C2ER THE COUNCIL FOR COMMUNITY AND ECONOMIC RESEARCH

Green Jobs in Arizona, 2010

A Survey Report from the State's Companies

Prepared for the Office of Employment and Population Statistics,
Arizona Department of Administration

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The Arizona Green Economy 2010:

A Report from the State's Companies February 2011

Introduction

This report is part of a broader Arizona Commerce Authority-sponsored project of research studies, surveys, and analyses designed to help better understand Arizona's green economy. The project is led by the Council for Community and Economic Research (C2ER). The initiative was funded through a U.S. Employment and Training Administration (ETA) grant to the Arizona Department of Economic Security and Arizona Commerce Authority as part ETA's State Labor Market Information (LMI) Improvement program. The grant funds are being used to improve Arizona's capacity to track global business, economic, and technology trends, and to develop a host of tools to better assess, understand, and respond to the needs of emerging green industries, their workers, and future employees. Among the key objectives of this initiative are to promote and improve the dissemination of intelligence on the green economy in Arizona and provide a foundation for future analysis.

The Arizona Green Jobs Survey was implemented because very little systematic data existed about the state's green economy. The primary goal of the survey was to create a baseline of information about how many green jobs exist in the state, the kinds of industries that employ workers requiring green skills, the kinds of occupations that were most prominent, and the skills required to succeed. Along with other analyses related to the wider Arizona green economy project, the survey also generated useful data on the current state of green-related industries, growth opportunities available to the state's green economy, and the education and training required for the state to meet the needs of a growing segment of its economy.

The survey results were generated as part of a larger research program, and they were also designed to create new information about Arizona's green jobs that could be integrated with other labor market and workforce information systems. The results of this analysis can help policy makers in creating a consensus about the state's strengths and opportunities in growing a greener economy.

The survey was implemented in a way that is consistent with other surveys that the Labor Market Information agency conducts, including the Occupational Employment Survey, and it will provide an important foundation for future research on the green economy. A copy of the survey instrument is included in Appendix A, and a description of the survey methodology can be found in Appendix B.

Key Survey Findings

In the spring and summer of 2010, the Council for Community and Economic Research (C2ER), under contract with the Arizona Commerce Authority, surveyed more than 5,000 companies to obtain their perspectives about the jobs available in the green economy. This survey builds on other C2ER-coordinated research efforts being implemented under the ARRA-funded LMI Improvement Grant, including a research study of key economic drivers of the state's green economy.[1] The survey obtained information from businesses about their green workforce, including the unique green skills required to succeed as well as the education, experience, and credentials sought for their workers.

The survey provides valuable data on Arizona's green employment trends, but it also helps shed light on other critical issues such as the regional composition of the state's green economy, the near-term employment picture for green jobs, and the state's capacity to provide needed training and education resources for those pursuing careers in green industries.

The survey results provide the first baseline assessment of the overall number of green jobs in Arizona, along with key sectors, industry clusters, and occupational categories. The data also assess areas of anticipated job growth and the education and training needs of these occupations and industry specializations. Several primary themes have emerged:

- ***Survey results indicate that Arizona is presently home to 30,716 green jobs.***
  This figure represents 1.3 percent of total statewide employment, falling slightly below average shares found in several previous studies of U.S. and other states' green employment.

- ***Service industries dominate Arizona's green employment activities.***
  Like the rest of the Arizona economy, most of the state's green jobs are located in service-related sectors, such as architecture, construction, and engineering.

- ***Green jobs and green industries closely align with existing industries and industry clusters.***
  At present, nearly all of Arizona's green jobs are located in firms that employ workers in both green occupations and traditional occupations.

- ***Arizona does not yet appear to have any clear emerging large clusters of businesses or jobs in the leading clean tech sectors.***
  However, Arizona is home to several leading research institutions that are creating significant new competitive advantages for the state in areas such as advanced energy storage, nano-materials, or biofuels.

- ***Small businesses account for the bulk of existing and new green jobs.***
  About half of the current green jobs are found in companies employing 50 people or fewer. An estimated 73 percent of new green jobs will be created in these small firms.

- ***A large number of the current jobs making up Arizona's green economy require relatively low skills and offer relatively lower average wages.***

[1] The Battelle Technology Practice, "The Emerging Green Industries in Arizona: Definitions, Industry Base, and Opportunity Areas," Report was prepared for The Arizona Commerce Authority, November 2010. This report is hereafter referred to as *2010 Battelle Study*.

Many of the state's current green jobs pay wages below state averages, and have limited education and training pre-requisites.

- ***The state's fastest growing green jobs tend to be concentrated in fields that provide higher quality and better paying jobs.***
  Many of the green industry sectors and occupations slated for rapid future growth also pay higher wages than statewide averages. In addition, the green economy appears to be poised as a solid base for middle skill jobs.

- ***Anticipated green job growth rates are quite impressive and represent a likely fast-growing sector in Arizona during the coming year and beyond.***
  Overall, Arizona-based businesses expect to see 8.6 percent growth in green jobs in 2011, far outpacing the projected statewide growth rate of only 0.7 percent for all jobs.

Report Organization and Content

The survey results provide a comprehensive picture of the state of Arizona's green economy with particular focus on the following questions:

Background
- What is the green economy?
- How was the Arizona green jobs survey conducted?

Survey Analysis
- Where are green jobs located?
- What does green industry look like in Arizona?
- What does the green workforce look like in Arizona?
- What are the education and training needs for leading green jobs?
- What growth is anticipated?

Conclusions
- Why does the green economy matter to Arizona?
- What is the bottom line?

Background

What is the Green Economy?

Definitions

The C2ER project team worked with a number of stakeholders in determining how best to define the green economy. It was clear when the project began that there was no consensus definition among key Arizona stakeholders on what constitutes a green job, a green business, or a green industry cluster. In turning outside the state for advice, the team fared no better in reaching a consensus. Dozens of different definitions have been used in studies in both the U.S. and overseas.[2]

At the Federal government level, statistical agency efforts to introduce greater rigor and improved standardization of definitions into the analytical process have been underway for the past several years. In September 2010, the U.S. Bureau of Labor Statistics (BLS) released its long-anticipated comprehensive approach and general principles applied in defining the green economy, incorporating a NAICS-based structure for categorizing green economy establishments.[3] While the BLS definition may not represent the final word in this discussion, it does provide a means to standardize research and to compare the green economy across various regional, industry, and occupational categories. That definition, first in its preliminary form and later in its final form, was used in the 2010 Arizona green jobs survey conducted for this project.

At the broadest level, BLS defines green economic activities as those "***that help protect or restore the environment or conserve natural resources.***"[4] This definition recognizes that traditional environmental industries, such as waste recycling, are a central component of the green economy. BLS' definitions also recognize that any green activity must contain an environmental value-added component, what the BLS refers to as "a discernible positive impact on the environment or natural resources conservation."[5] These "discernible positive impacts" include the following:

- The direct production of green goods and services, which are made specifically for the purpose of protecting or restoring the environment.
- The indirect production of green goods and services, which are made for another purpose, but have a favorable impact on protecting the environment or conserving natural resources relative to other goods or services generally used for the same purpose. Examples include electricity produced from renewable sources or hybrid vehicles.
- Specialized inputs used only in the production process for a direct or indirect green good or service. Examples include a wind turbine blade or fertilizer for organic crops.

[2] A sampling of some of these approaches can be found in 2010 Battelle Study.
[3] An initial draft for comments was issued in the March 16, 2010 Federal Register and was finalized in the September 21, 2010 Federal Register, which presented comments, BLS responses and BLS final definition to be used for data collection. See www.bls.gov/green
[4] See www.bls.gov/green
[5] Ibid.

- A service that specializes in the distribution of green goods, including specialized transportation, warehousing, and wholesale or retail trade services for green direct or indirect goods and services.

Based on its view of green economic activities as those helping to protect or restore the environment or conserve natural resources, the BLS has identified five categories of objective and measurable economic activities that comprise green economic activities:

1. **Renewable Energy:** Includes hydropower, wind, biomass, geothermal, solar, tidal, and hydrogen fuel cells, among other renewable sources.

2. **Energy Efficiency Equipment, Appliances, Buildings and Vehicles Goods and Services:** Includes the production of energy efficient products, cogeneration, along with goods and services that increase the energy efficiency of industry processes.

3. **Pollution Mitigation, Greenhouse Gas Reduction and Recycling and Reuse of Goods and Services:** Includes activities that reduce the emission of pollutants and remove pollutants and hazardous waste from the environment, nuclear energy, clean coal and other means to reduce greenhouse gas emissions in electricity generation from fossil fuels, and activities that collect and recycle materials and waste water.

4. **Organic Agriculture, Sustainable Forestry and Soil, Water and Wildlife Conservation, Agricultural and Natural Resources Conservation:** Includes reducing use of chemical fertilizers and pesticides, soil and water conservation, sustainable forestry, land management, and wildlife conservation.

5. **Governmental and Regulatory Administration, and Education, Training and Advocacy:** Includes goods and services related to activities that develop and enforce environmental regulations, increase public awareness of environmental issues, and provide training in the application of green technologies and practices.

Survey respondents were provided this definition (with examples) to help the company representative determine whether their firm employed workers in green occupations. It is notable that these economic activities do not precisely align with the concept of industries as an individual economic activity, and in fact activities related to an individual green category may be found in multiple industries. However, often the activity may be concentrated in a single industry or group of industries. Thus, in this report, the authors use the term "BLS green economic category" (or some variation thereof) to refer to these groups of activities and their related jobs. In some cases, they are described as industry clusters, but these clusters or industries do not necessarily have a unique set of North American Industry Classification System (NAICS) industries assigned to each green economic category.

How was the Arizona Green Job Survey Conducted?

The survey was developed based on preliminary guidance from BLS officials, and also was designed to align with similar surveys completed in states such as Washington and Oregon – as well as

recommendations put forth in the Workforce Information Council's Green Jobs Study Group reports.[6] The C2ER team mailed surveys to 10,000 Arizona-based businesses beginning in May 2010. Follow-up mailings were used, and C2ER conducted more than 17,000 follow-up telephone calls between June and September 2010.

The survey asked employers to self-report the number of green jobs within their companies. Self-reporting was utilized based on a belief that most firms provide a mix of green jobs and non-green jobs and that only they could help determine whether or not a job required green skills. Since no government statistics previously existed at the firm level, employers were given definitional options and asked to provide this data.

Because the Arizona Green Jobs Survey was completed at a time of significant statewide economic distress and a very real fear of a potential double-dip recession permeated the media at the time, the authors believe that employers may have undercounted green jobs because many individuals who might have done green jobs were doing other activities as well. Certainly, the firms significantly lowered their expectations for anticipated job growth. Unfortunately, this baseline survey cannot control for underlying economic conditions and the actual impact of the downturn on our results remains uncertain. To gain further insight into the conditions of the green economy in Arizona, the research team conducted a series of focus groups with green employers and other stakeholders across the state to supplement the survey.

Overall, 5,234 firms completed the survey, generating a response rate of 52.3 percent. This high response rate suggests that the survey analysis can provide a very comprehensive snapshot of the state of Arizona's green economy in 2010. However, because the survey intentionally tapped only a selected stratified sample of Arizona businesses, and some "non-green" industries were under-sampled while others were over-sampled, the survey results may not provide a complete picture of the entire Arizona green economy. In the analysis, C2ER weighted those results to reflect this stratification, but some industries or occupations may still be under-represented. Instead of trying to generate complete coverage, the sample frame was designed to help determine leading trends in economic sectors where green economic activity is most likely to occur, so that the results would be more useful in guiding policymakers and business leaders in determining how best investment and training resources might be most effectively deployed. More details on the survey frame are included in Appendix B.

[6] Washington Workforce Information Council, *Measurement and Analysis of Employment in the Green Economy*, Olympia, WA: WIC Green Jobs Study Group, October 2009; Worksource Oregon, *The Greening of Oregon's Workforce*, Salem, OR: Oregon Employment Department, June 2009.

Survey Analysis

Survey results indicate that Arizona is presently home to an estimated 30,716 green jobs, representing 1.3 percent of total statewide employment. This figure falls slightly below benchmarks found in other studies at both the national and state levels.[7] At the national level, the U.S. Department of Commerce has estimated that green jobs account for anywhere from 1.5 percent to 2.7 percent of total U.S. private sector employment, and roughly 1-2 percent of total private business activity.[8] However, Arizona's green employment concentration varies greatly by company size with a higher proportion of green jobs found in firms with less than ten employees and a lower share among firms employing more than 200 people. Among small firms, green jobs account for nearly 7 percent of total jobs, while green jobs represent a much smaller portion (1 percent) of large firm employment.

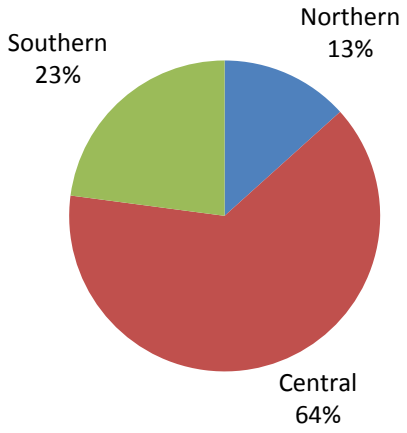
At the broadest level, it is difficult to speak of a typical green business in Arizona. The firms operate in a very diverse set of industries and regions, and provide an array of employment and career opportunities. Nevertheless, the survey results do suggest that most green businesses in Arizona are not "pure-play" green or clean tech companies. In other words, most green firms offer green products and services along with other more traditional offerings. And, while they have employees working in green careers, most of their workforce is employed in traditional activities and sectors. Many of the top providers of green jobs, such as residential plumbing and heating, ventilation and air conditioning (HVAC) contractors, fit this categorization. Our survey results reflect these patterns. While green jobs represent only 1.3 percent of total statewide employment, more than 5.5 percent of Arizona firms employ workers in some form of a green job.

Where are Green Jobs Located?

Simply put: everywhere. The Arizona Green Jobs survey found that green jobs are located in every part of the state and exist in 515 different industries and 218 occupational categories.

While Arizona's green jobs are located across the state, they tend to be dispersed in a similar pattern as overall employment. For instance, green jobs, like all other jobs, tend to be concentrated in the Phoenix area. As **Figure 1** shows, nearly two-thirds of Arizona's green jobs are located in the Central part of the state, which includes Maricopa, Pinal, and Gila

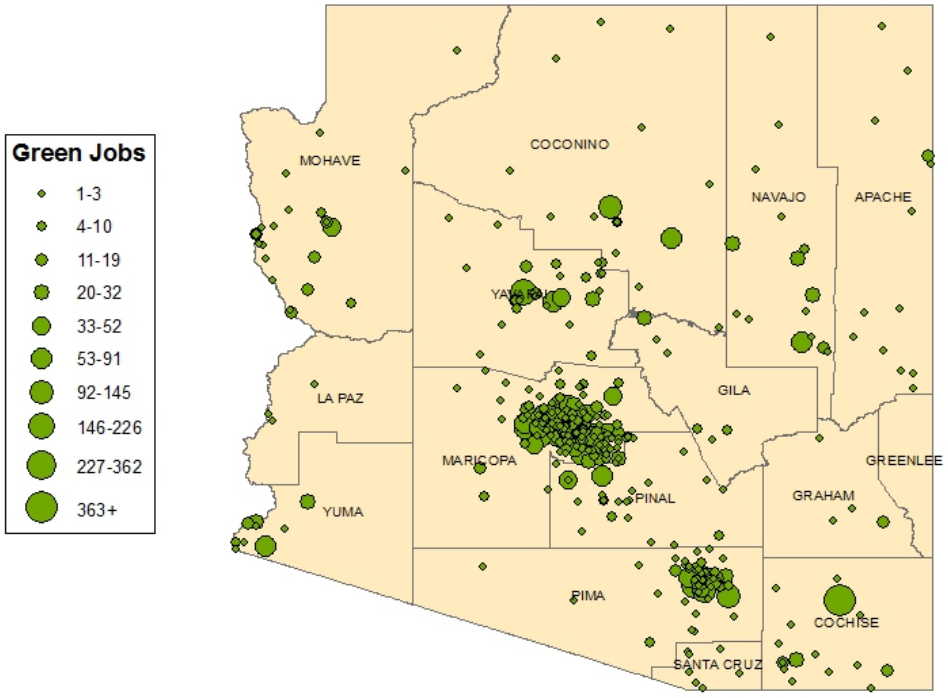
Figure 1: Green Jobs by Region



[7] For related state-level studies, see Kansas Department of Labor, *Kansas Green Jobs Report 2009*, (Topeka, KS: Kansas Department of Labor, 2010); Washington Workforce Information Council, *Measurement and Analysis of Employment in the Green Economy*, Olympia, WA: WIC Green Jobs Study Group, October 2009; Worksource Oregon, *The Greening of Oregon's Workforce*, Salem, OR: Oregon Employment Department, June 2009.
[8] Data are for 2007. See Department of Commerce, Economics and Statistics Administration, *Measuring the Green Economy*, April 2010.

counties. This concentration stems from several factors. First, as Arizona's population and business center, the Central region is home to a larger number of businesses and economic opportunities than less populated parts of the state. In fact, the distribution of Arizona's green jobs differs little from the overall statewide employment distribution.

Figure 2: Distribution of Green Jobs by Zip Code



Second, the industrial composition of Arizona's green businesses suggest that they are more likely to be located in larger business or population centers. Arizona is not home to a large number of stand-alone "pure play" green or clean tech firms such as wind farms, wind turbine manufacturers, or battery makers. These types of companies tend to operate in independent locations, and are often sited in rural areas. For example, the largest new U.S. wind power installations and wind power manufacturing projects in 2010 are located in rural communities.[9]

By contrast, Arizona's green jobs are concentrated in service sectors such as engineering services and landscaping. These sectors depend on providing services and support to large infrastructure or real estate projects, which in turn tend to be concentrated in areas of greater population density. For the near term future, we can expect that green jobs will follow all jobs. Centers of concentrated employment and business growth are likely to be centers of green job growth as well.

[9] American Wind Energy Association, "AWEA Mid-Year 2010 Market Report," July 2010. http://www.awea.org/documents/reports/2Q10.pdf

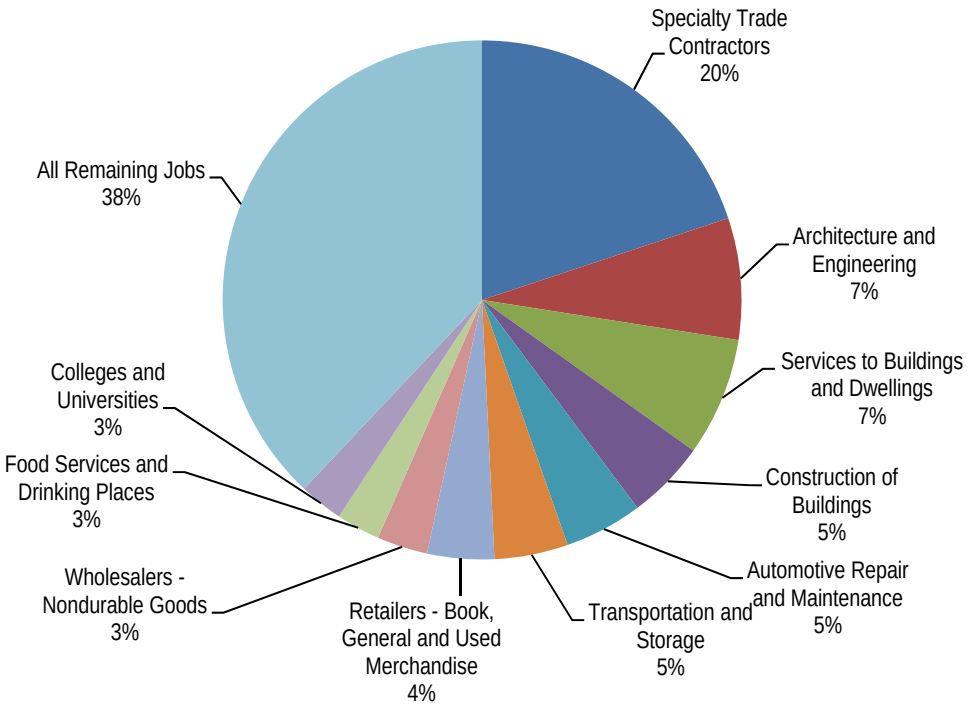
What Does Green Industry Look Like in Arizona?

Leading Industries

A large percentage of Arizona green jobs fall under the BLS-defined economic category of Reducing or Removing Pollution, Greenhouse Gas Reduction and Recycling or Reusing Waste Materials or Wastewater. This category contains an array of companies, ranging from engineering service firms to waste management firms to developers of new pollution control technologies. Other large sources of green jobs are firms in building construction fields, and in organic agriculture, forestry and conservation.

Some interesting patterns emerge when examining industries with high concentrations of green jobs. Service firms dominate Arizona's green economy (see **Figure 3** below)**.** The dominance of service sector industries within the green economy aligns with the overall makeup of the state economy. Similarly, manufacturing-related industries account for a small portion of Arizona's green jobs, accounting for less than one percent of the state's manufacturing employment.

Figure 3: Top 10 Green Industries by Number of Jobs



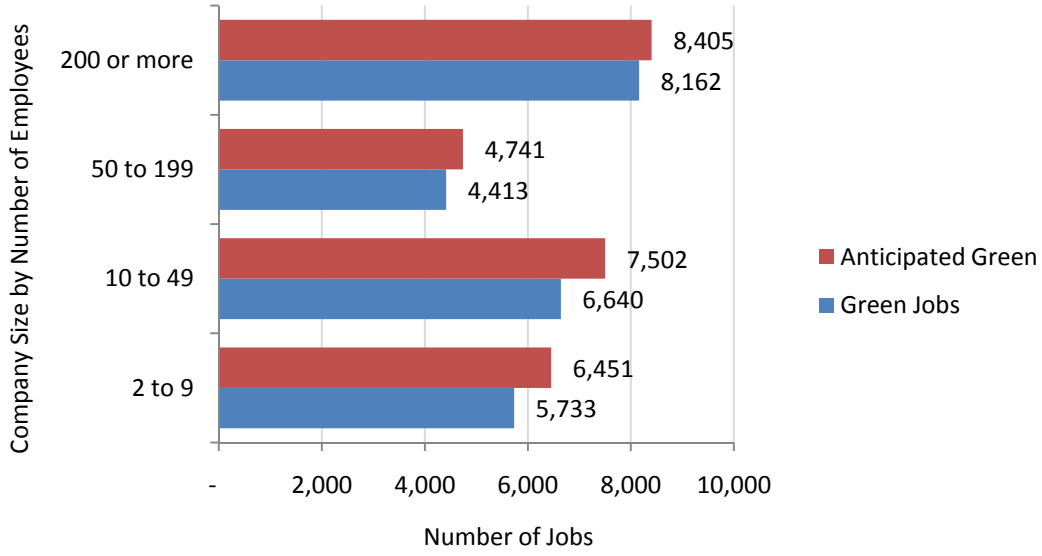
Not surprisingly, the leading service sectors are also areas of specialization and concentration for Arizona's economy in general. Many of the industries with large numbers of establishments are the same as those requiring green skills. For instance, eight of Arizona's ten largest green-related industry sectors (in terms of the number of businesses) also appear on the state's list of the ten industry sectors with the most establishments. This simply suggests that the nature of Arizona's green economic activity is strongly influenced by its overall mix of existing industries.

A review of anticipated job growth presents a slightly different picture. Some service sectors, such as personal services, are expected to add a significant number of new green jobs. Ironically,

despite the challenges that manufacturing has faced in Arizona and other states, many of the fastest growing industries for green jobs are tied to success in manufacturing. For example, companies in computer and electric product manufacturing anticipate green jobs to increase by 36 percent and companies in fabricated metal products manufacturing anticipate green jobs to increase by 30 percent within their firms.

Company Size

Figure 4: Green Jobs by Company Size



Data on the size of Arizona's green businesses follow a typical pattern. Most green businesses are small, yet, as a group, these small businesses generate more than half of total green employment. Meanwhile, a relatively small number of larger firms generate a significant portion of green jobs. This pattern mimics the overall firm size employment dynamics in Arizona. According to the latest (2007) Census Bureau data, more than 97 percent of Arizona firms are small (i.e. with fewer than 500 employees).[10] This large cohort of small firms accounts for 47 percent of total employment in the state.

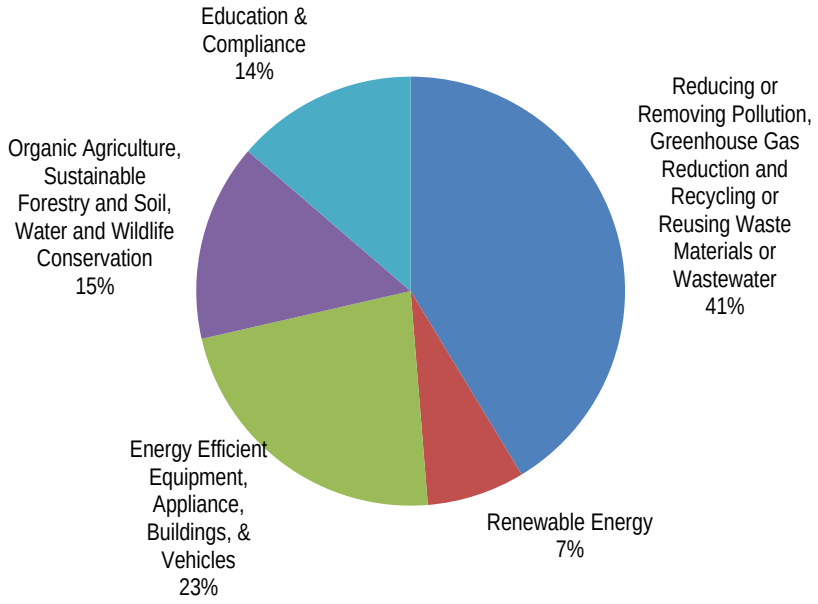
Many green industries, especially those related to energy production and transmission, require significant capital investments that are often outside the capabilities of smaller firms. As such, one might expect companies of different sizes to be focusing on different green categories. Somewhat surprisingly, the survey results did not identify significant sectoral differences in types of green jobs employment attributable to company size variation. While few small employers were focused on education and compliance activities (likely because this sector is dominated by educational institutions), the relative concentrations of small versus large firms in areas such as energy efficient equipment and buildings, and pollution reduction/recycling did not vary in a significant manner.

[10] U.S. Census Bureau, Statistics of U.S. Business. Available at: http://www.census.gov/econ/susb/

What Does the Green Workforce Look Like in Arizona?

Occupational Mix

Figure 5: Green Jobs by BLS Defined Green Category



An analysis of the distribution of occupations within the BLS-defined green economic categories – *pollution/waste removal and recycling, energy efficiency, organic agriculture, renewable energy, and education/compliance* – presents a distinctive mix of occupations and career opportunities. As shown in **Figure 5** above, the pollution/waste removal and recycling occupations make up 41 percent of all green jobs (many of which are lower skill occupations). Examples include workers in construction or those who work at recycling or waste management facilities. In the energy efficiency field (representing 23 percent of green jobs), lower-skill construction workers and HVAC/appliance technicians also account for most green jobs. In renewable energy (7 percent of green jobs), solar technicians and engineers are the largest occupation groups.

In 2010, service firms were the largest providers of green jobs. The largest single occupational category is construction builders and contractors which, excluding weatherization and solar installers, account for 3,418 green jobs across Arizona (See **Figure 6** next page).

Arizona has not traditionally served as a major manufacturing center. Not surprisingly, Arizona has not yet succeeded in building strong in-state capabilities for green-related manufacturing sectors. The survey results identified only 902 green manufacturing-related jobs, representing 3.6 percent of total green jobs. By comparison, overall manufacturing jobs in Arizona account for 6.5 percent of total statewide employment.

Figure 6: Top 10 Green Occupations by Number of Jobs

Occupation	Total Green Jobs	Average Green Wage	Average Statewide Wage*
Construction Builders and Contractors, exc. Weatherization and Solar Installers	3,418	$ 34,753	$ 39,001
Landscapers and Related Workers	2,128	$ 34,232	$ 23,620
HVAC and Appliance Installation/Repair (including Wind)	1,754	$ 38,678	$ 37,252
Commercial Drivers	1,442	$ 33,383	$ 35,097
Production Workers (Recycling and Reclamation)	1,303	$ 33,071	$ 39,263
Teachers and Instructors	1,200	$ 77,822	$ 44,789
Equipment and Maintenance Repair/Installation	1,192	$ 41,087	$ 42,677
Production Workers (exc. Recycling and Reclamation)	1,035	$ 34,710	$ 34,260
Heavy Equipment Operators	989	$ 36,564	$ 34,689
Engineers	911	$ 72,308	$ 83,034

Based on 2009 BLS Occupational Employment Statistics

Even though few of Arizona green companies appear to provide only green products or services, a few notable exceptions exist. For instance, solar photovoltaic and weatherization installers provide 877 green jobs statewide. More commonly, leading green occupations, such as construction laborers and HVAC installers, can be found in companies that support both green occupations and a host of other career options.

These broader occupational patterns may be partially attributable to the unique nature of Arizona's business mix, but they also result from inevitable time lags in the revision and enhancement of the U.S. government's occupational classification systems. As green is an emerging sector of the economy, new green occupations and industries often do not yet have their own distinctive occupational and industry classifications for use by government data collection systems. Fortunately, these systems are now being updated and data are emerging on new occupations. For example, new occupational classifications for solar photovoltaic technicians and wind turbine service technicians were added to the Standard Occupational Classification (SOC) system in 2010 so future BLS data will include specific references to such new occupations. However, that data collection is just beginning, and it will likely take several years to get good comprehensive occupational information.

The BLS defined categories of pollution/waste removal and recycling, energy efficiency, and renewable energy include occupations that Arizona firms in our survey suggest will grow rapidly in the next few years. For example, the demand for heavy equipment operators and solar technicians is expected to rapidly increase over the coming years. In contrast, anticipated growth in education and compliance fields (now at 14 percent of green jobs) is flat, with very limited job growth expected over the near term.

The green economy covers a wide range of occupations and career paths. **Figure 7** on the next page provides an illustrated word cloud that depicts the frequency of key terms in job titles reported by businesses identifying green jobs as part of their response to the Arizona Green Jobs Survey. The most frequently used terms, such as manager, specialist, and technician, all point to the technical nature of many green jobs. Supporting research from the Council of Economic Advisors and other green economy

analysts suggest that the future growth in green jobs is likely to be concentrated in middle-skill occupations, i.e. jobs that require some education and technical training beyond high school.[11]

Figure 7: The Most Common Green Occupations

Wages

Based on the Arizona Green Jobs Survey results, one must conclude that, at present, Arizona's green economy provides quite a diverse mix of job opportunities despite the relatively modest number of jobs currently available. These green jobs require a wide array of skills with commensurate pay, differing within each of the many industry sectors where green jobs can be found. To illustrate the variety of opportunities, average annual wages for green jobs range from a low of $17,160 per year for retail clerks to a high of more than $89,000 for workers engaged in electrical equipment and component manufacturing. Arizona is also home to a substantial portion of very high paying green jobs, with 14 percent of these positions providing annual average wages exceeding $62,000 per year. Furthermore, green jobs, on average, tend to pay annual wages slightly above Arizona's mean annual wage of $40,913.[12]

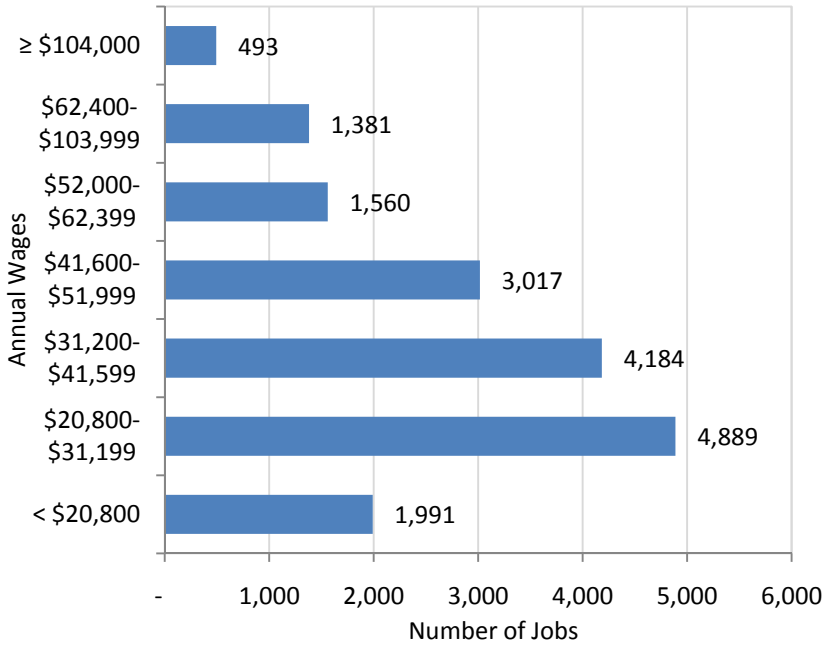
[11] Vice President of the U.S., Middle Class Task Force Staff Report, "Green Jobs: A Pathway to a Strong Middle Class," February 2009.
[12] Arizona Workforce Informer, http://www.workforce.az.gov/cgi/career/?PAGEID=3&SUBID=143.

Figure 8: Concentration of Existing Green Jobs by Skill and Income Level

Education	Certifications Required	< $32,000	$32,000-$62,000	>$62,000	TOTAL
Bachelor's/Graduate	Yes	0.1%	2.0%	2.5%	4.6%
	No	0.6%	7.7%	8.1%	16.4%
Some College/ Associates	Yes	0.5%	1.8%	1.4%	3.7%
	No	1.7%	3.2%	0.8%	5.7%
No Requirement/ High School	Yes	6.5%	10.9%	0.2%	17.7%
	No	27.5%	23.4%	1.0%	51.9%
TOTAL		37.1%	48.8%	14.1%	

However, this masks an important challenge for Arizona's green economy. The most significant finding may be that about half (51.9 percent) of green jobs have no educational requirements beyond high school and 37.1 provide wages below $32,000 per year (as illustrated in **Figure 8**). Of those jobs that require some post-secondary experience, about 21 percent require a Bachelor's degree or higher. For instance, the average pay for jobs in Arizona's ten largest employing green occupations ranges from a low of $33,071 per year for production workers in recycling and reclamation to a high of $72,308 for engineers. Thus, the job mix represents a typical pyramid (as illustrated in **Figure 9**) in which Arizona's current green economy has many lower skill jobs and few high skill jobs. One typically finds this pattern across the larger economy, especially in industries at risk of major technological disruption.

Figure 9: Income Distribution of All Green Jobs



The current challenge is that the Arizona green sector currently has many middle-income, low-skill jobs. This is useful in the short-term in helping to provide employment opportunities for low-skill workers, but the longer-term challenge is that these are not fast growing jobs. Future employment

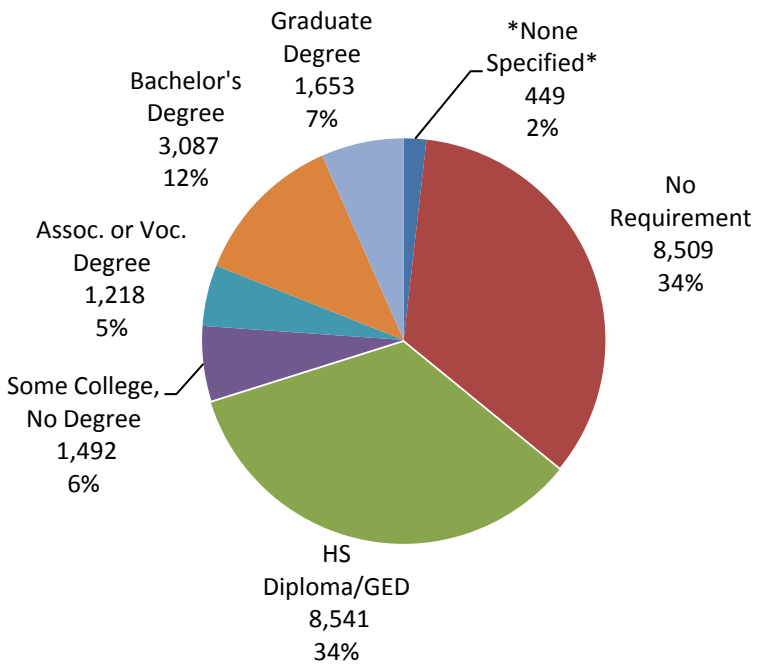
expectations suggest that higher skill demands will be much more rigorous and wages offered even more promising.

Some of the sectors and occupations with the highest anticipated job growth provide the best wages and also typically require certifications that can be achieved when combined with experience or education. For instance, the fastest anticipated job growth is expected to occur among weatherization and solar installers. These jobs offer annual average wages of more than $43,000 per year. Other fast growing occupations such as information technology analysts (average wage of $62,154) and architects (average wage of $75,199), also provide very competitive pay rates.

What are the Education and Training Needs for Leading Green Jobs?

The companies surveyed indicated that more than two-thirds of current green jobs require a high school degree or less. This coincides with the finding that a large proportion of the jobs provide lower than average wages. As **Figure 10** illustrates, about 19 percent of green jobs require a bachelor's degree or higher and about 11 percent require some college or an associate degree.

Figure 10: Green Jobs by Educational Requirement



Not surprisingly, this pattern is even more clearly illustrated among the most common green occupations. Construction workers/contractors and landscapers represent the two most common jobs that companies reported as green. Among construction occupations, only a few required an education beyond high school while landscaper jobs frequently had no educational requirement or required only a high school degree. Likewise, only a few HVAC and appliance repair or equipment and maintenance personnel required some college or an associate's degree. Among the top 10 green occupations, only engineers widely required a bachelor's degree or higher (See **Figure 11** next page). Clearly, green jobs offer a wide array of opportunities for the trades and for lower skill workers.

Figure 11: Level of Education for Top 10 Green Occupations

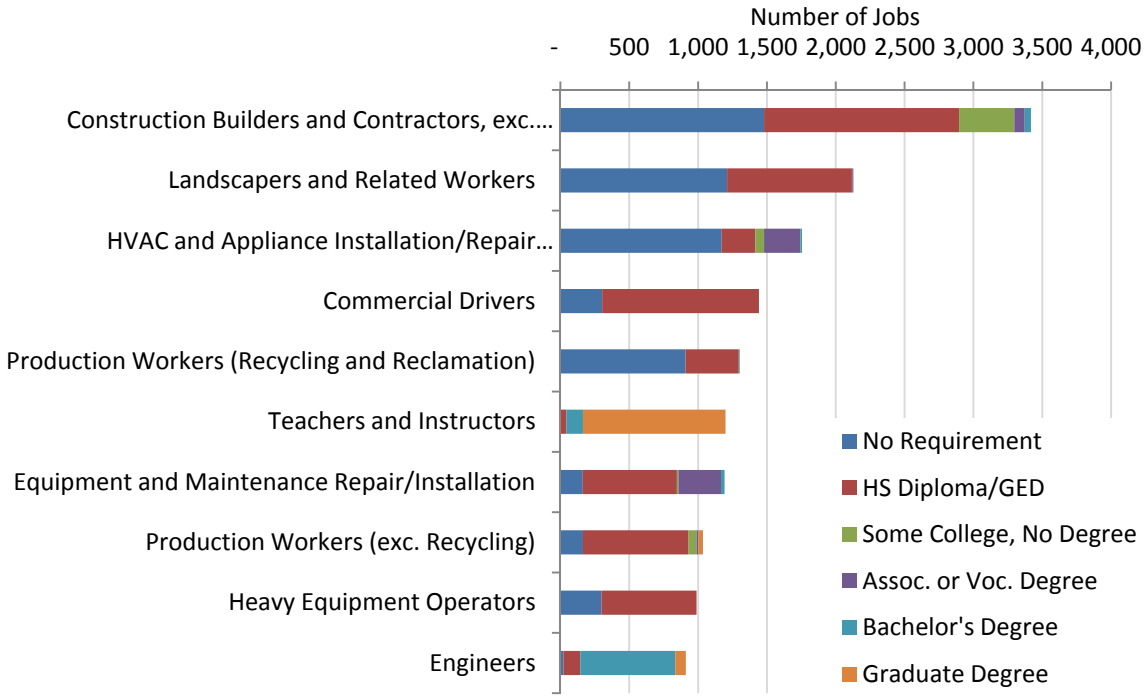


Figure 12 and **Figure 13** provide more in-depth assessments of the middle and higher skill jobs within Arizona's green economy. In **Figure 12**, weatherization and solar installers, HVAC repair, equipment maintenance, and even technical sales personnel emerge as the most green occupations requiring some college, an associates' degree, and higher levels of vocational education. In **Figure 13**, engineers, office managers, architects and teachers highlight the largest higher skill green jobs. Notably, these middle and upper skill green occupational categories also happen to be among the occupations with highest anticipated future growth rates. Again, these patterns suggest that Arizona's future green economy will look quite different from the present. Thus future green jobs will require higher skill levels, additional credentials and education, and provide better wages and benefits.

Figure 12: Top 10 Green Occupations Requiring: Some College or an Associates/Vocational Degree

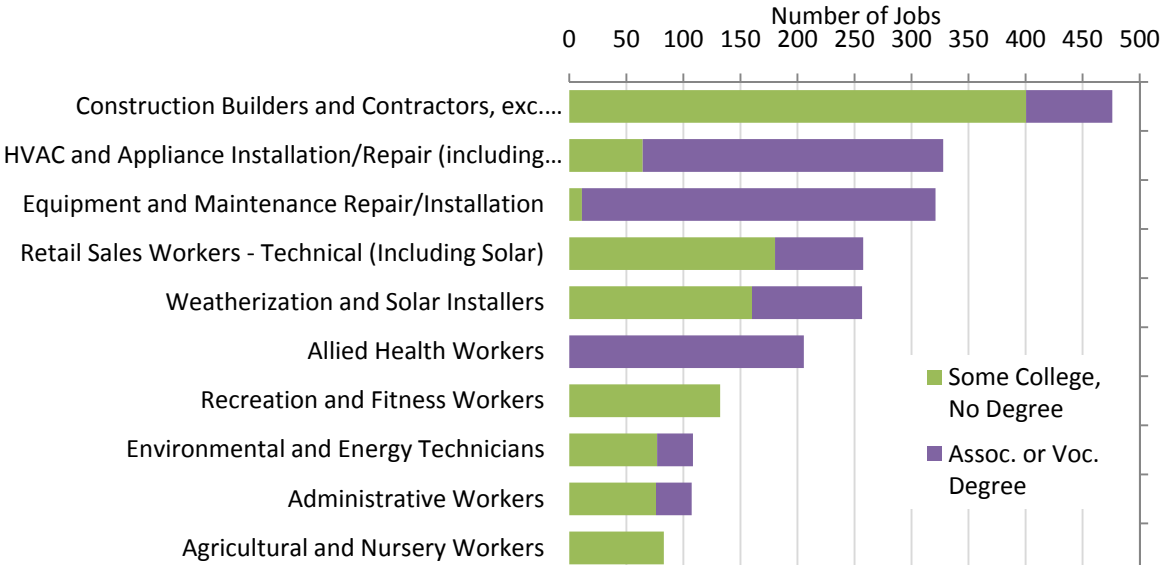
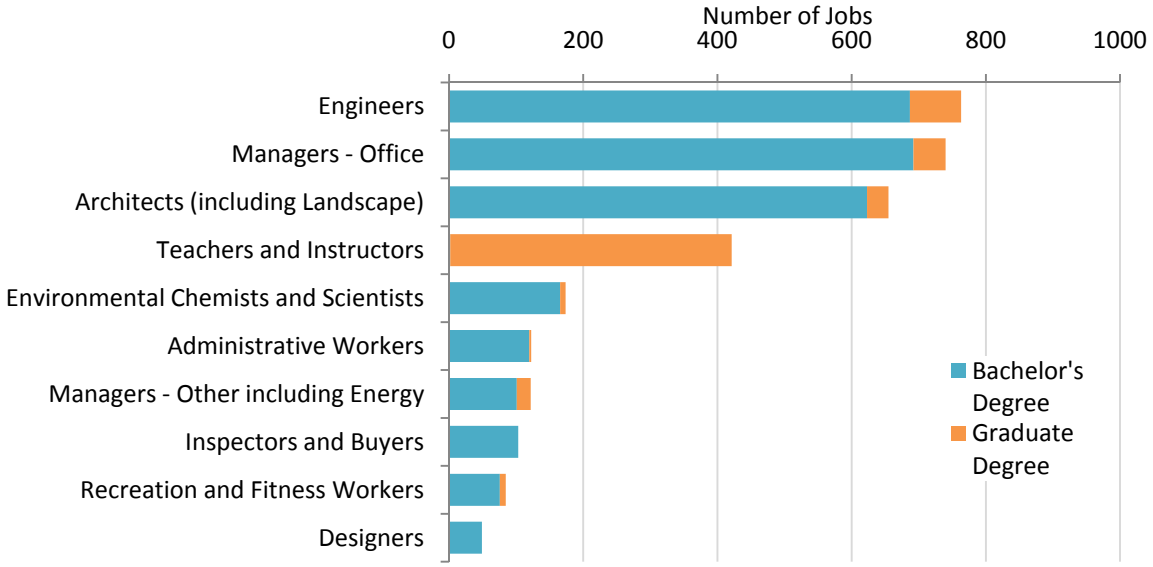


Figure 13: Top 10 Green Occupations Requiring: Bachelor's or Graduate Degree



The relatively lower pay of many current green occupations reflects the relatively lower requirements for training, certification, or licensing. Even so, many lower skill jobs offer wages at or above the state's mean wage. More than half of these positions paid wages above statewide averages, thus suggesting that this "no requirement" category of jobs in **Figure 11** includes much more than low skill, entry-level jobs. Overall, the average wage for positions listed as having "no requirement" was higher than the average wage for those occupations requiring a high school diploma or GED. This suggests that many of the jobs listed as having "no requirement" may indeed have some skill or training pre-requisites, but often those requirements are relatively not formalized (or are still emerging as the occupation changes). Frequently, there is an implicit requirement of some experience to compete for the job (especially in a high unemployment environment), in order to command the wage premium that appeared to have been offered to those with specialized skills (even if those skills were not acquired in a formal education or training environment).

In many industries or economic activity areas, green jobs are emerging as a set of opportunities. Consequently, they have not yet helped to produce a significant infrastructure of education and training tools. Fortunately, the Arizona's State Energy Sector Partnership (SESP) initiative, a Federally-backed effort to develop Arizona's workforce with education and training services related to the green energy economy, is working to begin addressing this issue through aggregation and refinement of curricula within the state and the development of new programs where they are needed.[13] The SESP initiative includes an integrated effort by the state's colleges and training providers to collaborate in sharing green energy curriculums as well as best practices on training and outreach to workers seeking opportunities in the green economy. In addition, selected SESP partners are developing training and certification programs for a host of green job occupations, such as solar thermal installers, energy auditors, and water management and recycling operations.

In preparing higher skill green job workers, it appears that few employers are currently utilizing the formal for-credit training programs now available at the state's community colleges—in large part because the companies require experience in green-related jobs before they hire. Furthermore,

[13] To learn more, visit http://www.arizonaworkforceconnection.com/sesp/default.asp

industry-recognized credentials also often require on-the-job work experience before an individual can achieve a credential. The need for work experience to qualify for either credentialing or jobs has created a bottleneck. In related focus group discussions, green employers expressed hesitancy about committing scarce resources to certifications. Their concerns included the cost of worker certification, confusion over the appropriate certifying entities, and the low priority nature of certification unless it is required by clients to conduct their work. However, green industry standards will continue to emerge (including certification norms), and it is likely that the number of certified workers will increase.

In the meantime, another "chicken and egg" scenario has arisen for lower skill occupations. For these jobs, a relatively small portion of green workers have certificates or licenses but clients are not yet demanding those credentials, so few employers demand them as a job prerequisite. Thus, workers see little need for tapping these new training and credentialing resources. However, as these emerging industries become more mature, it is widely expected that companies will seek workers with proven capabilities, and demand for formal certification and training will be expanded. Indeed, a national movement to create green job credentials is underway.[14] These efforts will not only improve the quality of training provided to green economy workers, but they should also improve job quality and wage rates as well.

During the current transition phase for the green economy, most employers and workers appear to be improvising – relying on a mix of some formalized training and a large portion of on-the-job skills development. In particular, the jobs that survey respondents noted had "no requirement" for employment tend to fall into this category. When asked in the survey to identify specialized training they used, business respondents listed dozens of different licenses, skills, and certifications. These included well-known programs, such as LEED (Leadership in Energy and Environmental Design) certification, Commercial Drivers Licenses, or OSHA-HAZWOPER (Hazardous Waste Operations and Emergency Response) Certification. With the exception of LEED certification, few of these credentials were uniquely focused on the green economy. It was far more common to see workers with general licenses or credentials deploying these skills in specific green economy activities. In addition, many issuers of these generalized licenses and credentials are seeking ways to add green elements to the existing programs.

[14] Sarah White, with Laura Dresser and Joel Rogers, *Greener Skills: How Credentials Create Value in the Clean Energy Economy*, (Madison, WI: Center on Wisconsin Strategy, 2010.)

What Growth is Anticipated?

According to the Arizona Commerce Authority, Labor Market Information division, overall nonfarm employment in the state is projected to grow by 0.7 percent in 2011.[15] Meanwhile, Arizona's green jobs are expected to grow at a much healthier pace in 2011, even in the face of the expected sluggish national rebound from the protracted economic downturn. At an anticipated 8.6 percent rate of growth between April 2010 and April 2011, green job growth would be about 12 times faster relative to total employment generated by the state's economy. The 8.6 percent anticipated growth of green jobs translates to about 2,500 to 2,700 new green jobs created year-over-year by April 2011.

Furthermore, the survey results suggest that small firms will likely lead the way. In the survey, firms with less than 50 employees anticipated green job employment growth rates of 12.5 to 13 percent.[16] Thus, of the 2,645 expected new jobs to be created in the April 2010 to April 2011 time frame, approximately 73 percent are expected to be created in companies with 50 employees or fewer.

The companies in industries with large concentrations of green jobs expect even more robust growth. With the exception of building construction, most of Arizona's current leading green industry sectors anticipate some growth over the coming year. In some sectors, such as specialty contractors and architecture and engineering, industry leaders anticipate very robust growth rates (see **Figure 14**). Finally, anticipated growth rates for these key Arizona-based industries far exceed national employment growth projections for these sectors.[17]

Figure 14: Fastest Growing Arizona Green Industries 2010-2011

Industry	Anticipated New Jobs	Percent Increase
Specialty Trade Contractors	967	20.3%
Wholesalers - Nondurable Goods	187	24.7%
Architecture and Engineering	149	8.3%
Retailers - Book, General and Used Merchandise	149	15.0%
Retailers - Motor Vehicle and Parts	124	23.8%
Computer and Electronic Product Manufacturing	91	35.7%
Services to Buildings and Dwellings	84	4.8%
Social Assistance, Including Vocational Rehabilitation	76	63.4%
Fabricated Metal Product Manufacturing	75	30.1%
Food Services and Drinking Places	55	8.5%

As current clusters of green jobs continue expanding, new opportunities are emerging. A number of occupational categories are expected to witness rapid increases in employment demand over the near term future. For example, the number of statewide jobs for weatherization and solar installers is anticipated to climb 31 percent by April 2011. As **Figure 15** illustrates, other fast growing occupations include production workers, architects, and HVAC/Appliance repairers and installers. At a time when

[15] Arizona Department of Commerce, "Forecast Update: Fewer Losses in 2010, Slower Growth in 2011," October 7, 2010.

[16] In other cases in which companies have projected their future growth and compared that information against actual growth, the companies were found to be about 50 percent more "optimistic" than what actually occurred. Thus, under such scenario, a still healthy 5.7 percent anticipated growth rate would be more likely to occur than what the companies reported in their surveys.

[17] Based on national estimates developed by EMSI. See www.economicmodeling.com

other economic engines have been sputtering, anticipated green job growth among Arizona's green economy firms is quite promising. Despite conservative estimates from company responses due to the uncertain economic conditions prevailing during the survey period, anticipated short-term growth is still strong.

Figure 15: Top 10 Occupations by Job Growth

Occupation	Green Jobs	Anticipated New Jobs	Percent Increase	Average Wage
Construction Builders and Contractors, (exc. Weatherization and Solar Installers)	3,418	299	8.7%	$ 34,753
Weatherization and Solar Installers	877	276	31.4%	$ 43,618
Landscapers and Related Workers	2,128	237	11.2%	$ 34,232
HVAC and Appliance Installation/Repair (including Wind)	1,754	208	11.8%	$ 38,678
Production Workers (exc. Recycling)	1,035	162	15.7%	$ 34,710
Commercial Drivers	1,442	131	9.1%	$ 33,383
Production Workers (Recycling and Reclamation)	1,303	108	8.3%	$ 33,071
Equipment and Maintenance Repair/Installation	1,192	100	8.4%	$ 41,087
Agricultural and Nursery Workers	896	97	10.8%	$ 25,960
Architects (including Landscape)	676	85	12.6%	$ 75,199

Conclusions

Why Does the Green Economy Matter to Arizona?

Success in developing a strong green economy, and in spawning numerous green jobs, could bring many benefits to Arizona. At the most basic level, green jobs bring many positive spillover effects as they help to reduce pollution and waste, increase energy efficiency, and contribute to overall productivity improvements. Green jobs can be a tangible embodiment of the "triple bottom line." They can simultaneously bring economic benefits, social and community benefits, and environmental benefits to the state.

In addition, recent research suggests that many green jobs may be less susceptible to outsourcing. This may be especially true in renewable energy fields such as biomass, biofuels, and in the installation and maintenance of solar and other renewable energy systems.[18]

Finally, success in emerging green industries will help generate wider economic prosperity and further strengthen Arizona's technology sector. Expectations of growth in various green economy sectors vary considerably, but nearly all of them anticipate rapid growth in coming years. Respondents to this survey anticipate about an 8.6 percent growth in Arizona's green jobs over the coming year. This compares very favorably to Arizona's projected overall employment growth rate of only 0.7 percent in 2011.

Long-term projections for green employment are even more optimistic.[19] For example, a recent American Solar Society analysis of the renewable energy sector projected job growth of anywhere from 16,000 to 37,000 new jobs between now and 2030. A recent study in California found that since 1995, the state's green jobs grew at a rate of 56 percent. In comparison, overall California job growth during that period, at 18 percent, was just a little over a third of green jobs growth.[20]

What is the Bottom Line?

The results of the 2010 Arizona Green Jobs Survey suggest a number of current themes about Arizona's green economy, circa 2010:

- ***Survey results indicate that Arizona is presently home to 30,716 green jobs.***
  This figure represents 1.3 percent of total statewide employment, falling slightly below benchmarks found in studies at both the national and state levels.

- ***Service industries dominate Arizona's green employment activities.***
  Arizona has never had a large-scale manufacturing base, and it has not yet developed a significant base of home-grown green manufacturers. Instead, most of Arizona's green jobs are

[18] Roger H. Bezdek, *Green Collar Jobs in the U.S. and Colorado*, Report Prepared for the American Solar Society, January 2009.
[19] For a more detailed summary of recent market analyses, see 2010 Battelle Study.
[20] Next 10, "Many Shades of Green: Regional Distribution and Trends in California's Green Economy," January 2011. Report available at: http://next10.org/next10/publications/pdf/2011_Many_Shades_of_Green_FINAL.pdf

located in service-related sectors. In particular, architecture, construction, and engineering related businesses are large generators of green jobs.

- ***Green jobs and green industries closely align with existing industries and industry clusters.***
  At present, nearly all of Arizona's green jobs are located in firms that employ workers in both green occupations and traditional occupations. A local HVAC repair and installation firm serves as a typical example. Some of its technicians might install environmentally-friendly or green systems, while others would install, repair, or maintain traditional systems. Similarly, a waste management firm might manage a recycling operation along with a more traditional landfill.

  The alignment between Arizona's green economy and its overall economy is quite significant. Eight of the ten largest green economy sectors also rank on the top ten list of Arizona's largest industries.

- ***Arizona does not yet appear to have any clear emerging large clusters of businesses or jobs in the leading clean tech sectors.***
  Our survey findings did not identify significant emerging clusters of firms or jobs in clean technology sectors such as advanced energy storage, nano-materials, or biofuels. However, Arizona is home to several leading research institutions and projects, such as Arizona State University's Lightworks. In addition, Arizona has emerged as a likely solar manufacturing state, tied to the development of several major projects, as well as the home to several other world-class firms in key clean tech markets, such as the global headquarters for First Solar.

  Much of this emerging activity is not captured in our survey results for several reasons. These activities are emerging and, because of their nascent state, they may not yet be generating significant employment opportunities. Moreover, many of these new activities and firms may not yet be captured in existing Federal state statistics and data categories. A portion of Arizona's green economy may still be emerging under the radar. Furthermore, the activities underway in larger institutions (such as the universities or in major corporations) may be so small as to not yet register with corporate human resources professionals. Thus, they may be under-reported in our survey, despite our efforts to generate survey information about those activities with which we are familiar.

- ***Small businesses account for the bulk of existing and new green jobs.***
  About half of the current green jobs – or about 15,234 of the state's 30,715 green jobs – are found in companies employing 50 people or fewer. Nearly three-quarters (73 percent) of the estimated 2,645 new Arizona green jobs to be created in the 2010-2011 timeframe will be created in firms with fewer than 50 employees – firms that often have limited human resource capabilities and *ad hoc* policies toward training and education.

- ***A large number of the current jobs making up Arizona's green economy require relatively low skills and offer relatively lower average wages.***
  At present, Arizona's green economy is not based on a strong foundation of good, career-level jobs. Many of the state's current green jobs pay wages below state averages. These jobs often require only limited education and training as pre-requisites for success. Yet, this pattern appears to be changing as many of the industries with high anticipated growth in green jobs also provide better quality jobs. In addition, the green economy appears to be poised as a solid base for middle skill jobs.

- ***The state's fastest growing green jobs tend to be concentrated in fields that provide higher quality and better paying jobs.***
  Many of the green industry sectors and occupations slated for the most rapid future growth are those that pay higher than average wages and demand higher educational attainment. The fastest anticipated job growth is expected to occur among weatherization and solar installers, who enjoy annual average wages of more than $43,000 per year. Many of these jobs are requiring credentials or specialized training beyond that required for typical installation workers in the construction or repair industries. Some other fast growing sectors, such as information technology analysts (average wage of $62,154) and architects (average wage of $75,199) require advanced science, technology, engineering, or math skills.

- ***Anticipated growth rates for green jobs are quite impressive and represent a likely fast-growing sector in Arizona during the coming year and beyond.***
  Arizona's green jobs are anticipated to grow at a healthy pace, even in the face of the current slow economic rebound. Overall, Arizona-based businesses are anticipating 8.6 percent growth in green jobs during 2011, far outpacing the projected statewide growth rate of only 0.7 percent for all jobs.

What We Mean by *"Green"*

We want to count the employees in which "green" skills are *essential* to their job.
Do you have any positions that might fit in one or more of the following 7 categories?

If so, please let us know by completing the entire survey.
If not, please answer questions 1 and 2, then return the survey form.

To determine which jobs should be counted in our survey, please review the following examples as a guide. The examples are NOT intended to be comprehensive.
We are attempting to count jobs in which **most of the employee's time** is focused on:

1. Increasing energy efficiency
Examples include: *"Energy Star" appliance production, LEED certified design and construction, logistics management, energy-efficient equipment production or installation, cogeneration*
Examples do NOT include: *workers at firms that have become "greener" by replacing light bulbs, reducing office thermostat temperatures, purchasing fuel efficient fleet vehicles, carpooling*

2. Producing renewable energy
Examples include: *solar PV cell manufacturing, wind turbine maintenance, hydro-electric generator repair, biodiesel production, geothermal drilling, renewable energy power plant design*
Examples do NOT include: *producing high-voltage electric lines*

3. Reducing greenhouse gases
Examples include: *smart grid systems, smart metering, carbon sequestration, nuclear power generation, clean coal production*
Examples do NOT include: *using natural gas or other fossil fuels*

4. Preventing or cleaning up pollution
Examples include: *green building materials production, air or water purification, pollution prevention, remediation technology production or services, green chemical production*
Examples do NOT include: *telecommuters or carpoolers, cleaners using "eco-friendly" chemicals*

5. Recycling or reducing waste
Examples include: *waste water treatment, production-generated waste recycling, recycled content product manufacturing*
Examples do NOT include: *workplaces using recycled paper*

6. Conserving land or natural resources
Examples include: *organic farming and food production, biomass feedstock production, soil and water conservation activities, consulting to reduce pesticide use*
Examples do NOT include: *volunteers, workers that "adopt-a-street," garbage disposal services*

7. Providing education, consulting, accreditation, or similar services supporting categories 1-6 above
Examples include: *policy analysis/compliance, energy auditing, environmental science research or instruction, carbon credit brokering, certification of environmental practices*
Examples do NOT include: *educational administrative staff, legal secretarial services*

If you need further assistance please contact any member of the Arizona Green Survey Team at 1-888-566-2177 or questions@AZgreensurvey.org.

ARIZONA DEPARTMENT OF COMMERCE
The center for economic advancement

Arizona Green Jobs Survey

ABOUT THE SURVEY
The Arizona Dept. of Commerce is measuring the number of green jobs that exist in Arizona. We define a green job as one that provides a service or produces a product in any one of the following categories:

1. Increasing energy efficiency
2. Producing renewable energy
3. Reducing greenhouse gases
4. Preventing or cleaning up pollution
5. Recycling or reducing waste
6. Conserving land or natural resources
7. Providing education, consulting, accreditation or similar services supporting categories 1-6

If you are uncertain about who should complete this survey, please direct it to your CEO or Human Resources Manager

If your firm has any positions in which working in one or more of these green categories is *essential*, please complete the entire survey. If not, please fill out the information on this page only.
--Your responses will be kept strictly confidential
--Include information for all locations in Arizona

OPTIONS FOR RESPONDING TO THE SURVEY
1. Respond online at www.azgreensurvey.org, or
2. Return the survey in the enclosed postage paid envelope
3. Return the survey by fax to 480-393-5098

If you have any questions, please contact the Green Survey Team toll-free at 1-888-566-2177.

Don't know if your jobs count as "green"?
The back of this survey has detailed guidelines and examples!

CONTACT INFORMATION (Please Print)

Name: _____

Company:

Phone: _____

Email: _____
(Study results available provided by email.)

To submit your response on the web, use the following to access the survey:

Survey ID: **Zip Code:**

PLEASE REPORT FOR ALL OF YOUR FIRM'S LOCATIONS IN ARIZONA

1. Approximately how many jobs did you have in Arizona during the pay period including April 12, 2010?
_____

2. Was working in one or more green categories essential to any of the jobs?
Circle one: YES NO

2A. If Yes: For how many jobs? _____

Please continue to the next page

2B. ***If No:*** Stop here.
Please return the survey via mail, fax, or web

Arizona Green Jobs Survey (*www.AZgreensurvey.org*)

Save Time. Save Energy. Respond Online.

We will contact businesses that don't return their surveys to ensure the accuracy of our results.

Job Title and Brief Description	Minimum Education Requirement	Special Requirements	Number of Green Workers in Selected Wage Ranges (Report all Workers According to an Hourly Rate)							Current Total Green Employment	Positions Currently Open	Projected Total Green Employment
List the job title and briefly describe any major job duties related to green activities **Only list jobs where work in green categories was essential to the job** **(Please Print)**	Enter one of the following codes: A = No Requirement B = HS Diploma /GED C = Some college, no degree D = Assoc. or Voc. Degree E = Bachlor's degree F = Graduate degree G=Other (please specify)	List any **required** special licenses, certificates, or other training **(Please Print)**	A under $10.00	B $10.00-$14.99	C $15.00-$19.99	D $20.00-$24.99	E $25.00-$29.99	F $30.00-$49.99	G $50.00 and over	Total number of jobs that worked in green areas during the pay period including **April 12, 2010**	Number of jobs *currently* available for hire or expected to be filled (include personnel replacements or new jobs)	Expected total number of jobs that will work in green areas during the pay period including **April 12, 2011**
										2010 Total	Open Positions	2011 Total
Example: Solar Panel Installer - Installs solar panels	D	operation of solar electrical systems				2	1			3	1	5
			A	B	C	D	E	F	G			
			A	B	C	D	E	F	G			
			A	B	C	D	E	F	G			
			A	B	C	D	E	F	G			
			A	B	C	D	E	F	G			
										2010 Total	Open Positions	2011 Total

If more space is needed, please copy this page or go to www.AZgreensurvey.org.

NOTE: The 2010 sum should **equal the number** entered for **question 2A** on page one.

Return this survey to:

Council for Community and Economic Research (C2ER)
PO Box 100127, Arlington, VA 22210
Phone: (888) 566-2177 | Fax: (480) 393-5098 | **questions@AZgreensurvey.org**
www.AZgreensurvey.org

Survey ID: **Zip Code:**

This survey is funded by a U.S. Department of Labor grant administered by

ARIZONA DEPARTMENT OF COMMERCE
The center for economic advancement

Appendix B: Methodology

Because the survey was deployed prior to final BLS definitional guidelines for assessing and tracking the green economy, the survey's definitions (which you can find on the survey instrument in Appendix A) were designed to coincide with seven categories of green economic activity developed in a preliminary BLS definition. The survey was also designed to align with similar surveys completed in states such as Washington and Oregon – as well as recommendations put forth in the Workforce Information Council's Green Jobs Study Group reports.[21] Even though the survey was already underway, the C2ER team re-categorized the final survey results to align with the categories identified in the final green economic activities definition published by BLS in September 2010.

The survey sample was composed of 10,000 Arizona-based businesses drawn from the Quarterly Census of Employment and Wages (QCEW). The survey sample was organized around three broad categories which sought to focus on industries in which the greatest concentration of green jobs-related activity is likely to occur. Based on research conducted in several other states as well as BLS definitions, the project team developed four separate sub-samples for the survey.

1. All firms with 200 or more workers in any month during the quarter. These firms were deemed most likely to have multiple activities that are not included in a single NAICS industry definition. This sample might include large firms that might engage in green economic activities as part of their overall portfolios of business. (Total: 1,581 firms, of which 37.6% responded)

2. All firms with between 50 and 200 workers operating in industries deemed green in guidance from BLS. (Total: 2,033 firms, of which 50.7% responded)

3. All remaining firms with less than 50 employees that operate in green industries and that (1) paid $10,000 or more in wages during 2009 Q3 AND (2) reported at least 2 employees during one month during the quarter (Total: 24,090 firms). Within this group, firms were identified in such a way as to determine where they were located in one of three regions in the state: Northern (Apache, Coconino, La Paz, Mohave, Navajo, and Yavapai Counties), Central (Gila, Maricopa, and Pinal Counties), or Southern (Cochise, Graham, Greenlee, Pima, Santa Cruz, and Yuma Counties). From this group, slightly more than one of four (or 6,386 firms) was selected for the sample, with the firm count in the sample equaling the proportion of all small firms located in the region. Based on these criteria we had our final two sub-samples:

    a. Of the 6,386 firms, about half employed 10 to 49 workers and constituted the third sample frame. (Total: 3,066 firms, of which 57.4% responded)

    b. The remainder of the 6,386 firms employed between 2 to 9 workers and constituted the fourth sample frame. (Total: 3,320 firms, of which 55.7% responded)

[21] Washington Workforce Information Council, *Measurement and Analysis of Employment in the Green Economy*, Olympia, WA: WIC Green Jobs Study Group, October 2009; Worksource Oregon, *The Greening of Oregon's Workforce*, Salem, OR: Oregon Employment Department, June 2009.

The survey was completed with 5,234 firms responding, resulting in an overall response rate of 52.3%. Once the survey was completed, a weighting methodology, linking administrative records from the Quarterly Census of Employment and Wages (QCEW) to the survey responses, was used to make inferences about total employment in Arizona.

The estimation procedure went as follows: Within each of the four sub-samples, described above, we created an adjustment weight for the survey responses by dividing the total number of jobs reported in the QCEW population for a particular sub-sample by the total number of jobs of companies samples for the survey in each of the reference sub-samples using available data from QCEW.

$$\frac{Jobs_{population\_employment\ (QCEW)}}{Jobs_{sample\_employment\ (QCEW)}}$$

This weight was then applied to the survey responses from each of our four sub-samples to adjust the observed values from the survey to an estimated total job count for each sub-sample, as illustrated in the following equation:

$$Weighted\ Jobs\ Estimate = \sum \left(Jobs_{survey\_responses} \left(\frac{Jobs_{population\_employment\ (QCEW)}}{Jobs_{sample\_employment\ (QCEW)}} \right) \right)$$

Then, we summed the weighted sub-sample job estimates to generate a total jobs estimate. Finally, we repeated this exercise for green employment, non-green employment, and any other job types.