preserving or restoring the environment. Several categories of green economic activity were nearly universally cited: renewable energy, energy efficiency, pollution prevention and cleanup, and natural resources conservation.

Also early in the definition work, BLS determined that a green jobs definition that met the criteria could not be developed by simply creating a list of occupations that might be termed “green.” BLS found that whether a job is considered green should be based on the impact of the product, service, or work activity on the environment, not on the nature of the work performed, i.e., the occupation.

BLS published its draft definition for public comment in the *Federal Register* in March 2010.¹² BLS proposed two approaches to identify environmental economic activity and count the associated jobs, which would be found across a range of industries and occupations. The two approaches are (1) the output approach, which identifies establishments that produce GGS and counts the associated jobs, and (2) the process approach, which identifies establishments that use environmentally friendly production processes and practices and counts the associated jobs.

The *Federal Register* notice described the two approaches: “In the output approach, BLS is concerned with jobs related to producing a specific set of goods and services and is not concerned with the environmental impact of the production process. The output approach alone, however, would not cover some activities and associated jobs that favorably impact the environment, although the product or service produced is itself not ‘green.’ The process approach is intended to address this aspect of green jobs. In the process approach, BLS is concerned with whether the production process has a favorable impact on the environment, but not with what good or service is produced. The process approach is relevant to any industry. Each approach requires different measurement strategies and will tend to count different jobs, with some overlap in industries that produce green goods and services.”¹³

The draft definition contained several concepts drawn from the Eurostat Environmental Goods and Services Sector Handbook and referenced an initial list of NAICS industries in which BLS considered GGS to be classified. The draft definition proposed the use of widely recognized federal product ratings or industry standards to objectively distinguish GGS from similar non-GGS. Such standards also would help BLS communicate clearly to re-

spondents what goods and services should be reported on surveys and help data users understand the resulting data. Examples of such standards are United States Department of Agriculture (USDA) Certified Organic, Energy Star, and the Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

The draft definition proposed using Statistics Canada’s revenue share method for measuring employment related to producing GGS. In the revenue share method, the survey would ask respondents what share of their revenue is from sale of green goods or services. This percentage would then be applied to the total employment in the establishment for estimating the number of jobs related to producing the green goods or services. Statistics Canada adopted this method because its data collection experience showed that businesses were generally not able to directly estimate the number of jobs related to GGS production. BLS concluded that the revenue share is a reasonable proxy for the share of employment, assuming that the labor inputs per dollar amount of sales are similar between green goods or services and other goods or services produced within the establishment.

BLS received 156 comments on the draft definition. These comments were summarized and responses provided in a September 2010 *Federal Register* notice that also issued the final BLS green jobs definition.¹⁴ The final definition retains the output and process approaches, the use of recognized industry standards for identifying GGS, and the revenue share method for measuring GGS employment. BLS dropped some of the Eurostat concepts and terminology that proved confusing to the public and simplified and consolidated the definition. BLS added several GGS identified by commenters but significantly narrowed the scope of the definition by excluding the distribution of green goods.

The BLS green jobs definition is as follows: “BLS has developed this definition of green jobs for use in data collection in two surveys. Green jobs are either:

- A. Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources.
- B. Jobs in which workers’ duties involve making their establishment’s production processes more environmentally friendly or use fewer natural resources.”

BLS developed this definition for collecting data. It was not created to be a governmentwide standard definition of green jobs or to represent a consensus among federal agencies.

The BLS green jobs definition represents the output approach (A) and the process approach (B). Because these two separate approaches define and measure green jobs differently and because the resulting data overlap to some unknown extent, they are not intended to be additive. In addition, BLS identified categories of GGS for use in measuring jobs related to the output approach and identified categories of GTP for use in measuring jobs related to the process approach. These categories are shown in the discussion of the surveys that follow.

Several points about the BLS green jobs definition may be important to users. The BLS green jobs definition does not consider job quality aspects, such as wages, union membership, benefits, or advancement through career ladders. Several comments on the draft definition urged BLS to use such criteria. However, BLS decided against doing so because this would be contrary to the criterion of objectivity. BLS would have to judge, for example, what level of worker safety would be high enough for the job to be included as a green job. However, data users may use information on worker safety, wages, and other topics to select jobs from the BLS data that meet their own criteria regarding these topics. An example of using other information is found in the Parrott and Wiatrowski article in this issue, which provides safety and health information for occupations that comprise the largest number of GTP jobs.

The BLS definition does not automatically include inputs or distribution of outputs or follow a green good or service through the supply chain. Instead, inputs and outputs are evaluated as to whether they provide any direct benefit to the environment. This evaluation led BLS to include organic products only in the industry in which they are produced (agriculture) and in which the environmental benefit therefore occurs and not in industries in which organic products are processed, transported, or sold (manufacturing, transportation services, and wholesale and retail trade).

Similar to organic products, products containing recycled inputs are considered only in the industry in which these inputs are introduced. For example, steel containing recycled content is identified as a green product of the iron and steel industry, because the environmental benefit occurs as recycled inputs are introduced when the steel is produced. But the manufacture, transport, and sale of fabricated products made of steel containing recycled inputs are not included as green products, because no further environmental benefit from the recycled content occurs.

The distribution of green goods is excluded from the

definition of GGS. Transporting and selling green goods do not directly benefit the environment compared with transporting or selling any other good.

Electric power distribution services are excluded as a green service, similar to the decision to exclude distribution of green goods. Goods and services for improving the efficiency of the electric power grid, including Smart Grid technologies, are included in the “energy efficiency” category, however. Nuclear power is included as a green service on the basis of lower greenhouse gas emissions relative to other major sources of electric power. The recycling and waste reduction category of GGS includes reuse, remanufacturing, composting, and avoiding the creation of waste materials.

The final list of 2007 NAICS industries in which GGS are classified was published along with the final definition.¹⁵ BLS developed this list by reviewing all detailed (six-digit) NAICS industry definitions and product lists. Exhibit 1 shows the five categories of GGS: energy from renewable sources; energy efficiency; pollution reduction and removal, greenhouse gas reduction, and recycling and reuse; natural resources conservation; and environmental compliance, education and training, and public awareness. The industry list indicates which categories of green goods or services are classified into each industry and provides examples. With the introduction of the 2012 NAICS, the list was converted to the new industry classification and now includes 325 detailed industries.

For each 2007 NAICS sector, table 1 shows the number of detailed industries identified as in scope or not in scope for green goods or services and provides information on the number and share of establishments and employment in and out of scope in each sector. In-scope industries account for 23.7 percent of all establishments and 20.0 percent of total wage and salary employment in 2011. The sectors with the largest share of establishments and employment in scope for GGS are construction (97.4 percent of establishments and 90.0 percent of employment); followed by agriculture, forestry, fishing, and hunting (93.0 and 84.6 percent); and management of companies and enterprises (82.2 and 95.7 percent). Four sectors have less than 10 percent of establishments in scope (three of these also have less than 10 percent of employment in scope): wholesale trade (1.4 percent of establishments and 2.1 percent of employment); transportation and warehousing (4.3 and 10.7 percent); arts, entertainment, and recreation (5.5 and 8.8 percent); and retail trade (6.4 and 2.7 percent). An additional four sectors are entirely not in scope. Note that these data represent only the extent to which the GGS industry list covers the sectors; they do not rep-

Exhibit 1. Categories of green goods and services

Green goods and services are sold to customers and include research and development, installation, and maintenance services. Green goods and services fall into one or more of five groups:

1. *Energy from renewable sources.* Examples include electricity, heat, or fuel generated from renewable sources. These energy sources include wind, biomass, geothermal, solar, ocean, hydropower, and landfill gas and municipal solid waste.
2. *Energy efficiency.* Goods and services in this group improve energy efficiency. Included are energy-efficient equipment, appliances, buildings, and vehicles, as well as products and services that improve the energy efficiency of buildings and the efficiency of energy storage and distribution, such as Smart Grid technologies.
3. *Pollution reduction and removal, greenhouse gas reduction, and recycling and reuse.* These are products and services that
 - reduce or eliminate the creation or release of pollutants or toxic compounds or remove pollutants or hazardous waste from the environment;
 - reduce greenhouse gas emissions through methods other than renewable energy generation and energy efficiency, such as electricity generated from nuclear sources; and
 - reduce or eliminate the creation of waste materials and collect, reuse, remanufacture, recycle, or compost waste materials or wastewater.
4. *Natural resources conservation.* Goods and services in this group conserve natural resources. Included are products and services related to organic agriculture and sustainable forestry; land management; soil, water, or wildlife conservation; and stormwater management.
5. *Environmental compliance, education and training, and public awareness.* These are goods and services that
 - enforce environmental regulations
 - provide education and training related to green technologies and practices
 - increase public awareness of environmental issues.

resent counts of establishments actually producing GGS or the number of jobs related to such production.

The BLS approach to defining and measuring green jobs has certain limitations, some of which were pointed out in comments on the draft definition:

- In measuring jobs related to production of GGS, the BLS approach misses GGS produced by establishments classified in industries not on the BLS list of detailed industries where GGS are classified. If an establishment produces more than one type of good or service, it is classified by industry according to the majority of its output based on value. If an establishment in an industry not on the BLS list has green goods or services as a minority of its output, jobs related to production of these goods and services are not counted.
- The categories of GGS overlap, as do the categories of GTP in the process approach. For example, the environmental impact of a green good may include both reduction of greenhouse gases and increased energy efficiency. Because of this overlap, BLS has not attempted to collect or estimate the number of jobs related to each category of GGS or to each category of GTP.
- Because BLS collects data on GGS jobs and GTP jobs through two different surveys, the jobs captured by the two surveys may overlap in establishments that produce GGS using GTP. The extent of the overlap is unknown.
- The use of revenue share method to estimate employment related to producing GGS, as developed by Statistics Canada, requires certain assumptions, as discussed earlier.
- Data collection includes only wage and salary workers and excludes the self-employed and other classes of workers. This limitation results from use of the BLS business list as the sampling universe for surveys.

Table 1. 2007 NAICS industry sectors and 2011 annual average number of establishments and employment, in and not in scope for the Green Goods and Services survey									
2007 NAICS code	Sector	Number of detailed industries		Number of establishments, 2011			Employment, 2011		
		In scope	Not in scope	In scope	Not in scope	Percent in scope	In scope	Not in scope	Percent in scope
—	Total, all industries	333	861	2,112,134	6,788,107	23.7	25,861,335	103,449,745	20.0
Sectors in scope									
11	Agriculture, forestry, fishing, and hunting	56	8	89,170	6,711	93.0	985,293	179,206	84.6
22	Utilities	6	4	14,315	11,016	56.5	289,045	516,943	35.9
23	Construction	48	2	749,211	20,250	97.4	5,087,631	563,949	90.0
31–33	Manufacturing	127	345	81,997	259,955	24.0	3,495,456	8,550,659	29.0
42	Wholesale trade	1	70	8,694	605,226	1.4	117,298	5,428,579	2.1
45	Retail trade	1	74	16,623	243,944	6.4	133,247	4,788,874	2.7
48–49	Transportation and warehousing	10	47	10,769	241,686	4.3	534,698	4,440,242	10.7
51	Information	15	17	77,136	71,474	51.9	1,377,956	1,309,756	51.3
52	Finance and insurance	3	38	3,468	460,875	.7	33,258	5,499,322	.6
54	Professional, scientific, and technical services	21	27	628,903	409,833	60.5	5,055,118	2,724,229	65.0
55	Management of companies and enterprises	1	2	44,146	9,530	82.2	1,832,345	82,198	95.7
56	Administrative and support and waste management and remediation services	13	31	126,278	348,817	26.6	1,042,011	6,738,414	13.4
61	Educational services	5	12	27,946	139,670	16.7	3,704,528	8,387,156	30.6
71	Arts, entertainment, and recreation	3	22	7,211	123,438	5.5	202,388	2,107,575	8.8
81	Other services (except public administration)	16	33	184,127	1,134,645	14.0	1,027,015	3,414,913	23.1
92	Public administration	7	22	42,140	95,557	30.6	944,048	6,361,627	12.9
Sectors entirely not in scope									
21	Mining, quarrying, and oil and gas extraction	—	29	—	32,560	—	—	730,047	—
53	Real estate and rental and leasing	—	24	—	346,185	—	—	1,954,964	—
62	Health care and social assistance	—	39	—	826,075	—	—	18,362,350	—
72	Accommodation and food services	—	15	—	632,006	—	—	11,447,468	—
NOTE: Dash indicates data not applicable.					and employment data from the BLS Quarterly Census of Employment and Wages.				
SOURCES: Green goods and services industry list and establishment									

- Coverage of agriculture is incomplete. The BLS business list is derived from unemployment insurance tax reports to the states, and the coverage of agriculture varies from state to state. BLS has examined the agriculture coverage issue, however, and determined that the list is comprehensive enough for collecting green jobs data.

The GGS survey

To measure green jobs as defined in the output approach, BLS developed the GGS survey. This survey produces data on the number of jobs associated with production of GGS by industry for the nation, states, and the District of Columbia. Collection of data on the occupations of GGS jobs

is discussed in the next subsection.

Overall survey design. The GGS survey design is based on several premises:

- GGS are produced in a certain set of industries that can be identified in the NAICS descriptions and product lists.
- The extent to which an establishment in one of these industries produces GGS can be identified by the share of the establishment's revenue received from sales of such goods and services.
- Revenue share is a valid proxy for the share of the establishment's employment that is associated with production of GGS.

As a result, the GGS survey collects information on total employment and share of revenue from sale of GGS from a sample of establishments in the identified industries. Nonprofits, government units, and business startups without positive revenue are asked to provide the percentage of employment involved in production of GGS. Thus, the survey results reflect both share of employment and share of revenue responses, referred to collectively as "green activity."

GGS employment estimates include the full range of jobs found in the establishment. For example, a solar panel installation business might report that all its revenue is from the sale of GGS. In this case, all jobs are counted, including installers, managers, secretaries, etc.

Survey scope. The scope of the GGS survey data is defined by the industry list published with the final BLS green jobs definition, described earlier and summarized in table 1. Beginning with the collection of data for 2011, the 2012 NAICS industries were used.

Questionnaire design and testing. Development of the survey questionnaires involved devising questions that describe to respondents the types of goods and services of interest and that request the share of revenue. Questionnaire development included field-testing several versions to determine whether employers had the information and were willing to provide it, to determine whether the questions effectively conveyed the meaning of GGS to respondents, and to estimate the time the respondents needed to complete the survey. The field test confirmed that respondents could provide revenue share information but generally not share of employment related to producing GGS.

The final GGS survey forms consist of 14 separate questionnaires, each designed for an industry sector or group

of industries. For each type of green good or service, the individual questionnaires list the examples expected to be produced in the industries covered by that questionnaire. For example, the construction sector questionnaire lists weatherization and retrofitting projects but does not list production of USDA certified organic crops, which appears only on the agriculture sector questionnaire.¹⁶

Respondents are asked whether the establishment produces goods or services that fall into one or more of the GGS categories listed on the questionnaire. The categories are from the BLS green jobs definition shown in exhibit 1, with some editing for clarity in data collection. For each category, the questionnaire provides examples to assist respondents in understanding the specific types of goods or services. These examples often include references to industry standards, such as "Construction of ISO 21930:2007—compliant buildings" and "Construction of LEED certified buildings" shown in the construction sector questionnaire for the energy efficiency category. The category list also includes an "other" category for the respondents to list any other goods or services they produce that may be green. If the respondents indicate they produce any green goods or services, they are asked to complete the revenue questions.

The revenue questions include identifying the start and end dates of the establishments' fiscal year that includes April 15 of the reference year. Then respondents are asked whether the establishment had any revenue during the fiscal year from the sale of green goods or services identified in the earlier question. If yes, the share of total revenue from these sales is requested. Only the share or percentage of total revenue from GGS is requested, not the level of revenue. If the establishments had no sales revenue, as in government, nonprofit, or start-up establishments, respondents are asked for the percentage of worksite employees who primarily work on producing the green products or services identified.

Sample design. The GGS survey sample is selected primarily from the BLS Quarterly Census of Employment and Wages (QCEW) business list sampling frame. Private and government establishments are included, and any establishment with no employment for the preceding 12 months is excluded. The QCEW comes from state unemployment insurance tax records that employers file with individual state agencies, as well as federal agencies subject to Unemployment Compensation for Federal Employees. The QCEW includes several descriptive variables for each establishment, such as name, address, monthly employment, industry classification, and geographic information.

Because the extent of production of GGS as measured in the GGS survey was unknown and potentially infrequent, BLS used an additional business list that included establishments known to produce some kind of green good or service, to gain efficiency in producing the estimates. This business list, referred to as the “environmental establishments” list, included about 13,000 in-scope establishments comprising approximately one million employees. BLS staff identified these establishments (or units) internally through searching the Internet and using an environmental database maintained by a private environmental publishing firm. Sample units from this list were selected with higher probability than that of other units.

The GGS survey sample is about 120,000 establishments. For the 2011 survey, the sample included approximately 116,000 establishments selected from the second quarter 2010 QCEW frame and approximately 4,000 newly created establishments selected from the fourth quarter frame to represent new businesses created since the first quarter. The sample is allocated by state and industry. Beginning with the 2012 survey, the GGS sample is divided into three panels, each containing approximately 40,000 sample units. Two of the three panel samples overlap with the previous year’s sample to produce estimates of change in green employment. Details of the sample design are available in the GGS survey Technical Note.¹⁷

In addition to the sample allocation just mentioned, steps were taken to maximize the overlap between the GGS survey sample and the existing Occupational Employment Statistics (OES) survey sample. Specifically, a procedure was devised to replace nonoverlapping GGS sample units with similar OES sample units.¹⁸ This replacement procedure was done to support estimation of GGS employment and wages by occupation, described in the next subsection.

Data collection. BLS conducted the first GGS survey in 2011 as a mail survey, with telephone follow-up. For the 2012 survey, an Internet response option was added. Response rates of 70.6 percent and 74.1 percent were achieved for the 2010 and 2011 surveys, respectively.

Estimation. From the GGS survey data, BLS produced estimates by first applying the revenue or employment share reported by responding establishments to total employment for the establishment. Estimation procedures were then used to produce the number of jobs related to production of GGS and the number of other jobs, by industry, state, and public and private ownership. Details of

the estimation procedures are available in the GGS survey Technical Note.¹⁹

Publication. The GGS survey data are published annually, with 2010 data published in March 2012 and 2011 data forthcoming in early 2013. These data include GGS employment levels by industry and by private and public ownership for the nation and by industry sector for states and the District of Columbia. GGS employment as a share of total employment is also presented. All data are available in searchable and downloadable databases on the BLS public website, and measures of sampling error are provided. Highlights of results will be discussed in a forthcoming *Monthly Labor Review* article.

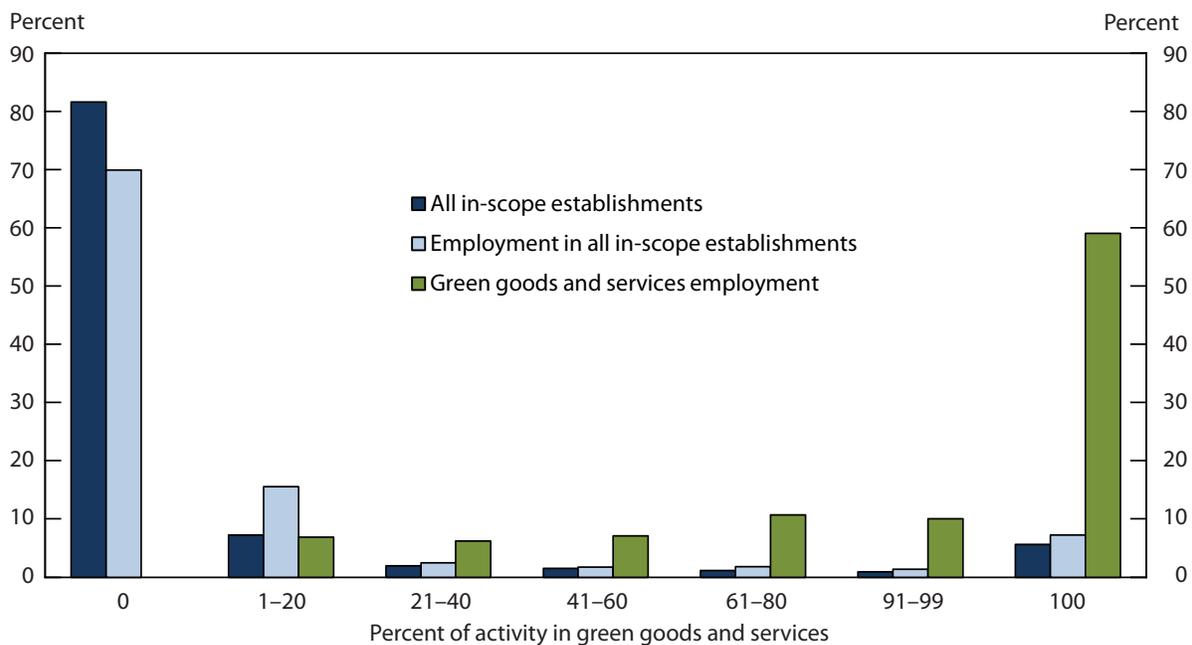
Limitations. Perhaps the most significant limitation in the GGS survey data is the use of revenue share as a proxy for measuring employment related to production of GGS. As already noted, this topic elicited comments in response to the *Federal Register* notice on the draft green jobs definition.

Because some establishments have more than one product or service, some of which are green and others that are not green, BLS needed a method for capturing only the green portion of employment within these establishments. Similar to the experience of Statistics Canada, during field testing, BLS found that establishments that produce both green and nongreen goods or services have significant difficulty reporting employment associated with only green products or services.²⁰ For example, establishments often have employees who work on both types of product and administrative and support staff who are not dedicated to a specific product or service. BLS found revenue share information to be more readily available and less burdensome for the respondent to provide.

The use of the revenue or employment share only affects establishments producing both GGS and non-GGS. If an establishment only produces green goods or services, its revenue or employment share would be 100 percent and all jobs in the establishment would be counted as GGS jobs. Using data from the 2010 GGS survey, chart 1 presents information by the share of activity (revenue or employment) related to producing GGS.²¹ About 5.6 percent of all in-scope establishments reported 100 percent of their activity was related to GGS. These establishments had 7.2 percent of all employment among in-scope establishments and 59.0 percent of GGS employment.

Most establishments reported no green activity, accounting for 81.6 percent of all in-scope establishments and 69.9 percent of employment. These establishments, of

Chart 1. Percent distribution of in-scope establishments and employment and green goods and services employment by share of activity in green goods and services, 2010



SOURCE: U.S. Bureau of Labor Statistics.

course, had no GGS employment. Between the 0 percent and 100 percent green activity are establishments that reported some of their activity was related to producing GGS. These establishments are spread throughout the range of percentages, with the largest concentration being 7.3 percent with 1 to 20 percent of their activity related to GGS, accounting for 15.5 percent of all employment in in-scope establishments and 6.9 percent of GGS employment.

Other limitations of the GGS survey are the exclusion of self-employed and unpaid family workers, incomplete coverage of agriculture, and lack of additivity with the GTP survey results. These limitations were discussed earlier.

GGS occupational data

In addition to the GGS survey results by industry, BLS produced data on the occupations and wages of jobs related to producing GGS. BLS accomplished this by expanding the existing OES survey to collect occupational employment and wage data from as many of the establishments in the GGS survey as possible and developed estimation procedures to generate the data. The results, referred to as GGS-OCC, are national employment and wages by occupation for establishments with all of their activity involving GGS. GGS-OCC also includes data for establishments with some activity involving GGS and no

green activity. This section describes how data were collected and the estimates produced, starting with a brief overview of the OES survey.

The OES survey is a semiannual mail survey that collects data on wage and salary workers in nonfarm establishments, to produce employment and wage estimates for about 800 occupations. These estimates are available by geographic area and by industry and ownership. The survey includes approximately 200,000 establishments in each of six semiannual panels and takes 3 years to fully collect the sample of 1.2 million establishments. Data are collected for reference months May and November, and employment estimates are benchmarked to an average of the May and November employment levels.

Survey scope and questionnaires. The GGS-OCC data have the same scope as the GGS survey, which is encompassed by scope of the OES survey, with the exception of agriculture. OES includes portions of the agriculture sector, but not other portions that are included in the GGS survey scope. The supplement to the OES survey sample, discussed in the following subsection, includes these additional agriculture industries.²²

The production of GGS-OCC data was designed to leverage the existing OES survey data. Thus, the same OES survey forms are used to collect regular OES data, as well

as data for additional units in the supplemental sample. A new form was developed for use in the additional agriculture sector industries.

Sample design. The GGS-OCC data are based on a subset of establishments that are in both the GGS survey sample and either the regular OES sample or the OES supplement. The four major steps in obtaining the sample for GGS-OCC are (1) select the OES sample, (2) select the GGS sample, (3) maximize the overlap between the OES and GGS samples, and (4) supplement the OES sample with establishments in GGS but not in OES. Step 3 was described earlier, in which a replacement procedure was introduced in the GGS sampling process to maximize the overlap with the OES sample.

Step 4 is necessary because, even with the overlap maximized, a supplemental sample is needed to provide sufficient coverage, capture the additional agriculture sector industries, and collect establishment-level data for state and local government. The supplemental sample is a subsample of the nonoverlapping GGS sample units.

In addition, the timing of the OES sample selection was changed from semiannual to annual. This change required addition of a births component for use in the second of the semiannual panels to account for new businesses created subsequent to the sampling frame reference date.

The resulting sample used in estimating GGS-OCC data included nearly 90,000 units, of which about 64,700 were in the regular OES sample and about 25,000 constituted the supplemental sample. Sampling procedures are discussed in detail in the GGS-OCC Technical Note.²³

Data collection. BLS collected data for the supplemental sample as part of the regular OES survey. Survey forms are sent by mail, with extensive telephone follow-up. Response options include mail, Internet, telephone, email, and provision of electronic files or payroll listings. Data are coded to the SOC.²⁴ For the survey panels included in the first set of GGS-OCC data, 66.4 percent of establishments responded, representing 59.9 percent of weighted employment. This percentage is lower than the 78 to 80 percent establishment response rates usually achieved for the regular OES survey. The effective response rate for the final GGS-OCC data is even lower, because it also considers whether the OES respondents also responded to the GGS survey, as described in the subsection that follows.

Estimation. Development of GGS-OCC estimates posed the question of how occupational employment and wages should be estimated for establishments that had only

part of their revenue or employment involving GGS. BLS examined two options. The first option was to produce estimates for three categories of revenue or employment share: all green, some green, and no green activity. The second option was to use the method from the GGS survey, that is, to apply the green activity share to employment by occupation in each responding establishment.

BLS selected the first option as the clearest way to represent the occupations of workers involved in producing GGS. The estimates for the “all green” category show the number of jobs by occupation known to be involved in producing GGS. Under the second option, in establishments producing both GGS and non-GGS, one must assume that the occupational mix of workers producing the GGS is the same as those producing other goods and services. This option would generate some results that might seem counterintuitive. For example, for some occupations that data users may consider “green” by definition, such as solar photovoltaic installers, some employment would be shown as nongreen in establishments with this occupation and reporting less than 100 percent of revenue from GGS.

To compute estimates, BLS matched each responding unit in the GGS-OCC sample to responses from the GGS survey to obtain the revenue or employment share. This exercise resulted in the effective response rate of 48.6 percent on the basis of the establishments that responded to both the GGS and OES surveys. To reduce nonresponse bias, BLS used imputation and weighting class adjustments.²⁵ In addition, OES benchmarking and wage updating and estimation procedures were adapted for GGS-OCC estimation.

Publication. BLS published the first GGS-OCC data in September 2012. These data include national occupational employment and wages for all three green activity categories (all green, some green, and no green). All data are available in searchable and downloadable tables on the BLS public website, and measures of sampling error are provided. Highlights of results are presented in the article in this issue by Zachary Warren. Data collection is continuing, with data for November 2012 planned for publication in the fall of 2013.

Limitations. Although BLS has published results for all three green activity categories, the results do not provide occupational data for all jobs identified as green in the GGS survey. As noted earlier, BLS determined that applying the revenue or employment share to occupational employment would produce results that may be confusing to data users. Although clearer in meaning, presenting

occupational data by revenue category is somewhat complex and requires careful analysis.

The relatively low effective 48.6 percent response rate reduces the amount of information that meets quality and confidentiality criteria for publication.

The GTP survey

To measure green jobs as defined in the process approach, BLS developed the GTP survey. This special employer survey produces national data on establishments' use of GTP and the occupations of workers who spend more than half their time involved in GTP.

Overall survey design. The process approach to defining green jobs includes jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources. To collect data from businesses on these jobs, BLS needed to design a survey that described environmentally friendly production processes in a way that allows the respondent to easily understand the nature and scope of the technologies and practices of interest.

Because the number of such technologies and practices is very large and no classification system existed that enumerates them, BLS used the Eurostat concepts

to develop categories of technologies and practices and to provide examples. The categories are shown in exhibit 2: energy from renewable sources; energy efficiency; pollution reduction and removal, greenhouse gas reduction, and recycling and reuse; and natural resources conservation. Although these categories are similar to the categories of GGS, they refer to technologies used or activities performed within an establishment, not to the product or service produced. For example, as a green technology or practice, energy from renewable sources refers to the generation of energy primarily for use within the establishment, such as running a solar system to generate electricity to power lighting or equipment in a store or factory. In the GGS context, the energy from renewable sources category refers to generating energy primarily for sale to customers.

Workers are considered involved in GTP if they research, develop, maintain, use, or install technologies or practices to lessen the environmental impact of their establishment or if they train the establishment's workers in these GTP. The GTP employment estimates include only those jobs in which the workers spend more than half their time involved in GTP. BLS used this time criterion to avoid including jobs in which these activities are incidental to the worker duties, such as jobs in which workers participate in office recycling.

Exhibit 2. Categories of green technologies and practices

Green technologies and practices are used to lessen the environmental impact of an establishment. These technologies and practices fall into one or more of four groups:

1. *Energy from renewable sources.* Examples include electricity, heat, or fuel generated from renewable sources primarily for use within the establishment. These energy sources include wind, biomass, geothermal, solar, ocean, hydropower, and landfill gas and municipal solid waste.
2. *Energy efficiency.* Technologies and practices are used to improve energy efficiency within the establishment. Included in this group is cogeneration (combined heat and power).
3. *Pollution reduction and removal, greenhouse gas reduction, and recycling and reuse.* Technologies and practices are used within the establishment to
 - reduce or eliminate the creation or release of pollutants or toxic compounds, or remove pollutants or hazardous waste from the environment;
 - reduce greenhouse gas emissions through methods other than renewable energy generation and energy efficiency; and
 - reduce or eliminate the creation of waste materials; collect, reuse, remanufacture, recycle, or compost waste materials or wastewater.
4. *Natural resources conservation.* Technologies and practices are used within the establishment to conserve natural resources. Included in this group are technologies and practices related to organic agriculture and sustainable forestry; land management; soil, water, or wildlife conservation; and stormwater management.

Some businesses may implement GTP by contracting for the work needed. The GTP survey counts only jobs in which the respondent employs the workers and excludes contractors. Contractors hired to implement GTP are providing GGS, and the related jobs would be represented in the GGS survey.

Survey scope. Consistent with the BLS process approach to defining green jobs, in which the focus is on the production process regardless of the product or service produced, the scope of the GTP survey includes all industries except private households. The survey references a specific pay period, which for the first GTP survey is the pay period that includes August 12, 2011.

Questionnaire design and testing. Development of the survey questionnaires involved devising questions that describe to respondents the types of GTP and that elicit responses as to whether establishments used any of these technologies and practices, whether they had employees involved in the technologies and practices, and if so, whether any of these employees spent at least half their time doing so. For these employees, the questionnaire needs to collect data on the number of workers by occupation and their wages.

To describe the types of GTP, BLS developed and tested descriptions derived from the categories shown in exhibit 2 and included examples for each category. These categories and examples are presented in a format that allows the respondent to indicate whether the technology or practice is used and whether any workers are involved. This format required indicating to the employer what is meant by “involved in.” The questionnaire asks the respondent to indicate whether employees spent any of their time “researching, developing, maintaining, using or installing technologies or practices to lessen the environmental impact of their establishment or training the establishment’s workers in these technologies or practices.”

A subsequent question narrows the employment inquiry to the number of workers spending more than half their time involved in GTP. For these workers, respondents were then asked to provide job titles, brief job descriptions, and the number of workers, by occupation and by wage interval, using a format similar to that used on the OES survey.

The GTP survey underwent rigorous design and response testing. To better understand environmental terminology and relevance, BLS conducted cognitive interviews with establishments thought to have GTP. A feasibility study was conducted to assess both the respon-

dent’s understanding of the survey’s language and their ability to provide the requested data. Five test panels were conducted to refine the survey procedures and collection instruments for the different response modes (mail, fax, email, and Internet). To further understand respondents’ and nonrespondents’ reactions to the survey questions and their reasons for response or nonresponse, BLS conducted response analysis surveys for a small number of respondents and nonrespondents in each of the five test panels.²⁶

Sample design. The GTP survey is drawn from the QCEW business list, plus a separate list for railroads. The lists were stratified by U.S. Census region and 2007 NAICS two-digit industry sector, and establishments with zero employment for the preceding 12 months were excluded.

As in the GGS survey sample design, the extent of use of GTP was unknown and potentially infrequent. Therefore, to gain efficiency in producing the estimates, BLS used an additional list of establishments known to use green technologies or practices. BLS compiled this list through web research and from other green business organization lists, resulting in a list containing about 31,000 establishments, which BLS then matched to the QCEW business list to create a “green list.” The green list was sampled with somewhat higher probability than the QCEW list. The sample includes about 35,000 establishments, with about 33,000 units from the QCEW list and about 2,000 units from the green list.

Data collection. The GTP survey is a mail survey offering mail, telephone, email, fax, and Internet response options. Extensive telephone follow-up was conducted, and a 70.0 percent response rate was achieved. Data are coded to the 2010 SOC. Extensive review of survey responses and occupational coding was conducted.

Estimation. BLS developed GTP survey estimates using sampling weight adjustments for nonresponse and benchmark employment factors. In addition, OES wage updating and estimation procedures were adapted for GTP estimation.²⁷

Publication. The first GTP data were published in June 2012, with a reference date of August 2011. These data include the incidence of specific GTP and the total number of jobs in which workers spent more than half their time involved in GTP. The data were published for all industries combined at the national and U.S. Census region levels and for industry sectors at the national level. In addition, national occupational employment and wage data

were published for jobs in which workers spent more than half their time involved in GTP. All data are available in searchable and downloadable tables on the BLS public website, and measures of sampling error are provided. Audrey Watson presents highlights of results in the visual essay in this issue.

Collection of a second GTP survey began in the fall of 2012, with data for September 2012 planned for publication in the summer of 2013. Whether the survey will be conducted a third time has not yet been determined.

Limitations. The GTP survey data do not indicate the level of employment related to each green technology or practice. Employers were not asked to associate these employees with specific green technologies or practices, and a given employee could be involved in multiple technologies or practices.²⁸

The GGS and GTP surveys are based on two distinct concepts and are not designed to be comparable. As noted earlier, jobs captured by the two surveys may overlap in establishments that produce GGS using GTP. Because of the conceptual differences and the overlap, data users should not sum the estimates to get a count of “total” green employment or consider the two estimates a range of the number of green jobs. Users should decide which of the approaches best suits their analytical needs. GTP and GGS survey estimates cannot be compared with each other to provide a measure of the change in green employment over time.²⁹

BLS also cautions users about comparing the GTP occupational data with data from the OES survey. The two data sources have differences in scope, reference periods, and methodology. The GTP survey includes agricultural

industries not included in the OES survey. Industry-specific estimates in the GTP survey include government establishments, and most industry estimates in the OES survey do not. The reference month for GTP is August 2011, and the May 2011 OES estimates are benchmarked to the average of the May 2011 and November 2010 reference periods.³⁰

Information on green careers

The BLS Employment Projections program began publishing information on green careers with “Careers in Wind Energy” in September 2010. Nine more articles have been published through January 2013, including articles on careers in solar power, green construction, electric vehicles, recycling, energy auditing, sustainability, environmental remediation, geothermal energy, and biofuels. Each article discusses how the particular technology works and identifies the important occupations involved. For the occupations, the nature of the work, credentials required, and wages are presented.³¹

BLS DEVELOPED A GREEN JOBS DEFINITION through extensive research and consultation and developed the three new data collection activities—the GGS survey, GGS-OCC data, and GTP survey—and green career information. Results from the GGS-OCC and GTP collection activities are addressed in further detail in this issue’s articles by Zachary Warren and Audrey Watson. In addition, Parrott and Wiatrowski provide extensive information on safety and health for occupations that comprise the largest number of GTP jobs. Results from the GGS survey will be presented in a forthcoming *Monthly Labor Review* article. □

Notes

¹ Energy Independence and Security Act, Title X, Pub. L. No. 110-140 (2007), <http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf>.

² American Recovery and Reinvestment Act, Pub. L. No. 111-5 (2009), <http://www.gpo.gov/fdsys/pkg/BILLS-111hr1enr/pdf/BILLS-111hr1enr.pdf>.

³ U.S. Department of Labor, “FY 2010 budget in brief,” p. 50, <http://www.dol.gov/dol/budget/2010/PDF/bib.pdf>.

⁴ Data are current as of time of publication; however, the data will be updated in a forthcoming *Monthly Labor Review* article. Percentage is based on total wage and salary employment covered by unemployment insurance, as measured by the BLS Quarterly Census of Employment and Wages program, <http://www.bls.gov/cew/>.

⁵ *Measurement and analysis of employment in the green economy* (Workforce Information Council Green Jobs Study Group Final Report, October 2009), <http://www.workforceinfocouncil.org/>

[Documents//WICGreenJobsStudyGroupReport-2009-10-01t.pdf](#).

⁶ For more information on the green jobs studies, see “California’s green economy: summary of survey results” (California Employment Development Department, October 2010), http://www.energy.ca.gov/cleanenergyjobs/GrSurveyRpt_1115.pdf; “Michigan green jobs report 2009” (Michigan Department of Energy, Labor and Economic Growth, May 2009), http://www.michigan.gov/documents/nwlb/GJC_GreenReport_Print_277833_7.pdf; “The greening of Oregon’s workforce: jobs, wages, and training” (Oregon Employment Department, Workforce and Economic Research Division, August 2009), <http://www.qualityinfo.org/pubs/green/greening.pdf>; and “2008 green economy jobs in Washington State” (Washington Employment Security Department, January 2009), http://www.energy.wsu.edu/documents/Green_Jobs_Report_2008_WEXVersion.pdf.

⁷ Erich C. Dierdorff, Jennifer J. Norton, Donald W. Drewes, Christina M. Kroutalis, David Rivkin, and Phil Lewis, “Greening of the world of work: implications for O*NET-SOC and new and emerging

occupations” (National Center for O*NET Development, February 2009), <http://www.onetcenter.org/reports/Green.html>; Mark Muro, Jonathan Rothwell, and Devashree Saha, *Sizing the clean economy: a national and regional green jobs assessment* (Brookings Institution, July 13, 2011), <http://www.brookings.edu/research/reports/2011/07/13-clean-economy>; “Measuring the green economy” (U.S. Department of Commerce, Economics and Statistics Administration, April 2010), http://www.esa.doc.gov/sites/default/files/reports/documents/greeneconomyreport_0.pdf; *The clean energy economy: repowering jobs, businesses and investments across America* (The Pew Charitable Trusts, June 2009), <http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Report/Clean%20Energy%20Economy.pdf>; and “Current and potential green jobs in the U.S. economy,” *U.S. Metro Economies* (Waltham, MA: Global Insight Inc., The United States Conference of Mayors, October 2008), <http://www.usmayors.org/pressreleases/uploads/GreenJobsReport.pdf>.

⁸ *The Environmental Goods and Services Sector: A Data Collection Handbook* (Luxembourg: Office for Official Publications of the European Communities, Eurostat, September 2009), http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=ks-ra-09-012.

⁹ “Survey of environmental goods and services” (Statistics Canada, June 2008), <http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=1209&lang=en&db=imdb&adm=8&dis=2>.

¹⁰ Daniel E. Hecker, “High-technology employment: a NAICS-based update,” *Monthly Labor Review*, July 2005, pp. 57–72.

¹¹ *Ibid.*, p. 58.

¹² *Federal Register*, March 16, 2010, vol. 75, no. 50, pp. 12,571–12,573.

¹³ *Ibid.*

¹⁴ *Federal Register*, September 21, 2010, vol. 75, no. 182, pp. 57,506–57,514.

¹⁵ See the final list of 2007 NAICS industries and the BLS green jobs final definition at <http://www.bls.gov/ggs/ggsfaq.htm#3>.

¹⁶ The 14 GGS survey forms questionnaires are for NAICS codes 11 agriculture; 23 construction; manufacturing (3 questionnaires, one each for NAICS codes 31, 32, and 33); 42 wholesale trade; 48 transportation; 51 information and 71 arts, entertainment, and recreation; 61 educational services and 813 religious, grantmaking, civic, professional, and similar organizations; 92 public administration; 811 repair and maintenance; 2211 electric power generation, transmission, and distribution; 2213 water, sewage, and other systems; and a combined questionnaire for 5112 software publishers; 52 finance and insurance; 54 profession-

al, scientific and technical services; 55 management of companies and enterprises; and 561 administrative and support services. See <http://www.bls.gov/respondents/ggs/forms.htm>.

¹⁷ For details of the sample design, see GGS survey Technical Note at http://www.bls.gov/ggs/ggs_technote_extended.pdf.

¹⁸ The replacement procedure is described in the GGS-OCC Technical Note, part IV, at http://www.bls.gov/ggsocc/survey_methods.pdf.

¹⁹ For more information, see GGS survey Technical Note at http://www.bls.gov/ggs/ggs_technote_extended.pdf.

²⁰ Robert Viegas, Kristin Fairman, Donald Haughton, and Richard Clayton, “Measuring green industry employment” (U.S. Bureau of Labor Statistics, 2012), pp. 2,000–2,001, http://www.amstat.org/sections/srms/proceedings/y2011/Files/301278_66470.pdf.

²¹ Data are current as of time of publication; however, the data will be updated in a forthcoming *Monthly Labor Review* article.

²² The OES survey was expanded only to produce GGS-OCC estimates. The additional responses are not used in the regular OES estimates.

²³ For more information on sampling, see GGS-OCC survey Technical Note, part IV, at http://www.bls.gov/ggsocc/survey_methods.pdf.

²⁴ The GGS-OCC estimates are based on data collected over a 3-year period and include data collected under both the 2000 SOC and the 2010 SOC. The treatment of the classification systems is described in GGS-OCC Frequently Asked Question (FAQ) 8 at <http://www.bls.gov/ggsocc/faq.htm#8>.

²⁵ For more information on procedures BLS used to reduce nonresponse bias, see http://www.bls.gov/ggsocc/survey_methods.pdf.

²⁶ For more information on sampling, see GTP survey Technical Note, part V, at http://www.bls.gov/gtp/survey_methods.pdf.

²⁷ Further details on estimation procedures are available in the GTP Technical Note, part III, at http://www.bls.gov/gtp/survey_methods.pdf.

²⁸ For more information, see GTP FAQ 8, <http://www.bls.gov/gtp/faq.htm#q8>.

²⁹ For more information, see GTP FAQ 11, <http://www.bls.gov/gtp/faq.htm#q11>.

³⁰ For more information, see GTP FAQ 12, <http://www.bls.gov/gtp/faq.htm#q12>.

³¹ The green career articles are available at <http://www.bls.gov/green/greencareers.htm>.